

ASHWANI KUMAR

COSTING

THE ULTIMATE GUIDE TO COST OPTIMISATION DECISIONS

EXPERT



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Preface

This book is dedicated to my grandfather Pt. Malawa Ram, my father Sh. Som Nath and my mother Smt. Pushpa Rani. This book is designed to provide a systematic and an in-depth knowledge about the subject and contains various problems relating to costing in business and their possible solutions. It will be helpful in the subject concerned to post matric commerce students, aspirants for CMA, CA, CS courses and industrial management. I am thankful to my premier institute i.e. “Institute of Cost Accountants of India” for recognizing my work on cost control technique through standard costing by publishing my articles on material cost control and labour cost control in January and October, 2019 issues respectively (included in the book), and other organizations. I am grateful to my wife Smt. Santosh Sharma who helped me in completing this work, my brothers Sh. Varinder Kumar, Sh. Narinder Kumar, Sh. Ashok Kumar and my friend Sh. Rakesh Kumar who persuaded me from time to time in this regard. Though every care has been taken to minimize errors, yet not ignoring human error, valuable suggestions from the concerned (readers and applicants) will always be considered, welcomed and honored.

A book on Cost Accountancy

Name of the book : “ Costing Expert “

Name of the Author : Ashwani Kumar Practicing Cost Accountant (Rtd. Lec. Economics)

B, Sc., M. A. (Eco.), M. Com., FCMA.

Content : The book on Cost Accountancy named “costing Expert” contains problems relating to cost ranging from simple to complex with relevant solutions. It contains nine chapter which are **1. Material Costing 2. Cost control through material control 3. Unit Costing 4. Process costing 5. Joint products and by products 6. Budgetary control 7. Standard costing 8. Cost volume – Profit analysis 9. Cost analysis and decision making.**

For Whom : The book will be helpful for students appearing for B. Com., M. Com., aspirants for CA, CMA, CS and other professional examinations. The book will also be helpful to the management practically applying cost control techniques to minimize cost for optimum price fixation. It will also be helpful professionals such as cost accountants engaged in the field relating to cost control, cost audit etc.

Specialty : The book contains numerical problems taken from various universities and professional examinations including CA, CMA, CS and CIMA and their relevant solutions. It is written in simple language, easy to understand the subject matter. The problems taken and solved are in a sequence of simple to complex. The students and other professional examinees will be able to solve each and every problem in the subject as there are more than sufficient specimen problems relating to the subject in the book along with the solutions. The book contains two articles written by me and published in the Journal “The Management Accountant” of the Institute of Cost Accountants of India and recognized and recommended for reference by professional body ICAI – CA and some other world wide bodies working on the subject cited.

1. Material Control

In any production unit material covers more than 60% of the cost in the production process. We also know that production is nothing but to change or increase the utility as desired, of the available material. So, we can say material plays an important role in the production process. To serve the main purpose of the production unit or a business house i.e. for profit maximization material control becomes necessary.

Materials control can be defined as a systematic control over purchasing, storing and consumption of materials. Material Control helps to maintain a regular and timely supply of material by avoiding over and under stocking. Strategy is so applied that the chances of interruption because of scarcity of material or supply of material to the production department are minimized, otherwise the other sources of production will go wasted and giving rise to increase in Cost of production. Similarly the over stocking of the material in store will lead to locking up huge amount of money in store, making a scarcity in other sources of production, interest payment and hence rise in the cost of production as compared to the competitors and leading to other problems such as decrease in profit share or fall in sale and market share. Material Control ensures that a right –quality and quantity of material is available to the company at the right time. Material control helps to reduce the losses and wastage of materials by maintaining their efficient purchase, storage and use or consumption in the factory. The importance of material control lies in its role in reducing the cost of production and increasing the profitability of the company.

Material control means it is the process which involves, planning, controlling and scheduling the material requirement that is from procurement, storing and usage of material with an object of earning economy and efficiency that means procuring the material at the minimum possible cost and its efficient supply to the production department.

Objectives of material Control: As already discussed material is the main source in the production process on which other sources works and increase the desired utility (degree of satisfaction of consumers of the commodity, after consuming the commodity) of the material. The following are the objectives of the material control:

1. To avoid over stocking: Over stocking of material means locking up a huge amount of money in the material which could have been otherwise used in employing other sources of production, it increases the carrying cost, chances of pilferage, spoilage and wastage. So an adequate availability (quantity) of material should be present in the store.
2. To avoid understocking: There is always a gap between the initiation of purchase requisition by the purchase department and receiving of material in store and forwarding it to the production department. The raw material or other material should be always ready whenever required for production purpose. So keeping in view all this under stocking should be avoided otherwise the other sources of production such as labour and machinery may have to remain idle up to the next arrival of material in the department. So, again it is essential to have an adequate stock of material or in other words we can say under –stocking of material should be avoided. So, it is the objective of the material control, to avoid under stocking.
3. To minimize wastage: To maintain a standard material efficiency, it becomes necessary to minimize waste of the material. Adequate acceptable quality of the finished goods supplied to market depends upon the quality of the material, though not always as other factors are also responsible, which require a strict control over

minimizing the waste at any stage from the very beginning of the purchase, store and issuing to the production. Wastage should be at a minimum acceptable quantity otherwise it may lead to high cost of production.

4. Price of the material: To Capture a market, the finished goods should be supplied at a competitive price. For this material price should be as minimum as possible taking into consideration the material quality. So it is the objective of the material control system to avail the material at a minimum possible price and of acceptable quality.
5. Minimizing Spoilage and Obsolescence: The next very important objective of material control is to minimize spoilage and obsolescence. If a system is so followed which give rise to spoilage of material in the store due to non –delivery to the next department, it may lead to high cost of production. A system should be so followed that material which enters first in the store should be issued first than the material which enters later in the store. It is the duty of the storage department to minimize spoilage and obsolescence.
6. Payment to the suppliers: –Suppliers of material should be paid for the supplies only after a proper checking of quantity and quality of the material received. After proper checking the payment to the supplies should be ordered.

Essentials of a Good Material Control: –

Strict material control is necessary to achieve long term goals of the company. Loose control will give rise to unnecessary increase in the cost of production so hinders achievement of the long term goals.

1. Proper Coordination: – There should be a proper coordination among various departments connected with the operations of material. Good coordination in production department, purchase department, quality control, Store and finance department is essential. Store department initiate the requisition of material, purchase department after receiving requisition initiate the activity to purchase and so on up to the receiving of the material, its quality checking and final payment a system is kept on.
2. Standardizing the various types of forms: – For a good material control, the requisition forms, issuing of material form, transfer of material from one job to another should be used, otherwise there can be wastage of time and money.
3. There should be a system of internal check at all the levels from the beginning of the process required for production.
4. In the store a proper method of classification and codification of material is required for a proper control. Daily there are so many types of items required which needs for proper functioning, a system of classification and codification.
5. Minimum and maximum level of stock of the material should be fixed to avoid under and overstocking.
6. Re –ordering level for each types of material used in production should be pre –fixed because there is always a gap of time between re –ordering and its receiving to avoid any interruption in production i.e. to keep the material ready whenever required in the production.
7. A well planned store keeping should be there to avoid any carelessness, leakage, spoiling and theft etc.
8. Proper inspection of the material by receiving department is required.
9. EOQ of each type of the material should be fixed to minimize the cost.
10. A proper method of valuing the issue of material to the production department should be followed. It is essential from the point of view of valuing the final product to be sold in the competitive market and the valuation of the inventories in the stock of raw material.

To have a proper control on the material there are three stages: –

1. Purchase Control

2. Store Control

3. Issue Control

1. Purchase Control: – Purchase department is responsible for purchase control. The head of the purchase department is generally known as purchase manager. He is held responsible for the quality and price of the material. For this a centralized purchase department is required to have a proper control. All requisitions of the material are received in the department, quotations are sent, comparative statement prepared and quality material supplies at minimum possible price are selected, orders are placed, a regular in touch with the finance department is required for availability of finance, Deliveries are received, properly checked in terms of quantity and quality and then sent to the store.

Centralized purchase department is essential. The basic objective behind it is:

- a. To make availability of material at all the times to curb any interruption of material to production.
- b. To earn discount on bulk purchases and take benefit of liaison between the purchase department members and the reputed suppliers.
- c. To make purchase in reasonable quantity to keep investment in material at minimum possible.
- d. So that quality of material can be maintained as the department is held responsible.
- e. A cordial relation between supplier is developed which is beneficial to avail good terms in payments and to earn a reasonable credit period.
- f. Alternative source of supply are found out in the event of contingencies and for smooth un-interruption in supply of the material whenever required.

Functions of Purchase department

In any production process the material, which is to be produced after a desired operation and to come out as a finished product of required utility, plays an important role. Without material the whole production process becomes a futile exercise. Purchase department is held responsible for procurement of material of right quality at right time.

Following are the functions of a purchase department: –

1. What to purchase?
2. When to purchase?
3. How much to purchase?
4. From where to purchase?
5. At what price to purchase?

The purchase department does not initiate the requisition for purchase at its own. The store department which is fully responsible for the storage of the various types of the material items needed has to keep a watch on the material which is needed to be received to supply to the production department on demand, has to send a request to the purchase department to purchase the required material.

To perform the above mentioned functions the purchase department follows the following procedure: –

- (a) Receiving a purchase requisition.
- (b) Exploring the sources of supply, Sending the request for quotations, receiving quotations, making comparative statements and selecting the supplier.
- (c) Preparation and execution of purchase orders.

(d) Receiving and inspecting material.

(e) Checking and passing bills for payment.

(a) Receiving a purchase requisition: – The store keeper which is responsible of the material in the store has to initiate request for purchase. He has to classify the various materials in the order of the speed of flow. Fast moving, slow moving, non –moving or dormant material are classified. The various values such as maximum level of material, minimum level of material, Re –ordering level are pre –mentioned depending upon their speed of movement to the production department. The requisition for purchase is approved by an executive, such as plant superintendent or works manager, in addition to the one originating the requisition.

It is prepared in triplicate. one copy is sent to the purchase department the second one is kept in the record of store or the department initiating the request. The third one is sent to the concerned executive.

Specimen copy of the purchase requisition is given below: –

No.....	<u>ABC Ltd</u> <i>Purchase Requisition</i> <u>Regular</u> <i>Special</i>	Date..... Date by which materials are required.....		
Sr. No.	Articles Name	Code No. (Store)	Quantity required	Remarks
Requested by.....				
Approved by.....				
For use for Purchase Department				
Quotations invited on.....				
From 1.....				
2.....				
3.....				
4.....				
Other action.....				
Purchase Officer.....				

The purchase requisition is initiated by the store department. A request copy is sent to the purchase department to take further action regarding purchases. In the purchase requisition, number and date is mentioned which depicts the date when the request has been initiated to purchase a material. It tells about the name of the article required to be purchased its store code No. as there are so many such items of same. Quantity required

is also mentioned in the request and it is signed by the person responsible of store control and it is also approved by the executive concerned and is sent to the purchase department.

(b) Exploring the sources of Supply: –

Generally the purchase department for each type or specification of the material keeps a record of reputed and trustworthy supplier. The purchase requisition is received by the department and is properly scrutinized. The next action of the department is started to choose the suppliers. For this the procedure is to demand tenders from the suppliers regarding the supply of the material of mentioned quantity, quoting the price of the material to be supplied.

While selecting the suppliers of material to whom orders are to be placed the purchase department should keep in mind (i) Quality of the material to be supplied by the Supplier (ii) The price at which it is going to send the material (iii) The terms of payments for the material supplied (iv) The time period in which the required quantity can be supplied (v) The management of the supplying firms (may be serious i.e. the management may be having a special interest).

Keeping all the above one supplier with minimum quoted price is selected to supply.

A specimen of tender form is given as under: –

ABC Ltd. <u>Tender Form</u>							
No:		Tender No.....					
To		Date.....					
.....							
Dear Sir, Please let us have your best offer for supply of the items mentioned below. The items should be sent on F.O.R. The closing date of receiving Tender is The tenders will be opened on.....at .....(Time). Dispatch the copy duly filled in within the earliest possible time.							
Yours faithfully, ABC Ltd. (Purchase Officer)							
Sr. No.	Description of Item	Quality	Quantity	Price	Terms of Delivery	Other terms	Remarks

Comparative Statement of Quotations (Specimen Copy)

ABC Ltd.					
<u>Comparative Statement of Quotations</u>					
Tender No:					
Date:					
Name of Material:					
Store Code No:					
Sr. No.	Name of Supplier	Quantity	Price quoted	Terms of Delivery	Remarks

While selecting the supplier on the basis of the comparative statement one thing should always be kept in mind that quality should not be sacrificed, because quality of the finished goods always depends upon the quality of the material used in production process.

(c) Purchase order: – After selecting the supplier, the next step is placing a purchase order to the suppliers. It is a written document sent to the suppliers to inform them about sending the mentioned material and of mentioned quantity within the specified time period. The supplier is bound to supply the material under the terms and conditions already negotiated. Purchase order binds both the buyer and seller to the terms under which the material is to be sent.

A number of copies of purchase order are prepared which are useful in the various departments for taking appropriate action. One copy of the purchase order should be sent to the supplier who has to send the material. The second copy is sent to the department who has requested to the purchase department to purchase the material. The third copy is sent to the accounts department where payment of bill of the material is to be initiated. The fourth copy is sent to the receiving department where delivery of the material is to be received. The fifth copy can be retained by the purchase department for future references.

There should be a proper follow up to ensure that the material is received in time. If it is not so or there is a delay, action should be taken. Alternate source should be tapped if there is any type of difficulty in receiving from the selected supplier. The selected suppliers should be repeatedly contracted for not delivering the supply within time specified. Penalties can be levied for delay in supply. In future whose trustworthiness is doubtful and repeatedly delay the supply, their names should be deleted from the list of suppliers to whom tenders are to be issued for purchase. A strict and repeatedly follow up ensures the supply in time and a safeguard against closure of the factory due to the non –receipt of the required material.

Specimen form of purchase order

ABC Ltd. Purchase Order						
No.....		Dated..... Requisition Purchase No.....				
To .....		.....				
Your quotation number.....has been accepted. Please supply the following items in accordance with the instructions mentioned therein and terms and conditions listed on the reverse of the purchase order.						
Sr. No.	Name of the item	Quantity	Rate	Total Cost	Delivery Date	Remarks
Terms of delivery Terms of payment Packing and dispatch instructions Discount allowed						
Purchase Officer						

(d) Receiving and Inspecting: –

The next step in the purchase process is receiving and inspecting the received material sent by the suppliers. In small concerns it becomes the duty of the storekeeper to receive the delivery and inspects the quality of the material received and enter into the books of record. A separate department may be possible in large concerns who is responsible for this activity of receiving the right quantity of material of right quality.

Records are maintained by the receiving and checking department and a material inspection report is prepared showing the items whose quantity and quality has been checked and is accepted and which items are rejected.

On completion of the inspection process goods received note is prepared and is added to the existing stock of the material in the store.

One copy of the goods received note will be kept by the receiving department. Four copies are sent to the storekeeper who again check the quantity of the material and sign the copies and keep one of the copies with him and send the others to (i) Purchase department (ii) The accounts department (iii) The department which initiated the requisition.

Specimen copy of the material Inspection report

ABC Ltd.						
Material Inspection Report						
No.....			Goods Received No.....			
Date.....			Date.....			
Purchase Order No.....			Suppliers Name.....			
Date.....						
Sr. No.	Description	Item Code No.	Quantity			Remarks
			Received	Accepted	Rejected	
Inspector.....						

Goods received Note

Goods received Note						
Suppliers Name.....			No.....			
Purchase Order No.....			Date.....			
Sr. No.	Description	Code No.	Quantity	Date	Amount	Remarks
Received by.....			Inspected by.....			
Storekeeper.....						
Posted by.....			Costed by.....			

(e) Checking and Passing the bills for payment

Purchase process does not complete until the suppliers are paid for and material reaches the store properly. It is the duty of the store department to check the quantity of the material and tally the invoices sent by the suppliers, their accuracy in the material terms. Discounts earned are properly checked.

After carefully checking by the store department, it request the accounting department for making the payment of the invoice to the supplier.

Trade discount, cash discount if paid cash, quantity discount should be carefully scrutinized, their arithmetical accuracy should be properly checked. If transport charges are borne by the suppliers on the part of the buyer then this should be added while calculating the cost of material. Sales tax, Vat or any other charge should also be added. Similarly the insurance charges paid by supplier are also added to the price of the material. After carefully scrutinizing and checking the arithmetic accuracy the department should approve the bill for final payment to be made by the cash department.

Store Control: –

One of the most essential parts of material control is store control. Material is always kept in the company of a required quantity before issuing to the production. It is not possible all the time to purchase the material instantly and send it to the production department where it is converted into finished goods. Some quantity of material though not in large amount has to be kept in the store. As the material is kept in store a strict control is desired from the point of view of pilferage, leakage, theft and waste etc. Arrangements should be done to minimize as far as possible to curb increase in cost due to mismanagement of store. The material should be kept in store in such a way that it is readily available when required. It should always in the knowledge of the in –charge which material is to be received in how much quantity and at what time. If there is not a control over the store then it may be possible that a huge amount of money to be locked in the material which is very slow moving and a very small amount in fast moving material. The situation may arise that material required may not be available and leading to close down production up to the next supply of material and a wastage (remaining idle) of the other sources of production in that particular period. So in a net shell it is essential that there should be a proper store control system.

For proper store control the efficient store department is essential. If efficient store department is present in the organization, it will minimize the unnecessary rise in cost which are due to mismanagement in storage of material. Let us take various points that should be kept in mind in store control and try to minimize various difficulties faced by the department and leading to high cost of production which can otherwise be evaded through store control.

Store Department: its Location: –

Store department should be located in such a way that it is accessible to all the concerned. The store should be at such a place that it can receive the supply from the suppliers. It should be also near to the departments to whom the materials in the store is to be issued. It may be at a place linked with roads, railways to minimize the cost of loading and unloading the material. In the store there should be sufficient space to keep all the item in an easy accessible manner. Special arrangements are required for the items where there is possibility of leakage, evaporation and spoiling due to atmospheric conditions such as rusting due to presence of moisture. Bin system should be adopted to keep the material items. Bin is a place or space where items are kept or are to be kept. All bins should be serially numbered. For example for bulky and heavy material, a big hall can be treated as one bin. The building of the store department should be properly constructed from the point of view of avoiding losses due to damage and pilferage.

Classification and Codification: –In the production process there are number of items needed. Memorizing the item used in the production process becomes difficult. It becomes much more difficult for the illiterate persons engaged in production. In assemblies so many items of different names and different sizes are needed. The best way is

classification and codification. We can assign numbers. Material can be classified either on the basis of their nature or on the basis of their usage. For example material may be classified as construction, consumable stores, spare parts, Lubricating oils etc. After classification the next step is to codify the items present with the mainly classified items. If in a group there are, say 1000 items which can be classified into 25 groups then first two digits can be assigned to the classified group, the next two digits to the quality and so on for next sub groups.

Classification and Codification helps in material control. Secrecy of description can be maintained because of distinctive store code number is used. It avoids the duplication of the items because of multiple names. A different numerical value is given to different item. So it facilitates the identification of various items of store resulting into prompt issue of stores. This is particularly useful in those cases where the same material is known by more than one name.

Types of Store: – Store is a place where various items needed in the production process are kept and are used whenever desired in the process. It may be raw material, indirect material, consumable stores, spare parts or various other items. The items should be kept in a place from where there can be easily taken without delay. Three types of store can be there in an organization. There are

1. Centralized Stores.
2. Decentralized Stores.
3. Central Store along with Sub –stores.

1. **Centralized Stores: –** In some organizations or business units or production units there is only one place where all the items are kept. This place is known as a central store. All the items are received and issued from this place. One of the important benefits of such stores is that it minimizes the cost in terms of investment and due to centralization of work at one place only secondly confusion of responsibility fixation on happening of any uneven is removed.

Advantages of centralized stores:

1. Less storage space is required as compared to decentralized stores.
2. Economy in cost. Examples are reduced clerical costs and economy in record and stationery.
3. Economy from the point of view of staff deployed. Less staff is needed in centralized store than those of decentralized stores.
4. Investment in Stocks is minimized because of common item of stores used in different department are kept at one place.
5. Better control is possible.
6. Better layout of stores is possible.

Disadvantages of Centralized Stores: –

1. Increase in transport cost is movement of material from one central place to the department where it is needed because all departments cannot be near this place.
2. Break down in the production process is possible whenever transport system fails.
3. Greater risk of loss in the event of happening the contingencies such as fire.
4. Inconvenience and delay is possible in the departments which are far away from this place.

2. **Decentralized Stores: –** To overcome the disadvantages mentioned above decentralized store can be made. Sometimes it may not be possible to do so because of the financial position of the organization. Decentralized stores means every department having its own store where the items are needed can be kept. An uninterrupted supply of the items is possible in such type of stores. The main drawback is that it increases the total cost of storage, more employees,

more clerical work, more stationery, more investment in stores.. These types of stores are not very popular because heavy expenditure is required.

3. **Centralized Stores –with Sub stores.: –**

To overcome the difficulties in the both systems sub stores are established near the department where the material is needed. Centralized store is big one where all the items are kept and items from this store are sent to sub stores where the items are sent to the department consuming them. The risk of transport failure are minimized and covered. Here a proper quantity of material is kept in the sub store whenever there is a decrease in the required quantity, the keeper of the sub store sends a request to the central store to send a required quantity of the material. We can compare it with the main cash book and petty cash book, where a minimum amount of cash is always kept.

Storekeeper: – Storekeeper is an important person for the store. He is in charge of the store department and also responsible for store control. He may be called store keeper, store superintendent or chief store keeper. He must be a skilled person and take care of store. He keeps a watchful eye on the movement of the materials with a view to control the material in the store. A storekeeper should have technical knowledge and experience in the maintenance of the store. He should have an organizing ability and undoubtful integrity.

Duties of the Storekeeper: –

1. Receiving the material: – The primary duty of the storekeeper is to receive the material from the supplier. At the time of receipt of material, he has to see that the materials have been sent by the supplier on the basis of purchase order.
2. Arranging the material: – The material received by the storekeeper must be arranged in a proper manner. Bins should be allotted to each and every item.
3. Preservation of Material: – After the receipt of material they are to be preserved properly. It is the duty of the store keeper to keep the material in store in safe custody, otherwise the quality of material may deteriorate or loss of material is possible.
4. Recording: –It is the duty of the storekeeper to record the receipt and issue of the material in the respective bin card regularly. It will indicate the quantity of stock held in the store every time. For recording, the store keeper maintains store ledger and bin cards.
5. Issue of material: – The storekeeper issues the materials as per the requisition of the production. Whenever the storekeeper receives requisition he issues material from the store.
6. Issuing Purchase requisition: – When the stock reaches the re –ordering level, the storekeeper sends purchase requisition to the purchasing department for the fresh purchase of materials. Accordingly, the purchasing department purchases the material as per quantity and quality stated there in.
7. Supervision: The storekeeper must coordinate and supervise the duties of staff under his control. As he is the head of the store department, he manages the entire department.

Along with the above duties of the storekeeper there are some additional responsibilities also.

- a. He is responsible to maintain proper records of material relating to receipt and issue.
- b. Regularly or occasionally checking the physical quantity of the material and verify them with bin cards.
- c. Preventing any un authorized person from entering into the store room.
- d. Maintaining the stock register, entering therein all receipts issues and balance of materials.
- e. Checking and controlling losses due to evaporation, leakage, theft and due to other reasons.
- f. Arranging for physical verification of store items periodically.

- g. Keeping the store always neat and tidy. (orderly well arranged)
 - h. Supplying information of materials, Stock position and so on whenever needed.
- A specimen copy of Bin-Card

Bin Card

Maximum Stock Level.....

Material Code.....

Minimum Stock Level.....

Description.....

BC No.....

Bin No.....

Reorder Level.....

Ordering Quantity.....

Receipt			Issues			Balanced	Audit	
Date	GRN No.	Quant.	Date	MRR No.	Quant.	Quant.	Date	Initial

Material requisition by Production Department

To The Store Manager, Please issue materials To Department.	No..... Date..... Job No..... Prod. Order No.....

Code or Item No.	Description	Quality	Quantity	Cost Office	
				Rate per Unit	Amount (₹)

Authorized by.....	Date.....	Price by.....	Date.....	
Storekeeper.....	Date.....	Calculations by.....		
Received by.....	Date.....			
BIN Card No.....	Posted to.....			

<u>Goods received Note</u>				
To.....		Serial No.....		
Carrier.....		Date issued.....		
Date of Delivery.....		Purchase Order No.....		
Description	Code	Quantity	Packages	Gross Weight
Inspection Report			Received by..... Required by.....	

Quantity Passed	Quantity rejected	Remarks	Accepted..... Date.....
Inspector..... Date.....			

Requisition for Stores: The store keeper is fully responsible for a proper and an adequate level of stock of each material in the store. He knows the maximum level of stock that should be kept in stock to avoid unnecessary lock of capital in stock, he also knows the minimum level so that situation may not arise to stop production due to shortage of the available stock of material in store. He also knows the reordering quantity of material so as to minimize the overall cost of the material. Storekeeper knows that there is always a time lag between the sending a requisition for purchase to the purchase department and actual receiving the stock into the store. He sends a request to the purchase department mentioning the description of material, quality of material, quantity of material, to purchase the material.

Store or Material record: –To keep the material record two important documents are there one is Bin Card the second is Store ledger.

1. **Bin Card:** – Bin Card is a document kept in the store which shows the quantity of material in hand on particular date and time. Store keeper is responsible for the balance quantity of the material. Bin Card shows the minimum stock which is required to be kept at all the times, it also shows the maximum level of quantity of stock which can be held at a time to avoid any unnecessary lock of capital. Reordering level tells the quantity of stock on reaching which next order is to be placed for next purchase. Ordering quantity level is also mentioned therein. The bin card document shows the quantity of material received and issued and balance quantity of stock. Specimen copy of the bin card (Standard proforma) has been given. This document is generally placed or hung on the bin where the material of the quality is placed.

Double bin system can be adopted to facilitate any uninterrupted production. In double bin system the minimum level of stocks as required and mentioned in the bin card is kept in a separate bin. This minimum level of stock is always kept unless next delivery is received. On receipt of the next delivery of the new stock the earlier kept minimum stock is issued and minimum quantity of material of fresh stock is kept in so as to maintain quality of the stock.

Store Ledger: – It is a book or a file in which we contain the accounts of different stock items which is in the store. When the store keeper gets or issues any item's of inventory, he records it in the respective inventory item's account. So, every item account shows the total receipt, total issue and total balance. Both quantity and value of item is recorded in each account.

Date	Particulars	Receipts				Issues				Balance			Remarks
		G.R. No.	Qty.	Rate	Amount	S.R. No.	Qty	Rate	Amount	Qty	Rate	Amount	

<u>ABC Ltd.</u> <u>Store Ledger</u>	
Name of the article.....	Maximum Quantity.....
Code No.....	Minimum Quantity.....
BIN No.....	Ordering Quantity.....

Difference between Bin Card and Store Ledger: –

Following are the main differences between bin card and store ledger: –

1. On the basis of usage: – Bin Card is maintained by the storekeeper. Store Ledger is prepared by cost accounting department.
2. Nature: – Bin Card is a record of quantity only whereas store ledger is a record of quantities and value.
3. Period: – In bin card, entries are made immediately after each transaction. In store ledger, entries are made periodically.
4. Posting: – Posting are made before a transaction in bin card. Posting are made after a transaction in store ledger.
5. Bin card is kept inside the store. Store ledger is kept outside the store.

Both bin card and store ledger are the two documents and both are necessary because a crosscheck is possible of the transaction. In bin card only quantities received and issued are mentioned whereas in the store ledger both quantity and value of the material received and issued is shown. Store ledger maintenance is the responsibility of cost accounting department. Whose head is a technical expert man known as cost accountant. Physical check is possible by both the documents whereas the store ledger does an additional work of issue of and

receipt of the value of stock. Issue of quantity and value of stock sent for production is very important from the valuation of finished goods.

Illustration 1 A company has received quotations from four different suppliers. You are required to prepare a comparative statement if company is in need of 10,000 kg of the product.

Supplier 1. Rate per kg of product ₹ 10.60

Supplier 2. Rate per kg of product ₹ 11 if the quantity of product purchased is more than 5,000 kg then discount @ 10% for additional purchases.

Supplier 3. Rate per kg ₹ 11.25 but purchases more than 5000 kg will be given discount @ 12%.

Supplier 4. Rate per kg ₹ 11.35 but a discount @ 15% for additional purchase if more than 5000 kg.

Solution: – Comparative statement of quotations received from different Suppliers of the product.

<u>Comparative statement of quotations</u>					
Tender No.....					
Date.....					
Name of Material.....					
Store Code No.....					
Sr. No.	Name of supplier	Quantity	Price Quoted	Terms of Delivery	Remarks
1.	Supplier 1.	10,000 kg	₹ 1,06,000	Not Negotiated	
2.	Supplier 2.	10,000 kg	₹ 1,04,500 I		
3.	Supplier 3.	10,000 kg	₹ 1,05,750 II		
4.	Supplier 4.	10,000 kg	₹ 1,04,988 III		

As per the comparative statement the minimum quotation given is of supplier 2. So he should be ordered to send the required product.

Working Note: – I. Supplier 2. For 5000 kg rate is ₹ 11 and discount @10% for purchase more than 5000 kg

$$\begin{aligned}
 &= (5000 \times 11 + 5000 \times 11 \times 0.9) \\
 &= 55000 + 49500 \\
 &= ₹ 1,04,500
 \end{aligned}$$

II. For Supplier 3.

$$\begin{aligned}
 \text{Total Value} &= (5000 \times 11.25 + 5000 \times 11.25 \times 0.88) \\
 &= ₹ 1,05,750
 \end{aligned}$$

III. For Supplier 4.

$$\begin{aligned}
 \text{Total Value} &= (5000 \times 11.35 + 5000 \times 11.35 \times 0.85) \\
 &= 56,750 + 48,238 \\
 &= ₹ 104,988
 \end{aligned}$$

Illustration 2. On inviting tenders for purchase of material of specific specifications, two quotations are received as under: –

- (a) Offered to send material @ ₹ 5 per unit
- (b) ₹ 4.75 per unit but transport charges at a flat rate of ₹ 2000 irrespective of the amount purchased.

Advice which of the supplier should be selected if there is a requirement of 5000 units of the material

Also calculate the minimum quantity of the material after which second supplier will be beneficial to be ordered.

Solution: –

(I) At 5000 units of material requirement

Price of the quotations (b) is

$$\begin{aligned}
 &= ₹ \frac{(4.75 \times 5000 + 2000)}{5000} \\
 &= \frac{23750 + 2000}{5000} \\
 &= ₹ 5.15 \text{ per unit}
 \end{aligned}$$

Price offered in (a) = ₹ 5

Supplier (a) should be ordered to supply

(II) Transport charges ₹ 2000

Differences in the price per kg of material

$$\begin{aligned}
 &= 5.00 - 4.75 \\
 &= ₹ 0.25
 \end{aligned}$$

The B.E.P where both are of equal value

$$\begin{aligned}
 &= \frac{2000}{0.25} \\
 &= 8000 \text{ units}
 \end{aligned}$$

So, if the requirement is more than 8000 units Suppliers (b) is beneficial and it is less than 8000 units suppliers (a) is beneficial.

Illustration 3. A lorry load of material of mixed goods was purchased for ₹ 80,000. Later on it was sorted out into the following three categories:

Category A	1000 units	Selling price	₹ 20 per unit
Category B	1600 units	Selling price	₹ 31.25 per unit
Category C	2000 units	Selling price	₹ 45 per unit

Find the purchase rate per unit on each grade of the material assuming that all grades yield same rate of profit.

Solution: – As it is given in the question same rate of profit is there in each category of material.

Let us find out the ratio of allocation of purchase cost for each category.

			₹
Sales value of	Category A	=1000x20	= 20,000
	Category B	=1600x31.25	= 50,000
	Category C	= 2000x45	= 90,000
So the apportionment of cost is			
	A : B : C	:: 20,000 : 50,000 :	90,000
		= 20 : 50 : 90	
		= 2 : 5 : 9	
Cost allocated to Category A =		80,000 x $\frac{2}{16}$	= ₹ 10,000
	Cost per unit =	$\frac{10,000}{1000}$	= ₹ 10 per unit
Cost allocated to Category B =		80,000 x $\frac{5}{16}$	= ₹ 25,000
	Cost per unit =	$\frac{25,000}{1600}$	= 15.625 per unit
Cost allocated to Category C =		8,000 x $\frac{9}{16}$	= ₹ 45,000
	Cost per unit =	$\frac{45,000}{2000}$	= 22.50 per unit

Illustration 4. A lorry load of material of mixed goods was purchased for ₹ 100,000. There were sorted out in the following grades whose market rates are shown against each: –

Order A :	2000 units	Sold @	₹ 18 per unit
Order B :	3000 units	Sold @	₹ 15 per unit
Order C :	3250 units	Sold @	₹ 12 per unit

Find purchase rate per unit on each grade of the material assuming that all grades yield same rate of profit.

Solution: – As it is given in the question that each type of material yield same rate of profit, so the cost should be apportioned on the basis of the proportion of sales value. First of all find out sales value ratio.

Material of Order A :	2000 units	@ 18.00	₹ 36,000
Material of Order B :	3000 units	@ 15.00	₹ 45,000
Material of Order C :	3250 units	@ 12.00	₹ 39,000

Ratio of apportionment of cost

$$A : B : C \quad :: 36 : 45 : 39$$

$$= 12 : 15 : 13$$

Cost apportioned to Order A =	$\frac{12}{40} \times 100000$	= ₹ 30,000
Cost per unit =	$\frac{30,000}{2000}$	= ₹ 15

$$\begin{array}{lcl}
 \text{Cost apportioned to Order B} & = & \frac{15}{40} \times 100000 = ₹ 37,500 \\
 \text{Cost per unit} & = & \frac{37500}{3000} = 12.50 \\
 \text{Cost apportioned to Order C} & = & \frac{13}{40} \times 100000 = ₹ 32,500 \\
 \text{Cost per unit} & = & \frac{32500}{3250} = ₹ 10
 \end{array}$$

Issue of Material: – The materials stored in the stock room are issued to various jobs or production departments against the authorized material requisitions. The material issued is recorded in the store ledger and the respective jobs or production departments are debited with the price of material issued. As the market price tends to vary so there is a difference in the price at which material was purchased and the market price at the time of issue. It is always a matter of discussion and different views are kept by the concerned about the price at which the material to be issued. Some are in favour of historical cost i.e. original price at which the material was purchase. Still other is in favour of prevailing market price. Before we discuss the various methods of valuing the material issue let us see the procedure followed for material issue. As already discussed storekeeper is in charge of the material in the store, he is responsible for the stock. Before issue he should go through the document on the basis of which he has to issue the material required by the needing department. The document is the material requisition. A specimen copy of material requisition form is given below:

<u>ABC Company</u> Material Requisition							
Department.....				No.....			
Job No.....				Date.....			
To							
The Storekeeper							
Please issue the materials stated herein.							
Description	Code No.	Quantity	For Cost Office		Bin Card No.	Store Ledger Folio	Remarks
			Rate	Amount			
Authority by.....				Received by.....			
Issued by.....				Checked by.....			

The material requisition is signed by a person authorized to sign the document. To remove the other complications such to send store requisition by an unauthorized person, a specimen signature copy of the authorized person is kept with the storekeeper who has to issue the material. The material issued is properly entered in the bin card. If it is not done then stock in the store will not tally with the required at the end After this the store requisition is sent to the costing department to fill the columns of cost to debit the job or the production department.

The requisition are serially numbered by the storekeeper so that no requisition is left out and proper debit and credit can be given regarding the material to the production department and store ledger and similarly entered in the bin card maintained for the material.

Transfer of Surplus Material: – Sometimes material issued is more than the required in the job or production department. Sometimes no arrangement is there to send the exact quantity of material. Such surplus material will be either transferred to the store or transfer to another job where ever it is needed. The situations are the iron rods and sheets that cannot be issued in exact pieces required because the storekeeper is not having any arrangement there to do so. Then the whole quantity is supplied, as the requisition or sent material is sent to the cost department to value the material sent for the job the same will be debited to the job. When some part or quantity is returned the excess amount and value debited earlier might have been credited otherwise unnecessary rise in the cost of production. A return note is prepared and the items are sent back to the store where a credit is given to the job and similarly cost department also credits the value. But in the event the material is desired in the other job, the material can be transferred to the job requiring material to save the transport cost in moving material from job to store and then from store to the other job. A transfer note is prepared and note is sent to the costing department for information to credit the former job and debit the later with the value and quantity of material.

Specimen copy of material returned note

ABC Ltd.						
<u>Material Return Note</u>						
Credit.....				No.....		
Job No.....				Date.....		
Department/Shop.....						
Serial No.	Description	Code No.	For Cost Office		Amount	Remarks
			Quantity	Amount		
Approved by.....			Received by.....			
Returned by.....			Priced by.....			
Bin No.....			Store Ledger Folio.....			

Specimen copy of Performa regarding material transfer from one Job to another.

ABC Ltd.					
<u>Material Transfer Note</u>					
From:				No.....	
Job No.....				Date.....	
Department/Shop.....					
To					
Job No.....					
Department/Shop.....					
Description	Code No.	Quantity	For Cost Office		Remarks
			Rate	Amount	

Approved by.....			Received by.....		
Debited job No			Priced by.....		
Credited Job No.....					

Material abstract or Material Issue analysis report: –

It is a statement which shows the value of particular type of material used in different jobs. The material is issued from the store for different jobs. When material is used for a particular job, the job is debited with the value of material transferred to the job and is debited with the value of material transferred to the job and store is credited with the same value. Similar is the case with the other jobs consuming the particular material. After the end of a period material abstract report is prepared which shows the value of material issued from store to different jobs. This report should tally with the report shown in stores ledger.

A specimen copy of material abstract is shown as week –ending

Material Requisition or Transfer Note or Refund Note No.	Amount ₹	Job Nos.				Total for Jobs	Overheads (Indirect Material Charged) ₹
		201	202	203	204		
Total:							

Methods of valuing the material issue: –

Material cost issued to complete the finished goods is included in the total cost incurred. So its valuation becomes important. It is the amount spent on purchase of the material and taking it to the store. All the carriage inward expenses incurred are added to value the material. Insurance, its carrying cost is a part of the cost of material. Let us assume a particular type of material is purchased at ₹ 100 per unit and the supplies has given a trade discount of ₹ 5 per unit and transport and other costs such as insurance etc. are ₹ 3 per unit. There cost of material that is to be debited to the production is ₹ 98 per unit (₹ 100 – 5+3). Now another problem arises here that stock of material in the store consists of different consignments received at different dates and at different prices. At the same time material purchased at different prices are issued to the same or different jobs. The problem arises at which price the material is to be issued to particular or different jobs at the same time or we can say in other terms at which material price a job is to be debited. Let us assume that two jobs require same material whose 30 units are present 10 units purchased @ ₹100, 10 units @ ₹ 110 per unit and another 10 units @ ₹ 112 per unit and 12 units are sent to Job I and 18 units to Job II from the same godown, the problem arises which job should be debited with which unit material cost.

If same purchase price is paid for all the lots of a given material, no difficulty will be encountered in the valuation of that material when it is issued to jobs or work orders. However that is not the case always material price always go on changing in the market. The stock of material in the store will consist of materials of different values and the problem arises that what should be the price when material is issued. There are various methods of pricing the material issue there are: –

I Based on Cost Price:

1. First in First out method (FIFO)
2. Last in First out method (LIFO)
3. Highest in First out method (HIFO)
4. Average Cost Method
5. Inflated Price Method
6. Specific Price Method
7. Base – Stocks Method
8. Weighted Average Price Method

I. Based on market price

- (i) Replacement price (ii) Realizable value

III. Based on standard price

- (1) Current standard price (2) Base standard price

1) FIFO (First in first out method)

This method of valuing the issue of stock to the production is easy to operate. A sequence is applied and costs are fully absorbed in this method. In the event of falling prices this is the best to cover the cost incurred on material.

The following are advantages of FIFO method:

- (i) It is simple and easy to calculate.
- (ii) FIFO method is based on sound principle that material are issued in sequence of the purchase.
- (iii) The closing stock will be valued at the current market price as latest purchase will be in the stock.
- (iv) When prices are falling the costs incurred in past which are more than their present value are covered under this method.
- (v) In this method the cost of finished product is the actual cost because actual value of material purchased is debited to the job.
- (vi) As the material is issued in a sequence of first in first out chances of deterioration, evaporation obsolescence are avoided as oldest material is issued first to production.
- (vii) This method is very much useful when prices remains stable.

Disadvantages: This method suffers from the following disadvantages:

- (i) Issue price does not reflect the current market price and so the cost of production.
- (ii) For pricing on requisition, more than one price are often taken.
- (iii) When prices are falling it is beneficial to the company to absorb the high cost of material which was purchase earlier, but the cost of production and the price quoted may not be near about the prevailing market price because of high cost of productions and high selling price.
- (iv) Similar jobs comparison becomes difficult.
- (v) When purchase are made frequently the calculation becomes a cumbersome process.

2) Last in first out method (LIFO)

In this method the material purchased in last is issued first. This method is opposite of the FIFO method. In the event of rising prices this method is best and is always near about the market price. Under this method product cost is calculated on a basis which approximates to replacement cost.

The following are advantages of LIFO method.

- (i) This method is very simple to operate and quite useful where transaction are not too many and prices are fairly steady.
- (ii) Production is charged at the most recent prices so that it is based on the principle that costing should be related to current price levels.
- (iii) During the period of rising prices there is no windfall profit as in case of FIFO method.
- (iv) Closing stock will be valued at earlier price and will not therefore, show unrealized profit.
- (v) In the event of rising prices the burden of income tax is reduced.

Disadvantages:

- (i) Under this method, closing stock is not shown at current market prices.
- (ii) More than one price has to be adopted for pricing a single requisition.
- (iii) This method is not good in the event of falling prices, because of recovery of huge investment in past is not possible.
- (iv) This system of material issue is not accepted by income tax authorities in the event of rising prices.
- (v) In the event of frequent fluctuations in price, calculations become complicated and cumbersome.
- (vi) Two similar jobs cannot be compared because of charging different rates of material to different jobs.

3) Highest in first out method: According this method, the inventory of materials of goods should be valued at the lowest possible prices. Materials of goods purchased at the highest prices are treated as being first issued irrespective of the date of purchase. This method is very suitable when the market is constantly fluctuation because cost of heavily priced materials or goods is recovered from the production or sales at the earliest. However, the method involves too many calculations as is the case of FIFO or LIFO methods. The method has therefore not been adopted widely.

4) Average cost method: Under this method, material issued are valued at average price. This is calculated by dividing the total of the price of material on the stock from which the material to be priced could be drawn by the number of prices used in that total.

When a fresh receipt is made, a new average price is to be determined. The rate is revised when an earlier consignment is exhausted.

Suppose 100 units of raw material are purchased at ₹ 4.00 per unit. 200 units @ 5 per unit and 300 units @ ₹ 6.00 per unit then average price will be $= \frac{4+5+6}{3} = ₹ 5$ per unit.

Advantages of simple average method:

- (i) It is easy to operate and simple to calculate.
- (ii) Issue price remains the same until a fresh purchase is made.
- (iii) A particular purchase at higher or lower rate cannot disturb the price to a great extent.

Disadvantages:

- (i) The method does not depend on any logic because under this method simple average of purchase price is taken whereas the quantity of material purchase at different prices are ignored.
- (ii) Correct valuation of closing stock is not possible under this method.
- (iii) Issue Price does not relate to the current market price.

5) Inflated price method: In some types of materials, there is always a natural loss, which cannot be avoided. For example in timber loss in weight is natural due to seasoning and evaporation and if it is valued at the price at which it was purchased otherwise the actual recovery of cost of material is not possible. In such cases material is issued at an inflated price. For example 100 tons of material is purchased at ₹ 60 per ton and 4 ton of material is loss due to loading, unloading and natural loss, then value of material issued to production the price of ₹ 62.5 to recover the material cost of allocate the actual cost to production $(\frac{60 \times 100}{96})$ i.e. ₹ 62.50 per ton.

6) Specific price method: This is another simple method of valuing the material. In this case different consignments or lots are kept at the bin with tags depicting the purchase price. The material can be issued to production from any lot with the specific price shown on the tag. The method is beneficial because it recovers the actual value of material issued to production. The main drawback is that with the change in the lot issued to the production the price of final product will frequently change which sometimes may not be in favour of the company from the point of view of market penetration or acquiring a desired market share.

7) Base stock price method: This method is based on the principle that a certain minimum quantity of material is always maintained in to ensure continuous production. This minimum stock is treated as fixed asset and is called as base stock. Since minimum stock is created out of first lot of material purchased, it is always valued at cost price of first lot of materials. The quantity in excess of base stock is issued at a price similar to FIFO or LIFO method.

8) Weighted Average price method: This method is based on the presumption that once the material are put into a common bin they lose their separate identity. Hence the inventory consists of no specific batch of goods. The inventory is thus priced on the basis of average price paid for the goods, weighted according to the quantity purchased at each price. Weighted average price method is very popular on account of its being based on the total quantity and value of material purchased besides reducing number of calculations. As a matter of fact the new average price is to be calculated only when a fresh purchase of material is made in place of calculating it every now and then as is the case with FIFO, LIFO, HIFO. Let us understand it with an example.

100 units of raw material purchased @ ₹ 10 per unit , 1500 units @ ₹ 12 per unit and 2000 units @ ₹ 14.35 per unit
1500 units @ ₹ 12 per unit and 2000 units @ ₹ 14.35 per unit

The weighted average price can be calculated as

$$\begin{aligned}
 &= \frac{(1000 \times 10 + 1500 \times 12 + 2000 \times 14.35)}{(1000 + 1500 + 2000)} \\
 &= \frac{10000 + 18000 + 28700}{4500} \\
 &= \frac{56700}{4500} \\
 &= ₹ 12.6 \text{ per unit}
 \end{aligned}$$

The advantage of this method is that it fully recovers the cost of material. The value of material issued calculated on weighted average method is debited to the production. The calculated average weight price is always near about to the prevailing market price.

Illustration: 5: The following are the transactions in respect of purchase and issue of components forming part of an assembly of a product manufactured by a firm which requires to update its cost of production, very often for bidding tenders and finalizing cost plus contracts.

The stock on 1st January 2001 was 4000 numbers valued at ₹ 5.00 each. Adopt FIFO method to value stock on 31st March 2001 after posting the following transaction in respect of material.

Date			Quantity (in Nos)	Particulars
2001	January	13	1000	Purchase at ₹ 5.25 each
	January	20	2000	Issued to production
	February	3	1500	Purchased at ₹ 5.30 each
		18	2400	Issued to production
		26	1000	Issued to production
	March	10	1000	Purchased at ₹ 5.40 each
		17	1500	Purchased at ₹ 5.30 each
		29	2000	Issued to production

Solution:

In valuing the material issue under FIFO method. The material which is purchase in earlier dates are valued first and balance material at every issue is sent at the new rates. Similarly inventories are valued at the recent rates of purchase. It has been shown as below.

Stock Ledger (FIFO method)

Date	Receipts			Issues			Stock		
	Quantity No's.	Rate ₹	Value ₹	Quantity No's	Rate ₹	Value ₹	Quantity No's	Rate ₹	Value ₹
Jan 1, 2001	—	—	—	—	—	—	4,000	5.00	20,000
Jan 13, 2001	1,000	5.25	5,250	—	—	—	5,000		25,250
Jan, 20	—	—	—	2000	5.00	10,000	3,000		15,250
Feb 3, 2001	1,500	5.30	7,950	—	—	—	4,500		23,200
Feb 18, 2001	—	—	—	2,000	5.00	10,000	2,100		11,100
				400	5.25	2100			
Feb 26, 2001	—	—	—	600	5.25	3150			
				400	5.30	2120	1,100		5830
March 10, 2001	1000	5.40	5400	—	—	—	2,100		11,230
March 17, 2001	1,500	5.30	7,950	—	—	—	3,600		19,180
March 29, 2001	—	—	—	1,100	5.3	5830	1,600		8490
				900	5.4	4860			

The closing stock is 1600 numbers of the component		₹
under FIFO method 1500 numbers purchased on March 17, 2001 @ 5.30	=	7950
100 numbers purchased on March 10, 2001 @ 5.40	=	540
Closing stock of components on 31st March 2001	=	8490

Illustration 6: From the information given below prepare a store ledger showing the value of material issued to the job requiring the raw material and the value of the inventories in the store at the end of the period. FIFO method of valuing the material is to be used Also solve the same using LIFO method.

Opening stock of material 5000 units @ ₹ 9 per unit on Nov. 01, 2005

Date	
10 Nov. 2005	Issued to production 2000 units
12 Nov. 2005	Received 1500 units purchased @ ₹ 9.20 per unit
15 Nov. 2005	Issued to production 1,000 units
18 Nov. 2005	Received 1000 units purchased @ ₹ 9.25 per units
25 Nov. 2005	Issued to production 2500 units
30 Nov. 2005	Received 2500 units purchase @ ₹ 9.30 per unit
Dec. 10, 2005	Issued to production 1500 units
Dec. 15, 2005	Received 1500 units purchased @ ₹ 9.40 per unit
Dec. 20, 2005	Issued to production 2500 units
Dec. 25, 2005	Received 1500 units purchased @ ₹ 9.40 per unit
Dec. 28, 2005	Received 1000 units purchased @ ₹ 9.35 per unit
Dec. 29, 2005	Issued to production 1500 units

Solution:

Store Ledger (FIFO Method)

Date	Received			Issued			Balance		
	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)
9 Nov 2005	—	—	—	—	—	—	5,000	9	45000
10 Nov	—	—	—	2000	9	18000	3000	9	27000
12 Nov	1500	9.20	13800	—	—	—	3000	9	27000
							1500	9.20	13800
15 Nov.	—	—	—	1000	9	9000	2000	9	18000
							1500	9.20	13800
18 Nov.	1000	9.25	9250	—	—	—	2000	9	18000
							1500	9.20	13800
							1000	9.25	9250
25 Nov.	—	—	—	2000	9	18000	1000	9.20	9200
				500	9.20	4600	1000	9.25	9250
30 Nov.	2,500	9.30	23500	—	—	—	1000	9.20	9200
							1000	9.25	9250
							2500	9.30	23250
10 Dec.	—	—	—	1000	9.25	9200	500	9.25	4625
				500	9.25	4625	2500	9.30	23250
15 Dec.	1500	9.40	14100	—	—	—	500	9.25	4625
							2500	9.30	23250
							1500	9.40	14100
20 Dec.	—	—	—	2500	9.25	4625	500	9.30	4650
				2000	9.30	18600	1500	9.40	14100

25 Dec.	1500	9.40	14100	—	—	—	500	9.30	4650
							300	9.40	2820
28 Dec.	1000	9.35	9350	—	—	—	500	9.30	4650
							3000	9.40	28200
							1000	9.35	9350
29 Dec.	—	—	—	500	9.30	4650	2000	9.40	18800
				1000	9.40	9400	1000	9.35	9350

As FIFO method of valuing the material is applied the stock of inventories will be from latest purchases.

		₹
Opening Stock	=	5000
Units Received	=	9000
Total	=	14000
Issued to production	=	11000
Balance units in stock	=	3000

		₹
So inventories on 31st Dec, 2005	= 1000×9.35	= 9350
	2000×9.40	= 18800
	Total	= 28,150

b. Stock Ledger (LIFO Method)

Date	Received			Issued			Balance		
	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)
01 Nov.	—	—	—	—	—	—	5000	9	45000
10 Nov.	—	—	—	2000	9	18000	3000	9	27000
12 Nov.	1500	9.20	13800	—	—	—	3000	9	27000
							1500	9.20	13800
15 Nov.	—	—	—	1000	9.20	9200	3000	9	27000
							500	9.20	4600
18 Nov.	1000	9.25	9250	—	—	—	3000	9	27000
							500	9.20	4600
							1000	9.25	9250
25 Nov.	—	—	—	1000	9.25	9250	2000	9	18000
				500	9.20	4600			
				1000	9.00	9000			
30 Nov.	500	9.30	23250	—	—	—	2000	9	18000
							2500	9.30	23250
10 Dec.	—	—	—	1500	9.30	13950	2000	9	18000
							1000	9.30	9300
15 Dec.	1500	9.40	14,100	—	—	—	2000	9	18000
							1000	9.30	9300
							1500	9.40	14100
20 Dec.	—	—	—	1500	9.40	14100	2000	9	18000
				1000	9.30	9300			

25 Dec.	1500	9.40	14100	—	—	—	2000	9	18000
							1500	9.40	14100
28 Dec.	1000	9.35	9350	—	—	—	2000	9	18000
							1500	9.40	14100
							1000	9.35	9350
29 Dec.	—	—	—	100	9.35	9350	2000	9	18000
				500	9.40	4900	1000	9.40	9400

Stock of inventories under LIFO method

= 2000 Units @ 9.00	= ₹ 18000
1000 units @ 9.40	= ₹ 9400
Total	= <u>₹ 27400</u>

Illustration 7: You are presented with the following information by an engineering company related to 3rd week of January 2011.

The transaction in connection with the material are as follows:

Date	Receipts		Issues (Units)
	Unit	Rate per unit	
15th Jan	50	25.00	—
16th Jan	30	26.00	—
17th Jan	—	—	40
18th Jan	50	28.00	—
19th Jan	—	—	20
20th Jan	—	—	40

Calculate the value of material issued under (i) FIFO method, (ii) LIFO method and (iii) weighted average method of issue of material and value of the closing stock under each method.

Solution:

i) Cost of material issued under FIFO method

		₹
17th Jan issued 40 units	= 40@25.00	= 1000
19th Jan issued 20 units	= 10@ 25 =250	= 510
	10@26 = 260	
20th Jan issued 40 units	= 20@26 = 520	= 1080
	20@28 = 560	
Closing stock on 20th January	= 30 units @ 28	= ₹ 840

ii) Cost of material under LIFO method

			₹	Total ₹
17th Jan issued 40 units	= 30@ 26	=	780	1030
	10 @25	=	250	
19th Jan issued 20 units	= 20@28	=	560	560
20th Jan issued 40 units	= 30@28	=	840	1090
	10@25	=	250	
Closing stock of material on 20th January under LIFO method	= 30units@25	=	₹ 750	

iii) Cost of material issued under weight average method

17th Jan issued 40 units	=	$40 \times \left(\frac{50 \times 25 + 30 \times 26}{50 + 30} \right)$
	=	40×25.375
	=	₹ 1015
19th Jan issued 20 units	=	$20 \times \left(\frac{40 \times 25.375 + 50 \times 28}{40 + 50} \right)$
	=	$20 \times \left(\frac{1015 + 1400}{90} \right)$
	=	$20 \times \frac{2415}{90}$
	=	₹ 537
20th Jan issued 40 units	=	$40 \times \left(\frac{2415}{90} \right)$
	=	₹ 1073 (approx..)

Closing stock under weighted average method

$$= 30 \times \frac{2415}{90}$$

$$= ₹ 805$$

Illustration 8: From the information given below regarding the receipt and issue of material from the store to a particular job in the process of production, prepare store ledger under HIFO (highest in first out) method and value the inventories in the store at the end of a particular week.

Date	Particular
1st of the month	opening stock 3000 kg @ ₹ 6.00 per kg
1st day of week	Purchased 2000 kg of material @ ₹ 6.50 per kg
2nd day of week	Issued 3000 kg of material to job
3rd day of week	Purchased 3000 kg of material @ ₹ 6.75 per Kg
4th day of week	Issued 2500 kg of material to job
5th day of week	Purchased 2500 kg of material @ ₹ 7.00 per Kg
6th day of week	Issued 3500 Kg of material to job
7th day of week	Purchased 1500 kg of material @ ₹ 7.10 per kg

Solution: As we are preparing store ledger on FIFO method. In the case of issue of material, the material with highest value is issued to the production.

Store Ledger (FIFO Method)

Date	Received			Issued			Balance		
	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)
1st day of week	—	—	—	—	—	—	3000	6	18000
	2000	6.50	13000	—	—	—	2000	6.50	13000
2nd day of week	—	—	—	2000	6.50	13000	2000	6	12000
				1000	6.00	6000			
3rd day of week	3000	6.75	20250	—	—	—	2000	6	12000
							3000	6.75	20250
4th day of week	—	—	—	2500	6.75	16875	2000	6	12000
							500	6.75	3375
5th day of week	2500	7.00	17500	—	—	—	2000	6	12000
							500	6.75	3,375
							2500	7.00	17,500
6th day of week	—	—	—	2500	7.00	17500	1500	6	9000
				500	6.75	3375			
				500	6.00	3000			
7th day of week	1500	7.10	10650	—	—	—	1500	6	9000
							1500	7.10	10,650

	Quantity Kg	Value ₹
Opening stock of material	= 3000	18000
Received during the week	= 9000	61400
Total	= 12000	79400
Less issued to production	= 9000	59750
Closing stock at the end of the week	= 3000	19650
1500 units @ ₹ 6	= ₹ 9000	
1500 units @ ₹ 7.10	= ₹ 10650	
		₹ 19650

(Keeping a base stock under FIFO method)

Illustration 9: From the following details of store receipts and issues of material in a manufacturing unit, prepare the store ledger using the method of keeping a base stock of 2000 units under FIFO.

Nov. 1, 2010

Opening stock 2000 units @ ₹ 12 each

Nov. 3, 2010	Received 4500 units @ ₹ 12.60 each
Nov. 4, 2010	Issued 3500 units
Nov. 5, 2010	Received 1500 units @ ₹ 12.70 each
Nov. 8, 2010	Issued 2500 units to production
Nov. 10, 2010	Received 4000 units @ ₹ 12.80 each
Nov. 16, 2010	Issued 3500 units to production
Nov. 20, 2010	Received 1500 units @ ₹ 13.00 each
Nov. 24, 2010	Issued 2000 units to production
Nov. 25, 2010	Received 3000 units @ ₹ 13.40 each
Nov. 28, 2010	Issued 2500 units to production
Nov. 29, 2010	Received 2500 units @ ₹ 13.50 each
Nov. 30, 2010	Issued 3000 units to production

Solution: Store Ledger Keeping base stock under FIFO for the month of Nov. 2010

Date	Received			Issued			Balance		
	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)	Quantity (Units)	Rate (₹)	Value (₹)
Nov. 1	—	—	—	—	—	—	2000	12	24000
Nov. 3	4500	12.60	56700	—	—	—	2000	12	24000
							4500	12.60	56700
Nov. 4	—	—	—	2000	12	24000	3000	12.60	37800
				1500	12.60	18900			
Nov. 5	1500	12.70	19050	—	—	—	3000	12.60	37800
							1500	12.70	19050
Nov. 8	—	—	—	2500	12.60	31500	500	12.60	6300
							1500	12.70	19050
Nov. 10	4000	12.80	51200	—	—	—	500	12.60	6300
							1500	12.70	19050
							4000	12.80	51200
Nov. 16	—	—	—	500	12.60	6300	2500	12.80	32000
				1500	12.70	19050			
				1500	12.80	19200			
Nov. 20	1500	13.00	19500	—	—	—	2500	12.80	32000
							1500	13.00	19500
Nov. 24	—	—	—	2000	12.80	25600	500	12.80	6400
							1500	13.00	19500
Nov. 25	3000	13.40	40200	—	—	—	500	12.80	6400
							1500	13.00	19500
							3000	13.40	40,200
Nov. 28	—	—	—	500	12.80	6400	2500	13.40	33,500
				1500	13.00	19500			
				500	13.40	6700			
Nov. 29	2500	13.50	33750	—	—	—	2500	13.40	33500
							2500	13.50	33750
Nov. 30	—	—	—	2500	13.40	33500	2000	13.50	27000
				500	13.50	6750			

Note: Base stock of 2000 is to be kept in stock for emergency and FIFO method of issue is to be followed so the stock is kept from the latest consignment of lot received.

Illustration 10: The following information is extracted from the stores ledger:

Material X	
Opening Stock	Nil
Purchases:	
Jan 1	100@ ₹ 1 per unit
Jan 20	100@ ₹ 2 per unit
Issues:	
Jan 22	60 for job W –16
Jan 23	60 for job @W –17

Complete the receipts and issues valuation by adopting the first in first out, last in first out and the weighted average method. Tabulate the values allocated to job W –16, job W –17 and the closing stock under the methods aforesaid and discuss from different points of view which method you would preferred.

(CA inter Nov. 1985)

Solution:

a) Statement showing receipts and issue of material under FIFO

Date	Received			Issued			Balance		
	Quantity No. units	Rate per unit ₹	Value ₹	Quantity No. units	Rate per unit ₹	Amount ₹	Quantity No. unit	Rate per unit	Amount ₹
Jan 1	100	1	100	—	—	—	100	1	100
Jan 20	100	2	200	—	—	—	100	1	100
							100	2	200
Jan 22	—	—	—	60	1	60	40	1	40
				(job w –16)			100	2	200
Jan 23	—	—	—	40	1	40	80	2	160
				20	2	40			
				(job w –17)					

b) Statement showing issue and receipt of material under LIFO

Date	Received			Issued			Balance		
	Quantity units	Rate	Value ₹	Quantity units	Rate	Value ₹	Quantity Units	Rate	Value ₹

	per unit ₹			per unit ₹			per unit		
Jan 1	100	1	100	–	–	–	100	1	100
Jan 20	100	2	200	–	–	–	100	1	100]
							100	2	200]
Jan 22	–	–	–	60	2	120	100	1	100]
				(job w –			100	2	80]
				16)					
Jan 23	–	–	–	40	2	80	80	2	80]
				20	1	20			
				(job w –					
				17)					

c) Statement showing the receipts and issue of material under in weighted average method.

Date	Received			Issued			Balance		
	Quantity units	Rate per unit ₹	Value ₹	Quantity units	Rate per unit ₹	Value ₹	Quantity Units	Rate per unit ₹	Value (₹)
Jan 1	100	1	100	–	–	–	100	1	100
Jan 20	100	2	200	–	–	–	200	1.5	300
Jan 22	–	–	–	60	1.5	90	140	1.5	210
				(job w –					
				16)					
Jan 23	–	–	–	60	1.5	90	80	1.5	120
				(job w –					
				17)					

Statement showing the value of material allocated to job w –16 and job no. 17 and closing stock under different methods.

Particular	Method		
	FIFO (₹)	LIFO (₹)	weighted Average (₹)
Material cost allocated to job w –16	60	120	90
Material cost allocated to job w –17	80	100	90
closing stock	160	80	120

Comments: Under FIFO method there is a huge amount in closing stock and the jobs are allocated with lesser value leading to low value of cost of production on the other hand in LIFO method closing stock of material is at much lesser value and the jobs are allocated with high material cost and so high cost of production.

In case of weighted average method the jobs are allocated almost at equal material value efficiency, comparison becomes possible between the jobs and also the closing stock is not too heavy as well as too low. So weighted average method in this question is best in valuation of material allocated to different jobs as well as the closing stock of material lying in store with the company.

Return to the material: When material is sent to the production, the production cost is debited with the value of the material sent. Some surplus material may be returned to the store. When it is returned to the store, problem arises at which price the returned material is taken back and credit is given to the concerned department. Two methods of valuing the returned material may be.

- (i) At the price it was sent or issued.
- (ii) At the current price of issue.

- (i) **At the price it was issued:** This method is very simple and acceptable method because price at which the particular material was issued can be ascertained from the material requisition. The value of material return is treated as fresh purchases and is kept on the bin at the original price at which it was issued. It will not disturb even the method of valuing the material issue as returns are treated as fresh purchases. Suppose a lot of material of 100 units is issued from store which was purchased @ ₹ 10 and 15 units of material are returned on some later date then the returned material will be valued at ₹ 150 i.e. the original purchase price. It is the most desirable method.
- (ii) **At the current price of issue:** Under this method the returned material is valued at the price at which material on the date of return can be issued. This method is not very popular because it will need adjustment in production order, on account of different rates being applied on returns.

Illustration 11: From the details of purchases and issue of a store, prepare a store ledger using weighted average method of valuing the issues.

Jan 1	Opening stock 1500 units @ ₹ 10 each
Jan 2	Issued 1000 units to production
Jan 4	Received 4000 units @ ₹ 11 each
Jan 8	Issued 1500 units to production
Jan 10	Returned 200 units by production department (from material issued on Jan 2)
Jan 16	Received 2000 units @ ₹ 11.50 each
Jan 19	Returned to supplier 400 units out of received on Jan 4
Jan 20	Received 1000 units @ ₹ 12.00 each
Jan 24	Issued to production 2500 units
Jan 28	Received 1000 units @ ₹ 12.50 each

Jan 31

Issued to production 3200 units

(calculations to made units two decimal places)

Stores Ledger (Weighted Average Method)

Date	Received			Issued			Balance		
	Quantity (units)	Rate ₹	Amount ₹	Quantity (units)	Rate ₹	Amount ₹	Quantity (Units)	Rate ₹	Amount ₹
Jan 1	—	—	—	—	—	—	1500	10	15000
Jan 2	—	—	—	1000	10	10000	500	10	5000
Jan 4	4000	11	44000	—	—	—	4500	10.89	49000
Jan 8	—	—	—	1500	10.89	16335	3000	10.89	32665
Jan 10	200	10	200	—	—	—	3200	10.83	34665
Jan 16	2000	11.50	23000	—	—	—	5200	10.09	57665
Jan 19	—	—	—	400	11	4400	4800	11.10	53265
Jan 20	1000	12	12000	—	—	—	5800	11.25	65265
Jan 24	—	—	—	2500	11.25	28125	3300	11.25	37140
Jan 28	1000	12.50	12500	—	—	—	4300	11.54	49640
Jan 31	—	—	—	3200	11.54	36943	1100	11.54	12697

(Calculations are made up to two decimal places)

Illustration 12: From the following transaction extracted from the books of accounts of a manufacturing concern as on 31st December 1980, work out (a) consumption value of raw material in the month and (b) value of closing stock as on 31st December 1980, under the following four methods of pricing issues:

- (i) FIFO (ii) LIFO (iii) Moving Average cost
(iii) Weighted average cost (end of month)

Show the results in tabular form.

		Quantity in units	Rate per unit ₹
1980 December	1. Opening stock	300	9.70

“ “	3. Purchases	250	9.80
“ “	11. Issues	400	
“ “	15. Purchases	300	10.05
“ “	20. Issues	210	
“ “	25. Purchases	150	10.30
“ “	29. Issues	100	

(ICWA inter June, 1981)

Solution:

FIFO method of valuing the material issue

Date	Particulars	Received			Issued			Balance		
		Units	Rate	Value	units	Rate	Value	Units	Rate	Value
		Units	₹	₹		₹	₹		₹	₹
Dec 1980										
01	Opening Stock	—	—	—	—	—	—	300	9.70	2910
03	Purchases	250	9.80	2450	—	—	—	300	9.70	2910]
								250	9.80	2450]
11	Issued to Production	—	—	—	300	9.70	2910	150	9.80	1470]
15	Purchases	300	10.05	3015	100	9.80	980			
					—	—	—	150	9.80	1470]
20	Issued to production	—	—	—	150	9.80	1470	300	10.0	3015]
25	Purchase	150	10.30	1545	60	10.05	603	5		
					—	—	—	240	10.0	2412]
29	Issued to production	—	—	—	100	10.05	1005	5		
								240	10.0	2412]
								150	5	1545]
								10.3		
								0		
								140	10.0	1407]
								150	5	1545]
								10.3		
								0		

Consumption value of raw material during the month

	Units	Rate	Amount
		₹	₹
	300	9.70	2910
	100	9.80	980
	150	9.80	1470
	60	10.05	603
	100	10.05	1005
Total	710		6968

Value of closing stock

	Units	Rate ₹	Amount ₹
	140	10.05	1407
	150	10.30	1545
Total	290		2952

(ii) LIFO method of valuing the material issue

Date		Received			Issued			Balance		
	Particulars	Units	Rate ₹	Amount ₹	units	Rate ₹	Amount ₹	Units	Rate ₹	Amount ₹
Dec 1980										
01	Opening stock	—	—	—	—	—	—	300	9.70	2910
03	Purchases	250	9.80	2450	—	—	—	300	9.70	2910
								250	9.80	2450
11	Issued to production	—	—	—	250	9.80	2450	150	9.70	1455
15	Purchases	300	10.05	3015	150	9.70	1455	150	9.70	1455
					—	—	—	300	10.0	3015
20	Issued to production	—	—	—	210	10.05	2110.5	90	10.0	904.50
25	Purchases	150	10.30	1545	—	—	—	150	9.70	1455
								90	10.0	904.50
								150	5	1545
									10.3	
29	Issued to production	—	—	—	100	10.30	1030	50	5	515.00
									10.3	
									0	

Consumption of value of raw material during December 1980.

	Units	Rate ₹	Amount ₹
	250	9.80	2450
	150	9.70	1455
	210	10.05	2110.50
	100	10.30	1030.00
Total	710		7045.50

Closing stock of raw material

	Units	Rate ₹	Amount ₹
	150	9.70	1455
	90	10.05	904.50
	50	10.30	515
Total	290		2874.50

(iii) Moving average cost method of valuing the issue of material

Date		Received			Issued			Balance		
	Particulars	Units	Rate ₹	Value ₹	units	Rate ₹	Value ₹	Unit s	Rat e ₹	Value ₹
Dec 1980										
01	Opening stock	—	—	—	—	—	—	300	9.70	2910
03	Purchases	250	9.80	2450	—	—	—	550	9.75	5360
11	Issued to production	—	—	—	400	9.75	3900	150	9.75	1460
15	Purchases	300	10.05	3015	—	—	—	450	9.94	4475
20	Issued to production	—	—	—	210	9.94	2087.40	240	9.94	2387. 60
25	Purchases	150	10.30	1545	—	—	—	390	10.0	3932. 8 60
29	Issued to production	—	—	—	100	10.08	1008	290	10.0	2924. 8 60

Value of material issued to production

Units	Rate ₹	Amount ₹
400	9.75	3900

	210	9.94	2087.40
	100	10.08	1008.00
Total	710		6995.40

Value of closing stock=

290 units = ₹ 2924.60 at moving average cost method of valuation.

(iv) weighted average method (Periodic) of valuing the issue of material

Date	Particulars	Received			Issued			Balance		
		Units	Rate ₹	Value ₹	units	Rate ₹	Value ₹	Units	Rate ₹	Value ₹
Dec 1980 01	Opening stock	—	—	—	—	—	—	300	9.70	2910
03	Purchases	250	9.80	2450	—	—	—	250	9.80	2450
15	Purchases	300	10.05	3015	—	—	—	300	10.05	3015
25	Purchases	150	10.30	1545	—	—	—	150	10.30	1545
								1000	9.92	9920
11	Issued to production	—	—	—	400	9.92	3968			
Dec 1980 20	Issued to production	—	—	—	210	9.92	2083.20			
Dec 1980 29	Issued to production	—	—	—	100	9.92	992			
Dec 1980					710		7043.20			

Value of material issued to production

	Units	Rate ₹	Amount ₹
Total	710	9.92	7043.20

Value of closing stock=

290 units = 290 @ ₹ 9.92

= ₹ 2876.80

Illustration 13: Following is the information given by company regarding the purchase and issue of material used in production of a product. You are required through a statement, to find out the value of material issued to production during the month Sept. 2001 and the closing stock at the 30th Sep, 2001. There were an opening stock of 2000 units valued at unit price of ₹ 10.

Sept. 01, 2001	Purchased 1000 @ ₹ 11.50 per unit
" 02	Issued 1500 units for production
" 05	Purchased 2500 units @ 12.00 per unit
" 07	Issued 1500 units for production
" 10	Purchased 2000 units @ ₹ 12.30
" 12	Issued 2500 units for production
" 14	Purchased 1000 units @ ₹ 12.50
" 17	Issued 1500 units for production
" 20	Purchased 2500 units @ ₹ 12.70

Sept. 22, 2001	Issued 1500 units for production
Sept. 24, 2001	Purchased 2000 units @ ₹ 13.00 per unit
Sept. 25, 2001	Issued 2500 units for production
Sept. 27, 2001	Purchased 1000 units @ ₹ 13.20 per unit
Sept. 29, 2001	Issued 1500 units for production
Sept. 30, 2001	Purchased 2500 units @ ₹ 13.40 per unit

Show the working under of material and its stock.

1. FIFO method of valuation
2. LIFO method of valuation

Solution:

(1) Store ledger under FIFO method of valuation.

Date	Particulars	Received			Issued			Balance		
		Units	Rate ₹	Value ₹	units	Rate ₹	Value ₹	Unit s	Rat e ₹	Value ₹
Sept. 2001	Opening stock	—	—	—	—	—	—	2000	10	20000
01	Purchased material	1000	11.50	11500	—	—	—	2000 1000	10 11.50	20000 45000
02	Issued for production	—	—	—	1500	10	15000	500 1000	10 11.50	5000 115000
05	Purchased material	2500	12.00	30000	—	—	—	500 1000 2500	10 11.50 12.00	5000 11500 300000
07	Issued for production	—	—	—	500 1000	10 11.50	5000 11500	2500	12.00	300000
10	Purchased material	2000	12.30	24600	—	—	—	2500 2000	12.00 12.30	300000 246000
12	Issued for production	—	—	—	2500	1200	30000	2000	12.30	24600
14	Purchased material	1000	12.50	12500	—	—	—	2000 1000	12.30 12.50	24600 125000
17	Issued for production	—	—	—	1500	12.30	18450	500 1000	12.30 12.50	6150 12500
20	Material purchased	2500	12.70	31750	—	—	—	500 1000 2500	12.30 12.50 12.70	6150 12500 31750
22	Issued for production	—	—	—	500 1000	12.30 12.50	6150 12500	2500	12.70	31750
24	Material purchased	2000	13.00	26000	—	—	—	2500 2000	12.70 13.00	31750 260000
25	Issued for production	—	—	—	2500	12.70	31750	2000	13.00	260000
27	Material purchased	1000	13.20	13200	—	—	—	2000 1000	13.00 13.20	26000 13200

29	Issued to production	—	—	—	1500	13.00	19500		13.20	
								500 1000	13.00 13.20	6500 13200
30	Purchased material	2500	13.40	33500	—	—	—	500 1000 2500	13.00 13.20 13.40	6500 13200 33500

Statement of value of material issued to production

Units	Rate ₹	Amount ₹
1500	10	15000
500	10	5000
1000	11.50	11500
2500	12.00	30000
1500	12.30	18450
500	12.30	6150
1000	12.50	12500
2500	12.70	31750
1500	13.00	19500
12500		149850

Value of closing stock under FIFO method.

Units	Rate ₹	Amount ₹
500	13.00	6500
1000	13.20	13200
2500	13.40	33500

4000	53200

(2) Store ledger under LIFO method of valuation.

Date	Particulars	Received			Issued			Balance		
		Units	Rate ₹	Value ₹	units	Rate ₹	Value ₹	Unit s	Rat e ₹	Value ₹
Sept. 2001	Opening stock	—	—	—	—	—	—	2000	10	20000
01	Purchased material	1000	11.50	11500	—	—	—	2000 1000	10 11.5	20000 11500
02	Issued for production	—	—	—	1000 500	11.50 10	11500 5000	1500	10	15000
05	Purchased material	2500	12.00	30000	—	—	—	1500 2500	10 12	15000 30000
07	Issued for production	—	—	—	1500	12	18000	1150 0 1000	10 12	15000 12000
10	Purchased material	2000	12.30	24600	—	—	—	1500 1000 2000	10 12 12.3	15000 12000 24600
12	Issued for production	—	—	—	2000 500	12.30 12	24600 6000	1500 500	10 12	15000 6000
14	Purchased material	1000	12.50	12500	—	—	—	1500 500 1000	10 12 12.5	15000 6000 12500
								0		

17	Issued for production	—	—	—	1000	12.50	12500	1500	10	15000
					500	12	6000			
20	Material purchased	2500	12.70	31750	—	—	—	1500	10	15000
								2500	12.7	31750
								0		
22	Issued for production	—	—	—	1500	12.70	19050	1500	10	15000
								1000	12.7	12700
								0		
24	Material purchased	2000	13.00	26000	—	—	—	1500	10	13000
								1000	12.7	12700
								2000	0	26000
								1300		
25	Issued for production	—	—	—	2000	13.00	26000	1500	10	15000
					500	12.70	6350	500	12.7	6350
								0		
27	Material purchased	1000	13.20	13200	—	—	—	1500	10	15000
								500	12.7	6350
								1000	0	13200
								13.2		
								0		
29	Issued for production	—	—	—	1000	13.20	13200	1500	10	15000
					500	12.70	6350			
30	Purchased material	2500	13.40	33500	—	—	—	1500	10	15000
								2500	13.4	33500
								0		

Statement of value of material issued.

Units	Rate	Amount
	₹	₹
1000	11.50	11500

500	10.00	5000
1500	12.00	18000
2000	12.30	24600
500	12.00	6000
1000	12.50	12500
500	12.00	6000
1500	12.70	19050
2000	13.00	26000
500	12.70	6350
1000	13.20	13200
500	12.70	6350
12500		1,54,550

Value of closing stock

Units	Rate ₹	Amount ₹
1500	10	15000
2500	13.40	33500
4000		48500

(3) In the FIFO method the material which entered first in the store is issued first to production. In the particular question there is 4000 units of material in the record. All the material which entered first has been issued except 4000 units. 500 @ ₹ 13, 1000 @ ₹ 13.20 and 2500 @ ₹ 13.40 and the total value of stock came out to be ₹ 53200. This method is suitable in the particular question of rising process, because of material in stock is more of the value. The total value of material which entered was of the value ₹ 2,03,050. Material issued is of ₹ 1,49,850 and in stock is ₹ 53200.

In the case of LIFO method the material which entered last is issued to production first. This is the best method in the particular question of rising prices trend. Out of total

material of value ₹ 2,03,050 ₹ 1,54,550 has been issued to production and stock of ₹ 48,500 is present in the stock which is at lesser value than the FIFO method.

Exercise

1. What do you understand by production?
2. What do you understand by utility?
3. Differentiate between the material and finished product.
4. Why material control is essential?
5. What is normal waste?
6. Whether increase in material efficiency is possible through material control?
7. What are the objectives of material control?
8. Where is the most suitable place of store in any production unit?
9. “Cost of the final product depends upon the quality of the material used in production”. Comment on the statement.
10. Material requisition is initiated by which department?
 - (i) Production department
 - (ii) store department
 - (iii) Purchased department comment
11. What are the essentials of material control?
12. Describe various functions of purchase department.
13. Draw a specimen copy of purchase requisition.
14. What do you understand by comparative statement for seller's selection?
15. Draft a purchase order Performa.
16. What is goods receipt note?
17. By whom purchase requisition is sent?
18. Differentiate between bin and bin card?
19. Draft a specimen copy of store ledger.
20. Show with a suitable example FIFO method of issue of material.
21. List the various different methods of material issue.
22. Why proper method of valuation of material issue is necessary?
23. What circumstances make it necessary to prepare material transfer note?

24. What is material requisition?
25. What is material inspection report?
26. Mention the important requirements you would consider while laying down an efficient system of material control in your organization.
- (ICWA inter)
27. State functions of purchase department in any factory.
- (B.Com Punjab)
28. What is importance of good store keeping in an organization? What are the duties of a store keeper?
29. What are the methods of valuing the material returned by production department?
30. Describe weighted average method of valuation of the material issue. What are its advantages?
31. In inflationary conditions which of the two methods FIFO or LIFO should be used and why?
32. In most industrial units material cost constitutes the bulk of the total cost of production. Describe in detail the salient features of a good “Material control system”. Which will help to exercise effective control over the cost of material.
- (ICWA Inter)
33. Explain the procedure you would adopt in dealing with
- (i) Excess material issued returned by the production department.
 - (ii) Normal uncontrollable losses due to evaporation or other climate conditions.
 - (ii) Losses due to mismanagement and avoidable breakage in the store.
34. What do you understand by material abstract or material issue analysis sheet?
35. What are various advantages of standard cost method of material issue.
36. What are the advantages of a separate purchase department in an organization.
37. What is difference between a Bin card and a store ledger? Or what is Bin card and a store ledger?
- (B. Com Punjab)
38. Where store ledger is maintained?

39. From the information given below prepare a comparative statement. If the company plans to purchase 15000 units of material.

Quotation 1. Rate per unit of the product ₹ 15.00

Quotation 2. Rate per unit of the product ₹ 14.75 and a discount of 10% on purchases in excess of 10,000 units.

Quotation 3. Rate per unit of the product ₹ 14.60, and a discount of 12% on purchases in excess of 12,000 units.

The quotation with minimum value of total units is to be ordered, show your working.

Ans.

Quotation 1. ₹ 2,25,000
Quotation 2. ₹ 2,13,875
Quotation 3. ₹ 2,13,744

40. On inviting tenders for purchase of material of a specific specification, two quotations are received from the suppliers which are as under.

(a)

Supplier 1 Offered to send the material at ₹ 10 per unit of the material. supplied.

Supplier 2 offered to send that material at ₹ 9.50 per unit of the material supplied plus a flat rate of transport charges ₹ 5000.

The company at present has planned to purchase 5000 units of the material. Prepare a comparative statement and guide the company properly which quotation should be accepted.

(b) Will your decision differ if the company plans to prepare 10,050 units of the material?

(c) Also calculate the minimum units after which the second company will be offered to send the material.

Ans. $\left[\begin{array}{l} \text{(a) Supplier 1. To be ordered} \\ \text{(b) Supplier 2. To be ordered} \\ \text{(c) 10,000 units} \end{array} \right]$

41. A lorry load of material of mixed goods was purchased for ₹ 3,03,300. Later on it was sorted out into the following three categories:

Category X	5000 units	Selling price ₹ 30 per unit
Category Y	2600 units	Selling price ₹ 35 per unit
Category Z	2400 units	Selling price ₹ 40 per unit

Find the purchase rate per unit as each grade of the material assuming that all grades yield the same rate of profit.

Ans : $\left[\begin{array}{l} X = ₹ 27 \\ Y = ₹ 31.50 \\ Z = ₹ 36 \end{array} \right]$

42. A lorry load of material of mixed goods was purchased for ₹ 4,93,000. On sorting the following categories of material was found out.

Category A	8900 units	selling price ₹ 20 each
Category B	8500 units	selling price ₹ 22 each
Category C	8600 units	selling price ₹ 25 each

Lot up to 1000 kg @ ₹ 22/ – per kg	} F.O.R. suppliers factory
Between 1000 –1500 kg @ ₹ 20/ – per kg	
Between 1500 –2000kg @ ₹ 18/ – per kg	

You are required to find out the purchase price for each category of material so that same rate of profit from each category is obtained.

Ans.	A: ₹ 17
	B: ₹ 18.70
	C: ₹ 21.25

43. The particulars relating to 1200 kg of a certain raw material purchased by a company during June were as follows:

- (a) Lot prices quoted by suppliers and accepted by the company for placing the purchase order:
 - b) Trade discount 20%
 - c) Additional charges for containers @ ₹ 10 per draw of 25 kg
 - d) Credit allowed on return of containers @ ₹ 8 per drum.
 - e) Sales tax @ 10% on raw materials and 5% on drums.
 - f) Total freight paid by the purchased ₹ 240
 - g) Insurance ₹ 2.5 % (on net invoice value) paid by purchaser.
 - h) stores overhead applied at 5% on total purchase cost of material.

The entire quantity was received and issued to production. The containers are returned in due course. Draw up a suitable statement to show:

- a) Total cost of material purchased and

b) Unit cost of material issued to production

(ICWA inter)

Ans: $\left[\begin{array}{l} \text{Total cost: ₹ 23121.63} \\ \text{Cost per unit: ₹ 19.27} \end{array} \right]$

Hint:

	₹
Raw material 12kg ₹ 20	= 24000
Less trade discount @ 20%	= 4800
Containers required:	<u>19200</u>
$\frac{1200}{25} = 48 @ ₹ 10$	<u>480</u>
Sales tax 10% of 19200	1920
And 5% of 480	<u>24</u>
Net invoice	21624
Insurance @ 2.5% of 21624	540.60
Freight paid	<u>240.00</u>
Total	<u>22,404.60</u>
Less credit for drums 48 × 8	<u>384.00</u>
	<u>22,020.60</u>
Store overheads @ 5%]	
Of 22020.60	<u>1101.03</u>
Total cost	<u>23,121.63</u>

44. A manufacturer of Surat purchased three chemicals A, B and C from Mumbai. The invoice gave the following information:

	₹
Chemical A: 3000kg @ ₹ 4.20 per kg	12,600
Chemical B: 5000kg @ ₹ 3.80 per kg	19,000
Chemical A: 2000kg @ ₹ 4.75 per kg	9,500
Sales Tax	2055

Railway freight

1000
44,155

A shortage of 200kgs in chemical A of 280 kgs in chemical B and of 100 kgs in chemical C was noticed due to breakages. At Surat the manufacturer paid octroi duly @ ₹ 0.10 per kg. He also paid cartage ₹ 22 for chemical A ₹ 63.12 for chemical B and ₹ 31.80 for chemical C. Calculate the stock rate that you would suggest for pricing issue of chemical assuming a provision of 5% towards further deterioration.

(CA Inter)

Ans:

Stock rate per kg ₹
Chemical A= 5.20
Chemical B= 4.68
Chemical C= 5.76

Hint for chemical A:

Quantity		Value
3000 kg @ ₹ 4.20	= 12,600	12600
Freight: $1000 \times \frac{3}{10}$		300
Sales tax:		
	$\frac{12600 \times 2055}{41100}$	630
Shortage	200	
	2800	13530
Octroi @ ₹ 0.10		280
Cartage charges		22
Prevision of deterioration		
5%	140	
	2660kg	13832

45. From the following particulars work out the issue rate per 1000 each of first and second class bricks:

- Paid for supply at the kiln site for 30 lakhs first class bricks @ ₹ 30 per 1000.
- Paid for supply at the kiln site for 60 lakhs second class bricks @ ₹ 25 per 1000.
- Paid unloading charges @ ₹ 90 (Lump sum)
- Paid carriage charges for carrying all bricks from kiln to store yard @ ₹ 1.50 per 1000.
- Paid for stocking in the store yard ₹ 180 (Lump sum)
- Breakage in handling: 1% for first class bricks, 2% for second class bricks.

(ICWA: Inter)

Ans: [1st class bricks: ₹ 31.85, 2nd class bricks ₹ 27.07]

	₹
Hint : For second class bricks	
Cost at Kiln $6000 \times 25 =$	150,000
Carriage ₹ 1.50	9000
Unloading	60
Stocking	120
(6000×0.98) bricks	<u>= 159,180</u>
Rate $\frac{159180}{5880}$	<u>= ₹ 27.07</u>

46. Below is the information regarding the material of a certain specifications that is received and issued to the production. Prepare a store ledger and value the material issued and at the end of the month march, 2011 by following FIFO method.

Opening stock of material 1000 kg value @ ₹ 5.00 per kg.

March 2, 2011 Received 800 kg of material @ ₹ 5.10 per kg.

March 04, 2011	Issued to production 800 kg
March 07, 2011	Received 700 kg of material @ ₹ 5.15 per kg
March 09, 2011	Issued to production 800 kg
March 13, 2011	Received 1000 kg of material @ ₹ 5.20 per kg
March 15, 2011	Issued to production 800 kg
March 18, 2011	Received 500 kg of material @ ₹ 5.40 per kg
March 20, 2011	Issued to production 800 kg
March 23, 2011	Received 1000 kg of material @ ₹ 5.45 per kg
March 25, 2011	Issued to production 800 kg
March 27, 2011	Received 500kg of material @ ₹ 5.50 per kg
March 29, 2011	Issued to production 800 kg
March 31, 2011	Received 1000 kg of material @ ₹ 5.55 per kg

Ans.	[	Issued to production
		: ₹ 24945
		Closing stock:
		: ₹ 9390

47. Following information has been collected from the records of a company for the month of June, 2012.

Sales for the month ₹ 5,00,000

Opening stock as on 01.06.2012 : 5000 units @ ₹ 20 each.

Purchases (Including freight and insurance):

June 5 4000 units @ ₹ 22 each

June 15 6000 units @ ₹ 25 each

June 22 2500 units @ ₹ 26 each.

Closing stock as on 31.07.2012 : 4000 units

General administrative expenses : ₹ 1,00,000

You are required calculate the value of

- a) Closing stock as on 30.07.2012
- b) Cost of goods sold during June 2012
- c) Profit or loss for June 2012

Under (i) FIFO (ii) LIFO methods of valuation separately assuming prices of issues is being done at the end of the months after all receipts during the month.

		₹
Ans	Under FIFO	(a) ₹ 1,02,500
		(b) ₹ 4,00,500
		(c) ₹ 99,500
	Under LIFO	(a) ₹ 80,000
		(b) ₹ 4,23,000
		(c) ₹ 77,000

48. Following transactions have been recorded in respect of material used in a factory:

Date	Quantity received	Rate per unit	Quantity issued
	Units		Units
4.2.2011	500	10.00	—
6.2.2011	600	10.10	—
8.2.2011	—	—	600
15.2.2011	700	10.50	—
20.2.2011	—	—	800
23.2.2011	500	10.60	—
27.2.2011	—	—	400
28.2.2011	300	10.80	—

Prepare ledger sheet by pricing the issue under weighted overage method. Calculations are to made up to two decimal places.

Closing stock ₹ 8476

:800 units Issue ₹ 18,474

49. On the opening of a month there was 100 kg of a material valued at ₹ 25 each and during the month 150kg @ ₹ 30 was received and 160 kg of material was issued to production.

Calculate the value of issue of material and the value of closing stock under:

- (i) FIFO method

(ii) LIFO method
- (iii) Simple average price method

(iii) weighted average price method

Ans:	Value of Issue	Value of closing stock
	₹	₹
(i) FIFO:	4300	2700
(ii) LIFO:	4750	2250
(iii) Simple	4400	2600
Average:		
(iv) Weighted	4480	2520
average:		

50. Adarsh company purchased and issued the material in the following order:

		Unit	Unit Cost ₹
1 st January	Purchase	300	3.00
5 th January	Purchase	600	4.00
10 th January	Issue	500	—
12 th January	Purchase	700	4.00
15 th January	Issue	800	—
20 th January	Purchase	300	5.00
30 th January	Issue	100	—

Ascertain the quantity of closing stock as on 31st January and state its value under each following methods of pricing the issues: (a) weighted Average cost (b) FIFO (c) LIFO
(B.Com Punjab)

Ans:
$$\left[\begin{array}{l} \text{(a) 500 units @ 4.40 (approx.)} = ₹ 2,220 \\ \text{(b) 200 units @ 4 + 300 units @ 5} = ₹ 2300 \\ \text{(c) 300 units @ 3 + 200 units @ 5} = ₹ 1900 \end{array} \right]$$

51. Following information is provided by sunrise industries for the fortnight of April, 2010.

Material Exe:

Stock on	01.04.2010	100 units at ₹ 5 per unit
Purchases:	5.4.2010	300 units at ₹ 6 per unit
	8.4.2010	500 units at ₹ 7 per unit
	12.4.2010	600 units at ₹ 8 per unit
Issues	6.4.2010	250 units
	10.4.2010	400 units
	14.4.2010	500 units

Required:

- A) Calculate using FIFO and LIFO methods of pricing issues.
- The value of material consumed during the period.
 - The value of stock of materials on 15.04.2010.
- B) Explain why the figures in (a) and (b) in part (A) of this question are different under the two methods of pricing of material issues used. You need not draw up the stores ledger.

(C.A. Inter)

Ans.
$$\left[\begin{array}{l} \text{(a) Value of material consumed: ₹ 7,800, closing stock: ₹ 2800} \\ \text{(b) Value of material consumed: ₹ 8,300, closing stocks: ₹ 2300} \end{array} \right]$$

52. From the information collected from the books of a company given below prepare a store ledger account using the Highest in first out (HIFO) method of valuation of material issue. Opening stock as on 1st Nov. 2013. 4000 likes of material in the store valued at 18 per liter.

Nov. 4 Purchased 5000 liters @ ₹ 18.50 per liter
 Nov. 5 Issued to production 4000 liters
 Nov. 7 Purchased 4000 liters @ ₹ 19.50 per liter
 Nov. 10 Issued to production 5000 liter
 Nov. 13 Purchased 6000 liters @ ₹ 20.00 per liter
 Nov. 16 Issued to production 4000 liters
 Nov. 20 Purchased 4000 liters @ ₹ 20.20 per liter
 Nov. 24 Issued to production 5000 liters
 Nov. 27 Purchased 3000 liters @ ₹ 20.50 per liter
 Nov. 28 Issued to production 5000 liters
 Nov. 29 Purchased 3000 liters @ ₹ 20.70 per liter
 Nov. 30 Issued to production 2000 units

Ans.

Value of closing stock	:	₹ 74,700
3000 units @ 18 =		54000
1000 units @ 20.70 =		20700
Value of material issue	:	₹492200

Solutions of Numerical Problems

Material Control

39. Comparative Statement of quotations

Sr. No.	Name of Supplier	Quantity (Units)	Price Quoted ₹/ unit	Total material Cost ₹
1	Quotation 1	15,000	15.00	2,25,000

2	Quotation 2	15,000	₹ 14.75 Discount 10% in excess of 10,000 units	$(14.75 \times 10000) + (14.75 \times 5000 \times 0.9)$ $= 147500 + 66375$ $= ₹ 2,13,875$
3	Quotation 3	15,000	₹ 14.60 Discount @ 12% in excess of 10,000 units	$(14.60 \times 12000) + (14.60 \times 3000 \times 0.88)$ $= 175,200 + 38544$ $= ₹ 2,13,744$

Quotation No. 3 is acceptable quoting the minimum total material cost ₹ 213744.

40. (a) Comparative statement of Quotations

Sr. No.	Name of Supplier	Quantity (Units)	Price per unit ₹	Total material Cost ₹
1.	Supplier 1	5000	₹ 10	50,000
2.	Supplier 2	5000	₹ 9.50 per unit + ₹ 5000 transportation	$(5000 \times 9.50) + (5000)$ $= 47500 + 5000$ $= ₹ 52500$

Supplier 1. Quotes minimum price so should be ordered to send the material.

(b) Comparative state in second case

Sr. No.	Name of Supplier	Quantity (Units)	Price per unit ₹	Total material Cost ₹
1.	Supplier 1	10,050	₹ 10	100,500
2.	Supplier 2	10,050	₹ 9.50 per unit + ₹ 5000 transportation	$(10050 \times 9.50) + (5000)$ $= 95475 + 5000$ $= ₹ 100,475$

Supplier 2 having quoted minimum price should be ordered in this case.

(c) Transport cost = ₹ 5,000

$$\text{Different in unit price} = 10 - 9.50 = ₹ 0.50$$

$$\text{No's of units after which second supplier is economical} = \frac{5000}{0.5}$$

$$= 10,000 \text{ units}$$

Q: 41. Solution: Sales value of

Category X	$= 5000 \times 30$	$= ₹ 150,000$
Category Y	$= 2600 \times 35$	$= ₹ 91,000$
Category Z	$= 2400 \times 40$	$= ₹ 96,000$

$$\text{Distribution Ratio X:Y:Z} = 150:91:96$$

$$\text{Purchase cost of category X} = \frac{150}{337} \times 303,300$$

$$= ₹ 135,000$$

$$\text{Purchase cost of category Y} = \frac{91}{337} \times 303,300$$

$$= ₹ 81,900$$

$$\text{Purchase cost of category Z} = \frac{96}{337} \times 303,300$$

$$= ₹ 86,400$$

$$\text{Price per unit X} = \frac{135,000}{5000} = ₹ 27$$

$$Y = \frac{81,900}{2600} = ₹ 31.5$$

$$Z = \frac{86,400}{2400} = ₹ 36$$

42. Solution: Sales value of Category X = $8900 \times 20 = ₹ 178,000$

$$\text{Category Y} = 8500 \times 22 = ₹ 187,000$$

$$\text{Category Z} = 8600 \times 25 = ₹ 215,000$$

$$\text{Distribution ratio X:Y:Z} :: 178:187:215$$

$$\text{Purchase cost of category X} = \frac{178}{580} \times 493000 = ₹ 151,300$$

$$\text{Purchase cost of category Y} = \frac{187}{580} \times 493000 = ₹ 158,950$$

$$\text{Purchase cost of category X} = \frac{215}{580} \times 493000 = ₹ 182,750$$

$$\text{Price Per unit: X} = \frac{151300}{8900} = ₹ 17$$

$$X = \frac{158950}{8500} = ₹ 18.7$$

$$X = \frac{182750}{8600} = ₹ 21.25$$

Q: 43. Hint given

Q: 44. Solution

	Chemical A ₹	Chemical B ₹	Chemical C ₹
Purchase Value			
3000 × 4.2	12,600	5000 × 3.8	19,000
Freight charges			
1000 × $\frac{3}{10}$	300	1000 × $\frac{5}{10}$	500
Sales Tax	630	$\frac{19,000 \times 2055}{41100}$	950
		41100	
			$\frac{9500}{41100} \times 2055$
			475
Shortage 200 kg		280kg	100kg
Received 2800	13,530	4720kg	1900kg
		20450	10175
Octroi @ ₹ 0.10	280	472	190
Cartage Charges	22	63.12	31.80
Provision for deterioration		236kg	95 Kg

5% =140 kg	13832	4484 Kg	20985.	1805 Kg	10396.81
			12		
Net weight 2660 kg					$\frac{10396.81}{1805} = ₹ 5.76$
Rate per kg ₹ $\frac{13832}{2660}$	= ₹ 5.20		₹ $\frac{20985.12}{4484}$	= ₹ 4.68	

45 Solution:

	First class bricks	Second class bricks
	₹	₹
Cost of brick at Kiln	$\frac{30}{1000} \times 3000000 = 90,000$	$\frac{25}{1000} \times 6000000 = 150,000$
Unloading Charges	$90 \times \frac{1}{3} = 30$	$90 \times \frac{2}{3} = 60$
Cartage	@1.5 per 1000 = 4,500	1.5 × 6000 = 9,000
Stocking charges		
In store	$180 \times \frac{1}{3} = 60$	$180 \times \frac{2}{3} = 120$
Breakage	1% = 30,000	2 % = 120,000
Cost of bricks	297000 bricks 94590	588000 brick 159180
Cost per 1000 bricks	$\frac{94590}{2970} = ₹ 31.85$	$\frac{159180}{5880} = ₹ 27.07$

46. Solution: Store ledger (FIFO method of valuation)

Date	Particular	Received			Issued			Balance		
		Quantity kg	Rate	Value (₹)	Quantity kg	Rate ₹ /kg	Value ₹	Quantity kg	Rate ₹ /kg	Value ₹
March 1, 2011	Opening stock							1000	5	5000]
March 2, 2011	Received 800kg	800	5.10	4080	—	—	—	1000 800	5 5.10	5000] 4080]
March 4, 2011	Issued to production	—	—	—	800	5	4000	200 800	5 5.10	1000] 4080]
March 7, 2011	Received 700 kg	700	5.15	3605	—	—	—	200 800 700	5 5.10 5.15	1000] 4080] 3605]
March 9, 2011	Issued to production	—	—	—	200 600	5 5.10	1000 3060	200 700	5.10 5.15	1020] 3605]

March 13, 2011	Received 1000kg	1000	5.20	5200	—	—	—	200 700 1000	5.10 5.15 5.20	1020 3605 5200
March 15, 2011	Issued to production	—	—	—	200 600	5.10 5.15	1020 3090	100 1000	5.15 5.20	515 5200
March 18, 2011	Received 500kg	500	5.40	2700	—	—	—	100 1000 500	5.15 5.20 5.40	515 5200 2700
March 20, 2011	Issued to production	—	—	—	100 700	5.15 5.20	515 3640	300 500	5.20 5.48	1560 2700
March 23, 2011	Received 1000 kg	1000	5.45	5450	—	—	—	300 500 1000	5.20 5.40 5.45	1560 2700 5450
March 25, 2011	Issued to production	—	—	—	300 500	5.20 5.40	1560 2700	1000	5.45	5450
March 27, 2011	Received 500kg	500	5.50	2750	—	—	—	1000 500	5.45 5.50	5450 2750
March 29, 2011	Issued to production	—	—	—	800	5.45	4360	200 500	5.45 5.50	1090 2750
March 31, 2021	Received 1000 kg	1000	5.55	5550	—	—	—	200 500 1000	5.45 5.50 5.55	1090 2750 5550

₹

Closing stock:	200 units @ 5.45	=	1090
	500 units @ 5.50	=	2750
	1000 units @ 5.55	=	5550
	Total ₹	=	9390

Issued to production = ₹ (4000+4060 + 4110 + 4155 + 4260 + 4360)

= ₹ (24945)

Reconciliation:

	Units (Kg)	Value (₹)
Opening stock	1000	5000
Purchases during the period	5500	29335
Total	6500	34335
Issued to production	4800	24945
Balance	1700	9390

47.

₹

(i) (a) Under FIFO method

Opening stock as on 01.06.2012	₹	100,000
(5000 units @ 20/-)		
Purchases during the month	₹	
June 5 4000 units @ ₹ 22	88,000	
June 15 6000 units @ ₹ 25	150,000	
June 22 2500 units @ ₹ 26	65,000	303,000
12,500	Total	403,000

Material issued (Sold)

₹

5000×20 =	1,00,000	
4000×22 =	88,000	
4500×25 =	1,12,500	3,00,500
Closing stock 1500×25 = 37500		1,02,500
2500× 26 = 65000		

(b)

Material cost	3,00,500
General admin expenses	1,00,000
Cost of goods sold	4,00,500
(c) Profit for June 2012	99,500
Sales	5,00,000

(ii) Under LIFO Method

(a) Total cost of material received 4,03,000

Material issued:	₹	
1000×20 = 20000		
4000×22 = 88000		
6000×25 = 150000		323000
2500×26 = 65000		
Closing stock 4000×20 = 80,000		80,000

₹

(b) Material cost 3,23,000

General admn. Cost	1,00,000
Cost of goods sold	4,23,000
(c) Profit for June 2012	77000
Sales	500,000

48. Store Ledger for February 2011

Date	Received			Issued			Balance		
	Quantity (Units)	Rate Per unit (₹)	Value ₹	Quantity ₹	Rate per unit ₹	Value ₹	Quantity (Units)	Rate Per unit ₹	Value ₹
4.2.2011	500	10	5000	—	—	—	500	10	5000
6.2.2011	600	10.10	6060	—	—	—	1100	10.05	11,060
8.2.2011	—	—	—	600	10.05	6030	500	10.06	5030
15.2.2011	700	10.50	7350	—	—	—	1200	10.32	12380
20.2.2011	—	—	—	800	10.32	8256	400	10.31	4124
23.2.2011	500	10.60	5300	—	—	—	900	10.47	9424
27.2.2011	—	—	—	400	10.47	4188	500	10.47	5236
28.2.2011	300	10.80	3240	—	—	—	800	10.60	8476

49.

(i) Valuation under FIFO method	₹
Opening stock 100kg @ ₹ 25	= 2500
Received during the month	= 4500
150 kg @ 30	
Issued to production	7000
100 kg @ ₹ 25 = 2500	
60 kg @ ₹ 30 = <u>1800</u>	4300
Closing stock 90@ 30	2700
(ii) Valuation under LIFO method	₹
Opening stock 100 kg @ 25	2500
Received during the month 150 kg @ 30	4500
	7000
Issued to production	
150 kg @ 30 4500	
10 kg @ 25 <u>250</u>	4750
Closing stock 90 @ 25	2250
(iii) Valuation under simple average method	₹
Opening stock 100 kg @ ₹ 25	2500
Received during the month 150 kg @ 30	4500
Total	7000

Issued to production 160 kg @ 27.50	4400
Closing stock 90 kg @ ₹ 28.88	2600
(iv) Valuation under weighted averaged method	₹
Opening stock 100 kg @ 25	2500
Received during the month 150 kg @ 30	4500
Total 250 kg @ 28	7000
Issued to production 160 kg @ 28	4480
Closing stock 90 kg @ 28	2520

50. (a) Store ledger under weighted average method

Date	Received			Issued			Balance		
	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹
1 st January	300	3	900	—	—	—	300	3	900
5 th Jan	600	4	2400	—	—	—	900	3.66	3300
10 th Jan	—	—	—	500	3.66	1833	400	3.6675	1467
12 th Jan	700	4.0	2800	—	—	—	1100	3.879	4267
15 th Jan	—	—	—	800	3.879	3103	300	3.88	1164
20 th Jan	300	5.0	1500	—	—	—	600	4.44	2664
30 th Jan	—	—	—	100	4.44	444	500	4.44	2220

(b) Store ledger under FIFO method

Date	Received			Issued			Balance		
	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹
1 st Jan	300	3	900	—	—	—	300	3	900
5 th Jan	600	4	2400	—	—	—	300	3	900
							600	4	2400
10 th Jan	—	—	—	300	3	900	400	4	1600
				200	4	800			
12 th Jan	700	4	2800	—	—	—	400	4	1600
							700	4	2800
15 th Jan	—	—	—	800	4	3200	300	4	1200
20 th Jan	300	5	1500	—	—	—	300	4	1200
							300	5	1500
30 th Jan	—	—	—	100	4	400	200	4	800
							300	5	1500

(c) Store Ledger under LIFO method

Date	Received			Issued			Balance		
	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹	Quantity (Units)	Price ₹ / Unit	Value ₹
1 st Jan	300	3	900	—	—	—	300	3	900
5 th Jan	600	4	2400	—	—	—	300	3	900
							600	4	2400
10 th Jan	—	—	—	500	4	2000	300	3	900
							100	4	400
12 th Jan	700	4	2800	—	—	—	300	3	900
							100	4	400
							700	4	2800
15 th Jan	—	—	—	800	4	3200	300	3	900
20 th Jan	300	5	1500	—	—	—	300	3	900
							300	5	1500
30 th Jan	—	—	—	100	5	500	300	3	900
							200	5	1000

51. (A) (a) Valuation under FIFO method

Value of material consumed

Date	Issued Units	Rate ₹ / Unit	Value (₹)	Total (₹) Value Issued upto
06.04.2010	250]	100 @ ₹ 5	500]	1400
		150 @ ₹ 6	900]	
10.04.2010	400]	150 @ ₹ 6	900]	4050
		250 @ ₹ 7	1750]	
14.04.2010	500]	250 @ ₹ 7	1750]	7800
		250 @ ₹ 8	2000]	

b) Valuation of stock under FIFO Method

Value of material received:

Date	Units	Rate (₹)	Value (₹)
01.04.2010	100	5	500
05.04.2010	300	6	1800
08.04.2010	500	7	3500

12.04.2010	600	8	4800
		Total	10600
Less issued under FIFO			7800
Closing stock as on 15.04.2010			2800

(A) (a) Valuation under LIFO method

Date	Issued (Units)	Rate ₹ / Unit	Value ₹	Total (₹) Value Issued upto
06.04.2010	250	6	1500	1500
10.04.2010	400]	7	2800	4300
14.04.2010	500]	8	4000	8300

b) Valuation of closing under LIFO

	₹
Value of material received	10,600
Less issued under LIFO	8300
Closing stock under LIFO	2300

52. Store ledger under FIFO method of valuation of material (Issue)

Date	Received			Issued			Balance		
	Quantity (liters)	Rate ₹ / liter	Value ₹	Quantity (Liters)	Rate ₹ / Liter	Value ₹	Quantity (Liter)	Rate ₹ / liter	Value ₹
1 st Nov	—	—	—	—	—	—	4000	18	72000
Nov 4	5000	18.50	92500	—	—	—	4000	18	72000]
							5000	18.50	92500]
Nov. 5	—	—	—	4000	18.50	74000	4000	18.00	72,000]
							1000	18.50	18,500]
Nov. 7	4000	19.50	78000	—	—	—	4000	18	72,000]
							1000	18.50	18,500]
							4000	19.50	78,000]
Nov. 10	—	—	—	4000]	19.50	78000]	4000	18	72000]
				1000]	18.50	18500]			
Nov. 13	6000	20	120,000	—	—	—	4000	18	72000]
							6000	20	120000]
Nov. 16	—	—	—	4000	20	80000	4000	18	72000]
							2000	20	40000]
Nov. 20	4000	20.20	80,8000	—	—	—	4000	18	72000]
							2000	20	40000]
							4000	20.20	80800]
Nov. 24	—	—	—	4000]	20.20	80,800]	4000	18	72000]
				1000]	20	20,000]	1000	20	20000]

Nov. 27	3000	20.5 0	61,500	—	—	—	4000	18	72000]
							1000	20	20000]
							3000	20.50	61500]
Nov. 28	—	—	—	3000]	20.50	61500]	3000	18	54,000]
				1000]	20	20,000]			
				1000]	18	18,000]			
Nov. 29	3000	20.7 0	62100	—	—	—	3000	18	54000]
							3000	20.70	62,100]
Nov. 30	—	—	—	2000	20.70	41400	3000	18	54000]
							1000	20.70	20700]

Value of closing stock = ₹ 74,700

(3000 @ 18 = 54000)

(1000 @ 20.70 = 20700)

Value of Material issued:	:	₹
4000 × 18.50	=	74,000
4000 × 19.50	=	78,000
1000 × 18.50	=	18,500
4000 × 20	=	80,000
4000 × 20.20	=	80,800
1000 × 20	=	20,000
3000 × 20.50	=	61,500
1000 × 20	=	20,000
1000 × 18	=	18,000
2000 × 20.70	=	41,400
Total	=	492200



2. Cost Control through Material Control

Efforts are made in material handling to minimize waste and losses. Store control techniques helps in keeping the material at right place and at right quantity level so as to ensure uninterrupted supply by avoiding under stocking and to curb unnecessary rise in cost due to over stocking. There are various techniques of controlling the cost through material control. Keeping the stock of material at an appropriate level, ordering the appropriate quantity of the material for fresh supply, keeping the stock of material under various systems such ABC, VED etc. These all techniques helps to have a control over the unnecessary rise in cost of production. Let us take all the techniques one by one to control the cost through material control.

1. Levels of Material in stock:

By keeping an appropriate level of stock in hand we can control the cost. If there is stock more than the desired level i.e. overstocking, it means first of all we have locked up a heavy amount of working capital in stock which could have been used otherwise, secondly the fear of obsolescence, pilferage, theft spoilage and if it happens may lead to unnecessary rise in cost of production. If the stock is less than the required level, it may give rise to a situation where there are chances of stopping production due to non availability of material and hence increasing other costs. So keeping the material at a desired level is necessary to control the cost.

Lead time:

It is the time period between placing a purchase order and receiving the material at sight. It may be minimum lead time, average lead time and maximum lead time. Minimum lead time is the shortest time period within which the fresh delivery of stock is received from the point of time of placing the order. Maximum lead time is the maximum time period required from placing the order and receiving the material. In between both is normal or average lead time.

(a) Maximum stock level: As already discussed it is the maximum level of stock that can be held up at any point of time. Stock should not exceed this level. The disadvantages of keeping more than the maximum level of stock in hand at any time are

1. Unnecessary lock of working capital in stock more than desired which could have been used otherwise.
2. Over stocking may lead to chances of obsolescence, pilferage or spoilage etc.
3. More space of store is required which could be used for other purposes.
4. Chances of deterioration in the quality of the material due to lying the material for a long time in the store due to non-moving.
5. Over stocking or keeping the stock more than the desired level is not beneficial in the situation of falling prices.

Formula to calculate maximum stock level is

= Reordering level + Reordering quantity

– Minimum consumption × minimum lead time

Here Re ordering Level = Maximum consumption × maximum lead time

Reordering quantity is the quantity of material that is ordered at one time supply.

So maximum stock level = Reordering Level + Reordering quantity

– Minimum consumption × Minimum lead time

Reordering level is the level of stock in hand which could be maximum utilized during the maximum lead time.

Say there is a maximum daily consumption of 10 units and 10 days is the maximum lead time. Then the

$$\begin{aligned}\text{Reordering level} &= 10 \times 10 \\ &= 100 \text{ units}\end{aligned}$$

or we can say in other words when the level reaches 100 units of material in the stock then a fresh order should be placed.

Reordering level of stock can also be found out as follows: Minimum stock level + Normal consumption during normal lead time

- (b) Minimum Stock Level: For uninterrupted availability of material so that production is not held up, a level of stock at hand at any time is required. This level is known as minimum stock level. The difference between the reordering stock level and the average consumption during average lead time is the minimum stock level.

$$\text{Minimum stock level} = \text{Reordering Level} - \text{Average consumption} \times \text{Average lead time}$$

Where Reordering Level = maximum consumption $\times$ maximum lead time

- (c) Average Stock Level = $\frac{1}{2}(\text{Maximum Stock Level} + \text{Minimum Stock Level})$

Average stock level can also be found out

$$= \text{Minimum stock level} + \frac{1}{2} \text{Reordering quantity}$$

- (d) Danger Level This is the level of stock of material where regular issue of material is stopped and the issue of material is only possible under specific instructions. The specific instructions are made so that production is not held up due to the shortage of material at any time and the purchase department at this level has to make special arrangements for the availability of material.

$$\text{Danger Stock Level} = \text{Average consumption} \times \text{Emergency Lead time}$$

This can also be found out

$$\text{as} = \text{Minimum usage} \times \text{Minimum Lead time}$$

Illustration : 1. If a production unit has maximum consumption of a raw material to be 100 units per day and minimum consumption to be 60 units per day and the lead time varies between 6–3 days. Find the reordering level of stock required to be maintained.

Solution: Reordering stock level = Maximum consumption $\times$ Maximum Lead time

$$\begin{aligned}&= 100 \times 6 \\ &= 600 \text{ units}\end{aligned}$$

Illustration 2. Maximum stock level and minimum stock level of the production units are 100 units and 60 units per day respectively. Find out the average stock level of the unit.

Solution : Average stock level = $\frac{1}{2}[\text{Maximum stock level} + \text{Minimum stock level}]$

$$\begin{aligned}&= \frac{1}{2}[100+60] \\ &= \frac{1}{2} \times 160 \\ &= 80 \text{ units}\end{aligned}$$

Illustration 3 : If the production units has maximum consumption of the raw material to be 100 units and minimum consumption to be 60 units per day and the lead time varies between 6–3 days. Find out the Danger stock level.

Solution : Danger level of stock = Minimum usage $\times$ Minimum lead time

$$= 60 \times 3$$

$$= 180 \text{ units}$$

Illustration : 4 Calculate maximum level, minimum level and reordering level of stock from the data given below:

Re-order period	:	5–15 days
Re ordering quantity	:	5150 units
Maximum consumption	:	400 units per day
Minimum consumption	:	200 units per day
Normal consumption	:	300 units per day

Solution:

Reordering stock level = Maximum consumption $\times$ Maximum re order period

$$= 400 \times 15$$

$$= 6000 \text{ units}$$

Minimum stock level = Reordering level – Average consumption

$\times$ Average reorder period

$$= 6000 - 300 \times 10$$

$$= 6000 - 3000$$

$$= 3000 \text{ units}$$

Maximum Stock Level = Reordering Level + Reordering quantity

– Minimum consumption $\times$ Minimum Lead time

$$= 6000 + 5150 - 200 \times 5$$

$$= 11150 - 1000$$

$$= 10150 \text{ units}$$

Illustration 5 Two Components A and B are used in a unit and the other information relating to components A and B are as follows:

Re-ordering period :	A : 4–6 weeks	B : 2–4 weeks
Re-ordering quantity :	A : 600 units	B : 800 units
Emergency lead time :	A : 1 week	B : 2 week
Average consumption :	70 units	
Minimum consumption :	40 units	
Maximum consumption :	100 units	

Calculate for each component

(a) Re-order Level (b) Minimum level (C) Maximum level

(d) Average Stock level (e) Danger Level

Solution :

(a) Re ordering Level = Maximum consumption $\times$ Maximum re order period

$$\text{For A} = 100 \times 6 = 600 \text{ units}$$

$$\text{For B} = 100 \times 4 = 400 \text{ units}$$

(b) Minimum level = Reordering Level – Normal Consumption $\times$ Normal reorder period

$$\text{For A} = 600 - 70 \times 5$$

$$= 600 - 350$$

$$= 250 \text{ units}$$

$$\text{For } B = 400 - 70 \times 3$$

$$= 400 - 210$$

$$= 190 \text{ units}$$

$$(c) \text{ Maximum Level} = \text{Reordering Level} + \text{Reordering quantity}$$

$$- \text{Minimum stock level} \times \text{Minimum Lead time}$$

$$\text{For } A = 600 + 600 - 540 \times 4$$

$$= 1200 - 260$$

$$= 1040 \text{ units}$$

$$\text{For } B = 400 + 800 - 40 \times 2$$

$$= 1200 - 80$$

$$= 1120 \text{ units}$$

$$(d) \text{ Average Stock level} = \frac{1}{2} (\text{Maximum Stock Level} + \text{Minimum stock level})$$

$$\text{For } A = \frac{1}{2} (1040 + 250)$$

$$= \frac{1}{2} \times 1290$$

$$= 645 \text{ units}$$

$$\text{For } B = \frac{1}{2} (1120 + 190)$$

$$= \frac{1310}{2} = 655 \text{ units}$$

$$(e) \text{ Danger Level} = \text{Average consumption} \times \text{Emergency Lead time}$$

$$\text{For } A = 70 \times 1 = 70 \text{ units}$$

$$\text{For } B = 70 \times 2 = 140 \text{ units}$$

(B) Economic Order Quantity :

In a continuous or fixed order – quantity system, when inventory reaches a specific level known as reorder level, a fixed amount of material is ordered. As we know if we order the material in small amounts or quantities then we are to place many orders depending upon the annual usage. In placing each order we have to incur a fixed amount of cost known as ordering cost including staff posted in purchasing activity inspection activity, cost of stationery, postage and various other charges required in placing the order. So small order means too many orders during the accounting period and so increase in total cost of placing orders. On the other hand if large orders are placed to save the above cost then other costs such as holding the material in store, loss due to deterioration, obsolescence, insurance will increase. So we have to compromise between the two types of costs which are inversely related to each other, and have to order a specific quantity of material in one lot this specific quantity of material is known as Economic order quantity. At the economic order quantity level of order the total cost incurred in purchasing the material and keeping it in the store will be minimum. So economic order quantity may be defined as "the quantity of material which is ordered to purchase the material in one lot at which the total cost of placing orders and keeping the material in the store, during the accounting period is minimum".

The cost incurred on placing various order is known as "Ordering Cost" and cost incurred on holding the material in the store is known as "Carrying cost".

Ordering cost: Ordering cost includes

1. Cost of staff posted in purchasing department inspection and payment.
2. Cost of stationery, postage, telephones and other related costs.

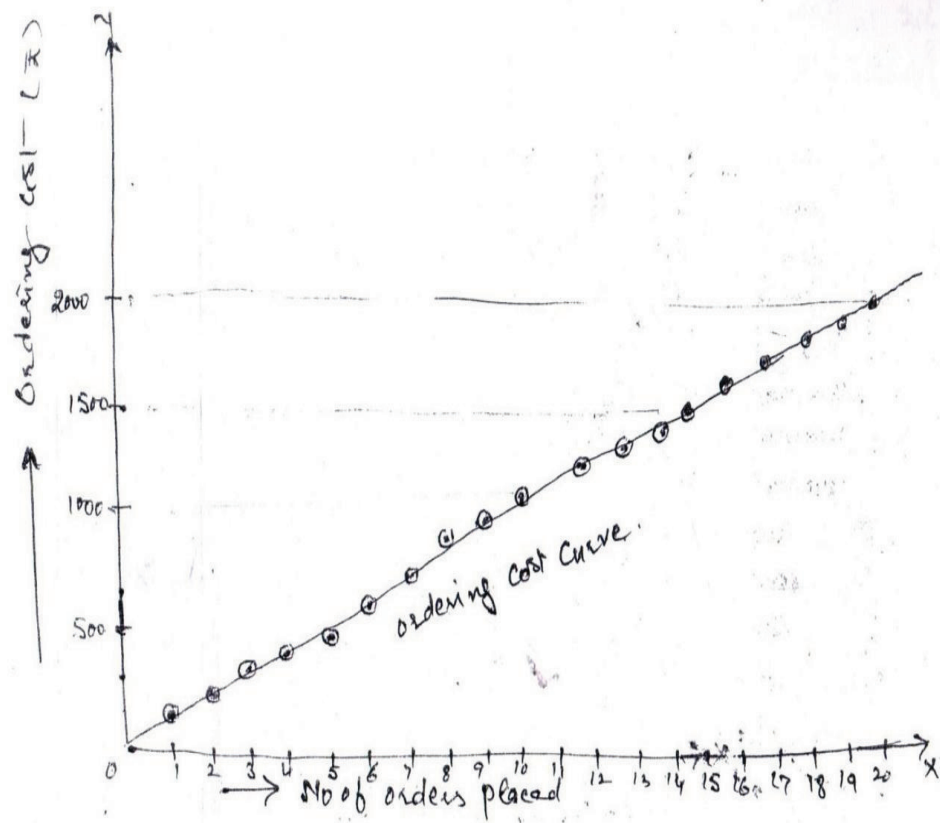
The cost varies with the number of order placed in a period. More number of order means more cost and less number of order means less cost. To minimise the cost on order we have to keep less number of orders as far as possible.

Carrying cost : The cost incurred on holding the material in store is known as carrying cost and includes.

- 1) Cost of storage in the store, a big lot of material means occupancy of more space in store which could have been utilized for other purposes.
- 2) Cost of obsolescence in case of large orders with low velocity of consumption.
- 3) Expenses on insurance.
- 4) Chances of pilferage, theft etc.
- 5) Cost of interest payment on the expenditure on stock.
- 6) Working capital locked up in stock which could have been used otherwise.
- 7) Transportation costs etc.
- 8) Graphical presentation of ordering cost

Let us take an example of a production unit which is in demand of 10,000 units ₹ 50 per unit and whose ordering cost is ₹ 100 per order placed.

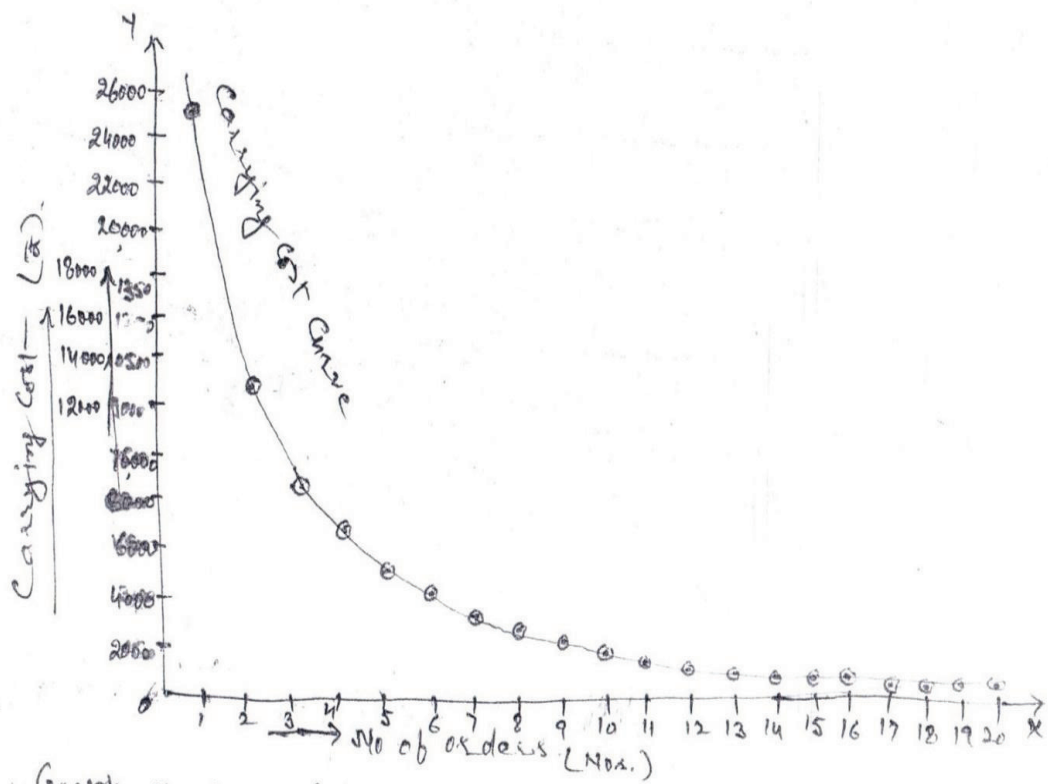
Orders	Units Per Order	Value per order	Ordering cost (₹)
1	10,000	5,00,000	100
2	5,000	2,50,000	200
3	3,333	1,66,650	300
4	2,500	1,25,000	400
5	2,000	1,00,000	500
6	1,667	83,350	600
7	1,429	71,450	700
8	1,250	62,500	800
9	1,111	55,550	900
10	1,000	50,000	1,000
11	909	45,450	1,100
12	833	41,650	1,200
13	769	38,450	1,300
14	714	35,700	1,400
15	667	33,350	1,500
16	625	31,250	1,600
17	588	29,400	1,700
18	556	27,800	1,800
19	526	26,300	1,900
20	500	25,000	2,000



Graph showing relationship between No of orders and the corresponding ordering cost

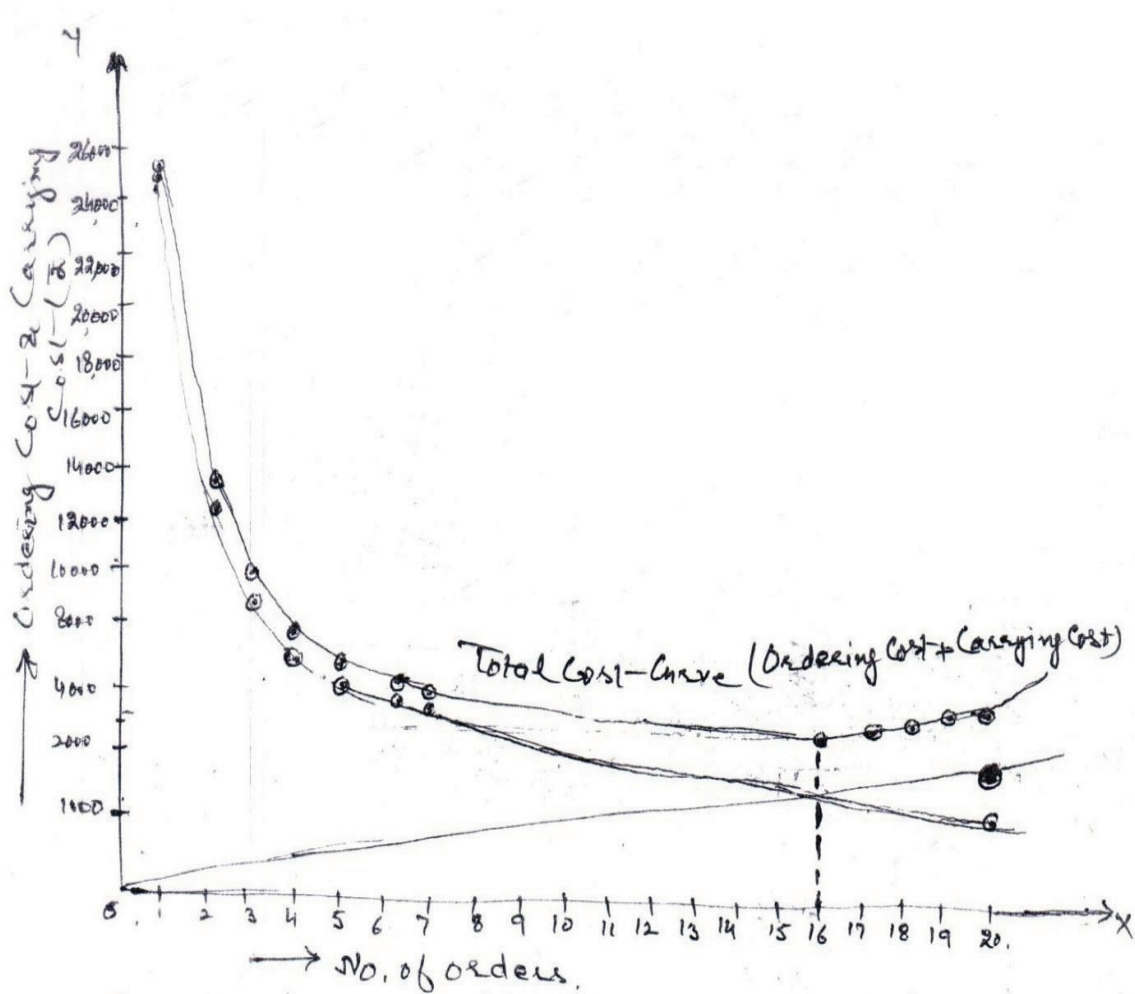
Graphical presentation of carrying cost . Let us take the same example as shown in presentation of ordering cost on graph and assume that the carrying cost is 10% of average inventory held.

Orders	Units per order	Value of Material Per order (₹)	Ordering cost (₹)	Average inventory (₹)	Carrying cost (₹) 10% of average inventory held	Total cost (₹)
1	10,000	5,00,000	100	2,50,000	25,000	25,100
2	5,000	2,50,000	200	1,25,000	12,500	12,700
3	3,333	1,66,650	300	83,325	8,333	8,633
4	2,500	1,25,000	400	62,500	6,250	6,650
5	2,000	1,00,000	500	50,000	5,000	5,500
6	1,667	83,350	600	41,675	4,168	4,768
7	1,429	71,450	700	35,725	3,573	4,273
8	1,250	62,500	800	31,250	3,125	3,925
9	1,111	55,550	900	27,775	2,778	3,678
10	1,000	50,000	1,000	25,000	2,500	3,500
11	909	45,450	1,100	22,725	2,273	3,373
12	833	41,650	1,200	20,825	2,083	3,283
13	769	38,450	1,300	19,225	1,923	3,223
14	714	35,700	1,400	17,850	1,785	3,185
15	667	33,350	1,500	16,675	1,668	3,168
16	625	31,250	1,600	15,625	1,563	3,163
17	588	29,400	1,700	14,700	1,470	3,170
18	556	27,800	1,800	13,875	1,388	3,188
19	526	26,300	1,900	13,150	1,315	3,215
20	500	25,000	2,000	12,500	1,250	3,250



Graph showing relationship between Number of orders and the Carrying cost.

Graphical Presentation of total cost (Ordering cost and the carrying cost) at various number of orders of material
 . Let us take the same example and draw a graph between the total cost and the number of orders.



From the graph we see that when the number of orders are sixteen the total material cost is minimum. So at this point 'Economic Order Quantity' is $\frac{10000}{16} = 625$ units per order.

Mathematical Derivation of Formula for finding "EOQ".

Let us derive a formula to calculate "Economic order quantity" mathematically. Before we derive the formula let us discuss the various assumptions which are as under.

- 1) Demand is known with certainty and is constant over time

Here we assume that the organization knows the demand of the material within the period and also the demand remains constant throughout the period.

- 2) lead time for the receipt of order is constant

Time required from placing on order and receiving the supply is constant.

3) No shortage is allowed.

4) The order quantity is received all at once

It is assumed that the quantity of material which is ordered is received at once i.e. at a point of time and not in instalments or within a span of time.

5) Quantity of material is received when the inventory reaches to zero level.

Let D be the annual demand of the material.

Q be the size of the order (i.e. the quantity of material ordered)

C_o be the ordering cost (cost per order)

C_c be the annual carrying cost per unit.

Then $\frac{D}{Q}$ = Number of orders placed per annum.

So ordering cost = $\frac{D}{Q} \times C_o$

Total Carrying cost = $\frac{Q}{2} \times C_c$

The total inventory cost T_c is the sum of total ordering cost and total carrying cost. The equation can be shown as

$$T_c = \frac{D}{Q} \times C_o + \frac{Q}{2} \times C_c$$

differentiating w.r.t. Q we get

$$\frac{dT_c}{dQ} = \frac{d}{dQ} \left(\frac{D \times C_o}{Q} \right) + \frac{d}{dQ} \left(\frac{Q}{2} \times C_c \right) = -\frac{D \times C_o}{Q^2} + \frac{C_c}{2} \quad \text{----- I}$$

When $\frac{dT_c}{dQ} = 0$, i.e. the slope of function is zero it is either maximum or minimum at that point i.e. $-\frac{D \times C_o}{Q^2} +$

$$\frac{C_c}{2} = 0$$

$$\Rightarrow \frac{C_c}{2} = \frac{D \times C_o}{Q^2} \text{ so } Q^2 = \frac{2D \times C_o}{C_c}$$

$$\Rightarrow Q = \sqrt{\frac{2D \times C_o}{C_c}} \text{ the point is either a point of maxima or minima}$$

Taking second derivative we get $\frac{d^2T_c}{dQ^2} = \frac{d}{dQ} \left[-\frac{D \times C_o}{Q^2} + \frac{C_c}{2} \right]$

$$= \frac{2D \times C_o}{Q^3} \text{ as all } D, C_o \text{ and } Q \text{ are positive}$$

so $\frac{2D \times C_o}{Q^3}$ is +ve, so it is a point of minima.

Total cost is minimum at the point where

$$Q_{(optimal)} = \sqrt{\frac{2D \times C_o}{C_c}}$$

so at this point Q is the optimal quantity of the material ordered where total cost is minimum

$$T_c \text{ minimum} = \frac{D}{Q_{optimal}} \times C_o + \frac{Q_{optimal}}{2} \times C_c$$

$$\text{so Economic order Quantity} = \sqrt{\frac{2D \times C_o}{C_c}}$$

Where D is the annual demand

C_o is the ordering cost

and Cc is the carrying cost per unit per annum

Illustration 6 : Shagoon India Ltd provides the following information in respect of material 'X' :

Re-order period 5 to 15 days

Rate of consumption :

Average 15 units per day
Maximum : 20 units per day
Yearly : 5000 units

Ordering costs are ₹ 20 per order

Purchase price per unit is ₹ 50

Storage cost are 10% of unit value

Compute:

(i) Reordering Level

(ii) Minimum Level

(iii) Maximum Level

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Solution: First of all let us find out the reordering quantity where D is annual demand Co is ordering cost Cc is the carrying cost per unit per annum.

$$\begin{aligned} \text{i.e. } EOQ &= \sqrt{\frac{2 \times D \times Co.}{Cc}} \\ &= \sqrt{\frac{2 \times 5000 \times 20}{10\% \text{ of } 50}} \\ &= \sqrt{\frac{2 \times 5000 \times 20}{5}} \\ &= 200 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{(i) Reordering Level} &= \text{Maximum consumption} \times \text{maximum re-order period} \\ &= 20 \times 15 \\ &= 300 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{(ii) Minimum Level} &= \text{Reordering Level} - \text{Average consumption} \times \text{Average reordering period} \\ &= 300 - 15 \times \frac{(5+15)}{2} \\ &= 300 - 15 \times \frac{20}{2} \\ &= 300 - 150 \\ &= 150 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{(iii) Maximum level} &= \text{Reordering Level} + \text{Reordering quantity} \\ &\quad - \text{Minimum consumption} \times \text{minimum re-order period} \\ &= 300 + 200 - (15 \times 2 - 20) \times 5 \\ &= 300 + 200 - 10 \times 5 \\ &= 500 - 50 \\ &= 450 \text{ units} \end{aligned}$$

Hint: *

$$\frac{\text{Minimum consumption} + \text{maximum consumption}}{2} = \text{Average consumption}$$

Putting the values we get

$$\frac{\text{Minimum consumption} + 20}{2} = 15$$

so minimum consumption = $2 \times 15 - 20$

$$= 30 - 20 = 10 \text{ units}$$

Illustration 7: From the information given as under find out

(i) Economic order quantity (ii) Reordering Level

(iii) Maximum material stock level

(iv) Minimum material stock level

Lead time varies	:	3–5 days
Maximum consumption	:	100 units per day
Minimum consumption	:	50 units per day
Ordering cost	:	₹ 10 per order
Cost per unit	:	₹ 100
Inventory storage cost	:	10% per unit per annum
Annual Demand	:	45000 units

Solution:–

$$\text{Ordering cost } C_o = ₹ 10$$

$$\begin{aligned} \text{Carrying cost per unit } C_c &= 10\% \text{ of } 100 \\ &= ₹ 10 \end{aligned}$$

$$\text{Annual Demand} = 45000 \text{ units}$$

$$\begin{aligned} \text{(i) So Economic order Quantity} &= \sqrt{\frac{2D \times C_o}{C_c}} \\ &= \sqrt{\frac{2 \times 45000 \times 10}{10}} \\ &= \sqrt{90000} \\ &= 300 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{(ii) Re ordering Level} &= \text{Maximum consumption} \times \text{Maximum Lead time} \\ &= 100 \times 5 \\ &= 500 \text{ units} \end{aligned}$$

$$\text{(iii) Minimum Level} = \text{Re ordering Level} - \text{Average consumption} \times$$

Average lead time

$$\begin{aligned} &= 500 - \left(\frac{100+50}{2} \right) \times \left(\frac{3+5}{2} \right) \\ &= 500 - 75 \times 4 \\ &= 500 - 300 \\ &= 200 \text{ units} \end{aligned}$$

$$\text{(iv) Maximum stock level} = \text{Re-ordering level} + \text{Re-ordering quantity} -$$

Minimum consumption $\times$ Minimum lead time

$$\begin{aligned} &= 500 + 300 - 50 \times 3 \\ &= 800 - 150 \\ &= 650 \text{ units} \end{aligned}$$

Illustration 8 : A company is producing a product A. For producing the product a component X is required. For producing one unit of the product A, 4 units of component X is needed. The purchase price of component X is ₹ 10 per unit. The cost of placing an order came out to be ₹ 20 and inventory carrying cost of 20% per unit. Calculate the quantity of the material which should be ordered once if the company produces 50000 units of product A.

Solution: Annual Demand = 50000 × 4

= 200000 of component X

Ordering cost Co = ₹ 20

Annual carrying cost = 20% of ₹10

= ₹2

$$\begin{aligned}\text{So Economic order Quantity} &= \sqrt{\frac{2D \times Co}{Cc}} \\ &= \sqrt{\frac{2 \times 200000 \times 20}{2}} \\ &= \sqrt{4000000} \\ &= 2000 \text{ units}\end{aligned}$$

Illustration 9 : A company's annual demand for a particular material is 6000 kg. The company is offered a discounted price if the company purchases the material in bulk quantities as shown below. The ordering cost per order is ₹1500 and annual carrying cost is 20%. You are required to advice the company at what unit price offered by the supplier should the company purchase the material and what will be the Economic order quantity to minimize the total material cost.

Price per unit	Purchases between
₹ 325	Less than 500 units
₹ 310	500 units and 1000 units
₹ 300	1000 units and 2000 units
₹ 280	2000 units and 3000 units
₹ 278	more than 3000 units

Solution:– Tabulated Statement showing the total material cost at various purchase levels.

Units	Material Purchase cost ₹	No. of orders ₹	Ordering cost ₹	Carrying cost ₹	Total cost ₹
400 units per order	19,50,000	15	22,5000	$\left(\frac{400}{2} \times 0.2 \times 325\right) = 13,000$	19,85,500
500 units per order	18,60,000	12	18,000	$\left(\frac{500}{2} \times 0.2 \times 310\right) = 15,500$	18,93,500
1000 units per order	18,00,000	6	9,000	$\left(\frac{1000}{2} \times 0.2 \times 300\right) = 30,000$	18,39,000
2000 units per order	16,80,000	3	4,500	$\left(\frac{2000}{2} \times 0.2 \times 280\right) = 56,000$	17,40,500
3000 units per order	16,68,000	2	3,000	$\left(\frac{3000}{2} \times 0.2 \times 278\right) = 83,400$	17,54,400

4000 units per order	16,68,000	15	2,250	$\left(\frac{4000}{2} \times 0.2 \times 278\right) = 1,11,200$	17,81,450
6000 units per order	16,68,000	1	1,500	$\left(\frac{6000}{2} \times 0.2 \times 278\right) = 1,66,800$	18,36,300

From the above statement we see Economic order Quantity = 2000 units where total cost 17,40,500 is minimum at all other levels and the number of orders during the year are three.

Illustration 10. A manufacturer has to supply his customer 600 units of his product per year. Storage is not allowed and the inventory carrying cost amount to ₹ 0.60 per unit per year. The set up cost per run is ₹80. Find

- The Economic order quantity.
- The minimum average yearly cost.
- The optimum number of order per year.
- The optimum period of supply per optimum order

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Solution: Carrying cost $C_c = ₹0.60$ per unit.
Ordering cost $C_o = ₹80$ per order.
Market Demand $D = 600$ units per annum

- So Economic order quantity = $\sqrt{\frac{2D \times C_o}{C_c}}$

$$= \sqrt{\frac{2 \times 600 \times 80}{0.6}}$$

$$= \sqrt{160000}$$

$$= 400 \text{ units}$$
- Total number of order = $\frac{600}{400}$

$$= 1.5 \text{ order say } 2 \text{ order}$$

₹

Total carrying cost = $\left(\frac{400}{2} \times 0.6\right) \times 80 = 120$

Ordering cost = $2 \times 80 = 160$

Total cost = 280

So minimum average cost = ₹ 280
- Optimum number of orders per year = 2
- Optimum period of supply per optimum order

$$= \frac{12}{600} \times 400 = 8 \text{ months}$$

Illustration 11. Shri Ram Enterprises manufactures a special product 'ZED'. The following particulars were collected for the year

- Monthly demand of ZED – 1000 units
- Cost of placing an order – ₹ 100
- Annual carrying cost per unit = ₹ 15
- Normal usage 50 unit per week.

- (e) Minimum usage per week = 25 units
- (f) Maximum usage per week = 75 units
- (g) Re-order period 4 to 6 weeks.

Compute from above

- (1) Re-ordering Quantity (2) Re order Level
- (3) Minimum Level (4) Maximum Level
- (5) Average stock Level

Solution: – Annual carrying cost $C_c = ₹15$ per unit

Ordering cost = ₹100 per order

Let us find out the annual consumption:

Normal usage = 50 units

No. of weeks = 52

So annual consumption = 50×52

= 2600 units

$$(i) \text{ Economic order Quantity } EOQ = \sqrt{\frac{2D C_o}{C_c}}$$

$$= \sqrt{\frac{2 \times 2600 \times 100}{15}}$$

= 186 (approximately)

(ii) Re-ordering level = Maximum consumption $\times$ Maximum reorder period

= 75×6

= 450 units

(iii) Minimum Level of stock = Reordering Level – Normal consumption $\times$

Normal reorder period

= $450 - 50 \times 5$

= $450 - 250$

= 200 units

(iv) Maximum Stock Level = Reorder Level + Reordering quantity

– Minimum consumption $\times$ Minimum reorder period

= $450 + 186 - 25 \times 4$

= $636 - 100$

= 536 units

$$(v) \text{ Average Stock Level} = \frac{\text{Maximum Stock Level} + \text{Minimum Stock Level}}{2}$$

$$= \frac{536 + 200}{2}$$

$$= \frac{736}{2} = 368 \text{ units}$$

(C) Stock Control through ABC Analysis:

This method of stock control or material control is generally known as 'Always Better Control' method. The items of material consumed in production are categorized as A, B and C category items. A type of material is the category of material which has low percentage from point of view of quantity but high percentage from point of view of value. C type of material is the category of material which has high percentage from the point of view of quantity but low percentage from point of view of its value. In between two categories are items having medium percentage of quantity with medium percentage of value. These type of items are categorized as 'B' type of categories. So named as ABC analysis 'A' type of items require a strict control because of their high price and high value. B type of items require a medium type of control and 'C' type of items require a little control.

The report of the India productive team on stores and inventory control in U.S.A., Japan and west Germany gives the following analysis for A,B,C Categorization.

Item type	Percentage of items	Percentage of costs
A	8%	75%
B	25%	20%
C	67%	5%
	100%	100%

Let us take a production unit requiring 5000 units of material valuing ₹10,00,000. The items to have a proper control can be categorized in A,B and C type of items.

A type of items:

8% of 5000 = 400 items

Value of items = 75% of ₹10,00,000

= ₹7,50,000

B type of items

25% of 500 = 1250 items

Value of items = 20% of ₹10,00,000

= ₹2,00,000

C type of items

67% of 5000 = 3350 items

Value of items = 5% of 10,00,000

= ₹ 50,000

Illustration 12. From the information given below categories the inventory items in A,B and C type on the basis

Category 'A' items the value of usage in production more then ₹ 2,000

Category 'B' items the value of usage in between ₹1000 and 2000

Category 'C' items the value of usage below ₹ 1000

S.No.	Part No.	Quantity (units)	Unit rate (₹)
1	1001	100	18
2	1002	125	1
3	1003	90	60
4	1004	75	2
5	1005	400	1.5
6	1006	325	1.2

7	1007	80	18
8	1008	75	4
9	1009	60	3
10	1010	55	20
11	1011	188	8
12	1012	39	40
13	1013	42	3
14	1014	154	2
15	1015	90	20
		1898	

Solution : –

S.No.	Part No.	Quantity used (units)	Rate per unit (₹)	Value (₹)
1	1001	100	18	1,800
2	1002	125	1	125
3	1003	90	60	5,400
4	1004	75	2	150
5	1005	400	1.5	600
6	1006	325	1.2	390
7	1007	80	18	1,440
8	1008	75	4	300
9	1009	60	3	180
10	1010	55	2	110
11	1011	188	8	1504
12	1012	39	40	1560
13	1013	42	3	126
14	1014	154	2	308
15	1015	90	120	10,800
		1848		24,793

Items with usage value more than or equal to ₹ 2000

= 2

Items with usage value more than or equal to ₹ 1000 and

less than ₹ 2000 = 04

Items with usage value less than ₹ 1000

= 09

Total value of A items = 5400 + 10800 = ₹ 16200

% of value of A items = 65.34%

Total value of B items = 1800 + 1440 + 1504 + 1560

$$= ₹ 6304$$

$$\% \text{ of value of B items} = 25.43\%$$

$$\text{Value of C items} = 125 + 150 + 600 + 390 + 300 + 180 + 110 + 126 + 308$$

$$= ₹ 2289$$

$$\% \text{ of value of C items} = 9.23\%$$

$$\text{Item \% of A items} = \frac{2}{15} \times 100 = 13.33\%$$

$$\text{Item \% of B items} = \frac{4}{15} \times 100 = 26.67\%$$

$$\text{Item \% of C items} = \frac{9}{15} \times 100 = 60\%$$

Classification of ABC items from various angles.

From point of view of	A type of items	B type of items	C type of items
1. Control	very strict control required	Moderate control	Loose control
2. Safety stock	Very low safety stock	Low safety stock	High safety stock
3. Delivery time	Phased delivery (say weekly)	Once in three months	Once in 6 months
4. Follow up	Maximum follow up needed	Periodic follow up	Exceptional
5. Sources of Supply	As many sources as possible	Two or more reliable source	One to two sources which are reliable
6. Forecasting	Accurate forecasting desired	Estimated on the Past data	Rough estimate
7. Centralized/ Decentralized Purchasing	Centralized purchasing	both are possible centralized or decentralized	Decentralized purchasing
8. Level of handling	Handled by senior officers to have a strict control because of high inventory value from investment or consumption point	middle level management are made responsible to handle such type of items	Lower management can be made responsible in this case

Advantages of ABC classification of items of material

1. A strict control is possible : When the items are classified according to A-items, B-items and C-items as discussed earlier a strict control is possible on A-type of items. These type of items are lesser in number or in quantity but investment in these is very high. As too much amount of capital is locked in these type of items a loose control can lead to high costs. When we classify the items it becomes possible for the management to have a strict control on these.

2. Beneficial to management : It is beneficial for management to have a control over a few items where there is high investment rather to control all the items.
3. Optimum utilization of available funds: Through ABC method of material control it is possible to utilize the available funds in most economical manner. If a large quantity of store of A type items are kept in store than the desired amount then there can be scarcity of funds to be utilized for other purposes. So through ABC we can optimally utilize the available funds.
4. Storage cost if reduced : As the items are kept at an optimum level in the store, the storage cost is reduced.

(D) VED Analysis: VED is an abbreviated form of Vital–Essential and Desirable. Vital material is the type of material whose non availability for few hours will stop production or we can say not tolerable even for a short period, these type of material will have to be available at all the times no matter how its price is. Essential material is the type of material whose non availability can be tolerated for a few hours or a day. Though their non availability are not tolerable in long run. Desirable material is the type of material which will not effect the production process for its non–availability even for few days though not for a very long period. In VED analysis price of the material is not important contrary to ABC analysis. A low priced item can be vital and strict control is desired even of a low value. We can cite here the example of vital drugs. The vital drugs are those which are needed for survival of patients. These drugs may be of low monetary value but still need strict control.

(E) Just in time inventory system : In just in time inventory system of inventory, the inventory in stock is kept at minimum point i.e. at minimum value. The delivery of material is ensured from the suppliers just at the time of its use or demand. As we known in case of Economics order quantity system, a fixed quantity of material is ordered to minimize the carrying or holding cost. This system (J,T) recognizes that a huge amount of money is spent on carrying and holding cost of inventory in store. Just in time system advocates the arrival of the material just at the time when it is needed to use.

In this system a few trust worthy suppliers are chosen which can send the quality and low priced material just at the time when it is needed. Depending upon the need or use of the material, the material can be ordered to the approved suppliers which are very few. Because of receiving inventory just in time of its use, the inventory investment and carrying cost will be minimum. Paper work will also be reduced because of dealing with smaller number of proved suppliers. Contrary to the Economic order quantity system, a desired quantity of material can be ordered.

Advantages of Just in time inventory system:

- (a) Low investment in inventory and low carrying cost is possible.
- (b) Unnecessary burden to paper work in purchasing will be reduced because of smaller number of suppliers and purchasing material when every desired.
- (c) This system is very useful in perishable type of goods in which the holding costs are very high.
- (d) It helps in reducing the wastage of time of work force in purchasing, receiving, inspecting and holding and the saved time can be utilized in other productive work or in production process.

(F) Input–Output Ratio: To judge the material efficiency input output ratio is helpful and found out. Input–output ratio can be found out from the formula given below:

$$\text{Input–Output Ratio : } \frac{\text{Units of material introduced or put to production}}{\text{Units of output of the product}} \times 100$$

The ratio is compared with the standard input–output ratio of company or with the industry. If it is more than desired or standard ratio, then sources of variation are found out for taking remedial actions.

Let us assume that 100 units of material are introduced in a production process and final output is 80 units then

$$\begin{aligned}\text{Input-Output ratio} &= \frac{100}{80} \times 100 \\ &= 125\%\end{aligned}$$

This method is helpful in taking appropriate decision at the upper level of management by company, the current with the standard and finding the causes its higher value.

(G) Material turn-over ratio: For material control, material turnover ratio is very helpful. Material turnover is the ratio of cost of material consumed during a period and the average cost of inventory held during the period.

$$\text{Material turnover ratio} = \frac{\text{Material consumed during a period}}{\text{Average inventory held during the period}}$$

Let us take an example:

Opening stock of material : 2000 units

Closing stock of material : 6000 units

Material purchased during the period = 1,04,000 units

Then material turnover ratio can be found out as:

Average cost of material held

$$\begin{aligned}&= \frac{\text{Opening stock of material} + \text{closing stock of material}}{2} \\ &= \frac{2000 + 6000}{2} \\ &= 4000 \text{ units}\end{aligned}$$

Opening stock of material = 2,000 units

Add: Purchases during the period = 1,04,000 units

Total = 1,06,000 units

Less: closing stock of material = 6,000 units

Material consumed during in period = 1,00,000 units

$$\begin{aligned}\text{Material turnover in days} &= \frac{100000}{4000} \\ &= 25\end{aligned}$$

$$\text{Inventory turnover in days} = \frac{\text{No. of days during the period}}{\text{Material turnover ratio}}$$

In the example let the number days = 365

$$\begin{aligned}\text{Then the inventory turnover in days} &= \frac{365}{25} \\ &= 14.6 \text{ days}\end{aligned}$$

On the basis of inventory turnover we can classify the material into fast moving and slow moving material. It is of no use of locking too much capital in slow moving items. The high turnover ratio is an indicator of fast moving material. The material turnover ratio helps the management to have an adequate material control. If material turnover ratio of a material is zero, it means the material is not moving at all, this type of stock should be sold out immediately to avoid unnecessary burden of carrying and holding cost and loss due to deterioration in future. Let us differentiate between fast moving, slow moving, dormant and obsolete stock.

Fast Moving Stock: The stock which is frequently used in production. It is issued within a small span of time. It is regularly used and regularly purchased. Turnover ratio is very high.

Slow Moving Stock: The stock which is not frequently used in production. It is not used after a regular intervals of time. So issue of such type of material is irregular.

Dormant Stock: The material below the slow moving stock which is rarely used in production is dormant stock of material. It is never in the favor of the company to lock up a heavy amount of capital in such type of stock. We can cite here the example of spare part of a machinery when it goes out of order or use.

Obsolete Stock : The inventory or stock which has not moved from a long time period and is of no use because of various reasons is termed as obsolete stock. It may be due to change in design of the product, change in the techniques of production, use of substitute of material etc. These type of stock should be sold immediately to avoid heavy losses in future.

Efforts should be made to reduce the quantity of dormant and obsolete stock. These stocks can be detected from the records of stock and material turnover ration and finding out the days of their movement. If these type of stocks are present in stock more than the required quantity in case of dormant stock or stock of dead or obsolete stock then it means unnecessarily investment in the inventory which is of no use and could be used for other beneficial purposes. Obsolete stock should be disposed off immediately to avoid extra carrying or holding cost and further losses due to deterioration.

Illustration13: The company is giving you the following information regarding two types of material A and B which are used in production of the productive. You are required to find out the type of material which can be categorized as fast moving in comparison with the other.

	Material A (Units)	Material B (Units)
Stock as on the beginning of the year	15000	10000
Stock at the end of the year	13000	8000
Purchases during the year	110000	133000

Solution: –

	Material A (units)	Material B (units)
Stock as on the beginning of the year	15,000	10,000
Add: Purchases during the year	110,000	133,000
	125,000	143,000
Loss: Stock at the end of the year	13000	8000
Consumption of material during the year	112,000	135,000
Average stock held :	$\frac{15000 + 13000}{2} = 14,000$	$\frac{10,000 + 8000}{2} = \frac{18000}{2}$ = 9000
Material turnover ratio:	$\frac{112,000}{14,000}$	$\frac{135,000}{9000}$

$$= 8$$

$$= 15$$

Material B is fast moving material in comparison to material

A Material turnover in days:

$$\begin{aligned} \text{Material A} &= \frac{365}{8} \\ &= 46 \text{ days (approx.)} \end{aligned}$$

$$\begin{aligned} \text{Material B} &= \frac{365}{15} \\ &= 24 \text{ days (approx.)} \end{aligned}$$

(H) Double bin system: This is another system of material control in which two bins (Two shelves, two racks or one shelf divided into two parts) are kept. One bin is for issue of material to production and when material from one bin is consumed fully then material from second bin is touched and taken from second bin to first one. This method of material control is very easy to operate and less expensive than other techniques of material control. Small organizations can adopt and afford this method of material control. The store keeper can do this work easily to divide the bin in two parts, one to issue material to production and other to issue material to the first one.

(I) Perpetual Inventory system :

This is another system used in material control. In this system of material control information regarding receipt, issue and current balance of material is always available.

The institute of cost and management Accountants of England and Wales, defines perpetual inventory as "A system of records maintained by the controlling department, which reflects the physical movement of stocks and their current balance".

Thus after every receipt or issue of material current balance is ascertained. It facilitate regular checking and obviate (clear away) closing down of work for stocktaking. Perpetual inventory and continuous stock taking are not one and same thing. Perpetual inventory system is a system of records showing current balance of material where as stock-taking is the physical checking of records with the actual stock.

Perpetual inventory system comprise of

- (a) Comparison of Bin cards (Quantitative perpetual inventory and store Ledge Accounts (quantitative-cum-value perpetual inventory)
- (b) Continuous stock-taking (Physical perpetual inventory)
- (a) Comparison of Bin-card and store Ledger Accounts

Bin-cards are maintained by the store keeper where as store ledger Accounts are maintained by the accounts department. Both the records generally tally to each other. However some situations are there because of which the two records may differ these are.

- (i) Wrong posting of an item in one of the records i.e. either in Bin Card or store Ledger Account.
- (ii) Omission of posting an item in store Ledger Account or Bin-card.

- (iii) Arithmetic errors.
- (b) Physical stock verification:—The correctness of balances shown by the two records can be verified through physical stock verification. Two ways of physical stock verification are there.
 - (i) Periodic stock verification.
 - (ii) Continuous stock verification.
- (i) Periodic stock verification : In this method stock verification is conducted on periodic basis i.e. once a year or after every specified period of time. Each item of stock is physically verified and tallied with the records shown by Bin-cards and store Ledger Accounts. This method is simple and economical to have material control, but store may have to be closed for stock taking for few days.
- (ii) Continuous stock—verification: The other method of physical stock verification is continuous method. The stock verification activity is done every day and chance of fraud are minimized because notice of stock items to be verified on each day is given on the day it is to be verified. The system does not necessitate the closing down of the store to facilitate stock-taking. There is less possibility of fraud and discrepancy, but this method is expensive and can be adopted in big concerns.

Under normal circumstances the stock of material shown by records should tally with the actual stock. But sometimes difference arises due to the following reasons.

- (i) Shrinkage and evaporation.
- (ii) Breakage and wastage of material due to improper handling.
- (iii) Loss due to theft.
- (iv) Loss due to accident, fire etc.
- (v) Over or short—issue.
- (vi) Losses arising due to breaking up of bulk material.

Advantages of perpetual Inventory system.

Advantages:

- (i) Errors and frauds can be easily detected so helps in preventing their occurrence.
- (ii) Production is not interrupted if stock verifications done on continuous and in a planned way.
- (iii) Investment in material is kept at the minimum level. Actual records are always compared with the maximum level and minimum level.
- (iv) In continuous stock taking the chances of shrinkage and evaporation, accident, fire etc. are can be curbed through their early detection.
- (v) Accurate and up to date accounts are maintained because both the record keepers become vigilant about the accuracy because of fear of stock taking.
- (vi) The system exercise better control over all receipts and issue in such a manner so as to give a complete picture of both quantities and value of stock in hand at all the times.

- (vii) Employment of specialized staff: Since the work is spread throughout the year, whole time specialized staff is engaged for the purpose.
- (viii) The efficiency of the persons engaged in store control and maintenance of store ledger account is increased.
- (ix) The system acts as an internal check because records are maintained in BIN card and store Ledger Account and any error whenever committed can be easily detected.
- (x) In the event of any mishappening, correct insurance claim could be lodged for claim.

Adjustment of Discrepancies:– Whenever it is found that the physical stock does not tally with the bin card or the store ledger, then adjustment entries are made. Stock adjustment account is opened and debit and credit to this account is made according to the situation. If the physical stock is more than that shown in the bin card or the store ledger, the discrepancy can be rectified by debiting the material control account and crediting the stock adjustment account. The receipt side of the store ledger should be increased and similarly the balance column. If physical stock is less than the store ledger or bin card balance then stock adjustment account should be debited with the difference and credit should be given to material or store control account and balance should be adjusted accordingly.

Let us clear with an example:

On stock taking the physical stock and the store ledger of a company show the following balance. Make an adjustment entry to rectify error.

Store ledger	Physical Stock	Rate per unit		
Material N	1000 units	1200 units	₹ 2	
			₹	₹
Store ledger control a/c		Dr	400	
To stock ledger adjustment a/c		Cr		400

At the end of the period stock adjustment account balance is analyzed to ascertain the reason of discrepancy. If it is due to unavoidable causes, the balance is transferred to costing profit and Loss account and if the discrepancy is due to avoidable reason the balance is transferred to factory overhead account or to store overhead account if so maintained.

In the above case the adjustment entry will be

	₹	₹
Store ledger adjustment a/c Dr.	400	
To costing profit and Loss a/c		400

Miscellaneous Illustrations on material control

Illustration 14 : From the information given below calculate:

- (a) Re-ordering Level
- (b) Maximum Level
- (c) Minimum Level
- (d) Average Stock level
- (e) Danger Level

A company is using two types of material X and Y in production of a product Z as under:

Average consumption:	100 units
Minimum consumption :	50 units
Maximum consumption :	200 units

Re-ordering period	: $\begin{cases} X : 5 - 7 \text{ weeks} \\ Y : 3 - 5 \text{ weeks} \end{cases}$
Re-ordering quantity	: $\begin{cases} X : 800 \text{ units} \\ Y : 500 \text{ units} \end{cases}$
Emergency lead time	: $\begin{cases} X : 3 \text{ weeks} \\ Y : 2 \text{ weeks} \end{cases}$

Solution :

- (a) Reordering Level

$$\begin{aligned}
 \text{For material X} &= \text{Maximum consumption} \times \text{maximum recording period} \\
 &= 200 \times 7 \\
 &= 1400 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 \text{For material Y} &= 200 \times 5 \\
 &= 1000 \text{ units}
 \end{aligned}$$

- (b) Maximum Stock Level = Re-ordering + Reordering level

$$- \text{Minimum consumption} \times \text{minimum recording period}$$

$$\begin{aligned}
 \text{For material X} &= 800 + 1400 - 50 \times 5 \\
 &= 2200 - 250 \\
 &= 1950 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 \text{For material Y} &= 500 + 1000 - 50 \times 3 \\
 &= 1500 - 150 \\
 &= 1350 \text{ units}
 \end{aligned}$$

- (c) Minimum Level = Reordering Level – Normal consumption ×

$$\text{Normal reordering period}$$

$$\begin{aligned}
 \text{For material X} &= 1400 - 100 \times 6 \\
 &= 1400 - 600 \\
 &= 800 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 \text{For material Y} &= 1000 - 100 \times 4 \\
 &= 1000 - 400 \\
 &= 600 \text{ units}
 \end{aligned}$$

$$(d) \text{ Average Stock Level} = \frac{1}{2} (\text{Maximum Stock level} + \text{Minimum Stock level})$$

$$\begin{aligned}
 \text{For Material A} &= \frac{1}{2} (1950 + 300) \\
 &= \frac{1}{2} \times 2750 \\
 &= 1375 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 \text{For material Y} &= \frac{1}{2} (1350 + 600) \\
 &= \frac{1950}{2} \\
 &= 975 \text{ units}
 \end{aligned}$$

$$(e) \text{ Danger Level} = \text{Average consumption} \times \text{Emergency Lead time}$$

$$\text{For material X} = 100 \times 3 = 300 \text{ units}$$

$$\text{For material Y} = 100 \times 2 = 200 \text{ units}$$

Illustration 15 : A purchase manager has decided to place order for minimum quantity of 500 No's of a particular item in order to get a discount of 10%. From the records, it was found out that in the last year, 8 orders each of size 200 nos. have been placed. Given ordering cost = ₹ 500 per order, inventory carrying cost = 40% of this inventory value and the cost per unit = ₹ 400. Is the purchase manager justified in his decision? What is the effect of his decision to the company?

(C.A. Final)

Solution:

Ordering cost Co	= ₹500 per order
Carrying cost CC	= 40% of 400
	= ₹160 per unit
Consumption during the year	= 8 orders of 200 Nos
	= 8 × 200
	= 1600 units

Economic Order Quantity

$$\begin{aligned} &= \sqrt{\frac{2D \times Co}{Cc}} \\ &= \sqrt{\frac{2 \times 1600 \times 500}{160}} \\ &= \sqrt{2 \times 10 \times 500} \\ &= 100 \text{ units} \end{aligned}$$

No's of orders at E.O.Q.

$$= \frac{1600}{100} = 16 \text{ orders}$$

(a) Cost at E.O.Q. Level

$$\begin{aligned} &= \text{Purchasing cost of material} + \text{ordering cost} + \text{carrying cost} \\ &= (1600 \times 400) + (16 \times 500) + \left(\frac{100}{2} \times 160\right) \\ &= 640000 + 8000 + 8000 \\ &= ₹6,56,000 \end{aligned}$$

(b) Cost as per last year 8 orders of 200 units each

$$\begin{aligned} &= \text{Purchase cost} + \text{ordering cost} + \text{carrying cost} \\ &= (1600 \times 400) + (8 \times 500) + \left(\frac{200}{2} \times 160\right) \\ &= 640,000 + 4000 + 16000 \\ &= ₹ 6,60000 \end{aligned}$$

(c) Cost according to the decision of purchase manager

Quantity of material in one order = 500 units

$$\text{No's of orders} = \frac{1600}{500} = 3.2 \text{ orders}$$

= say 4 orders

Total cost = Purchase cost + ordering cost + carrying cost

$$\begin{aligned} &= 1600 \times (400 \times 0.90) + (4 \times 500) + \left(\frac{500}{2} \times 160 \times 0.90\right) \\ &= 5,76,000 + 2000 + 36,000 \\ &= ₹6,14,000 \end{aligned}$$

Purchase manager's decision is right : The total cost for material i.e. purchasing, ordering and carrying is minimum

Effect : Comparing with Last year's decision of 8 orders in a year there is saving of ₹ 46000

and when we compare it with Economic order Quantity level there is a saving of ₹ 42000

This is due to the discount offered by the supplier. If no discounts are given then we are to compare only the sum of the ordering cost and the carrying cost which will in any case minimum in the case of following economic order quantity orders.

Illustration 16: Annual demand for a particular item of inventory is 10,000 units. Inventory carrying cost per unit per year is 20% and ordering cost is ₹40 per order. The price quoted by supplier is ₹4 per unit. Without using the formula to calculate the Economic order quantity, prepare a tabulated chart which clears that at a particular ordering quantity the total cost will be minimum and also calculate the ordering quantity level where total cost is minimum.

Solution:– Chart showing the total cost at different levels of purchases

No of orders 1	Quantity of material ordered (units) 2	Material cost (Purchase cost (₹) 3	Material ordering cost (₹) 4	Average inventory held (units) 5	Inventory carrying cost (₹) 6 (4 × 0.2)	Total cost (₹) (3+4+6) 7
4	2,500	40,000	160	1250	1000	41,160
5	2,000	40,000	200	1000	800	41,000
6	1,667	40,000	240	833.5	667	40,907
7	1,429	40,000	280	714.5	572	40,852
8	1,250	40,000	320	625	500	40,820
9	1,111	40,000	360	555.5	444	40,804
10	1,000	40,000	400	500	400	40,800
11	909	40,000	440	454.5	364	40,804
12	833	40,000	480	416.5	333	40,813

It is clear from the above chart if we go through the 7th column of total cost incurred on material, then ₹40,800 is the minimum cost and the number of orders to be placed at this level as 10 and the number of orders to be placed at this level or 10 and the quantity of material that is to be ordered at this level is 1000 units.

So Economic Order Quantity is 1000 units

Illustration 17 : Analyze the items given below into A, B and C categories and prepare a report showing your findings with comments.

A category of items ₹ 10,000 or above value

B category of items ₹ 4,000 to ₹ 10,000 value

C category of items below ₹ 4,000 value

S.No.	Items No.	No. of units	Price per unit
1	534	60	15
2	512	50	81
3	543	45	30
4	540	65	110

5	535	55	100
6	522	245	110
7	530	55	20
8	533	80	100
9	536	20	40
10	520	18	40
11	524	25	40
12	525	140	225
13	537	35	40
14	518	45	30
15	541	15	18
16	515	28	20

Solution :

S.No.	Item No.	No. of units of items	Price Per unit (₹)	Value (₹)
1	534	60	15	900
2	512	50	81	4,050
3	543	45	30	1,350
4	540	65	110	7,150
5	535	55	100	5,500
6	522	245	110	26950
7	530	52	20	1100
8	533	80	100	8000
9	536	20	40	800
10	520	18	40	720
11	524	25	40	1,000
12	525	140	225	31500
13	537	25	40	1,400
14	518	45	30	1,350
15	541	15	18	270
16	515	28	20	560
Total ₹				92600

$$\text{A type items} = \frac{2}{16} \times 100 = 12.5\%$$

$$\text{B type items} = \frac{4}{16} \times 100 = 25\%$$

$$\text{C type items} = \frac{10}{16} \times 100 = 62.5\%$$

Depending upon value

$$\text{A type items} = \frac{(26950+31500)}{92600} \times 100 = \frac{58450}{92600} \times 100$$

$$= 63.12\%$$

$$\text{B type items} = \frac{(4050+7150+5500+8000)}{92600} \times 100 = \frac{24700}{92600} \times 100$$

$$= 26.67\%$$

$$\text{C type items} = \frac{900+1350+1100+800+720+1000+1400+1350+270+560}{92600} \times 100$$

$$= \frac{9450}{92600} \times 100$$

$$= 10.21 \%$$

A type items are Item No. 6 and Item No: 12 in which 63.12% of total inventory value is locked up.

B type items are no. 2,4,5,8 in which 26.67% of inventory value is locked up

C type items are No: 1,3,7,9,10,11,13,14,15,16 in which 10.21% of total inventory value is locked up.

Illustration 18 : A company requires 10,000 units of a component A for the production of product Z. Price of the component is ₹400 per unit and cost of placing an order and its execution require ₹800 per order. The carrying cost is 10%. You are required to prepare a table showing total cost at different levels of order at 500,550,580,600,630,650,700,750 and 800 units of quantity in one order. From the table so prepared find out the quantity of the component which should be ordered in one time so that the total cost incurred is minimum. Also find out the minimum cost.

Table showing the total cost incurred on component at given different levels of order

Sr. No.	Annual requirement (units)	No. of units ordered	Price Per unit (₹)	Purchase cost (₹)	No. of orders	Ordering cost Per Order (₹)	Total ordering cost (₹)	Total carrying cost (₹)	Total Cost (₹)
1	10,000	500	400	40,000,00	20	800	16,000	$\frac{500}{2} \times 400 \times 10\% = 10000$	40,26,000
2	10,000	550	400	40,000,00	18.18	800	14,544	11,000	40,25,544
3	10,000	580	400	40,000,00	17.24	800	13,792	11,600	40,25,392
4	10,000	600	400	40,000,00	16.67	800	13,336	12,000	40,25,336
5	10,000	630	400	40,000,00	15.87	800	12,696	12,600	40,24,600
6	10,000	650	400	40,000,00	15.38	800	12,304	13,000	40,25,304
7	10,000	700	400	40,000,00	14.29	800	11,432	14,000	40,25,432
8	10,000	750	400	40,000,00	13.33	800	10,664	15,000	40,25,664
9	10,000	800	400	40,000,00	12.5	800	10,000	16,000	40,26,000

At ordering quantity 630 units component the total cost is minimum, So Economic order quantity as per the table shown above is 630 units. The minimum cost at this level is ₹40,24,600

Exercise

- 1) What are the various techniques of material control?
- 2) Enumerate and explain the different levels in material control?
- 3) What are the advantages of keeping minimum level of stock in store?
- 4) Write a short note on material re-order level.
- 5) Show that at economic order quantity the total cost in respect of material is minimum through an example.
- 6) Derive a mathematical formula for Economic order quantity.

Derive E.O.Q. = $\sqrt{\frac{2 \times D \times C_o}{C_c}}$ when D is annual demand, C_o is the ordering cost and C_c is the carrying cost.

- 7) What do you understand by Danger level in inventory control system.
- 8) What are various assumptions in the derivation of formula for Economic order quantity?
- 9) Fill in the blanks:

- (a) Maximum stock level = _____ $\times$ _____
- (b) Maximum Stock level = Reordering Level = _____ + _____ $\times$ _____
- (c) Minimum Stock level = Reordering Level - (_____ $\times$ _____)
- (d) Average Stock level = $\frac{1}{2}$ (_____ + _____)
or = Minimum Stock level + $\frac{1}{2}$ _____

(e) Danger level = Average consumption $\times$ _____

Maximum consumption, Reordering quantity
Normal consumption, Maximum Stock, maximum
reorder period for emergency purchases.
Maximum reorder period, Minimum consumption,
Minimum reorder period, Normal reordering period
Minimum stock level

- 10) What is ABC system for inventory control?
Clear it through an example.
- 11) What do you understand by ordering cost?
- 12) What is to be included in carrying cost?
- 13) If no discount is given by the suppliers of material then show with a suitable example that to find out Economic order Quantity it is not necessary to add the purchase cost of material.
- 14) Is it necessary always that at 'Economic order Quantity' level, carrying cost to be equal to the ordering cost?
- 15) Explain VED analysis.
- 16) "To be able to calculate a basic EOQ certain assumptions are necessary". List down these assumptions.
(CA inter)
- 17) Differentiate between slow moving and fast moving material used into A, B and C type of items.
- 18) Write a formula to calculate Reordering level of stock.
- 19) Categories on percentage of the value of material used into A, B and C type of items.

- 20) Explain Perpetual inventory system in material control.
- 21) What adjustment entries can be passed for variation in the store ledger and the physical verification?
- 22) What are the possible reason of variation in the store ledger and physical stock taking?
- 23) As Bin-card and the store ledger the same document? Who is responsible to complete these?
- 24) Is perpetual inventory system helpful in curbing errors and frauds in records? Explain how?
- 25) What is material turnover ratio?
- 26) What are various causes of becoming a stock to be obsolete?
- 27) From the point of view of 'extent of control' differentiate between A, B and C type of items.
- 28) Write short notes on the following:
 - (i) Re-ordering level (ii) Minimum Stock level
 - (iii) Maximum stock level (iv) Danger level
 - (v) Average stock level
- 29) Find out annual consumption of a material from the data given below.

Ordering cost	: ₹ 20 per order
Inventory carrying cost	: 10%
Purchase price per unit	: ₹ 400
Economic order quantity level	: 160 units
- 30) In a production process 100 units a material is put in production and finally 80 units of finished product are obtained. Find out the input-output ratio.
Also tell the usage of this ratio. How this ratio is useful in inventory control system?
- 31) Pass an adjustment entry if on physical verification it is found that there is shortage of 100 units of an item priced at ₹ 10 per unit. Whether a reason of its shortage affects the posting?
- 32) There is a loss of material due to theft in the store. What is the proper place of debiting such type of loss? Costing profit and loss account or General profit and loss account why?

Numerical Problems:

1) From the details given below calculate:

- (a) Reorder Level (b) Minimum Level

- (c) Maximum Level (d) Danger Level

Reordering quantity is to be calculated on the basis of the following information.

Cost of placing a purchase order is ₹20.

Purchase price per unit inclusive of transportation cost is ₹50

Annual cost of storage per unit is ₹5

Details of Lead time : Average 10 days Maximum 15 days

Minimum 6 days, For emergency purchase 4 days

Rate of consumption : Average : 15 units per day

Maximum : 20 units per day

(C.A. inter)

Ans $\left[\begin{array}{ll} (a) 300 \text{ units} & (c) 440 \text{ units} \\ (b) 150 \text{ units} & (d) 60 \text{ units} \end{array} \right]$

$$\text{Hint : R.O.Q} = \sqrt{\frac{2 \times 5000 \times 20}{5}} = 200 \text{ units}$$

2) P. Ltd uses three types of Material A, B and C for production of 'x' the final product. The relevant monthly data for the components are as given below:

	A	B	C
Normal usage (units)	200	150	180
Minimum usage (units)	100	100	90
Maximum usage (units)	300	250	270
Reorder quantity (units)	750	900	720
Reorder Period (months)	2 to 3	3 to 4	2 to 3

Calculate for each component:

- (i) Reorder Level
 - (ii) Minimum Level
 - (iii) Maximum Level
 - (iv) Average stock Level

(ICWAI inter)

Ans: $\begin{bmatrix} (i) A: 900, & B: 1000, & C: 810 \\ (ii) A: 400, & B: 475, & C: 360 \\ (iii) A: 1450, & B: 1600, & C: 1350 \\ (iv) A: 925, & B: 1038, & C: 835 \end{bmatrix}$

3) Find out Economic order quantity from the information given below:

Annual consumption of material A= 1000 units

Ordering cost i.e. cost in placing an order = ₹ 40

Cost of holding the inventory in store = 10% of unit price

Purchase price of material A= ₹ 80 per unit

[Ans: $ECQ = 100$ units]

4) Find out the reordering quantity if

Average stock level of material = 15000 units

Minimum stock level of material = 5000 units [Ans: 20000 units]

Hint: Average stock level = Minimum stock level + $\frac{1}{2}$ reordering quantity

5) A company produces a product whose monthly demand is 5000 units. The product required a component X which is purchased at ₹100. For every finished product, one unit of the component is required. The ordering cost is ₹120 and the holding cost is 10% p.a.

You are required to calculate:

- (i) Economic order quantity.
- (ii) What is the minimum carrying cost, the company has to incur?
- (iii) If the minimum lot size to be supplied is 6000 units, what is extra cost, the company has to incur?

$$\text{Ans: } \left[\begin{array}{l} \text{i) = 1200 units} \\ \text{ii) = ₹6000} \\ \text{iii) = ₹19200} \end{array} \right]$$

Hint (iii) For Lot of 6000

No of orders = 10

Ordering cost = $10 \times 120 = 1200$

Carrying cost $\frac{6000}{2} \times 100 \times 10\% = \frac{30000}{31200}$

As per E.O.Q :

No of orders = 50

Ordering cost = $50 \times 120 = 6000$

Carrying cost : $\frac{1200}{2} \times 100 \times 0.1 = 6000$ 12000

Extra cost incurred = ₹19200

6) A manufacturing company purchased 2400 pieces of a component from a subcontractor at ₹500 per piece and use them in its assembly department, at a steady rate. The cost of placing an order and following it up is ₹2500. The estimated stock holding cost is approximately 1% of the value of average stock held. The company is at present, placing orders which at present vary between an order placed every two months (i.e. six orders p.a.) to one order per annum. Which policy would you recommend?

[ICWA inter]

$$\text{Ans: } \left[\begin{array}{l} E.O.Q = 4899 \text{ pieces} \\ \text{Orders} = 5 \text{ during the period} \end{array} \right]$$

7) Purchase department of a company is planning to purchase the raw material X used in production of a product A. On scrutinizing the quotations it is found that one of the suppliers of the material has given the quotation as under:

Price per ton	Tons
₹1200	Less than 500
₹1180	500 and less than 1000
₹1160	1000 and less than 2000
₹1140	2000 and less than 3000
₹1120	3000 and above

The other supplier has offered to send the material at a flat rate of ₹1175 per ton without any precondition of the lot size.

The annual requirement of material is 5000 tons. The delivery cost per order is ₹1200 and the stock holding cost is estimated at 20% of material cost per annum. You are required to advise the purchase department by properly scrutinizing the two quotations, which of the suppliers of material should be ordered, also calculate the benefit in monetary terms of ordering one over the other.

Ans: $\left. \begin{array}{l} \text{(i) First supplier should be ordered to send the} \\ \text{material and lot size is 1000 tons and 5 orders during} \\ \text{the year should be ordered.} \\ \text{(ii) } 5929155 - 5922000 = ₹7155 \end{array} \right\}$

- 9) From the data given below in respect of material M for the year ended 31.03.2014. Calculate (i) Inventory turnover ratio (ii) The number of days for which average inventory is held.

Opening stock as on 01.04.2013 : ₹80,000

Closing stock as on 31.03.2014 : ₹70,000

Purchases during the year : ₹1,77,500

Ans: [(i) = 2.5 (ii) = 146 days]

- 9) Following information relating to a type of raw material is available.

Annual demand : 2400 units

Storage cost 2% per annum

Unit price : ₹2.40

Interest rate 10% per annum

Ordering cost per order : ₹4

Lead time : Half month

Calculate E.O.Q and total inventory cost in respect of the particular raw material.

(ICWAI inter)

Ans: [258 units, ₹5837.15]

Hint: Demand annual D = 2400 units, carrying cost = ₹2.40 × (10+2)%

Ordering cost $C_o = ₹4$

$C_c = ₹0.288$

$$E.O.Q = \sqrt{\frac{2D \times C_o}{C_c}} = \sqrt{\frac{2 \times 2400 \times 4}{0.288}} = 258 \text{ units}$$

$$\text{Total cost} = [(2400 \times 2.4) + (10 \times 4) + \left(\frac{258}{2} \times 0.288\right)] = [5760 + 40 + 37.15]$$

$$= ₹ 5837.15$$

- 10) Your factory buys and uses a component for production at ₹10 per piece. Annual requirement is 2000 numbers, carrying cost of inventory is 10% p.a. and ordering cost is ₹40 per order. The purchase manager argues that as the ordering cost is very high, it is advantageous to place a single order for the entire annual requirement. He also says that if we order 2,000 pieces at a time, we can get a 3% discount from the supplier. Evaluate the proposal and make your recommendations.

[I.C.W.A.I Final]

[Ans: The purchase manager's proposal is not acceptable because purchase on the basis of E.O.Q. is cheaper E.O.Q. = 400 units]

$$\text{Hint: Total cost under E.O.Q} = \left[(2000 \times 10) + \left(\frac{400}{2} \times 10 \times 0.1 \right) + \frac{2000}{400} \times 40 \right]$$

$$= 20000 + 200 + 200 = ₹20400$$

Total cost when Purchase manager proposal is accepted

$$= [(2000 \times 10 \times 0.97)] + \left[\frac{2000}{2} \times 10 \times 0.97 \times 0.1 \right] + [1 \times 40]$$

$$= 19400 + 970 + 40$$

$$= ₹20410$$

$$E.O.Q = \sqrt{\frac{2 \times 2000 \times 40}{10 \times 0.1}} = \sqrt{160000} = 400 \text{ units}$$

11) From the information given below categorize the items on the basis of numbers and the total value used in production into A, B and C. of a product No 10 in a factory.

Sr. No.	Item No.	No. of items (units)	Price per unit (₹)
1	1008	70	5
2	1009	50	12
3	1003	45	100
4	1004	65	130
5	1005	55	150
6	1001	150	189
7	1010	55	15
8	1011	60	25
9	1012	20	40
10	1013	15	40
11	1014	23	53
12	1002	190	260
13	1015	43	36
14	1016	41	15
15	1017	24	18
16	1018	128	20
17	1019	175	10
18	1020	38	12
19	1006	89	98
20	1007	56	87

To categorize items into A, B and C category, items with total value used in consumption more than ₹10,000 are to be kept as A items. For B category the total value of an item used should be between ₹4000 and ₹10,000 and for C category it should be less than ₹4000.

$$\text{Ans: } \begin{bmatrix} \text{itemwise} & A & B & C \\ \text{value wise} & 10\% & 25\% & 65\% \\ & 61.80\% & 27.66\% & 10.54\% \end{bmatrix}$$

12) On physical verification of stock in the store of a company the following discrepancies have been noted.

Items	Physical check (units)	Store Ledger (units)	Physical check (units)	Cost/unit (₹)
A	1000	1000	960	50
B	1000	1000	950	40
C	800	800	820	30

(i) What action should be taken to record the information shown above.

(ii) Suggest what reasons for such discrepancies may be and recommend a possible course of action that a management could take to curb such discrepancies.

Average monthly market demand

2000 tubes

Ordering cost	₹100 per order
Inventory carrying cost	20% per annum
Cost of tubes	₹500 per tube
Normal usage	100 tubes per week
Minimum usage	50 tubes per week
Maximum usage	200 tubes per week
Lead time to supply	6–8 weeks

Compute from above:

- (1) Economic order quantity. If the supplier is willing to supply quarterly 1,500 units at a discount of 5% is it worth accepting?
- (2) Maximum Level of stock.
- (3) Minimum Level of stock.
- (4) Reorder Level (CA inter)

Ans: [1. EOQ=102 units (approx.). The offer of the supplier sending quarterly 1500 units at discount of 5% is acceptable as it will save total cost on material to the tune of ₹68,550. 2. 1402 units 3. 900 units 4. 1,600 units]

14) (a) State whether the following statements are true or not? Give reasons:

- (i) At 'Economic Order Quantity point' the ordering cost and the carrying costs are equal to each other.
- (ii) Proper balance between shortage cost and carrying cost is obtained in order to calculate 'Economic Order Quantity level'.
- (iii) In event of same per unit price of the material irrespective of the size of order, the ordering cost and carrying cost of the material are the only decisive factors.
- (v) Reordering quantity and Economic order quantity, both are one and the same and are always equal.

(b) Compute EOQ from the following information:

Annual usage of material A	= 6000 units
Price per unit	= ₹20 per unit
Ordering cost	= ₹60 per order
Storage rate	= 2% per annum
Interest rate	= 5% per annum
Obsolescence rate	= 3% per annum

Ans: [a. (i) False (ii) False (iii) True (iv) False (v) False
b. 600 units]

15) A company's monthly requirement of an inventory item is 1,800 units. The cost of processing an order is ₹5 and the carrying cost per unit is 20 paise. The company's supplier agrees to offer quantity discount as under:

Lot size	Up to 400	401–600	601–800	801–1000	100 and above
(in units) :					
Discount (₹):	Nil	6	10	15	20

Lead time is 2 days and the company wishes to keep a safety stock equal to 50% of the usage in the lead time.

- (a) Find the Economic order quantity (EOQ) without considering the offer of discount.

- (b) Explain the reasons for your calculations.
- (c) Calculate reorder point taking 30 working days in a month.
- (d) Tabulate different types of cost as also effect of discount on different order sizes taking 1,2,3 7 orders a month and indicate the E.O.Q.

(C.A. Final)

Ans: $\left[\begin{array}{l} (a) 1039 \text{ units} \\ (e) 180 \text{ units} \\ (d) 450 \text{ units} \end{array} \right]$

- 16) From the following details, draw a plan of ABC selective control.

Item	Units	Unit cost
1	7,000	5.00
2	24,000	3.00
3	1500	10.00
4	600	22.00
5	38,000	1.50
6	40,000	0.50
7	60,000	0.20
8	3,000	3.50
9	300	8.00
10	29,000	0.40
11	11,500	7.10
12	4,100	6.20

(CA. Final)

$\left[\begin{array}{l} A \text{ item } 2,5,11 \\ B \text{ items } 1,3,6,12 \\ C \text{ items } 4,7,8,9,10 \end{array} \right]$

Numerical Solutions

Material Cost Control

- 1) (a) Re-ordering Level = Maximum consumption per day ×
Maximum lead time
= 20×15
= 300 units
- (b) Minimum Stock level = Reordering level – Average consumption
× Average lead time
= $300 - (15 \times 10)$
= $300 - 150$
= 150 units
- (c) Maximum Stock level = Reordering quantity + Reordering level –
– Minimum consumption × Minimum lead time
= $200 + 300 - (10 \times 6)$
= $500 - 60$
= 440 units
- (d) Danger Level = Average consumption × Emergency lead time
= 15×4
= 60 units

$$\text{*Reordering Quantity} = \sqrt{\frac{2D \times Co}{Cc}} = \sqrt{\frac{2 \times 5000 \times 20}{5}}$$

$$= 200 \text{ units}$$

$$\text{**Average consumption} = \frac{\text{Maximum Consumption} + \text{Minimum Consumption}}{2}$$

$$\begin{aligned} \text{Minimum consumption} &= 2 \times \text{Average consumption} - \text{Maximum consumption} \\ &= 2 \times 15 - 20 = 30 - 20 \\ &= 10 \text{ units} \end{aligned}$$

2)

Units

	A	B	C	
(i) Reordering level				
= Maximum consumption ×	300×3	250×4	270×3	
Maximum lead time	=900 units	= 1000 units	=810 units	
(ii) Maximum level				
= ROQ+ROL – minimum	= 750+900–	= 900+1000	=720+810–	
Consumption ×minimum	(100×2)	–(100×3)	(90×2)	
lead time	=1650 – 200	=1900 –300	=1530– 180	
	= 1450 units	=1600 units	= 1350 units	
(iii) Minimum level= ROL –	= 900 – (200	= 1000–(150	= 810– (180×	
average consumption ×	×2.5)	×3.5)	2.5)	
average lead time	= 900– 500	= 1000– 525	= 810 – 450	
	= 400 units	= 475 units	= 360 units	

(iv) Average stock level

$\frac{\text{Maximum level} + \text{minimum level}}{2}$	$\frac{1450 + 400}{2}$	$\frac{1600 + 475}{2}$	$\frac{1350 + 360}{2}$
$\frac{1850}{2}$	$\frac{2075}{2}$	$\frac{1710}{2}$	
= 925 units	= 1038 units	= 855 units	

- 3) Annual consumption D = 1000 units
 Ordering cost C_o = ₹40
 Carrying cost C_c = 10% of ₹80
 = ₹8 per unit

$$\begin{aligned} \text{Economic order quantity} &= \sqrt{\frac{2D \times C_o}{C_c}} \\ &= \sqrt{\frac{2 \times 1000 \times 40}{8}} \\ &= \sqrt{10000} \\ &= 100 \text{ units} \end{aligned}$$

- 4) Average Stock level = 15000 units
 Minimum stock level = 5000 units
 We know that

$$\begin{aligned} \text{Minimum Stock level} &= \text{Average Stock level} - \frac{1}{2} \text{reordering quantity} \\ &= 5000 = 15000 - \frac{1}{2}(ROQ) \\ \Rightarrow \text{Reordering quantity} &= (15000 \times 2) - (5000 \times 2) \\ &= 30000 - 10000 \\ &= 20000 \text{ units} \end{aligned}$$

- 5) (i) Annual demand of Product = 12×5000
 = 60000 units

Consumption of component $\times$ per annum = 60,000 units

Ordering cost = ₹120 per order

Carrying cost = 10% of 100
 = ₹10 per unit

$$\begin{aligned} \text{Economic Order Quantity} &= \sqrt{\frac{2D \times C_o}{C_c}} \\ &= \sqrt{\frac{2 \times 60000 \times 120}{10}} \\ &= 1200 \text{ units} \end{aligned}$$

- (ii) Carrying cost = Average inventory $\times$ cost per unit (carrying)
 $= \frac{1200}{2} \times 10$
 $= 600 \times 10$
 $= ₹6,000$

- (iii) Minimum supply = 6000 units per order
 Average stock kept = $\frac{6000}{2} = 3000$ units

$$\begin{aligned}
 \text{No's of order} &= 10 \text{ orders} && ₹ \\
 \text{Ordering cost} &= 10 \times 120 = && 1200 \\
 \text{Carrying cost} &= 3000 \times 10 = && 30,000 \\
 \text{Total} &= && 31,200 \\
 \text{As per E.O.Q} &&& ₹ \\
 \text{Ordering cost} &= \frac{60000}{1200} \times 120 = && 6000 \\
 \text{Carrying cost} &= 600 \times 10 = && 6000 \\
 &&& \underline{\hspace{1cm}} \\
 &&& = 12,000 \\
 \text{Extra Cost incurred:} &= && \underline{\hspace{1cm}} 19,200
 \end{aligned}$$

- 6) Annual Demand D = 24000 pieces
Ordering cost Co = ₹2500
Carrying cost Cc = 1% of 500
= ₹5 per unit

$$\begin{aligned}
 \text{Economic Order quantity} &= \sqrt{\frac{2D \times Co}{Cc}} \\
 &= \sqrt{\frac{2 \times 24000 \times 2500}{5}} \\
 &= \sqrt{2 \times 24000 \times 500} \\
 &= \sqrt{24000000} \\
 &= 4,899 \text{ units}
 \end{aligned}$$

Comparing company policy and economic Order quantity level. Cost under company policy

$$\begin{aligned}
 \text{No. of orders} &= 6 \\
 \text{Ordering cost} &= 6 \times 2500 = ₹ 15000 \\
 \text{Carrying cost} &= 2000 \times 5 = ₹ 10000 \\
 \left[\frac{24000}{6} \times \frac{1}{2} \times 5 \right] &= ₹ 25000
 \end{aligned}$$

Under E.O.Q. method

$$\begin{aligned}
 \text{No. of orders} &= \frac{24000}{4899} = 5 \text{ orders} \\
 \text{Ordering cost} &= 5 \times 2500 = ₹ 12500 \\
 \text{Carrying cost} &= \left(\frac{24000}{5} \times \frac{1}{2} \times 5 \right) = ₹ 12000 \\
 \text{Total} &= ₹ 24500
 \end{aligned}$$

Saving of ₹ 500 by adopting E.O.Q method.

So it is better to the company policy of 6 order.

- 7) Tabulated statement showing the total material cost at various purchase levels.

Units Per order (units)	Material Purchase Cost (₹)	No. of orders	Ordering cost (₹)	Carrying cost (₹)	Total cost (₹)
	'000		'000	'000	'000
400	6,000	13	15.6	(200 × 0.2 × 1120)44.8	6060.40
500	5,900	10	12.0	59	5971.00

1000	5,800	5	6	116	5922.00
2000	5,700	2.5	3	228	5931.00
3000	5,600	1.7	2.04	336	5938.04
4000	5,600	1.25	1.5	336	5937.5

Minimum cost is at the point where no. of orders are 5 and quantity ordered is 1000 units per order.

Cost under E.O.Q. system and price at ₹1175 per tone

$$\text{Economic Order Quantity} = \sqrt{\frac{2D \times Co}{Cc}}$$

$$= \sqrt{\frac{2 \times 5000 \times 1200}{1175 \times 20\%}} = 226 \text{ (approx)}$$

$$\text{No of orders during the year} = \frac{5000}{226}$$

$$= 23 \text{ (rounded up)}$$

$$\begin{aligned} \text{Total cost} &= \text{Material cost} + \text{Ordering cost} + \text{Carrying cost} \\ &= (1175 \times 5000) + (23 \times 1200) + \left(\frac{226}{2} \times 1175 \times 20\%\right) \\ &= 58,75,000 + 27,600 + 26,555 \\ &= ₹ 59,29,155 \end{aligned}$$

It is beneficial to accept the discount scheme offered and 1000 units in one lot should be purchased @ ₹1160 per ton

$$\begin{aligned} \text{The saving in cost} &= 59,29,155 - 59,22,000 \\ &= ₹ 7,155 \end{aligned}$$

(8)

	₹
Opening stock on 01.04.2013	= 80,000
+purchase during the year	= 177500
	= 257500
Less closing stock on 31.03.14	= 70000
Material consumed during the year	= 187500

$$\begin{aligned} \text{(i) Material turnover ratio} &= \frac{187500}{\left(\frac{80000+70000}{2}\right)} \\ &= \frac{187500}{75000} \\ &= 2.5 \end{aligned}$$

$$\begin{aligned} \text{(ii) No. of days for which average inventory is held} &= \frac{365}{2.5} \\ &= 146 \text{ days} \end{aligned}$$

$$9) \quad \text{Annual demand D} = 2400 \text{ units}$$

$$\text{Unit price} = ₹ 2.40$$

$$\text{Storage cost} = 2\% \text{ per annum}$$

$$\begin{aligned}\text{Interest rate} &= 10\% \text{ per annum} \\ \text{Carrying cost} &= 12\% \text{ per annum} \\ &= 2.4 \times 0.12 \\ &= 0.288 \text{ per unit}\end{aligned}$$

$$\text{Ordering cost} = ₹ 4$$

$$\begin{aligned}\text{(i) Economic Order Quantity} &= \sqrt{\frac{2D \times Co}{Cc}} \\ &= \sqrt{\frac{2 \times 2400 \times 4}{0.288}} = 258 \text{ units (approx..)}\end{aligned}$$

$$\text{(ii) No. of orders} = \frac{2400}{258} = 9.30$$

say = 10 orders

$$\begin{aligned}\text{Total cost} &= \text{Material cost} + \text{ordering cost} + \text{carrying cost} \\ &= (2400 \times 2.4) + (10 \times 4) + \left(\frac{258}{2} \times 0.12 \times 2.4\right) \\ &= 5,760 + 40 + 37.15 \\ &= ₹ 5837.15\end{aligned}$$

$$10) \text{ Annual requirement } D = 2000 \text{ numbers}$$

$$\begin{aligned}\text{Carrying Cost} &= 10\% \text{ per annum} \\ &= 10 \times 10\% \\ &= ₹ 1.00\end{aligned}$$

$$\text{Ordering Cost} = ₹ 40$$

$$\begin{aligned}\text{Economic order Quantity} &= \sqrt{\frac{2D \times Co}{Cc}} \\ &= \sqrt{\frac{2 \times 2000 \times 40}{1}} \\ &= \sqrt{160000} \\ &= 400 \text{ numbers}\end{aligned}$$

Total cost depending on E.O.Q. basis of purchases:

$$\begin{aligned}&= \text{Material cost} + \text{Ordering cost} + \text{Material carrying cost} \\ &= (2000 \times 10) + (5 \times 40) + \left(\frac{400}{2} \times 0.1 \times 10\right) \\ &= 20000 + 200 + 200 \\ &= ₹ 20400\end{aligned}$$

Depending upon the proposal given by purchase manager

$$\begin{aligned}\text{Total Cost} &= \text{Material cost} + \text{Ordering Cost} + \text{Carrying cost} \\ &= (2000 \times 9.7) + (1 \times 40) + \left(\frac{2000}{2} \times 9.7 \times 0.1\right) \\ &= 19,400 + 40 + 970 \\ &= ₹ 20,410\end{aligned}$$

Purchasing on the basis of E.O.Q is recommended as it is cheaper than other as proposed by the manager.

11) Item wise Categorization into A,B and C

$$\text{Total number of items} = 20$$

No. of items under A Category = 2

No. of items under B Category = 5

No. of items under C Category = 13

$$\text{A items Share item wise} = \frac{2}{20} \times 100 = 10\%$$

$$\text{B items Share item wise} = \frac{5}{20} \times 100 = 25\%$$

$$\text{C items Share item wise} = \frac{13}{20} \times 100 = 65\%$$

$$\text{A item share value wise} = \frac{28350 + 49400}{125,799} \times 100 = 61.81\%$$

$$\begin{aligned} \text{B item share value wise} &= \frac{4500 + 8250 + 8450 + 8722 + 4872}{125,799} \times 100 \\ &= 27.66\% \end{aligned}$$

$$\begin{aligned} \text{C item share value wise} &= \frac{(350 + 600 + 825 + 1500 + 800 + 600 + 1219 + 1548 + 615 + 432 + 2560 + 1750 + 456)}{125,799} \times 100 \\ &= \frac{13255}{125799} \times 100 = 10.54\% \end{aligned}$$

Total Showing value of consumption during the period (Item wise)

Sr. No.	Item No.	No. of Items Units	Price Per (Unit) ₹	Total Value Consumed ₹
1.	1008	70	5	350
2.	1009	50	12	600
3.	1003	45	100	4500
4.	1004	65	130	8450
5.	1005	55	150	8250
6.	1001	150	189	28350
7.	1010	55	15	825
8.	1011	60	25	1500
9.	1012	20	40	800
10.	1013	15	40	600
11.	1014	23	53	1219
12.	1002	190	260	49400
13.	1015	43	36	1548
14.	1016	41	15	615
15.	1017	24	18	432
16.	1018	128	20	2560
17.	1019	175	10	1750
18.	1020	38	12	456
19.	1006	89	98	8722
20.	1007	56	87	4872
Total:				125,799

Q 12) (i) First of all investigate reasons for discrepancies

- (a) If it is due to normal or an unavoidable reason then debit the Factory overhead a/c and credit store ledger control a/c if there is loss in physical stock.

	₹	₹
(A) Factory overhead a/c	Dr 2000	
To Store ledger control a/c		2000

(B) Factory overhead a/c	Dr	2000	
To Store ledger control a/c			2000
(C) Store ledger control a/c	Dr	600	
To Factory overhead a/c			600

- (b) If it is due to abnormal reasons may be due to mishandling of store or sue to mistake of store keeper.
Then it will not be debited to Factory overhead rather to costing Profit Loss a/c.

		₹	₹
(A) Costing P&L a/c	Dr	2000	
To Store ledger control a/c			2000
(B) Costing P&L a/c	Dr	2000	
To Store ledger control a/c			2000
(C) Store ledger control a/c	Dr	600	
To Costing P&L a/c			600

- (c) If it is due to some error in recording then Debit W.I.P a/c and credit store ledger control a/c and vice-versa.

		₹	₹
(A) W.I.P a/c	Dr	2000	
To Store ledger control a/c			2000
(B) W.I.P. a/c	Dr	2000	
To Store ledger control a/c			2000
(C) Store ledger control a/c	Dr	600	
To W.I.P. a/c			600

100 tubes per week

13) Normal usage =

$$\text{Annual usage } D = 52 \times 100$$

$$= 5200 \text{ tubes}$$

$$\text{Ordering Cost} = ₹ 100 \text{ per order}$$

$$\text{Carrying Cost} = 20\% \text{ P.A.}$$

$$= 500 \times \frac{20}{100}$$

$$= ₹ 100 \text{ per tube}$$

$$\text{Economic order Quantity} = \sqrt{\frac{2D \times Co}{Cc}}$$

$$= \sqrt{\frac{2 \times 5200 \times 100}{100}}$$

$$= \sqrt{10400}$$

$$= 102 \text{ (approx.)}$$

Total Cost under E.O.Q. scheme of purchase.

$$\text{No. of orders} = \frac{5200}{102} = 51$$

$$\begin{aligned}\text{Total Cost} &= \text{Purchase Cost} + \text{Ordering Cost} + \text{Carrying Cost} \\ &= (5200 \times 500) + (51 \times 100) + \left(\frac{102}{2} \times 500 \times 20\%\right) \\ &= 26,00,000 + 5100 + 5100 \\ &= 26,10,200\end{aligned}$$

Total Cost under discount scheme

$$\text{No. of orders} = 4$$

$$\begin{aligned}\text{Total Cost} &= \text{Purchase cost} + \text{Ordering cost} + \text{Carrying cost} \\ &= (5200 \times 500 \times 0.95) + (4 \times 100) + \left(\frac{1500}{2} \times 500 \times 0.95 \times 20\%\right) \\ &= (24,70,000) + (400) + (71,250) \\ &= ₹ 25,41,650\end{aligned}$$

Total Cost under discount scheme is less than that of under E.O.Q. without discount scheme.

$$\begin{aligned}\text{Total saving} &= 26,10,200 - 25,41,650 \\ &= ₹ 68,550\end{aligned}$$

Q.14) (b)

$$\text{Annual usage } D = 600 \text{ units}$$

$$\text{Ordering cost } C_o = ₹ 60 \text{ per order}$$

$$\text{Carrying cost } C_c = (2+5+3)\% \text{ p. annum}$$

$$= 10\% \text{ per annum}$$

$$= 20 \times \frac{10}{100}$$

$$= ₹ 2 \text{ per unit}$$

$$\begin{aligned}\text{Economic order Quantity} &= \sqrt{\frac{2D \times C_o}{C_c}} \\ &= \sqrt{\frac{2 \times 6000 \times 60}{2}} \\ &= \sqrt{360000} \\ &= 600 \text{ units}\end{aligned}$$

$$\text{Q.15) (a) Annual requirement } D = 1800 \times 12$$

$$= 21600 \text{ units}$$

$$\text{Ordering Cost} = ₹ 5 \text{ per order}$$

$$\text{Carrying cost} = 0.20 \text{ per unit}$$

$$\begin{aligned}\text{Economic order Quantity} &= \sqrt{\frac{2D \times C_o}{C_c}} \\ &= \sqrt{\frac{2 \times 21600 \times 5}{0.2}} \\ &= 1039 \text{ units (approx.)}\end{aligned}$$

$$\text{(b) Monthly requirement} = 1800 \text{ units}$$

$$\text{daily requirement} = \frac{1800}{30}$$

$$\begin{aligned}
 &= 60 \text{ units} \\
 \text{Lead time} &= 2 \text{ days} \\
 \text{requirement in lead time} &= 60 \times 2 = 120 \text{ units} \\
 \text{Reordering point} &= \text{Minimum level} + \text{Consumption during lead time} \\
 &= (50\% \text{ of } 120) + 120 = 60 + 120 = 180 \text{ units}
 \end{aligned}$$

Tabulated total cost statement is respect of material at different order size.

Order's No.'s	Order Size (Units)	Ordering Cost ₹	Carrying Cost ₹	Discount ₹	Total ₹
1.	1800	5	$\frac{1800}{2} \times 0.2 = 180$	20	5+180-20 =165
2.	900	10	$\frac{900}{2} \times 0.2 = 90$	15	85
3.	600	15	$\frac{600}{2} \times 0.2 = 60$	6	69
4.	450	20	$\frac{450}{2} \times 0.2 = 45$	6	59
5.	360	25	$\frac{360}{2} \times 0.2 = 36$	—	61
6.	300	30	$\frac{300}{2} \times 0.2 = 30$	—	60
7.	257	35	$\frac{257}{2} \times 0.2 = 26$	—	61

Cost is minimum when numbers of orders are 4 and ordering quantity is 450 units per month.

Q. 16) Selection of items under ABC system of inventory control.

Item	Units	Unit Cost ₹	Total Cost ₹	Category
1	7000	5.00	35,000	B
2	24000	3.00	72,000	A
3	1500	10.00	15,000	B
4	600	22.00	13,200	C
5	38000	1.50	57,000	A
6	40000	0.50	20,000	B
7	60000	0.20	12,000	C
8	3000	3.50	10,500	C
9	300	8.00	2,400	C
10	29000	0.40	11,600	C
11	11500	7.10	81,650	A
12	4100	6.20	25,420	B

Category of items	Consumption Value	Item Number
A	more than ₹50,000 & equal to	2,5,11
B	between ₹15,000 and < 50,000	1,3,6,12
C	less than ₹ 15,000	4,7,8,9,10

Consumption percentage

(i) Item wise:

$$\text{A Type} = \frac{3}{12} \times 100 = 25\%$$

$$\text{B Type} = \frac{4}{12} \times 100 = 33.33\%$$

$$\text{C Type} = \frac{5}{12} \times 100 = 41.67\%$$

(ii) Value wise:

$$\text{A Type} = \frac{72000 + 57000 + 81650}{355770} \times 100$$

$$= \frac{210,650}{355770} \times 100$$

$$= 59.21\%$$

$$\text{B Type} = \frac{35000 + 15000 + 20000 + 25420}{355770} \times 100$$

$$= \frac{95420}{355770} \times 100$$

$$= 26.82\%$$

$$\text{C Type} = \frac{(13200 + 12000 + 10500 + 2400 + 11600)}{355770} \times 100$$

$$= \frac{49700}{355770} \times 100 = 13.97\%$$



3 UNIT COSTING

The concerns which produces single product or one or more grades of a product adopt this system of costing known as unit costing. There is always a continuous and bulk production of the product. The total cost incurred on the production of the bulk amount is added up and is divided by the quantity of the product to find out the cost per unit quantity of the product. Say, a company produces 1000 litres of a material and total cost incurred up to the level of sale is ₹ 10,000

then the cost per unit/litre will be equal to ₹ 10 (₹ 10000 ÷ 1000)

$$\text{Unit Cost} = \frac{\text{Total Cost}}{\text{Total quantity or the number of units produced}}$$

The method is very simple. The cost is collected elementwise i.e. material, labour, factory, administration, selling and distribution etc. The process of collecting the cost elementwise will be helpful in having control at different levels, fix responsibilities and taking any appropriate remedial measure.

In some concerns single product may be produced in different grades depending upon the quality required in the market at various prices. In such cases the costs incurred should be apportioned to the grades of the product on an appropriate, logical, acceptable, predetermined basis.

Cost accumulation procedure:

In unit costing, cost is accumulated on elementwise i.e. the cost incurred on material, labour and overhead as already discussed.

1. **Cost of material consumed:** As we know production is nothing but to produce, change or raise the desired utility out of the available material. So, material becomes the main important part in the process of production. The cost of material used for the production is ascertained primarily through material requisition slips. The material issues should be allowed against authorised requisitions only. Normal losses of material in storage or handling will be adjusted against issue prices i.e. the price of material will be raised. This is done to accumulate all the costs incurred on the material used in the production from the point of initiation of purchase up to the point it is ready to be used in the production. Care should be taken to separate the normal and abnormal losses in the path of material issue. Only normal losses are charged to material cost and abnormal losses are charged to costing profit and loss account.
2. **Cost of labour:** Labour plays an important role in the production of the products. Care should be taken to separate the labour between direct and indirect. Direct labour is one which is mainly engaged in increasing the utility of the product up to the desired level. A separate record is necessary for such workers. Some workers may be there which are not mainly concerned with manufacturing and doing other factory activities. Separate record should be kept for such workers.
3. **Overhead Cost:** For the smooth and uninterrupted production, overhead cost are incurred. The overhead costs are classified according to their functions. The functions can be at factory level, administration level, selling and distribution level. So, the same are named as factory overheads, administration overheads, selling and distribution overheads. When factory overheads are added to the prime cost (Sum of direct material and direct labour cost) we get factory cost. When administration overheads are added to factory cost, we get cost of production. Selling and distribution overheads are then added to cost of production (For those goods which are sold, at an appropriate acceptable method) to get cost of goods sold or the cost of sales. Cost of production becomes main part in the decision making process, so in some companies while preparing records under unit costing selling and distribution costs are ignored.

Advantages of unit costing:

1. Separation of cost among elements helps the management to have proper control over production process.
2. Helpful to find out the cost incurred per unit of the product.
3. Helpful to quote the price of the product to various types of suppliers.
4. To check the cost incurred at various level and comparison with the past.
5. Helpful in cost minimisation through minimising the normal or abnormal losses.
6. Helps the management at various levels to be cost conscious.

Tenders and Quotation:

Very often a production in response to the advertisement in the press or otherwise by the buyers or consumers is required to submit a tender or quote the price of the product. Care should be taken to fill the tenders because the receipt of orders depends upon the acceptance of tenders supplied by the manufactures. Acceptance of

tenders depend upon the price quoted. The minimum price quotations are always acceptable, so the manufacturers should quote minimum acceptable price by adding a part of desired profit in the selling price quoted.

The preparation of tenders require information regarding prime cost, administration and selling overheads and the desired profit. Cost of production i.e. the sum of prime cost, factory overheads, administration overheads became a major important part in the process of filling the quotations. The past records are projected taking into consideration the normal working conditions.

Cost Sheet:

It is a statement which provides a detailed information regarding the cost incurred on the production of the commodity. The total cost is separated into different elements of cost such as raw material, labour, factory, administration, selling and distribution. The cost sheet can be drawn with as much details regarding costs as may be necessary. It is often considered good to prepare cost sheet with cost data of the previous periods.

In the cost sheet a separate column is prepared to show the cost per unit of the product. A specimen format of cost sheet is given below.

Cost Sheet:

Total units produced

Particulars	Current period		Previous period	
	Total (₹)	Per unit (₹)	Total (₹)	Per unit (₹)
Raw material				
Opening stock				
Add purchases				
Total				
Less closing stock				
Raw material Consumed				
Direct labour	..	...		
				
	...	...		
Prime Cost :				
Factory overheads:	...	...		
Add: opening work in progress (WIP)				
	...	...		
Less: closing WIP				
	...			...
				
	...			...
Works Cost				
	...		...	

Administration overheads	..... ...	..... ...	..... ...	..... ...
Cost of Production of goods manufactured:	..... ...	..... ...	..... ...	..... ...
Add opening finished Stock	..... ...	..... ...	..... ...	..... ...
Less: closing finished stock	..... ...	..... ...	..... ...	..... ...
Cost of production of goods sold	..... ...	..... ...	..... ...	..... ...
Selling and distribution overheads	..... ...	..... ...	..... ...	..... ...
Cost of Sales	..... ...	..... ...	..... ...	..... ...

Production account:

When cost sheet is presented in the traditional ledger form, it is known as production account. Production account is generally divided into four parts. In the first part, raw material cost is added to the direct labour cost on the debit side to calculate prime cost. In the second part cost of goods manufactured is found out by adding works overheads. In the third part of the account gross profit is found out by debiting the sales, the cost of goods manufactured and in the fourth part administration, selling and distribution overheads are debited to find out the net profit. Following is the specimen of the production account.

Production account

Dr.		Cr.	
Particulars	Amount (₹)	Particulars	Amount (₹)
To Direct material		By Prime cost c/d	.....
“ Direct Labour			
“ Direct expenses			
Total		Total	.....
To Prime Cost b/d		By Cost of goods	
“ Works overheads		Manufactured	.....
“ admn. Overheads			
“ WIP (opening)			

“ less WIP (Closing)			
“ less sale of scrap .....	.....		.....
Total	.....	Total	.....
To Cost of goods			
Manufactured b/d	.....	By Sales	.....
“ opening stock of		By Closing stock of	
Finished goods	.....	Finished goods	.....
“ Gross profit c/d	.....		.....
Total	.....	Total	.....
		By Gross profit b/d	.....
To S & D overheads	.....		
To Net profit	.....		
Total	.....	Total	.....

Illustration 01:

A manufacturer manufactures 1000 units. The data relating to the various types of cost incurred by the manufacturer is given below.

Raw material purchased during period:	₹ 1,50,000
Closing stock of raw material at the end:	₹ 5,000
Direct labour cost:	₹ 60,000
Factory overhead cost:	₹ 35,000
Administration overheads:	₹ 30,200
Selling cost:	₹ 7,800

The manufacturer wants to earn $16\frac{2}{3}$ % profit on the sales.

Prepare a cost sheet and evaluate the selling price per unit of the product.

Solution:

Statement of cost of goods manufactured

	₹	₹
Opening stock of raw material =	0	
Raw material purchased =	1,50,000	
Less closing stock =	(5,000)	
Raw material consumed =		1,45,000

Add :

Direct labour	=	60,000
Prime Cost	=	<u>2,05,000</u>
Add :		
Factory overhead cost	=	<u>35,000</u>
Works cost	=	2,40,000
Add :		
Administration expenses	=	<u>30,200</u>
Cost of production	=	<u>2,70,200</u>
Add :		
Selling cost	=	<u>7,800</u>
Cost of sales	=	<u>2,78,000</u>
Profit:		
$16\frac{2}{3}$ % on sales or $\frac{1}{6}$ th on sales		
or $\frac{1}{5}$ th on cost of sales		
$(2,78,000 \times \frac{1}{5}) = 55,600$		<u>55,600</u>
Sales	=	<u>3,33,600</u>
Selling price per unit	= $\frac{\text{Sales}}{\text{Units sold}}$	
	= $\frac{3,33,600}{1000}$	
	= ₹ 333.60	

Illustration 02:

Following are the particulars for the production of 800 units of a product ' X ' .

Opening stock of raw material: ₹ 10,000 , purchase of raw material = ₹ 88,000 , closing stock of raw material = ₹ 8,000

Direct wages paid = ₹ 40,000

Factory overheads = 1.5 times the labour cost.

Administration overheads = 0.8 times the labour cost.

Selling and distribution overheads = ₹ 8,000

You are required to submit a statement showing the price at which product should be sold so as to earn a profit of $16\frac{2}{3}$ % on selling price.

Solution:

Statement of cost and profit for the manufacture of 800 units of 'X'

		Total cost (₹)	Cost per unit (₹)
	(₹)		
Opening stock of raw material	10,000		
Purchases during the period	88,000		
	98,000		
Less closing stock of raw material	8,000	90,000	112.50
Direct wages		40,000	50.00
Prime cost		1,30,000	162.50
Factory overheads (1.5 × 40,000) 1.		60,000	75.00
Works Cost		1,90,000	237.50
Administration overheads (0.8 × 40,000) 2.		32,000	40.00
Cost of production		2,22,000	277.50
Selling and distribution overheads		8,000	10.00
Cost of goods sold		2,30,000	287.50
Profit = $16\frac{2}{3}$ % on selling price. (i.e. $\frac{1}{6}$ of selling price or $\frac{1}{5}$ of cost price) 3.		46,000	57.50
Total Sales		2,76,000	345.00

(1) Factory overheads = 1.5 times the direct labour = $1.5 \times 40000 = ₹ 60,000$

(2) Administration overheads = 0.80 times the direct labour
 $= 0.8 \times 40000 = ₹ 32,000$

(3) Profit = $16\frac{2}{3}$ % on selling price. = $\frac{1}{6}$ of selling price or $\frac{1}{5}$ of cost price
 $= \frac{1}{5} \times 2,30,000 = ₹ 46,000$

Illustration 03:

From the particulars given under for the production of 2000 units of a product and other information prepare a cost statement showing profit if 20 % of profit on sales is desired.

Opening stock of raw material : ₹ 28,500

Purchase of raw material : ₹ 12,500

Closing stock of raw material : ₹ 13,500

Expenses incurred on labour : ₹ 35,000 , Factory overheads : ₹ 43,750

Administration overheads : ₹ 31,250 , selling and distribution expenses : ₹ 25,000

Also quote a price for 1000 units if it is expected

(a) The wage rate to increase @ 20 % (b) Factory overheads to be absorbed at the same rate as direct labour (c) Other cost remaining the same. Selling and distribution cost to be recovered at the same rate.

Solution:

Statement of cost and profit (2000 units)

	₹	Total (₹)	Cost per unit (₹)
Opening stock of raw material	28,500		
Purchase of raw material	1,25,000		
Total stock	1,53,500		
Less closing stock	13,500		
Raw material consumed	1,40,000	1,40,000	70
Direct labour		35,000	17.50
Prime cost		1,75,000	87.50
Factory overheads		43,750	21.875
Works cost		2,18,750	109.375
Administration overheads		31,250	15.625
Cost of production		2,50,000	125.000
Selling and distribution overheads		25,000	12.50
Cost of goods sold		2,75,000	137.50
Profit @ 20 % on sales = $\frac{1}{5}$ th of sales = $\frac{1}{4}$ th of Cost		68,750	34.375
Sales		3,43,750	171.875

Statement of cost for quoting for 1000 units

	Total (₹)	Cost per unit (₹)
Raw material	70,000	70
Direct labour (1)	21,000	21
Factory overheads (2)	26,250	26.250
Administration overheads	15,625	15.625
Selling and distribution overheads	12,500	12.500
Total Cost	1,45,375	145.375
Profit = $\frac{1}{4}$ th of Cost	36,344	36.344
	1,81,719	181.719

(1) Direct labour = $17.5 \times 1.2 = ₹ 21.00$ per unit

(2) Factory overheads = $\frac{43750}{35000} \times 21000 = ₹ 26,250$

Illustration 04:

The following particulars are extracted from the books of a company relating to commodity 'A' for the half year ending 30th June, 1993.

	₹
Purchase of raw material	1,32,000
Direct wages	1,10,000
Rent rates, insurance and works cost	44,000
Carriage inward	1,584
Stock on 01.01.1993	
Raw material	22,000
Finished product (1600 Tonnes)	17,600
Stock on 30.06.1993	
Raw material	24,464
Finished products (3200 Tonnes)	35,200
Work in progress on 01.01.1993	5,280
Work in progress on 30.06.1993	17,600
Factory supervision	8,800
Sales : Finished products	3,30,000

Advertising discounts allowed and selling cost @ ₹ 0.75 per tonne sold. 25,600 tonnes of commodity was sold during the period.

You are required to ascertain

- (i) Prime cost (ii) Factory cost (iii) Cost of sales
(iv) Profit (v) No. of tonnes of commodity sold.

Solution:

Cost sheet of commodity 'A' for the period ending 30.06.1993

Raw material	₹	₹
Opening stock	22,000	
Add; Purchases	1,32,000	
	1,54,000	
Less: Closing stock	24,464	
	1,29,536	
Add: Carriage inward	1,584	
Cost of material consumed		1,31,120
Direct wages		1,10,000
Prime Cost		2,41,120
Rent rates and insurance & works cost	44,000	
Cost of factory supervision	8,800	52,800
Add: opening work in progress		5,280
		2,99,200
Less: closing work in progress		17,600
Factory Cost		2,81,600
Add: opening stock of finished goods		17,600
(1600 tonnes)		2,99,200
Less: Closing stock of finished goods		35,200
(3200 tonnes)		2,64,000
Add: Advertisement and selling cost		19,200
@ ₹ 0.75 per tonne of 25,600 tonnes sold		
Cost of goods sold		2,83,200
Profit		46,800
Sales		
		3,30,000

(i) Prime Cost = ₹ 2,41,200

(ii) Factory Cost = ₹ 2,81,600

(iii) Cost of sales = ₹ 2,83,200

(iv) Profit = ₹ 46,800

(v) No. of tonnes of the commodity sold = 25,600

Illustration 5:

A company currently is producing 2000 units of a product 'S' and is expecting to increase its sales by 50 % as there is available capacity. The data relating to current production and expectations in future are given as under.

Current:	₹
Raw material consumed	1,50,000
Direct labour cost	90,000
Factory overheads	63,000
Administration expenses	37,000
S & Distribution expenses	10,000

Profit @ 20 % on sales

All products 2,000 units produced, are sold,

Expectations in the future: 10 % expenses in labour cost and raw material is expected to increase. Factory cost will increase in line with labour cost. Administration expenses and S & distribution expenses are expected to increase by ₹ 550 and ₹ 500 respectively.

Prepare the cost and profit statement in both the situations.

Solution:

Cost and Profit statement for the product 'S' of the company

	Current (2000 units) ₹	Future (3000 units) ₹
Raw material (1,50,000 × 1.5 × 1.1)	1,50,000	2,47,000
Direct labour (90,000 × 1.5 × 1.1)	90,000	1,48,000
Prime Cost:	2,40,000	3,96,000
Factory overheads	63,000	1,03,950
Factory Cost:	3,03,000	4,99,950
Administrative expenses	37,000	37,550
Cost of production:	3,40,000	5,37,500

Selling and distribution expenses	10,000	10,500
Cost of goods sold:	3,50,000	5,48,000
Profit 20 % on sales = $\frac{1}{5}$ th of sales		
= $\frac{1}{4}$ th of cost	87,500	1,37,000
Sales:	4,37,500	6,85,000
Selling price per unit = $\frac{437500}{2000}$	218.75	
And $\frac{685000}{3000}$		228.33
Percent Increase in profit per unit = $\frac{228.33 - 218.75}{218.75} \times 100$		Or
= $\frac{9.58}{218.75} \times 100$		= $\frac{137000 - (87500 \times 1.5)}{87500 \times 1.5} \times 100$
= 4.38 %		= $\frac{5750}{131250} \times 100 = 4.38 \%$

Illustration 6:

A manufacturer is producing 1000 units of a product. Though capacity is present, but sale in the market is the main constraint.

The manufacturer gives you the information of his production records and earn a profit of $16\frac{2}{3}\%$ on the total sales.

Opening stock of the raw material	35,000
Purchase of raw material	2,35,000
Closing stock of the raw material	40,000
Direct wages given to the manufacturing labour	54,000
Factory overheads (50% Fixed)	29,500
Administrative overheads (Fixed)	10,500
Selling and distribution expenses	
(50 % Fixed)	6,000
Sales	39,600

In the meantime an order for the supply of 100 units of finished product has been received. Prepare the original cost statement showing the profit and advise the manufacturer, the minimum price that can be quoted if same percentage of profit is desired.

Solution:

Cost and Profit statement for 1000 units

	Total (1000 unit)	Cost per unit
	₹	₹
Opening stock of raw material	35,000	
Add Purchases during the year	2,35,000	
Total:	2,70,000	
Less Closing stock	40,000	
Raw material consumed	2,30,000	230.00
Direct labour	54,000	54.00
Prime Cost:	2,84,000	284.00
Factory overheads	29,500	29.50
Works Cost:	3,13,500	313.50
Administration overheads	10,500	10.50
	3,24,000	324.00
Selling and distribution expenses	6,000	6.00
Cost of sales:	3,30,000	330.00
Profit = $\frac{1}{6}$ of sales		
= $\frac{1}{5}$ of costs	66,000	66.00
Sales:	3,96,000	396.00

Price to be quoted per unit:

₹

Prime cost per unit = 284.00

Factory cost (Variable portion) = 14.75

Total variable cost per unit = 298.75

Add profit @ 20 % on cost = 59.75

Selling price = ₹ 358.50

Fixed costs have been ignored as the capacity to produce is present and on quoting the extra order at minimum price the company will earn total profit = $59.75 \times 100 = ₹ 5975.00$

Illustration 7:

A factory's normal capacity is 1,26,000 units per annum. The estimated costs of production are as under:

Direct material: ₹ 3 per unit

Direct labour: ₹ 2 per unit (subject to minimum ₹ 49,100 p.m.)

Overhead fixed: ₹ 1,50,000 per annum.

Variable overhead: ₹ 2 per unit.

Semi variable: ₹ 75,000 p.a. up to 50 % capacity and an addition ₹ 15,000 for every 20 % increase in capacity or part thereof.

Each unit of raw material yield scrap, (10%) which is sold @ ₹ 1.00 per unit. In a year the factory worked at 50 % capacity for the first four month but it was expected that it would work @ 80 % capacity for the remaining part of the year.

During the four months, the selling price per unit was ₹ 13. What should be the price in the remaining part of the year to earn a total profit of ₹ 2,99,360 ?

Solution:

Cost sheet of the factory

	For the first 4 months of the year (₹) 21,000 units		For the rest of part of the year (₹) 67,200 units	
	Per unit	Total	per unit	Total
Raw material 63,000 – 2100 2,01,600 – 6720	2.90	60,900	2.90	1,94,880
Direct labour @ 2.00	2.34	49,100	2.00	1,34,400
Prime Cost:	5.24	1,10,000	4.90	3,29,280
Overheads:				
Fixed: 1,50,000 (1:2)		50,000		1,00,000
Variable: @ ₹ 2		42,000		1,34,400
Semi variable		25,000*		68,000**
Cost of production:	10.81	2,27,000	9.40	6,33,680
Profit:	2.19	46,000	3.77	2,53,360
	13.00	2,73,000	13.17	8,85,040

To earn a target profit of ₹ 2,99,360, the unit should be sold @ 13.17

i.e $[(299360 - 46000) + 633680] \div (67200) = ₹ 13.17$ [for solution of * & ** see note at end of Chapter]

Illustration 8:

A company functioning at 50 % of normal productive capacity produced 10,000 units of product 'P' in the first half of the year.

Units produced during the period: 10,000

Selling and distribution overheads 8,000 per annum and ₹ 1.00 per unit variable. 20 % of profit is earned on sales.

The supplier of the raw material has been agreed to supply material @ ₹ 4.00 if purchase is more than 10,000 units. During the second half of the year the company is expected to function at 80% the normal capacity, if every expectation go as desired then

- (ii) Prepare the cost statement for the second half of the year and the profit portion if the company desire to earn 25 % profit on sales and also find out the selling price per unit.

Cost statement of the company in respect of Product 'P'

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Works Cost:	14.05	1,40,500	12.05	1,92,800
Administrative overheads: (25,500 + 20,000)	4.55	45,500	3.60	57,500
Cost of production:	18.60	1,86,000	15.65	2,50,300
Selling and distribution overheads:	1.40	14,000	1.25	20,000
Cost of goods sold:	20.00	2,00,000	16.90	2,70,300
Profit: 20 % on sales or 25 % on cost. 2 nd half 25 % on sales or $33\frac{1}{3}\%$ on cost	5.00	50,000	5.63	90,100
Sales:	25.00	2,50,000	22.53 (Approx)	3,60,400

To earn 25 % profit on sales, the company should sell the unit @ ₹ 22.53, because the company earns economies in increased production.

Illustration 9:

A company is producing at 80 % of the normal capacity 50,000 units of a commodity in the current year and is planning to increase the capacity to 100 %.

The data relating to the current production and the future expectations is given as under.

Current year

Raw material purchased 50,000 units @ ₹ 3.00 per unit.

Direct labour cost @ ₹ 1.80 per unit. Factory overheads (1) Fixed: ₹ 20,000

Semi fixed ₹ 50,000 (fixed portion ₹ 10,000, variable ₹ 0.80 per unit), variable ₹ 1.00 per unit.

Administrative overheads: ₹ 1.60 per unit. Selling and distribution expenses Fixed: ₹ 20,000 ,

Variable ₹ 0.50 per unit.

Profit earned: $16\frac{2}{3}\%$ of sales.

Expected in coming year

Working at full capacity

Raw material: ₹ 2.80 (Supplier agreed to send raw material at decreased

Rate if purchased more than 50,000 units). All the other costs remains at the same rate

but the company decide to fix price in such a way to earn profit @ 20 % on sales.

You are required to prepare in both years Cost statements showing profit portion

and also fix the selling price.

Solution:

Cost Sheet of the company

units)*	For the current year(80 % capacity)(50,000 units)		For the coming year (100 % capacity)(62,500	
	Per unit (₹)	Total (₹)	per unit (₹)	Total (₹)
Raw material:	3.00	1,50,000	2.80	1,75,000
Direct labour:	1.80	90,000	1.80	1,12,500
Prime cost:	4.80	2,40,000	4.60	2,87,500
Factory overheads				
Fixed:		20,000		20,000
Semi fixed: (Fixed:10000+variable @ 0.8)		50,000		60,000
Variable: @ ₹ 1.00		50,000		62,500
Works cost:	7.20	3,60,000	6.88	4,30,000
Administrative overheads @ ₹ 1.60		80,000		1,00,000
Cost of production:	8.80	4,40,000	8.48	5,30,000
Selling and distribution expenses: (Fixed: ₹ 20,000 variable: ₹ 0.50)		45,000		51,250
Cost of goods sold:	9.70	4,85,000	9.30	5,81,250
Profit: (Current $16\frac{2}{3}$ % of sales $\frac{1}{6}$ of sales or $\frac{1}{5}$ of cost) (Expected 20 % of sales $\frac{1}{5}$ of sales or $\frac{1}{4}$ of cost)		97,000		1,45,312.50
Sales:	11.64	5,82,000	11.63 (Approx.)	7,26,562.50

The company has raised profit portion from $16\frac{2}{3}$ % of sales to 20 % of sales. But due to increase in capacity and earning a discount on raw material, the company is able to maintain the price of the product in the market and even at lesser rate.

$$\text{*Units of production at 100 \% capacity} = \frac{50000}{80\%} \times 100\% = 62,500 \text{ units}$$

Treatment of scrap:

In the process of manufacturing it may happen sometime a certain portion of the material come out as a waste, we can cite here an example of a factory producing nuts and bolts. In the process of producing nuts and bolts, a certain portion of the metal will go waste. It is sometime become necessary to arrive at the desired utility to the satisfaction of the consumers and to arrive at desired quality of the product. The waste product is of a very small in quantity as well as in value. The waste sometimes is saleable in the market. As for as accounting purpose is concerned the value of scrap can be treated as

1. Material scrap: The scrap that arises at the initial stage of production, the value will be deducted from the cost of material. The raw material cost = Raw material cost required – the value of scrap.
2. Factory scrap: If the scrap arises at the second stage. It should be adjusted against factory cost.

Illustration 10:

From the information given below prepare

(a) Cost sheet for the period showing profit.

(b) Profit and loss account.

The company produced 10,000 units of a product 'X'

Raw material introduced: ₹ 1,56,000 Closing stock: ₹ 11,000

Overheads: ₹ 53,000 Factory overheads: ₹ 31,800 Administrative overheads: ₹ 30,500

Selling and distribution overheads: ₹ 15,000

During the manufacturing a scrap which arises normally was sold for ₹ 300. The company earns profit @ $16\frac{2}{3}$ % on sales.

Solution:

Cost sheet for the period showing profit

	₹	Total (₹)	Per unit (₹)
Raw material introduced:	1,56,000		
Less raw material in stock:	11,000		
Raw material consumed:	1,45,000		
Less sale proceeds of scrap:	300	1,44,700	14.47
Direct labour:		53,000	5.30
Prime Cost:		1,97,700	19.77

Factory overheads:	31,800	3.18
Work Cost:	2,29,500	22.95
Administration overheads:	30,500	3.05
Cost of production:	2,60,000	26.00
Selling and distribution overheads:	15,000	1.50
Cost of goods sold:	2,75,000	27.50
Profit $\frac{1}{6}$ on sales = $\frac{1}{5}$ on cost	55,000	5.50
Sales:	3,30,000	33.00

Profit and loss account for the period ending

Dr.			Cr.		
Particulars	Total (₹)	Per unit (₹)	Particulars	Total (₹)	Per unit (₹)
To Purchases	1,56,000	15.60	By Cash (sale		
“ Direct labour	53,000	5.30	Proceeds of scrap)	300	0.03
“ Factory overheads	31,000	3.18	By Sales	3,30,000	33.00
“ Administrative					
Overheads	30,500	3.05			
“ Selling & distribution					
Overheads	15,000	1.50			
“ Net profit	55,000	5.50	By Closing Stock	11,000	1.10
Total	3,41,300	34.13	Total	3,41,300	34.13

Illustration 11.

Following figures are collected from the books of the Iron foundry after the close of the year:

₹

Opening stock in the beginning of the year: 7,000

Purchases during the year: 50,000

Direct wages: 10,000

Works overheads 50 % of direct wages and stores overheads @ 10 % on the cost of material.

Closing stock at the end of the year : ₹ 5,000

10 % of the castings were rejected being not up to the specification and a sum of

₹ 400 was realised on sale as scrap. 10 % of the finished casting were found to be defective in manufacture and were rectified by expenditure of additional works overhead charges to the extent of 20 % on proportionate direct wages. The total gross output of casting during the year was 1000 tons. Find out the manufacturing cost of the saleable casting per ton. (B.Com. Punjab)

Solution:

Cost Sheet			
₹	Total (₹)	Per ton (₹)	Quantity (Ton)
Opening stock of raw material: 7,000			
Add purchases during the year: 50,000			
<u>57,000</u>			
Less closing stock: <u>5,000</u>			
Raw material consumed:	52,000		
Direct wages:	10,000		
Works overheads (50 % of direct wages)	5,000		
Stores overheads (10 % of material)	5,200		
Total:	72,200		1,000
Less sale proceeds of rejected castings	400		100
Cost of casting manufactured:	71,800	79.78	900
Additional cost of rectifying			
10 % of finished i.e. (1000 – 100), 900 = 90			
20 % of ₹ 10 = ₹ 2 per rejected = 90 × 2	180	0.20	
Manufacturing cost of saleable casting	71,980	79.98	900

$$\text{Manufacturing cost per casting} = \frac{71980}{900} = ₹ 79.98$$

Illustration 12:

The following data relates to production of a commodity 'A' of a company for the year ending March, 1993.

Raw material purchased 10,000 units @ ₹ 5 per unit. Direct labour cost incurred ₹ 24,500 Factory overheads ₹ 15,900. 500 units on which factory overheads were allocated were destroyed and were having saleable value in the market at ₹ 4.80 per unit. Administrative overheads incurred were ₹ 10,000 and selling and distribution overheads ₹ 2,000. The company earned a profit @ $16\frac{2}{3}\%$ on sales. You are required to prepare cost statement of the company and find the selling price per unit of the commodity.

Solution:

Cost statement of the company for the year ending March, 1993

	Total (₹)	units
Raw material 10000 units @ ₹ 5	50,000	10,000
Direct labour:	24,500	
Prime Cost:	74,500	10,000
Factory overheads 15,900		
Less saleable proceeds of		
Destroyed units: 2,400	13,500	500
Works Cost:	88,000	9,500
Administrative overheads	10,000	
Cost of production:	98,000	9,500
Selling and distribution overheads	2,000	-----
Cost of sales:	1,00,000	9,500
Profit: $16\frac{2}{3}$ % on sales or 20 % on cost		
$\frac{1}{5}$ of cost :	20,000	-----
Sales:	1,20,000	9,500

Profit earned $16\frac{2}{3}$ % on sales = $120000 \times \frac{50}{3} \times \frac{1}{100} = 20000$. Selling price per unit = $\frac{120000}{9500} = ₹ 12.63$ (Approx.)

Illustration 13: From the following particulars prepare a production account showing the details of cost and their break up and also calculate gross profit and net profit.

	Opening (₹)	Closing (₹)
Stock of raw material	30,000	25,000
Stock of Work in progress	15,000	12000
Stock of finished goods	30,000	35,000
	₹	₹
Raw material purchased	75,000	Salesmen salary & commission 4,500
Direct wages	45,000	Office rent, rates etc. 3,000
Indirect wages	2,500	Sundry office expenses 3,500
Factory expenses	20,000	Advertisement 3,500
Depreciation of plant & machinery	4,500	Carriage outwards 4,500
Sales	2,25,000	

Solution:

Dr.		Production Account		Cr.	
Particulars		Amount		Particulars	Amount
		(₹)			(₹)
To	Raw material consumed				
	Opening stock	30,000			
	Purchase	75,000			
		1,05,000			
	Less closing stock	25,000			
		80,000		By Prime Cost c/d	1,25,000
To	Direct wages	45,000			
		1,25,000			1,25,000
To	Prime Cost b/d	1,25,000			
"	Indirect wages	2,500			
"	Factory expenses	20,000			
"	Depreciation of P&M	4,500			
"	Work in progress				
	Opening	15,000		By Cost of goods	
	Less closing	12,000	3,000	manufactured c/d	1,55,000
	Total	1,55,000		Total	1,55,000
To	cost of goods manufactured b/d	1,55,000		By Sales	2,25,000
"	opening stock of finished goods	30,000		" closing stock of finished	
"	Gross profit c/d	75,000		goods	35,000
	Total	2,60,000		Total	2,60,000

To	Office expenses		By Gross profit b/d	75,000
	Office rent, rates	3,000		
	Sundry office Exp.	3,500		
		6,500		
“	selling expenses			
	Salesmen salary & Comm.	4,500		
	Advertisement	3,500		
	Carriage outward	1,500		
		9,500		
	Net Profit	59,000		
	Total	75,000	Total	75,000

Illustration 14:

Avon toys Co. are manufacturers of two types of toys 'x' and 'y'. The manufacturing cost for the year ended 31st December, 2010 were:

Direct material: ₹ 2,00,000 Direct wages: ₹ 1,12,000 and Production overheads: ₹ 24,000

There was no work in progress at the beginning or at the end of the year. It is ascertained that

(i) Direct material of type toy 'x' cost twice as much as direct material of the type 'y'. (ii) Direct wages for type 'y' were 60 % of those for type 'x'. (iii) Production overhead was 30 paise, the same per toy of 'x' and 'y' type. (iv) Administration overhead for each grade was 100 % of direct labour. (v) Selling cost was 25 paise per toy. (vi) Production during the year was: type 'x' 20,000 toys of which 18,000 were sold. Type 'y' 60,000 toys of which 50,000 were sold. (vii) Selling price were ₹ 12 per toy for type 'x' and ₹ 6.20 for each toy for type 'y'.
Prepare a statement showing the cost per toy for each type of toy and the profit made on each type of toy.

(B. Com. Punjab)

Solution: Statement showing the cost per toy of Avon toy company for the year ending 31st Dec. 2010.

Particular	Type of toy			
	X (20,000 units)		y (60,000 units)	
	Total (₹)	Cost per toy (₹)	Total (₹)	Cost per toy (₹)
Direct material:	80,000		1,20,000	
Direct wages:	40,000		72,000	
Prime Cost:	1,20,000	6.00	1,92,000	3.20
Production overheads:	6,000	0.30	18,000	0.30
Works Cost:	1,26,000	6.30	2,10,000	3.50
Administration overheads:	40,000	2.00	72,000	1.20
Cost of production:	1,66,000	8.30	2,82,000	4.70
Less closing stock [x= 2,000 units,				

	Y= 10,000 units	16,600		47,000	
Cost of goods sold		1,49,400	8.30	2,35,000	4.70
Selling cost		4,500	0.25	12,500	0.25
Cost of sales		1,53,900	8.55	2,47,500	4.95
Profit:		62,100	3.45	62,500	1.25
Sales:		2,16,000	12.00	3,10,000	6.20

Note: (i) Allocation of material:

Let material consumed per unit of y = a

So material consumed per unit of x = 2a

$$20000 \times 2a + 60000 \times a = 200000$$

$$100000 a = 200000$$

$$a = 2$$

$$\text{So material consumed for x} = 20000 \times 2a = 20000 \times 2 \times 2$$

$$= ₹ 80,000$$

and for y = 60000 a

$$= 60000 \times 2$$

$$= ₹ 1,20,000$$

(ii) Allocation of Direct wages:

Let the direct wages per unit for x = m

So for y = 0.6 m

$$\text{So } 20000 m + 60000 \times 0.6 m = 112000$$

$$20000 m + 36000 m = 112000$$

$$56000 m = 112000$$

$$m = 2$$

$$\text{Direct wages for x} = 20000 m = 20000 \times 2$$

$$= ₹ 40,000$$

$$\text{and for y} = 60000 \times 0.6 m = 60000 \times 0.6 \times 2$$

$$= ₹ 72,000$$

(iii) Administration overheads:

For x = 100 % of direct wages = ₹ 40,000
 and for y = 100 % of direct wages = ₹ 72,000

Illustration 15:

AB & Co. manufactures two types of pen P and Q. The cost data for the year ended 30th September, 1990 is as follows:

	₹
Direct material	4,00,000
Direct wages	2,24,000
Production overheads	96,000
	7,20,000

It is further ascertained that:

- (a) Direct material in type P costs twice as much as direct material in type Q.
- (b) Direct wages for type Q were 60 % of those for type P.
- (c) Production overhead was the same rate for both types.
- (d) Administration overhead for each was 200 % of direct labour.
- (e) Selling costs were 50 paise per pen for both types.
- (f) Production during the year

Type P 40,000

Type Q 1,20,000

- (g) Sales during the year:

Type P 36,000

Type Q 1,00,000

- (h) Selling prices were ₹ 14 per pen for type P and ₹ 10 per pen for type Q.

Prepare a statement showing per unit cost of production. Total cost, Profit and also Total sales value and Profit separately for two types of pens P and Q. [ICWA Inter]

Solution:

Statement of cost and profit

Particulars	Product			
	P (40000 units)		Q (120000 units)	
	Total (₹)	Per unit (₹)	Total (₹)	Per unit (₹)
Direct material:	1,60,000		2,40,000	
Direct wages:	80,000		1,44,000	
Prime cost:	2,40,000	6.00	3,84,000	3.20
Production overheads:	24,000	0.60	72,000	0.60
Works cost:	2,64,000	6.60	4,56,000	3.80
Administration cost:	1,60,000	4.00	2,88,000	2.40
Cost of production:	4,24,000	10.60	7,44,000	6.20
Less closing stock: P=4000 units	42,400	.....		
Q = 20000 units			1,24,000	.....
Cost of goods sold:	3,81,600	10.60	6,20,000	6.20
Selling cost:	18,000	0.50	50,000	0.50
Cost of sales:	3,99,600	11.10	6,70,000	6.70
Profit:	1,04,400	2.90	3,30,000	3.30
Sales:	5,04,000	14.00	10,00,000	10.00

Working Notes:

(a) Let direct material per unit for Q = x

For P = 2x

$$40000 \times 2x + 120000 \times x = 400000$$

$$200000 x = 400000$$

$$X = 2.$$

So direct material for P = $40000 \times 2 \times 2$

$$= ₹ 1,60,000$$

For Q = $1,20,000 \times 2$

$$= ₹ 2,40,000$$

(b) Let direct wages per unit for P = x

For Q = 0.6 x

$$40000x + 120000 \times 0.6x = 224000$$

$$112000x = 224000$$

$$X = 2$$

Direct wages for P = $40000 \times 2 = ₹ 80,000$

For Q = $120000 \times 0.6 \times 2 = ₹ 1,44,000$

(c) Let production overheads for both P and Q = x

$$40000x + 120000x = 96000$$

$$160000x = 96000$$

$$X = 0.6$$

for P = $40000 \times 0.6 = ₹ 24,000$

For Q = $120000 \times 0.6 = ₹ 72,000$

Numerical Problems

Q 1 From the data given below prepare a cost statement showing the profit portion

	₹		₹
Raw material purchased :	55,000	Closing stock of raw material :	3,000
Direct expenses :	4,000	Direct labour :	10,000
Factory overheads :	5,000	Administration overheads :	4,500
Selling and distribution overheads : ₹ 1,500			

Profit : $12\frac{1}{2}\%$ on sales

Ans:-	Prime cost = ₹ 66,000	Works cost = ₹ 71,000
	Cost of goods sold = ₹ 75,500	Cost of sales = ₹ 77,000
	Profit = ₹ 11,000	Sales = ₹ 88,000

Q 2 For the manufacture of a final product having a desired utility for the consumers of company purchased the raw material for ₹ 40,000 and incurred the following expenses to send the end product to the consumers.

	₹
Direct expenses :	4,000
Direct Labour :	9,000
Factory Overheads :	7,000
Administration overheads :	7,000

Selling and distribution expenses : 3,000

You are required to prepare a statement showing cost elementwise and the portion of profit if $16\frac{2}{3}\%$ profit is earned on sales.

Ans:-	Prime cost = ₹ 53,000	Works cost = ₹ 60,000
	Cost of production = ₹ 67,000	Cost of sales = ₹ 70,000
	Profit = ₹ 14,000	Sales = ₹ 84,000

Q3. The following is the data of a company producing 1,000 units of a commodity. Prepare a cost sheet showing the profit and selling price per unit.

	₹		₹
Opening stock of raw material :	3,000	Purchases (raw material) :	30,000
Closing stock of raw material :	4,000	Direct Labour :	6,500
Direct Expenses :	2,500	Factory overheads :	6,500
Administrative overheads :	4,500	Selling expenses :	2,000

The company earned a profit @ 25 % on the sales.

Ans :

Cost per unit = ₹ 51
Profit per unit = ₹ 17
Selling Price = ₹ 68

Q4 :

	₹
Opening Stock of raw material :	8,000
Purchase of raw material :	35,000
Closing Stock of raw material :	3,000
Direct wages :	7,000
Direct expenses :	4,300
Manufacturing overheads :	6,400
Administrative and Office overheads :	4,500
Selling and distribution expenses :	2,800

From the above data relating to the production of 1,000 units of the end product, prepare a cost sheet showing profit and selling price per unit of the product, if mark up of profit is @ 20 % on cost of sales.

Ans.
$$\left[\begin{array}{l} \text{Cost per unit} = ₹ 65 \\ \text{Profit per unit} = ₹ 13 \\ \text{Selling Price} = ₹ 78 \end{array} \right]$$

Q 5. Following inventory data relates to XYZ Ltd :

		Inventories	
		Beginning	Ending
Finished goods	₹	1,10,000	95,000
Work in progress	₹	70,000	80,000
Raw materials	₹	90,000	95,000

Additional information:

Cost of goods available for sale = ₹ 6,84,000

Factory overheads = ₹ 1,67,000

Total goods processed during the period = ₹ 6,54,000

Direct material used = ₹ 1,93,000

Requirements :

(I) Determine raw material purchases.

(ii) Determine the direct labour cost incurred.

(iii) Determine the cost of goods sold.

[B. Com. (Hons.) Delhi]

Ans : [(I) ₹ 1,98,000 (ii) ₹ 2,24,000 (iii) ₹ 5,89,000]

Hint : (i) Let x be the purchases.

$$\text{Then } 90000 + x - 95000 = 193000$$

$$\Rightarrow x = 193000 + 95000 - 90000$$

$$x = ₹ 1,98,000$$

(ii) Let y be the Labour cost.

$$\text{Then } 193000 + L + 167000 + 70000 = 654000$$

$$\Rightarrow L = 654000 - 193000 - 167000 - 70000$$

$$= ₹ 2,24,000$$

(iii) Let z be the cost of goods sold.

$$\text{Then } z = 654000 - 80000 + 110000 - 95000$$

$$z = ₹ 5,89,000$$

Q 6. From the information given below, prepare a cost sheet and estimate selling price if the company earns 20 % on sales.

Opening stock of raw material : ₹ 4,500

Closing stock of raw material : ₹ 8,500

Raw material purchased during the year : ₹ 49,000

Direct expenses : ₹ 3,300

Direct labour cost : ₹ 12,000

Factory overheads : ₹ 13,950

Administrative overheads : ₹ 15,750

Selling and distribution expenses : ₹ 2,700

Units prepared during the production period : 450

Ans. $\left[\begin{array}{ll} \text{Cost of sales : ₹ 92,700} & \text{Cost of sales per unit : ₹ 206} \\ \text{Profit : ₹ 23,175} & \text{Profit per unit : ₹ 51.5} \\ \text{Sales : ₹ 1,15,875} & \text{Selling price : ₹ 257.5} \end{array} \right]$

Q 7. A company is producing 1,000 units of a product. The company is having an extra capacity and willing to quote for 200 units of the product.

From the information given below prepare a cost sheet for the current production and advice a price to be quoted for the new offer.

Opening stock of raw material : ₹ 5,000

Direct Labour : ₹ 12,000

Closing stock of raw material : ₹ 6,000

Factory overheads : ₹ 11,750

Purchases during the period : ₹ 54,000

Administrative overheads : ₹ 7,250

(Raw material)

Selling and distribution overheads : ₹ 3,000

Profit rate : $16\frac{2}{3}\%$ of sales

Though capacity is there but the labour cost has to be engaged at increased rate of 10 % and factory overheads to increase at the same rate as labour, other costs do not change with the increase in production.

Ans. $\left[\begin{array}{ll} \text{(I) Selling price : ₹ 104.40} & \text{Total value of sales : ₹ 1,04,400} \\ \text{(ii) quoting price : ₹ 94.95} & \text{Total sales (200 units) : ₹ 18,990} \end{array} \right]$

Q 8. On June 30,2010 a flash flood damaged the warehouse and factory of ABC corporation completely destroying the work in progress inventory. There was no damage either to the raw material or finished goods inventories. A physical verification taken after the flood revealed the following valuations.

₹

₹

Raw material : 62,000

The inventories on Jan 1, 2010 consisted the following

Work in progress : 0

Raw material : 30,000

Finished goods : 1,19,000

Work in progress : 1,00,000

Finished goods : 1,40,000

A review of the books and records disclosed that the gross profit margin historically approximated 25 % on sales. The sales for the first six months of 2010 were ₹ 3,40,000. Raw material purchased were ₹ 1,15,000. Direct labour cost for the period were ₹ 80,000 and manufacturing overheads has historically been 50 % of direct labour.

Compute the cost of work in progress, inventory cost on June 30, 2010 by preparing a statement of cost and profit.

[B. Com. Hins. Delhi]

Ans. [Closing W. I. P. : ₹ 69,000 ; Profit : ₹ 85,000]

Hint : Let x be the closing W. I. P.

Then [30000 + 115000 – 62000] + 80000 + 40000 + (100000 – x) + [140000 – 119000] =

(Raw material) (D. labour) (Manu. Over.) WIP Finished goods

[340000 – 25 % of 340000]

$$\Rightarrow x = 83000 + 80000 + 40000 + 100000 + 21000 - 25500$$

$$= ₹ 69,000$$

Q 9. The following particulars are extracted from the books of a company relating to the commodity ' P ' for the year ending 31st March, 2010.

₹

Purchase of raw material	:	48,500
Direct wages	:	15,400
Carriage inward	:	1,800
Factory overheads	:	12,300

Stock on 01.04.2009

Raw material	:	1,650
Finished product	:	8,100

Stock on 31.03.2010

Raw material	:	1,950
Finished products	:	4,100
Work in progress (01.04.2009)	:	5,300
Work in progress (31.03.2010)	:	2,000
Sales	:	1,10,000

Selling and distribution expenses were : 3,000

You are required to ascertain.

(i) Prime cost (ii) Factory cost

(iii) Cost of sales (iv) Profit

Ans. $\left[\begin{array}{ll} \text{(i) ₹ 65,400} & \text{(ii) ₹ 81,000} \\ \text{(iii) ₹ 88,000} & \text{(iv) ₹ 22,000} \end{array} \right]$

Q 10. From the data given below prepare a detailed statement in such a way that it is beneficial for the management to know the cost at various levels and take decisions accordingly.

Raw material purchased during the production process : ₹ 72,000

Other direct material needed : ₹ 2,300

Direct wages paid : ₹ 15,500

Carriage inward : ₹ 1,000

Carriage outward : ₹ 1,000

Stock Opening :

Raw material : ₹ 4,000

Finished goods : ₹ 6,000

W. I. Progress : ₹ 5,200

Factory overheads : ₹ 12,500

Administration overheads : ₹ 12,000

Selling and distribution overheads : ₹ 7,000

Closing stock :

Raw material : ₹ 8,000

Finished goods : ₹ 5,000

W. I. Progress : ₹ 5,500

Profit on sales : $11\frac{1}{9}\%$

Ans :

Prime cost : ₹ 86,800	Cost of goods sold : ₹ 1,12,000	Profit : ₹ 15,000
Factory cost : ₹ 99,000	Cost of sales : ₹ 1,20,000	Sales : ₹ 1,35,000

Q 11. The standard production for a particular work order is 20 units per day and piece rate wages is 60 paise per unit if daily production is more than 20 units. The rate is 50 paise per unit if daily production less than 20 units. Cost of material is 30 paise per unit. It is proposed to charge factory overheads under one of the following methods.

(I) 100 % labour cost.

(ii) 80 % on prime cost.

Tabulate the above data in the form of a suitable statement and indicate the factory cost per unit, under each of the above methods, if the daily production is :

(a) 15 units (b) 25 units (c) 20 units

Ans :

(a) ₹ 1.30, ₹ 1.44	(b) ₹ 1.50, ₹ 1.62
(c) ₹ 1.50, ₹ 1.62	

Q 12. X Ltd. Manufacturers four brands of toys - A, B, C and D. If the company limits the manufacture to just one brand the monthly production will be :

A – 50,000 units

B – 1,00,000 units

C – 1,50,000 units

D – 3,00,000 units

You are given the following set of information from which you are requested to find out the profit or loss made on each brand showing clearly the following elements :

(a) Direct cost : (b) Works cost : (c) Total cost.

	Brands			
	A	B	C	D
Actual production (units)	6,750	18,000	40,500	94,500
Direct wages (₹)	15,000	27,500	37,500	1,05,000
Direct material (₹)	50,000	92,500	1,27,000	3,80,000
Selling price per unit (₹)	20	15	10	8

Factory overhead expenditure for the month was ₹ 1,62,000. Selling and distribution cost should be assumed @ 20 % of works cost. Factory overhead expenses should be allocated to each brand on the basis of units which could have been produced in a month when single brand production was in operation.

Ans : $\left(\begin{array}{l} \text{(A) Direct cost : ₹ 65,000 ; Works cost : ₹ 89,300 ; Total cost : ₹ 1,07,160 ; Profit : ₹ 27,840} \\ \text{(B) Direct cost : ₹ 1,20,000 ; Works cost : ₹ 1,52,400 ; Total cost : ₹ 1,82,880 ; Profit : ₹ 87,120} \\ \text{(C) Direct cost : ₹ 1,65,000 ; Works cost : ₹ 2,13,600 ; Total cost : ₹ 2,56,320 ; Profit : ₹ 1,48,680} \\ \text{(D) Direct cost : ₹ 4,85,000 ; Works cost : ₹ 5,41,700 ; Total cost : ₹ 6,50,040 ; Profit : ₹ 1,05,960} \end{array} \right)$

Q 13. Following data is available for a company relating to the cost of production of a product subjected to cost audit. Prepare the export and local cost of goods sold necessary in cost audit.

Production — 10,000 units

Sales Local — 9,000 units

Sales export — 1,000 units

	₹
Material consumed 20 Tonnes @ ₹ 5 / Kg	1,00,000
Imported components @ ₹ 3 per unit	30,000
Direct labour	10,000
Factory overheads	15,000
Admn. Overheads	5,000
Freight and Packing (Local sales)	4,500
Export packing	1,000

Handling at port	500
Opening work in progress	10,000
Closing Work in progress	5,000

(ICWA Final)

$$\text{Ans: } \left[\begin{array}{ll} \text{Cost of goods sold} & \text{Export : ₹ 18,000} \\ & \text{Local : ₹ 1,53,000} \end{array} \right]$$

Q 14. The cost structure of an article, the selling price of which is ₹ 45,000 is as follows :

Direct material	: 50 %
Direct labour	: 20 %
Overheads	: 30 %

An increase of 15 % in the cost of material and of 25 % in the cost of labour is anticipated. These increased costs in relation to the present selling price would cause a 25 % decrease in the amount of present profit per article.

You are required :

1. To prepare a statement of profit per article at present and
2. The revised selling price to produce the same percentage of profit to sales as before.

(C.A. Inter)

Ans : Present profit = ₹ 15,000, Revised selling price = ₹ 50,625.

Hint : Let x be the total cost

Y be the amount of profit

$$\text{So } x + y = 45000 \text{ ----- (I)}$$

$$\text{Secondly } [x \times 0.5 \times (1.15) + x \times 0.2 \times (1.25) + x \times 0.3] + (1 - 0.25) Y = 45000$$

$$[0.575 + 0.25 x + 0.3 x] + 0.75 y = 45000$$

$$1.125 x + 0.75 y = 45000 \text{ ----- (II)}$$

From (I) & (II) we get

$$1.125 y + 0.75 y = 50625 - 45000$$

$$0.375 y = 5625$$

$$y = 15000$$

$$\Rightarrow x = 45000 - 15000 = 30000$$

$$\% \text{ of profit} = \frac{15000}{45000} \times 100 = 33\frac{1}{3} \%$$

$$\text{Revised cost} = 1.125 \times x = 1.125 \times 30000$$

$$= ₹ 33,750$$

To earn same percentage of profit on sales or $33\frac{1}{3} \%$ on sales

$$= \frac{1}{2} \text{ on cost}$$

$$\text{i.e. } P = \frac{1}{2} \times 33750 = ₹ 16,875$$

$$\text{so selling price} = 33750 + 16875 = ₹ 50,625$$

Q 15. A manufacturing company has an installed capacity of 1,20,000 per annum. The cost structure of the products manufactured is as under :

(i) Variable cost (per unit)

Material : ₹ 8.00

Labour : ₹ 8.00

(subject to maximum of ₹ 56,000 per month)

Overheads : ₹ 3.00

(ii) Fixed overheads ₹ 1,04,000 per annum.

(iii) Semi variable overheads ₹ 48,000 per annum at 60 % capacity which increase by ₹6,000 per annum for increase of every 10 % of the capacity utilization or any part thereof.

The capacity utilization for the next year is estimated at 60 % for two months, 75 % for 6 months and 80 % for the balance part of the year. If the company is planning to have a profit of 25 % on the selling price. Calculate the estimated selling price for each unit of production.

Assume there is no opening or closing stock.

(ICWA Inter)

Ans : ₹ 28.03 (approx.)

Q 16. A company presently sells an equipment for ₹ 35000. Increase in prices of labour and material cost are anticipated to the extent of 15 % and 10 % respectively in the coming year. Material cost represents 40 % of the cost of sales and labour cost 30 % of cost of sales. The remaining relates to overheads. If the existing selling price is retained, despite the increase in labour and material prices, the company would face a 20 % decrease in existing amount of profit on the equipment.

You are required to arrive at selling price so as to give the same percentage of profit on increased cost of sales as before. Prepare a statement of profit/loss per unit, showing the new selling price and cost per unit in support of your answer.

Ans : [Current Profit : ₹ 10,439. New selling price : ₹ 37,975.]

Q 17. Find out in the appropriate cost sheet from the selling rate per tonne of special paper manufactured by a paper mill for the Government in January, 2010 under the following divisions of cost.

(a) Prime Cost.

(b) Works Cost.

(c) Total Cost.

(d) Selling Price.

The cost sheet is to be prepared with reference to the data given below.

Direct materials:

Paper pulp ----- 500 tonnes @ ₹ 50 per tonne.

Other miscellaneous materials ----- 100 tonnes @ ₹ 30 per tonne.

Direct labour:

80 skilled men @ ₹ 3 per man day for 25 days.

40 unskilled man @ ₹ 2 per man day for 25 days.

Direct expenses:

Special equipment ---- ₹ 3,000

Special dyes ----- ₹ 1,000

Works overheads:

Variable ₹ 100 % and Fixed @ 60 % on direct wages.

Administration overheads @ 10 % and selling and distribution overheads @ 15 % on works cost.

Profit 10 % on total cost.

Finished products manufactured ----- 400 tonnes.

Credit on account of sales of the manufactured scrap --- ₹ 800.

There was no work in progress at the beginning or at the end of the month. The scrap value of the special equipment after utilization in manufacture is nil. (B. Com. Punjab)

Ans. [(a) ₹ 40,000 (b) ₹ 52,000 (c) ₹ 65,000 (d) ₹ 178.75 per unit]

Q 18. ABC Ltd. furnished information in relation to the production of 2000 units of product ' X ' for the year 2009.

₹

(i) Direct materials	2,00,000
(ii) Direct labour	1,50,000
(iii) Indirect wages (50 % fixed)	40,000
(iv) Consumable stores (70% variable)	30,000
(v) Office rent (100 % fixed)	60,000
(vi) Selling expenses (40 % variable)	80,000

In the year 2010, it is estimated that the production will increase by 50 %. The price of material and labour will go up by 10 % and 20 % respectively.

Compute selling price per unit of product 'X' for the year 2010, if the company wishes to maintain profit @ 10 % on cost. (ICWAI – Foundation Dec, 2008)

Q 19. A Ltd. Company has capacity to produce 1,00,000 units of a product every month. Its works cost at varying levels of production is as under:

Level	Works cost per unit (₹)
10 %	400
20%	390
30%	380
40%	370
50%	360
60%	350
70%	340
80%	330
90%	320
100%	310

Its fixed administration expenses amount to ₹ 1,50,000 and fixed marketing expenses amount to ₹ 2,50,000 per month respectively. The variable distribution cost amount to ₹ 30 per unit. It can market 100% of its output at ₹ 500 per unit provided it incurs the following further expenditure.

- (a) It gives gift items costing ₹ 30 per unit of sale.
- (b) It has lucky draws every month giving the first prize ₹ 50,000 second prize ₹ 25,000 third prize ₹ 10,000 and three consolidation prizes of ₹ 5,00 each to the customers buying the product.
- (c) It spends ₹ 1,00,000 on refreshment served every month to its customers.
- (d) It sponsors a television programme every week at a cost of ₹ 2,00,000 per month.

It can market 30% of its output at ₹ 550 per unit without incurring any of the expenditure referred to in (a) to (d) above.

Advise the company on its course of action. Show the supporting cost sheets. (C.A. Inter)

Ans. { The company should work at 100 % capacity. The total profit of profit of the company will increase by ₹ 66,00,000 p.m. }

Hint:

	₹	Profit (₹)
At 100% capacity Sales = 100000×500	500,00,000	
Work cost = 31,00,000		
Fixed Admn. Cost = 1,50,000		
Marketing = 2,50,000		
Variable distribution = 30,00,000		
Gift cost = 30,00,000		
Lucky draw = 1,00,000		
Refreshments = 1,00,000		
Advertisement = 20,00,000	<u>396,00,000</u>	
		<u>104,00,000</u>
At 30% Capacity: Sales = 30,000×550	165,00,000	
Cost Works = 114,00,000		
Fixed: Admn. 1,50,000		
Marketing 2,50,000		
Distribution = 9,00,000		
	<u>127,00,000</u>	
		<u>38,00,000</u>
	Difference =	<u>66,00,000</u>

Q 20. The particulars obtained from the records of M/S Jain industries for the year 2010 are given below, from which you are required to prepare a cost sheet and a statement showing estimated cost for 1000 units in future.

Opening Stock:	₹
Raw material	= 1,40,000
Finished products	= 20,000
Purchases	= 2,10,000
Factory wages	= 3,80,000
Factory overheads	= 70,000
Office overheads	= 40,000
Closing Stock:	
Raw material	= 19,600
Finished products	= 1,60,000

$$\text{Sales} = 7,56,000$$

At the end of the year, the number of units produced including the closing stock and the number of units sold was 4,000.

On the basis of the above the industry wanted to supply 1,000 units in future. It is estimated that the price of raw material and labour may rise by 15% and 10% respectively.

Assume that the same percentage of profit on the sales will be made. [B.Com.(Hons.)]

$$\text{Ans. } \left[\begin{array}{lll} \text{Prime cost : ₹ 7,10,400} & \text{Factory cost : ₹ 7,80,400} & \text{Cost of production: ₹ 8,20,400} \\ \text{Cost of sales: ₹ 6,80,400} & \text{Profit: ₹ 75,600} & \text{Estimated price: ₹ 2,52,211} \end{array} \right]$$

Hint: ₹

$$\begin{array}{lll} \text{Future Cost: Material} & = 82.6 \times (1.15) \times 1000 & = 94,990 \\ \text{Labour} & = 95 \times (1.1) \times 1000 & = 1,04,500 \\ \text{Overheads :} & 27.5 \times 1000 & = 27,500 \\ \hline & & 2,26,990 \\ & + \text{Profit } \frac{75600}{680400} \times 226990 & = 25,221 \\ & \text{Sales} & = 2,52,211 \end{array}$$

Q 21. The following data relates to production of 5000 units of a product and the company wants to supply 100 units in the market as there is a demand, but to produce extra 100 units the company has to incur an extra cost of 10% in material price and 15% in labour cost, though the other costs remaining at the same level

Data for 5000 units of the product:

Raw material consumed	: ₹ 2,10,000
Direct labour cost	: ₹ 38,000
Factory overheads	: ₹ 28,000
Administration overheads	: ₹ 4,000
Profit on sales	: $12 \frac{1}{2} \%$

The company desire to earn profit at the same rate in normal case. You are required to prepare a cost statement showing the profit portion for the normal production and also for the special order of 100 units.

$$\text{Ans. } \left[\begin{array}{lll} \text{Prime cost : ₹ 2,48,000} & \text{Cost of sales : ₹ 2,80,000} & \text{Profit : ₹ 40,000} \\ \text{New selling price for 100 units = ₹ 7238.86 (Approx.) i.e. @ ₹ 72.39 per unit} & & \end{array} \right]$$

Q 22. The following is the data given by a company producing and selling a product.

You are required to prepare cost and profit statement and estimate the selling price at 8000 units of production if profit earned on the selling price remains the same.

4000 units (₹) 6000 unit (₹)

Raw material consumed	:	48,000	72,000
Direct labour required	:	28,000	42,000
Direct expenses	:	4,000	6,000
Factory overheads	:	40,000	50,000
Administration overheads	:	31,000	39,000
Selling and distribution	:	12,000	16,000

Profit earned on selling price @ $16\frac{2}{3}\%$

Ans. [Cost of sales : ₹ 2,87,000 Sales : ₹ 3,44,400 Profit : ₹ 57,400]

Q 23. Cool wind Ltd. Manufactures fans, which are sold at ₹ 400 per piece. The cost of sale is composed of 40 % direct material, 30 % wages and 30 % overheads.

An increase in material price by 25 % and wages by 10 % is expected in the forth coming year, as a result of which the profit at current selling price may dwindle by 39 % of the present gross profit.

With the above information, you are required to : (a) prepare a statement showing current and future cost and profit at present selling price.

(a) Determine the future selling price, if the present rate of gross profit is to be maintained.

Ans.

Present profit	: ₹ 100	Total cost	: ₹ 300
Future profit	: ₹ 113	Total future cost	: ₹ 339
		Future selling price	= ₹ 452

Hint : Let x be the total present cost

	Present	Future
* Material	: 0.4 x	0.5 x
Labour	: 0.3 x	0.33 x
Overheads	: 0.3 x	0.30 x
	x	1.13 x

$$^* (400 - x) - (400 - 1.13 x) = 0.39(400 - x)$$

$$-x + 1.13 x + 0.39 x = 156$$

$$0.52x = 156$$

$$x = \frac{156}{0.52} = 300$$

So, present cost = ₹ 300.

Present profit = $400 - 300 = ₹ 100$ i.e. 25% on sales or $33\frac{1}{3}\%$ on cost

or we can say $\frac{1}{4}$ th of sales or $\frac{1}{3}$ rd of cost.

Q 24. The modern manufacturing company submits the following information on 31st march

19X1.

Sales for the year : ₹ 2,75,000

Inventories at the beginning of the year:

Finished goods : ₹ 7,000

Work in progress : ₹ 4,000

Purchase of material for the year : ₹ 1,10,000

Material inventory :

at the beginning of the year : ₹ 3,000

at the end the year : ₹ 4,000

Direct labour : ₹ 65,000

Factory overheads were 60% of the direct labour cost.

Inventories at the end of the year :

Work in progress : ₹ 6,000

Finished goods : ₹ 8,000

Other expenses for the year were :

Selling expenses 10% of sales

Administration expenses 5% of sales.

Prepare a statement of cost (C.A. Inter)

Ans. [Cost of sales : ₹ 2,51,250 Profit : ₹ 23,750]

Suggested Solutions

Q1.

Cost statement showing profit

	₹	₹
Opening stock of raw material	Nil	
Raw material purchased	<u>55,000</u>	
	55,000	
Less closing stock	<u>3,000</u>	

Raw material consumed	52,000
Add : Direct labour	10,000
Direct expenses	<u>4,000</u>
Prime cost	66,000
Add : Factory overheads	<u>5,000</u>
Works cost	71,000
Administration overheads	<u>4,500</u>
Cost of production	75,500
Selling and distribution overheads	<u>1,500</u>
Cost of sales	77,000
Profit $12\frac{1}{2}\%$ on sales or $\frac{1}{8}$ th of sales	
or $\frac{1}{7}$ th of cost of sales	<u>11,000</u>
Sales	<u>88,000</u>

Q 2. Statement showing Cost elementwise and profit portion

	₹
Raw material consumed :	40,000
Direct expenses :	4,000
Direct labour:	<u>9,000</u>
Prime Cost:	53,000
Factory overheads:	<u>7,000</u>
Works Cost:	60,000
Administration overheads:	<u>7,000</u>
Cost of production:	67,000
Selling and distribution expenses:	<u>3,000</u>
Cost of sales:	70,000
Profit: $16\frac{2}{3}\%$ on sales or $\frac{1}{6}$ th of sales	}
i.e. $\frac{1}{5}$ th of cost of sales	
	<u>14,000</u>
Sales:	<u>84,000</u>

Q 3.

Cost sheet showing the profit and selling price per unit

Particular	Total	Cost per unit
₹	(₹)	(₹)
Opening stock of raw material: 3,000		
Add purchases(raw material):30,000		
33,000		
Less closing stock(raw material): 4,000		
Raw material consumed:	29,000	29.00
Direct labour:	6,500	6.50
Direct expenses:	2,500	2.50
Prime Cost:	38,000	38.00
Factory overheads:	6,500	6.50
Administration overheads:	4,500	4.50
Selling and distribution expenses:	2,000	2.00
Cost of sales:	51,000	51.00
Profit 25 % on sales i.e. $\frac{1}{4}$ th. of sales or $\frac{1}{3}$ rd. of cost of sales	17,000	17.00
Sales:	68,000	68.00

Q 4.

Cost sheet showing profit and selling price per unit

Particular	Total	Per unit
₹	₹	₹
Opening Stock of raw material: 8,000		
Add purchases: 35,000		
Less closing stock: 3,000		
Raw material consumed:	40,000	40.00
Direct wages:	7,000	7.00
Direct expenses:	4,300	4.30
Manufacturing overheads:	6,400	6.40
Administration & office overheads:	4,500	4.50
Selling and distribution overheads:	2,800	2.80
Cost of sales	65,000	65.00

Profit: 20% on cost of sales		
i.e. $\frac{1}{5}$ of cost of sales		
	13,000	13.00
Total:	78,000	78.00

Q 5. (i) ₹

Material used in production	=	1,93,000
Add closing stock	=	95,000
		<u>2,88,000</u>
Less opening stock	=	90,000
		<u>1,98,000</u>
Raw material purchased	=	1,98,000
		<u>₹</u>

(ii) Total cost of goods processed during
the period = 6,54,000

Less (i) Raw material used: ₹1,93,000

(ii) Factory overheads: ₹ 1,67,000

(iii) Opening W.I.P. : ₹ 70,000

		<u>4,30,000</u>
Balance : Direct labour cost incurred	=	<u>2,24,000</u>
		<u>₹</u>

(iii) Total cost of goods processed

During period	=	6,54,000
Add : Opening stock (finished)	=	<u>1,10,000</u>
		7,64,000

Less: (i) Closing finished goods : 95,000

(ii) Closing W.I.P. 80,000

		<u>1,75,000</u>
Cost of goods sold		<u>5,89,000</u>

Cost of goods sold can also be found as

₹

Cost of goods available for sale (given) = 6,84,000

Less closing stock (finished goods) = 95,000

Cost of goods sold = 5,89,000

Q 6.

Statement of Cost and selling price

		₹	
	Opening stock of raw material	= 4,500	
	Raw material purchased during the year	= 49,000	
		53,500	
	Less: Closing stock of raw material	= 8,500	
	Raw material consumed	= 45,000	
Add:	Direct labour cost	= 12,000	
	Direct expenses	= 3,300	
	Prime cost	= 60,300	
Add:	Factory overheads	= 13,950	
	Works Cost	= 74,250	
Add:	Administrative overheads	= 15,750	
	Cost of production	= 90,000	per unit
Add:	Selling and distribution expenses	= 2,700	₹
	Cost of sales	= 92,700	206
Add: Profit earned 20% on sales i.e. $\frac{1}{5}$ of sales			
or $\frac{1}{4}$ th of sales			
		23,175	51.50
	Sales	= 1,15,875	257.50

Q7. (i)

Cost sheet for current production of 1000 units

Particular	Total (₹)	Per unit (₹)
Opening stock of raw material	5,000	
Add: Purchase of raw material	54,000	
	59,000	
Less closing stock of raw material		
	6,000	
Cost of raw material consumed		
	53,000	53.00
Add: (a) Direct labour	12,000	12.00
(b) Factory overheads	11,750	11.75
(c) Administrative overheads	7,250	7.25
Cost of production	84,000	84.00

Add:	Selling and distribution overheads	3,000	3.00
	Cost of Sales	87,000	87.00
Add:	Profit @ 20% of cost of sales	17,400	17.40
	Value of sales	1,04,000	104.40

(ii)

Statement for quoting for 200 units

	Per unit	200 units
	₹	₹
Material cost	53.00	11,600
Labour cost at increased rate @ 110 % of present	13.20	2,640
Factory overheads @ 110 % of present	12.925	2,585
Cost of production	79.125	15,825
Add: Profit @ 20 % on cost of production	15.825	3,165
Total	94.95	18,990

Q 8. Let us first of all find out the cost of sales

	₹
Sales	3,40,000
Profit @ 25 %	85,000
Cost of sales	2,55,000
Cost of sales	2,55,000
Add: Closing stock (finished goods)	1,19,000
	3,74,000
Less: Opening Stock (finished goods)	1,40,000
Works cost	2,34,000
Less: (a) Manufacturing overheads 40,000*	}
(b) Opening W.I.P. 1,00,000	
	1,40,000
	94,000
Add: Closing W.I.P. (not given)-----(assume = x)	x
Prime cost	(94,000 + x)

Now Prime Cost = Raw material consumed + Direct labour cost

$$94,000 + x = (30,000 + 1,15,000 - 62,000) + 80,000$$

$$94,000 + x = 83,000 + 80,000$$

$$94,000 + x = 1,63,000$$

$$x = 1,63,000 - 94,000$$

$$x = 69,000$$

So, Closing stock of work in progress = ₹ 69,000

*Manufacturing overheads are 50% of direct labour i.e. 50% of 80,000 = ₹ 40,000

The question can also be solved as

Cost of sales = 0.75 of sales (25% profit on sales)

$$= 0.75 \times 3,40,000$$

$$= ₹ 2,55,000$$

Let x be the closing W.I.P. then

$$[30,000 + 1,15,000 - 62,000] + 80,000 + 40,000 + 1,00,000 - x + 1,40,000 - 1,19,000 = 2,55,000$$

$$\Rightarrow x = 30,000 + 1,15,000 + 80,000 + 40,000 + 1,00,000 + 1,40,000 - 62,000 - 2,55,000 - 1,19,000$$

$$x = 69,000 \quad \text{So, W.I.P.} = ₹ 69,000.$$

Solution to * & ** of illustration 7 :

Company's normal capacity = 1,26,000 units, and for the first four months the company is working at 50 % capacity i.e. producing = $1,26,000 \times \frac{4}{12} \times \frac{50}{100} = 21,000$ units.

and for the rest of the period (8 months) it is expected to work at 80 % of capacity i.e. producing = $1,26,000 \times \frac{8}{12} \times \frac{80}{100} = 67,200$ units.

Now semi variable overheads are = ₹ 75,000 p.a. up to 50 % capacity and for every 20 % or any part thereof increase in capacity, there is an increase of ₹ 15,000 in semi variable overheads.

or we can say for 100 % capacity semi variable overheads will be = $75,000 + 3(15,000) = ₹ 1,20,000$

for separating semi variable into fixed and variable the calculation is as under.

$$F + 0.5 V = 75,000 \quad \dots\dots\dots (1)$$

$$F + 1 V = 1,20,000 \quad \dots\dots\dots (2)$$

$$\Rightarrow 0.5 V = 45,000$$

$$V = \frac{45,000}{0.5} = ₹ 90,000$$

$$F = 1,20,000 - 90,000 = ₹ 30,000$$

For 21,000 units. for first four months

$$F = 30,000 \times \frac{4}{12} = ₹ 10,000 \quad \text{and} \quad V = 90,000 \times \frac{21,000}{1,26,000} = ₹ 15,000$$

$$* \text{ Total semi fixed variable overheads} = F + V = 10,000 + 15,000 = ₹ 25,000$$

For 67,200 units for rest of the year

$$F = 30000 \times \frac{8}{12} = ₹ 20,000 \quad \text{and} \quad V = 90,000 \times \frac{67200}{126000} = ₹ 48,000$$

$$** \text{ Total semi fixed variable overheads} = F + V = 20,000 + 48,000 = ₹ 68,000.$$



4. Process Costing

In many industries homogeneous finished products are produced. In the final production identical various processes are carried on. After completing an identical work on the input the product is passed onto the next identical job to be done on it and in this way after going through many identical jobs the final good having a suitable utility is obtained.

In a particular process or job to be done on it each unit is processed in the same manner. We can take an example of soap making industry. The soap cakes are wrapped in attractive packs sold in the market has to pass through different types of identical processes. In the process type of production units, the output of one process becomes the input of the next process. When a process receives the input from the previous one apply a same repetitive type of job and its product so made becomes the raw material of the next one and so on this process continues with in the production unit up to the final product salable in the market.

Though the main target of the production unit is to earn profit in the market after selling the final production in the market, yet in some production units for the inter comparison of the performances and fixing the responsibility of middle level management, each process adds a fix percentage of profit on its production for the transfer.

In process costing, particular attention is given to (a) the costs relating to the process (b) the period for which cost for the process is collected (c) the complete units produced during the period (d) incomplete units in the stock at the end of a specific period (e) the normal and abnormal losses in the process (f) finding out the cost per unit of the production and the transfer price. Process costing is useful in industries having following characteristics

- (a) Homogeneous products are produced
- (b) continuous and mass production
- (c) loss of identity of production against a particular order
- (d) production involved different processes and output of one process forms input of another process

In particular, the following are examples of industries where process costing is applied.

- (i) Soap making
- (ii) Paper making
- (iii) Biscuit making
- (iv) Oil refining
- (v) Distillation process
- (vi) Textile Industry
- (vii) Coke works
- (viii) Paint, Ink and Varnish etc.
- (ix) Milk dairy
- (x) Box making
- (xi) Food Products
- (xii) Chemical works
- (xiii) Meat products

Main features of process costing:

- (i) The finished product of one process becomes the input material or raw material of the next process.
- (ii) Output of the process is homogeneous, e.g. in paint making each small quantity of the product is identical to the full lot.
- (iii) In process costing to measure the cost incurred on the production of the process it is very important to measure the effective production because at the end of the process some material will be there or may be there which may be incomplete. So to evaluate the cost the effective or equivalent production unit measurement is very important.
- (iv) To check the inefficiencies at the process level and inter process performance evaluation, sometimes goods are transferred not at cost but at transfer price after adding a certain profit on the cost.
- (v) Each process keeps proper and accurate record of the cost incurred on the unit it produces.
- (vi) There may arise normal or abnormal losses within the process because of various avoidable or unavoidable reasons. Treatment of normal and abnormal losses or gains is to be studied in this method of costing.
- (vii) Different products with or without byproducts are simultaneously produced at one or more stages or process of manufacture. The valuation of byproducts and apportionment of joint cost before point of

separation is an important aspect of this method of costing. In certain industries, byproducts may require for the processing before they can be sold. A main product of one firm may be byproduct of another firm and in certain circumstances, it may be available in the market at price which are lower than the cost to the first mentioned firm. It is essential, therefore that this cost be known so that advantages can be taken of these market conditions.

Advantages of process costing:-

- (i) Process costing is helpful in price fixation because the cost incurred at each level is ascertained and unit cost is calculated at each process level.
- (ii) Helpful in having proper control by the higher level management.
- (iii) It is simple and less expensive to find out the process cost.
- (iv) It is possible to determine the process cost at very short intervals. Reason of many major deviations can be found out easily such as too many abnormal losses.
- (v) Inter process performance evaluation is possible under process costing technique.
- (vi) Competitive price fixation to enhance sale is possible because easy and ready unit cost is always present in this type of costing system.

Limitations of process costing:

1. Cost accumulation is linked to particular period because cost relating to a process during a particular period is divided by output during that period. By the time costs are reported, it may be too late to permit exercise of control.
2. Under process costing, unfinished units in store at the end of the period are expressed in terms of percentage of completed units. This introduces subjective element in scientific cost determination.
3. When two or more dissimilar products are produced in the same process the costs incurred are allocated on some weightage which are expressed on points. There is subjectivity in giving points to different products because of absence of any scientific method so makes process costing inadequate for managerial purposes.
4. The whole concept of process costing system is based on average cost and average cost will provide for performance analysis and evaluation attempted for managerial control.
5. Costs obtained at the end of the accounting period are only historical value and are not very helpful for effective control.
6. There is a wide scope of errors while calculating average costs. An error in one average cost will be carried through all processes to the valuation work in process and finished goods.

Job order costing and process costing:

Two processes of costing are there. One is job costing and the other is process costing. Process costing is repetitive type and homogeneous units are produced in it. In job costing work is not repetitive type and work is done on each unit according to the customer's specific order. Job costing differ from one situation to another. In process costing same type of work is done in one process, same type of products are produced. The difference in the job order costing and the process costing can be summarized as below:

Job order costing	Process costing
1. Production is against a specific order of the customer.	1. Production is continuous flow and same type of products are made.
2. Each job is separate and independent of the other.	2. Homogeneous products are produced regularly and the products are produced. They lose their identity as they are manufactured in a continuous flow.
3. Individual cost is calculated for each job separately.	3. Average cost is calculated for each unit because identical units are produced and total cost incurred is divided by the equivalent units produced to find out the unit cost
4. There is no transfer of work from one job to another job, until it is necessary to do so.	4. There is always a continuous flow of transfer of work from one process to the other till its completion to final product.
5. No work in process in the beginning or at the end of the period.	5. There may be opening as well as closing work in progress in the process costing and difficulty in finding out the equivalent production.

6. Control is difficult because the work is non repetitive type and non-standardized. 7. Items of prime cost can be traced with job order. 8. It requires more forms and details regarding material and labor due to the need of allocation of the cost to the various jobs. 9. It is suitable where the goods are made according to the specification and the order of the customers	6. Control is possible because of repetitive type of work and process of standardized time and cost schedules. 7. Items of prime costs cannot be traced with the particular order due to continuous production. 8. It require less forms and details but a closer analysis of operations is needed. 9. It is suitable where same type of units are produced and the production is kept in stocks or stores. May or may not be sold at the time it is produced.

Steps to be followed in Process Costing

1. Proper record of opening work in progress at the beginning of the period. The record should be in quantity i.e. units of measurement and in value as well.
2. Degree of completion of work in progress in the beginning. This information is necessary to find out the equivalent production and the cost per unit of equivalent production.
3. Information of new units introduced in the process.
4. Costs incurred in the process and is debited to the process account.
5. The normal and abnormal loss or abnormal gain is found out. The normal and abnormal losses are credited to the process account while abnormal gains are debited.
6. Closing work in progress if any is found out and its degree of completion at the end is determined as it is necessary to find out the equivalent production and cost per unit of equivalent production and is credited to the process account.
7. The number of good units produces are found out.
8. The abnormal loss and abnormal gains are treated as good units produced and are valued at the rate of good units.

Illustration 1. A product has to pass through three processes I, II, III for completion and at every process an additional cost is incurred while going to the next process. The complete data regarding the production of the product in every process is given as under.

There is neither opening or closing work in process as well as no opening or closing stock. Prepare process account.

	Process-I	Process-II	Process-III
Direct Material (₹)	10000	4000	3000
Direct Labour (₹)	3000	2000	2500
Variable overheads(₹)	3000	2000	2500

Solution:r

Process 1 Account

Dr		Cr	
Particular	Amount(₹)	Particular	Amount(₹)
To Direct Material	10000	By Process II A/c	16000
To Direct Labour	3000		
To Variable overheads	3000		
Total	16000	Total	16000

Process II Account

Dr		Cr	
Particular	Amount (₹)	Particular	Amount(₹)
To Process I A/c	16000	By Process III A/c	24000
To Direct Material	4000		
To Direct Labour	2000		
To Variable overheads	2000		
Total	24000	Total	24000

Process III Account

Dr		Cr	
Particular	Amount (₹)	Particular	Amount(₹)
To Process II A/c	24000	By Process II A/c	32000
To Direct Material	3000		
To Direct Labour	2500		
To Variable overheads	2500		
Total	32000	Total	32000

Illustration 2: The following data relates to the production of 1000 units of product, in which the product for completion and ready for sale has to pass through various processes in the sequence I II and III. Raw material is fed into the process I and after a planned work the material is forwarded to II and then it goes to the final III process. You are required to prepare the process account at each level I II and III

Particular	Process I (₹)	Process II (₹)	Process III (₹)
Direct Material	25000	2000	2000
Direct Labour	6000	5000	9000
Variable cost	4000	3000	4000
Total	35000	10000	15000

Overhead costs incurred during the completion are ₹5000 and are apportioned to the process on the basis of direct labour cost of the process.

There is no work in progress in the beginning and at each end of each process. Neither there is any opening or closing stock in any process.

Solution:

Process 1 Account

Dr			Cr		
Particular	Cost per unit ₹	Total ₹	Particular	Cost per unit ₹	Total ₹
To Direct Material	25	25000	By Process II	36.5	36500
To Direct Labour	6	6000	A/c		
To Variable cost	4	4000			
To overhead cost ($\frac{5}{20} \times 6000$)	1.5	1500			
Total	36.5	36500	Total	36.5	36500

Process II Account

Dr			Cr		
Particular	Cost per unit ₹	Total ₹	Particular	Cost per unit ₹	Total ₹
To process I A/c	36.5	36500	By Process III	47.75	47750
To Direct Material	2.0	2000	A/C		
To Direct Labour	5.0	5000			
To Variable cost	3.0	3000			
To overhead cost (5/20*5000)	1.25	1250			
Total	47.75	47750	Total	47.75	47750

Process III Account

Dr			Cr		
Particular	Cost per unit ₹	Total ₹	Particular	Cost per unit ₹	Total ₹
To process II A/c	47.75	47750	By Finished	55	55000
To Direct Material	2.0	2000	Stock A/c		
To Direct Labour	9.0	9000	(Output		
To Variable cost	4.0	4000	Transferred)		
To overhead cost ($\frac{5}{20} \times 9000$)	2.25	2250			
Total	55	55000	Total	55	55000

Process Losses: In some processes the process losses are inevitable such as the process where material is needed to be heated, boiled, some weight loss cannot be avoided. Some substances are volatile and when they came in contact with atmosphere they evaporates such as ether, alcohol etc. In some other processes, where erasing and smoothening is necessary for shaping or finishing such losses cannot be avoided. These types of losses are outcome of the past experiences and can be standardized through various techniques developed. These types of losses are normal. There are certain other types of losses which are not due to above said reasons but are due to bad workmanship, rough handling, due to lack of skill or proper control and can be controlled, are abnormal losses. Their treatment in the process costing is different i.e. different for normal and abnormal losses. These can be discussed as:

Normal losses:

As said earlier these types of losses cannot be avoided and are inevitable. These losses become part and parcel of the production and these losses are charged to the process itself and not to the general profit and loss. Though the main issue is the general profit and loss but when we compare the performance and in responsibility accounting these losses ought to be charged to the process in which the loss occurs. Let 100 g of material is put to the process and the various costs incurred including material cost come to be ₹ 9500 and the normal loss is 5%. Then ₹ 9500 is to be charged to $(100-5) = 95$ g of the material produced for every 100 g i.e. the cost of production should be ₹ 100 per g of the product.

These normal losses are always pre estimated from the past experiences of production process and are standardized. Middle level management should be very much watchful to keep these losses within the pre estimated standard limits.

Illustrations:- A chemical factory is producing a final product which has to go through three processes I, II and III. In every process there is a normal loss in weight of the input material. The normal loss in various processes is as under:

Process I – 5%, Process II – 4%, Process III – 5%

The other data is given as:

	Process I (₹)	Process II(₹)	Process III (₹)
Raw material fed into Process I (1000 Kg)	1000	-	-
Direct Wages (₹)	600	500	800
Overhead Costs (₹)	300	336	796
Total	1900	836	1596

Prepare the Process account.

Solution

Process I account

Dr			Cr		
Particular	Quantity	Amount (₹)	Particular	Quantity	Amount (₹)
To Raw material	1000	1000	By normal Loss	50	-
To Direct wages	-	600	By Process II a/c	950	1900
To overhead cost	-	300			
Total	1000	1900	Total	1000	1900

Process II account

Dr			Cr		
Particular	Quantity	Amount (₹)	Particular	Quantity	Amount (₹)
To Process I a/c	950	1900	By normal Loss	38	-
To Direct wages	-	500	By Process III a/c	912	2736
To overhead cost	-	336			
Total	950	2736	Total	950	2736

Process III account

Dr			Cr		
Particular	Quantity	Amount (₹)	Particular	Quantity	Amount (₹)
To Process II a/c	912	2736	By normal Loss	45.6	-
To Direct wages	-	800	By Finished Stock A/c	866.4	4332
To overhead cost	-	796			
Total	912	4332	Total	912	4332

Illustration 4: The product of a company has to pass through three processes A, B and C before completion. In each process there is always a normal loss of 2% in weight and 10% of the material is wasted as scrap having a saleable value in the market. The scrap in each stage can be sold @ 100/- per ton.

From the information given below, prepare process accounts:

	Process A	Process B	Process C
Output transferred to next process	80%	60%	-
Output sent to warehouse	20%	40%	100%

	Tons	Amount (₹)	Tons	Amount(₹)	Tons	Amount(₹)
Raw material Put into the process	1000	150000	296	59200	172	37840
Direct Labour cost	-	50000	-	50000	-	15000
Overhead cost	-	30000	-	32800	-	12680

Solution:

Process A account

Dr			Cr		
Particular	Quantity Tons	Amount (₹)	Particular	Quantity Tons	Amount (₹)
To Raw material	1000	150000	By normal Loss 2%	20	-
To Direct wages	-	50000	By scrap 10%	100	10000
To overhead cost	-	30000	By Process B A/c	704	176000
			By Warehouse Stock a/c	176	44000
Total	1000	230000	Total	1000	230000

Process B account

Dr			Cr		
Particular	Quantity Tons	Amount (₹)	Particular	Quantity	Amount (₹)
To Process A a/c	704	176000	By normal loss 2%	20	-
To Direct material	296	59200	By Scrap	100	10000
To Direct labour	-	50000	By Process C a/c	528	184800
Overhead cost	-	32800	By warehouse a/c	352	123200
Total	1000	318000	Total	1000	318000

Process C account

Dr			Cr		
Particular	Quantity Tons	Amount (₹)	Particular	Quantity	Amount (₹)
To Process B a/c	528	184800	By normal loss 2%	14	-
To Direct material	172	37840	By Scrap	70	10000
To Direct labour	-	15000	By finished stock	616	243320
Overhead cost	-	12680			
Total	700	250320	Total	700	250320

Abnormal losses:- Apart from normal losses which are a part and parcel of production another type of loss known as abnormal loss may arise which may due to the occurrence of unexpected circumstances, carelessness, bad workmanship, loss of control, rough handling, lack of skill and many other reasons.

Abnormal loss = Actual loss – Normal loss

Abnormal loss is similarly charged as the normal production. A separate account is maintained to recover the abnormal loss, because this loss is not pre estimated and non-standardized. The efficiency or inefficiency of the process can be judged or evaluated only if we maintain a separate account to recover these losses.

$$\text{Value of abnormal Loss} = \frac{\text{Total cost of the process}}{\text{Normal production}} \times (\text{Units of abnormal loss})$$

These losses are not, as already stated, associated with the normal production and not part and parcel of the normal production and could be avoided, care should be taken by the concerned management to control these losses and if arises try to minimize the losses.

Such losses representing the cost of material, labour and overhead incurred on the wastage should be transferred to an abnormal loss account. If there is any scrap value on sale of the waste, it should be credited to abnormal loss account and the balance is transferred to costing profit and loss account.

Illustration 5: The following is the position of a process in a line production of the company.

Process A

	₹	Quantity (Kg)
Raw material fed into the process	12000	1000
Direct labour incurred	70000	-
Overhead absorbed	60000	-

Normal loss of the process 5%

Good quality product produced 900 Kg

The unit which were not up to the standard quality were sold in the market @100 per Kg. Prepare the process account and subsidiary account.

Solution:

Process A account

Dr			Cr		
Particular	Quantity (Kg)	Amount (₹)	Particular	Quantity (kg)	Amount (₹)
To Raw material	1000	120000	By normal loss 5%	50	-
To Direct labour	-	70000	By abnormal loss a/c (1)	50	13158
To overhead cost	-	60000	By stock a/c	900	236842
Total	1000	250000	Total	1000	250000

Abnormal loss a/c

Dr			Cr		
Particular	Quantity (Kg)	Amount ₹	Particular	Quantity (Kg)	Amount ₹
To Process A a/c	50	13158	By Cash a/c (Sale of scrap)	50	5000
			By costing P&L a/c	-	8158
Total	50	13158	Total	50	13158

Working: (1)

$$\begin{aligned}
 \text{Total working cost} &= 250000 \\
 \text{Sale of normal loss} &= \text{NIL} \\
 \text{Net Process cost} &= 250000
 \end{aligned}$$

Apportionment of cost to Abnormal and normal production loss = 50:900

$$\text{Abnormal production loss} = \frac{25000}{950} \times 50 = ₹ 13158$$

$$\begin{aligned}
 \text{Normal production} &= \frac{25000}{950} \times 900 = ₹ 236842 \\
 \text{Total} &= ₹ 250000
 \end{aligned}$$

Problem: 6

Following data are available pertaining to a product after passing through two processes A and B.

Output transferred to process C from process B 900 units for ₹10550.

Other expenses incurred in process C are

Material consumed (300 units) = 3510

Direct wages incurred = 3320

Overhead absorbed = 3320

Normal loss in the process is 5% and is sold in the market @ ₹3 per unit. Total 963 good units are obtained after completion of the process. Prepare appropriate accounts if abnormal loss if any are sold @ ₹ 10 per unit.

Solution:**Process C A/c**

Dr			Cr		
Particular	Quantity (Kg)	Amount (₹)	Particular	Quantity (kg)	Amount (₹)
To process B a/c	900	10550	By normal loss 5%	60	180
To Raw material	300	3510	By abnormal loss a/c (1)	177	3186
To Direct wages	-	3320	By finished good stock a/c	963	17334
To overhead cost	-	3320			
Total	1200	20700	Total	1200	20700

Abnormal loss a/c

Dr			Cr		
Particular	Quantity (Kg)	Amount ₹	Particular	Quantity (Kg)	Amount ₹
To Process C a/c	177	3186	By Cash a/c	177	1770
			By costing P&L a/c	-	1396
Total	177	3186	Total	177	3186

Working: (1)

Transfer from process B 900 unit	₹ 10550
Material added in process (300 unit)	₹ 3510
Other costs	₹ 6640
Total	₹ 20700
Loss Normal loss (scrap sold)	₹ 180
Balance	20520

$$\text{Abnormal loss 177 unit} = \frac{20520}{1140} \times 177 = ₹ 3186$$



Illustration 7: Following data are available pertaining to a product after passing through two processes A and B. Output transferred to process C from process B. 9120 units for ₹ 49263.

Expenses incurred in process C:

Sundry Material	= ₹ 1480
Direct labour	= ₹ 6500
Direct expenses	= ₹ 1605

The wastage of process C is sold at ₹ 1.00 per unit.

The overhead charges were 168% of direct labour. The final product was sold at ₹ 10.00 per unit fetching a profit @ 20% on sales.

Find the percentage of wastage in process C and prepare process C account.

[B.Com. Hons. Delhi]

Solution:**Process C account**

Dr.			Cr.		
Particular	Units	Amount (₹)	Particular	Units	Amount (₹)
To process B a/c	9120	49263	By normal loss a/c	456	456
To sundry material	-	1480	By Finished goods a/c		
To Direct labour	-	6500	(1) stock a/c	8664	69312
To Direct expenses	-	1605			
To overhead charges (168% of labour)	-	10920			
Total	9120	69768	Total	9120	69768

Percentage of normal loss in the process C $= \frac{456}{9120} \times 100 = 5\%$

Note (1) Let x be the number of units of normal loss = x

Good units = (9120-x)

Sale price of normal loss = ₹ 1 per unit

Sale price of good units = (10-20%)
= (10-2)
= ₹ 8 per unit

So $x \times 1 + 8(9120-x) = 69768$

$x + 72960 - 8x = 69768$

$-7x = 69768 - 72960$

$= 3192$

$x = \frac{3192}{7} = 456$

So normal loss = 456 unit

Good units = 9120-456 = 8664 units

Abnormal gain:

We know that in every process depending upon the past experiences a certain quantity of the material fed in to the process get wasted which is known as normal loss. These normal losses are pre-estimated and are standardized. Actual output = Actual input – Normal loss. Situation may arise when loss is less than the normal loss value. Take a situation let 1000 Kg of raw material is used in the production of a commodity and past experiences shows that 10% of the input material will be normally wasted i.e. 100 kg of material will go waste and only 900 kg of the final commodity will be produced, but if we get 925 kg of the commodity after the completion of process then (925-900) will be gain and will be known as abnormal gain. Its treatment will be same as abnormal loss.

Illustration 8: In a process industry, the following is a position of process 1, Prepare process account and other relating accounts.

Process 1

	₹
Raw material utilized (1000 units).	= 120000
Other costs including labour cost	= 16000
Normal loss of the process	= 10%
Actual output of the process	= 925 units

Process 1 account

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To Raw material	1000	120000	By normal loss 10%	100	1000
To other costs	-	16000	By finished good a/c	925	138750
To Abnormal gain	25	3750			
Total	1025	139750	Total	1025	139750

Normal output = (1000 – Normal loss)

$= (1000 - 10\%)$

$= 900 \text{ unit}$

Normal cost for normal output $= 136000 - 1000$
 $= ₹ 135000$

Abnormal gain [(925-900) = 25 units] $= \frac{135000}{900} \times 25 = ₹ 3750$

Abnormal gain a/c

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To normal loss a/c	25	250	By Process 1 a/c	25	3750
To costing P&L a/c	-	3500			
Total	25	3750	Total	25	3750

Illustration 9: A company product A has to pass through three processes named P, Q and R. The output at each level becomes the input of the next immediate process and output of process R is transferred to finished stock for sale.

The other relating information regarding the three processes is given as under:

	Process P	Process Q	Process R
Raw material cost (₹)	50000	-	-
Other direct material used	6000	5000	10000
Labour cost required	7400	6000	18000
Other variable cost (₹)	4000	4183	13305

The total units of raw material entered in process P are 50000 units and a normal loss in every process is P-4%, Q-5%, R-10% and the process loss at each stage is saleable in the market @ ₹ 10 per 100 units.

You are required to prepare process accounts if output at each process is P-48200, Q-45390, R-40351 units.

Process P a/c

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To Raw material	50000	50000	By normal loss 4%	2000	200
To other material used	-	6000	By Process Q a/c	48200	67480
To Labour cost	-	7400			
Variable cost	-	4000			
Abnormal gain a/c	200	280			
Total	50200	67680	Total	50200	67680

Process Q a/c

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To Process P a/c	48200	67480	By normal loss 5%	2410	241
To Direct material	-	5000	By abnormal loss	400	720
To Labour cost	-	6000	By process R a/c	45390	81702
Variable cost	-	4183			
Total	48200	82663	Total	48200	82663

Process R a/c

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To Process Q a/c	45390	81702	By normal loss 10%	4539	454
To Direct material	-	10000	By abnormal loss	500	1500
To Labour cost	-	18000	By finished goods stock a/c	40351	121053
Variable overheads	-	13305			
Total	45390	123007	Total	45390	123007

Abnormal loss a/c

Dr			Cr		
Particular	Quantity (units)	Amount (₹)	Particular	Quantity (units)	Amount (₹)
To process Q a/c	400	720	By cash a/c 900@10 per 100	900	90
To process R a/c	500	1500	By costing P&L a/c	-	2130
Total	900	2220	Total	900	2220

Normal loss a/c

Dr			Cr		
Particular	Quantity (Units)	Amount (₹)	Particular	Quantity (Units)	Amount (₹)
To process P a/c	2000	200	By abnormal gain a/c	200	20
To process Q a/c	2410	241	By cash a/c	6749	875
To process R a/c	4539	454			
Total	6949	895	Total	6949	895

Finished goods stock a/c

			Particular	Quantity (Units)	Amount (₹)
			To process a/c	40351	121053
			Total	40351	121053

Abnormal gain a/c

Particular	Quantity (Units)	Amount (₹)	Particular	Quantity (Units)	Amount (₹)
To normal loss a/c	200	20	By process P a/c	200	280
To Costing P&L a/c	-	260			
Total	200	280	Total	200	280

Working: Calculation of abnormal loss and gain.

$$\begin{aligned}
 1. \text{ Abnormal gain in process P} &= \frac{\text{Total cost for Normal Production}}{\text{Normal units produced}} \times \text{Normal gain in units} \\
 &= \frac{67400 - 200}{50000 - 2000} \times 200 \\
 &= 1.4 \times 200 = ₹ 280
 \end{aligned}$$

$$\begin{aligned}
 2. \text{ Abnormal loss in process Q} &= \frac{82663 - 241}{48200 - 2410} \times 400 \\
 &= 1.8 \times 400 = ₹ 720
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Abnormal loss in process C} &= \frac{123007 - 454}{45390 - 4539} \times 500 \\
 &= 3 \times 500 = 1500
 \end{aligned}$$

Good units transferred from P → Q = 48200 × 1.4 = ₹ 67480

Good units transferred from Q → R = 45390 × 1.8 = ₹ 81702

Good units transferred from R → finished stock = 40351 × 3 = ₹ 121053

Inter Process profits:

Sometimes in inter process comparisons inter process profits are found out. One process who enjoys the economies at its own level does not share with the others. The stock transferred to the next include the profit. The overall profitability of all the processes taken together is not effected. This process i.e. inter process profit adopted to be near to the market price.

In each process, the profit portion is shown in a separate column. Its actual cost is also shown separately to know the actual position of its working. The practice of including profit in transfer price is resorted to for the following main reasons:

(a) Profit for different processes is found out separately and thus each process is treated as an independent profit Centre.

(b) When stocks are introduced in a particular process it cannot take the benefit of the economies which are enjoyed by the previous process.

(c) Inter process comparison is possible i.e. who is contributing more to the overall profit and who is contributing less to the company's profit.

(d) This practice of accounting induces a spirit of competition in the functioning of processes and hence leads to earn over all economies.

Critics are of the view that the practice of calculating inter process profit at each level is time consuming and also complicated. For valuation of closing stock to the balance sheet, the unrealized profit has to be reduced first i.e. we see the stock is again valued at cost. So, it is of no use of adopting this system.

Treatment: Three column are made in every process. These are Total column, Cost column and profit column. When stock is transferred and fed into the next process its cost, total and the profit is shown separately.

The cost incurred in the process is shown taking are showing any profit from these. The stock transferred to the next process includes profit to be earned at the process stage. This process is adopted at each process and ultimately the last process transfer the stock to the finished stock for sale. To understand its treatment we can clear it with following illustration.

Illustration 10: Vishnu & Co. produces a product that passes through three processes, before it is transferred to finished stock. Following information is available for the month of December, 1993.

	Process I (₹)	Process I (₹)	Process III (₹)	Finished stock(₹)
Opening stock	40000	48000	32000	120000
Direct material	80000	84000	120000	-
Direct wages	60000	60000	64000	-
Production overheads	56000	24000	160000	-
Closing stock	20000	24000	16000	60000
Profit on cost of each process				
Inter process profit for opening stock	33 $\frac{1}{3}$ %	25%	25%	-
----		8000	8000	44000

Stock in process are valued at prime cost and finished stock has been valued at price at which it is received from process III. Sales during the period were ₹ 1400000. Prepare

(a) Process account showing profit element at each stage.

(b) Statement showing actually realized profit.

(c) Stock valuation for balance sheet purposes.

Solution:

Process I account

	Total(₹)	Cost(₹)	Profit(₹)		Total(₹)	Cost(₹)	Profit(₹)
To opening stock	40000	40000	-	By process a/c	288000	216000	72000
To Direct Material	80000	80000	-				
To direct wages	60000	60000	-				
Total	180000	180000	-				
Less closing st	20000	20000	-	Total	288000	216000	72000
To production	160000	160000	-				
overhead	56000	56000	-				
To G. profit a/c $33\frac{1}{3}\%$	216000	216000	-				
cost	72000	-	72000				
Total	288000	216000	72000				
Closing stock	20000	20000	-				

Process II account

	Total(₹)	Cost(₹)	Profit(₹)		Total(₹)	Cost(₹)	Profit(₹)
To opening stock	48000	40000	8000	By process III a/c	600000	404000	196000
To Process I a/c	288000	216000	72000				
To Direct Material	84000	84000	-				
To direct wages	60000	60000	-				
Closing stock	480000	400000	80000	Total	600000	404000	196000
24000	24000	20000	4000				
To production	456000	380000	76000				
overhead	24000	24000	-				
To Gross profit	480000	404000	76000				
120000	120000	-	120000				
	600000	404000	196000				
Closing stock	24000	20000	4000				

Process III A/C

	Total(₹)	Cost(₹)	Profit(₹)		Total(₹)	Cost(₹)	Profit(₹)
To opening stock	32000	24000	8000	By process III a/c	1200000	760000	440000
To Process II a/c	600000	404000	196000				
To Direct Material	120000	120000	-				
To direct wages	64000	64000	-				
Closing stock	816000	612000	204000	Total	1200000	760000	440000
16000	16000	12000	4000				
To production	800000	600000	200000				
overhead	160000	160000	-				
	960000	760000	200000				
To Gross profit	240000	-	240000				
Closing stock	1200000	760000	440000				
16000	16000	12000	4000				

Finished Stock A/C

	Total(₹)	Cost(₹)	Profit(₹)		Total(₹)	Cost(₹)	Profit(₹)
To opening stock	120000	76000	44000	By Sales a/c	1400000	798000	602000
To Process III a/c	1200000	760000	440000				
Closing Stock	1320000	836000	484000				
	60000	38000	22000				
Profit	1260000	798000	462000	Total	1400000	798000	602000
	140000	-----	140000				
Sales	1400000	798000	602000				
Closing stock	60000	38000	22000				

(b) Statement showing actually realized profit

	Apparent Profit from process (₹)	Unrealized profit in o. stock (₹)	Unrealized profit in C. stock (₹)	Actual profit (₹)
Process I	72000	-----	-----	72000
Process II	120000	8000	4000	124000
Process III	240000	8000	4000	244000
Process IV	140000	44000	22000	162000
Total	572000	60000	30000	602000

(c) Stock valuation for balance sheet purposes.

(₹)

Closing stock of process I at Cost = 20000

Closing stock of process II at Cost = 20000

Closing stock of process III at Cost = 12000

Closing stock of finished stock a/c = 38000

Closing stock to be shown in Balance sheet = 90000

Reconciliation:

Opening stock of all the processes (₹) 180000

(Cost) (4000+4000+24000+76000)

+ Cost incurred at each level

Process I	Material	80000	
	Wages	60000	
	Overheads	56000	
Process II	Material	84000	
	Wages	60000	
	Overheads	24000	
Process III	Material	120000	
	Wages	64000	
	Overheads	160000	
Total		708000	708000
Less cost of goods sold		Total	
		888000	
		798000	
Closing stock to be carried to Balance sheet		90000	

Illustration 11: A certain product passes through two processes desired before it is transferred to finished stock. Following information is obtained for the month of a particular year.

Item	Process I (₹)	Process II (₹)	Process III (₹)
Opening stock	7500	9000	22500
Direct material	15000	14000	----
Direct wages	11200	13000	-----
Production overheads	10500	4500	-----
Closing stock	3700	4500	11250
Profit % on transfer price to next process			
Inter process profit on opening stock	25% -----	20% 1500	- 8250

Stock in processes is valued at prime cost and finished stock has been valued at the price at which it was received from process II. Sales during the period were ₹ 140000.

Prepare and compute-

- Process cost accounts showing profit at each stage.
- Actual realized profit.
- Stock valuation for balance sheet purposes.

Solution:

Process I A/C

	Total (₹)	cost (₹)	Profit (₹)		Total (₹)	Cost (₹)	Profit (₹)
To opening stock	7500	7500	-	By process II account	54000	40500	13500
To direct material	15000	15000	-				
To Direct wages	11200	11200	-				
	33700	33700	-				
Closing stock	3700	3700	-				
	30000	30000	-				
To production overheads	10500	10500	-				
To profit @25%on transfer price or 1/3 rd of cost	40500	40500	-				
	13500	-	13500				
	54000	40500	13500		54000	40500	13500
Closing stock	3700	3700	-		-	-	-

Process II A/C

	Total (₹)	cost (₹)	Profit (₹)		Total (₹)	Cost (₹)	Profit (₹)
To opening stock	9000	7500	1500	By process II account	112500	75750	36750
To process I A/C	54000	40500	13500				
To direct material	14000	14000	-				
To Direct wages	13000	13000	-				
	90000	75000	15000				
Closing stock	4500	3750	750				
	85500	71250	14250				
To production overheads	4500	4500	-				

To profit @25%on transfer price or 1/3 rd of cost	90000	75750	14250				
	22500	-	22500				
	112500	75750	36750		112500	75750	36750
Closing stock	4500	3750	750		-	-	-

Finished stock A/C

	Total (₹)	cost (₹)	Profit (₹)		Total (₹)	Cost (₹)	Profit (₹)
To opening stock	22500	14250	8250	By sales A/C	140000	82500	57500
To process II A/C	112500	75750	36750				
	135000	90000	45000				
Less closing stock	11250	7500	3750				
	123750	82500	41250				
To gross profit	16250	-	16250				
Total	140000	82500	57500		140000	82500	57500
To stock carried on	11250	7500	3750		-	-	-

(b)

	Apparent profit(₹)	Unrealized profit		Transferred(₹)	Actual Profit
		Opening stock(₹)	Closing stock(₹)		
Process I	13500	----	----	----	13500
Process II	22500	1500	750	+750	23250
Finished stock	16250	8250	3750	+4500	20750
Total	52250	9750	4500	+5250	57500

(c) Cost of closing stock:	Cost (₹)
Process I	= ₹ 3750
Process II	= ₹ 3750
Finished stock	= ₹ 7500
Total	= ₹ 14950

Work in progress:

In any process at the end of accounting period it may happen that some products are not completed. Some work has to be done for its completion. The problem arises to value the closing stock in hand. The units which are complete may be calculated and valued as full costs are incurred. The stock or the units which are not fully completed can be calculated on the basis of the estimated work done. Let the total cost incurred on complete unit is ₹50 and say there are 10 complete units on which no work is required and 4 such units which are 60% complete i.e. 40% work is still required in respect of the costs. Then in valuation of stock in hand will be done as ₹(50×10×100%+4×50×60%) or equal to ₹(500+120) = ₹620.

The valuation of units which are not completed fully is not an easy job, because of no exact measure of work completed and required. It all depend on the estimation. The estimate should be as accurate as possible near to actuality. The estimate should be as accurate as possible in valuation of the work in progress because any mistake in the valuation will affect the stock valuation and so profit figure'

Meaning of Equivalent Production: As already discussed in the work in progress at the end of the accounting period all the units may not be fully completed. Some of the units may be there which are partially completed. On these units certain percentage of work will be still required for completion. The conversion of in-completed units into completed

ones is known as equivalent production. Let 50 units are such which are partially completed and an estimated 40% of work still required then we say (50×60%) i.e. out of 50 units, 30 units are complete. As already stated it is merely an estimation and no standard measure regarding it, is present. The material on which work is required to be done as has been issued is taken to be completed 100%. On it let 50% of labour work has been done and another 50% of work is still required then the unit will be 50% completed in terms of labour. Similarly we can calculate for other factors of production and value the in-complete units in terms of completed ones.

It is most important that the estimate should be as accurate as possible because any mistake would affect the stock valuation used in preparation of final accounts. The formula of equivalent production is:

Equivalent units of work in progress = Actual number of units in progress of manufacture × percentage of work completed

If actual number of units in progress of manufacture = 80

Percentage of work completed = 60%

Then equivalent units of work in progress = $\frac{80 \times 60}{100}$

= 48 completed units

Let us take an example of a process and try to calculate the amount or units of equivalent production. In the beginning of the process 15000 units are there in the process on which 40% work is complete. 60000 units are transferred to next process as completed units when 55000 units were fed into the process and 10000 in the process on which 50% of work is complete.

Units transferred to next process = 60000

Less opening units which were partially completed = 15000

= 45000

i.e. 45000 units are those which were completed from 0 to 100%

Add equivalent production of opening partially completed units = $\frac{15000 \times (100 - 40)}{100}$

= 9000 units

Add equivalent production of closing stock = 10000 × 50% = 5000 units

Total production during the month = 9000 + 45000 + 5000

= 59000 units

In preparing process accounts taking equivalent production in view three statements are required to be prepared. These are:

1. Statement of equivalent production.
2. Statement of cost.
3. Statement of apportionment of cost to different elements.

Procedure adopted in process costing regarding treatment of equivalent production, related costs can be summarized as.

1. First of all prepare a statement of equivalent production taking into consideration the process losses, degree of completion in opening and closing work in progress.
2. Prepare a statement of cost bifurcating it into various elements of cost such as material, labour and other factors and after properly crediting the value of the normal losses if any sold in the market.
3. Preparing a statement of apportionment of cost so arrived at in the various elements and finding of the cost unit of the related element.

This can be done by dividing the total cost related to the element by the number of equivalent units of production regarding the elements of cost.

4. Evaluate output finished, transferred and work in progress.

The problems on equivalent production and its treatment in process cost can be divided into four parts.

- When there is only work in progress and there is no process loss.
- When there is only work in progress and process losses.
- When there is opening and closing work in progress and no process losses.
- When there is opening and closing work in progress and process losses.

Let us take one by one clear its treatment.

- When there is only work in progress and no process loss.

In these types of problems no process losses either normal or abnormal are there. Only good production and work in progress at the end is there. In these, calculate the equivalent production in the process taking into consideration the degree of completion regarding each element i.e. material, labour and overheads etc.

Let 400 units of the product are complete and 100 units are such on which some work has been done and some work is still pending say 80% work regarding material, 60% of work regarding labour, 60% of work regarding overhead has been completed. Material cost incurred is ₹960, labour cost ₹460 and overhead cost ₹460.

The cost per unit of

$$(a) \text{ Material} = \frac{960}{\text{Equivalent production regarding material}} = \frac{960}{(400+100 \times 80\%)} = \frac{960}{480} = ₹2$$

$$(b) \text{ Labour} = \frac{460}{\text{Equivalent production regarding labour}} = \frac{460}{(400+100 \times 60\%)} = \frac{460}{460} = ₹1$$

$$(c) \text{ Overhead} = \frac{460}{\text{Equivalent production regarding overhead}} = \frac{460}{(400+100 \times 60\%)} = \frac{460}{460} = ₹1$$

Cost of completed units = $400 \times (2+1+1)$

$$= 400 \times 4 = ₹1600$$

Cost of w. i. p. = Material $80 \times 2 = 160$

= Labour $60 \times 1 = 60$

= Overhead $60 \times 1 = 60$

Total cost = ₹280

$$[960+460+460 = ₹1880]$$

Illustration 12: A company manufactures a product which involves two consecutive processes viz. Processing and polishing. For the month of March, 2010 the following information is available:

	Processing	Polishing
Input of units in process	1200	1000
Units completed	1000	500
Units under process	200	500
Material cost (₹)	96000	388000
Conversion cost (₹)	336000	54000

For incomplete units in process, charge material cost @ 100% and conversion cost @ 60% in the processing and 50% in polishing process. Prepare a statement of cost and calculate the selling price per unit which will result in 25% profit on sale price.

Solution:

Statement of equivalent production in processing

Input		Output		Equivalent Production (Units)			
Items	Units	Items	Units	Material		Conversion	
				% of completion	Units	% of completion	Units
Units introduced	1200	Units completed	1000	100%	1000	100%	1000
		Work in progress	200	100%	200	60%	120

			1200		1200		1120

Statement of equivalent Production in Polishing

Input		Output		Equivalent Production (Units)			
Items	Units	Items	Units	Material		Conversion	
				% of completion	Units	% of completion	Units
Units introduced	1000	Units completed	500	100%	500	100%	500
		Work in progress	500	100%	500	50%	250
			1000		1000		750

Statement of Cost in Processing

Element of Cost	Cost ₹	Equivalent Production	Cost per complete unit (₹)
Material	96000	1200	₹80
Conversion	336000	1120	₹300
			₹380

Statement of Cost in Finishing

Element of Cost	Cost ₹	Equivalent Production	Cost per complete unit (₹)
Material	388000	1000	₹388
Conversion	54000	750	₹72
			₹460

Statement of Evaluation

Process	Type of stock	Units	Value ₹
Processing	Completed	1000×(80+300)	380000
	W.I.P	200×80	16000
		120×300	+36000 = 52000
Polishing	Completed	500×460	230000
	W.I.P.	500×388	194000
		250×72	+18000 = 212000

Cost per unit in Polishing process = 388+72 = ₹460

Profit @ 25% on selling price. let it be = ₹x

$$x - 25\% \text{ of } x = 460$$

$$X = \frac{460}{75\%}$$

$$X = ₹613.33$$

(b) When there is work in progress with process losses.

Whenever there are process losses their treatment in process account are same as already discussed i.e. normal losses are deducted from the number of input units and cost is apportioned in the abnormal losses and normal production on the basis of their production. If there is any sale value of the normal loss units the sale value is deducted from the total cost and balance is apportioned in the ratio of normal and abnormal units. For the treatment of W.I.P. equivalent production method is adopted and cost incurred is recovered on the basis of equivalent production.

Illustration 13: During a month 5000 units were entered into the process for completion. A loss @ 5% was estimated normally. After the completion of the process 3500 good units were produced 1000 units were uncompleted and 250 units were wasted and could be sold @ ₹1.00 per unit. The position at the end of the process was.

The units which were not completed yet had be completed in respect of material, labour and overhead as

Material	75% Completed
Labour	60% Completed
Overhead	60% Completed

The cost of 5000 units was ₹15000

Direct material introduced during the process ₹5500

Direct wages amounted to ₹8700

Production overhead incurred were ₹4350

Units scrapped passed through the process, so were 100% completed as regards material, labour and overhead.

Find out

- (a) Equivalent Production
- (b) Cost per unit
- (c) Show necessary accounts

Solution:

Statement of equivalent production

Input units	Output	Units	Equivalent Production					
			Material		Labour		Overhead	
			Qty	%	Qty	%	Qty	%
5000	Normal loss	250	-	-	-	-	-	-
	Abnormal loss	250	250	100	250	100	250	100
	Finished goods	3500	3500	100	3500	100	3500	100
	W.I.Progress	1000	750	75	600	60	600	60
5000		5000	4500		4350		4350	

Statement of Cost

Element of cost	Cost ₹	Equivalent production (units)	Cost per unit ₹
Material:			
Cost of units entered	15000		
Direct Material	5500		
Total	20500		
Less scrapped value of N. loss	-250		
Balance	20250	4500	₹4.5
Direct Labour	8700	4350	₹2.0
Overheads	4350	4350	₹1.0
	33300		

Statement of Valuation

Production	Element of cost	Equivalent production units	Cost per unit ₹	Cost ₹	Total cost ₹
Abnormal loss	Material	250	4.5	1125	
	Labour	250	2.0	500	
	Overheads	250	1.0	250	1875
Finished goods	Material	3500	4.5	15750	
	Labour	3500	2.0	7000	
	Overheads	3500	1.0	3500	26250
Work in progress	Material	7500	4.5	3375	
	Labour	600	2.0	1200	
	Overheads	600	1.0	600	5175
		Total		33300	33300

Process Account

	Units	Amount ₹		Units	Amount ₹
To units introduced	5000	15000	By normal loss	250	250
To direct material	-	5500	By abnormal loss	250	1875
To direct labour	-	8700	By finished goods a/c	3500	26250
Overhead cost	-	4350	By W.I.P. a/c	1000	5175
	5000	33550		5000	33550

Abnormal loss account

	Units	Amount ₹		Units	Amount ₹
To process a/c	250	1875	By cash a/c	250	250
			By cost P&L a/c	-	1625
	250	1875		250	1875

(C) When there is opening and closing W.I.P. but no process losses

In these type of cases where there is no process losses but there is opening as well as closing work in progress, care should be taken in valuation of the opening and closing W.I.P. At what rate the closing work in progress is to be valued. Care should be taken on the material costing method applied i.e. FIFO, LIFO, average or weighted average. In each method, valuation of costing W.I.P. will be different. In first in first out method the closing W.I.P. will be valued

at the latest cost. In LIFO method closing W.I.P. will be valued at the rate on which the opening W.I.P. was present depending on the volume of W.I.P. and similarly in other two cases. Let us take one by one.

- (i) FIFO method:- In this method opening W.I.P. is considered to be completed first and units transferred to next process are taken from the opening W.I.P. The closing W.I.P. units are taken from the new units introduced into the process for production. Let us clear this point through example.

Illustration 14:- 500 units are already there in a process valued as

Material 100% complete Cost ₹1000

Labour 60% complete Cost ₹2000

Overheads 60% complete Cost ₹1000

Total = ₹4000

2500 units of material are entered into process and the cost incurred in the process is:

Material ₹ 2700

Labour ₹17150

Overheads ₹9800

500 units of product are still uncomplete and are in process and degree of completion is :

Material 100%

Labour 50%

Overhead 50%

Prepare the relevant account and value closing W.I.P.

Solution:

Statement of equivalent Production

Production	Units	Material		Labour and overheads	
		% Completion	Equivalent production	% completion	Equivalent production
Opening W.I.P.	500	----	----	40%	200
Completely processed during period (2500-500)	2000	100	2000	100%	2000
Closing W.I.P.	500	100	500	50%	250
Total	3000		2500		2450

Statement of cost

Element of cost	Cost incurred during the year ₹	Equivalent production (units)	Cost per unit ₹
Material	27000	2500	10.8
Labour	17150	2450	7.0
Overheads	9800	2450	4.0
Total	53950		21.8

Statement of valuation

		₹	Total
Opening W.I.P.			
Material	----	----	
Labour	200 @ 7	1400	
Overheads	200 @ 4	800	2200
Closing W.I.P.			
Material	500 @ 10.8	5400	
Labour	250 @ 7	1750	
Overheads	250 @ 4	1000	8150
Units completed			
During process	(2000×21.8)		43600
Total			53950

Process account

Dr			Cr		
	Units	₹		Units	₹
To opening wip.			By finished stock transferred to next		
To material	500	4000	₹(2200+43600+4000)	2500	49800
To Labour	2500	27000			
To overheads		17150	By closing wip	500	8150
		9800			
	3000	57950		3000	57950

Valuation of WIP and transfer on LIFO method

According to this method, units lastly entered in the process are completed first. This assumption will have different impact on the cost of completed units and closing W.I.P. The completed units will be shown at the rate of opening WIP.

Illustration 15:- Let there are 500 units of opening W.I.P. in a particular process whose degree of completion is 50% towards material, labour and overheads and cost is ₹1000 towards material, ₹2000 towards labour and ₹1000 towards overheads. 2500 units are entered into the process. The cost incurred is material ₹17000, Labour ₹3000 and ₹3500 towards overheads. 800 units are in process which are still incomplete and degree of incompleteness is 50%.

Prepare the relevant process accounts and value closing W.I.P.

Solution:**Statement of equivalent production**

Production	Units	Material		Labour		Overheads	
		Degree of Completion	Units	Degree of Completion	Units	Degree of Completion	Units
Opening wip	500	-	-	-	-	-	-
Completed during the process (2500-300)							
Closing W.I.P.	2200	100%	2200	100%	2200	100%	2200
	300	50%	150	50%	150	50%	150
	3000		2350		2350		2350

Total cost incurred during process = (17000+3000+3500)
= ₹23500

Equivalent production = 2350 units

Cost per unit of production = $\frac{23500}{2350} = ₹10$

W. I. Progress = 800 units

500 units from opening stock and 300 units from new introduced units.

Cost of W.I.P. = (1000+2000+1000) + (150×10)
= 4000+1500 = ₹5500

Process Account

Dr			Cr		
	Units	Cost (₹)		Units	Cost (₹)
To opening WIP	500	4000	To process II a/c	2200	22000
To material	2500	17000	To closing WIP (500+300)	800	5500
To labour	-	3000	$₹4000+3000 \times \frac{1}{2}$		
To overheads	-	3500			
Total	3000	27500		3000	27500

(C) Average cost method: In this method the opening W.I.P. and its cost is merged with the production and cost incurred in the current period. An average cost per unit is found out by dividing total cost by total units. This per unit cost is used in finding out the value of inventory i.e. W.I.P. and units transferred (Value) to the next process. This method is beneficial from the point whenever there are fluctuations in the prices whether increasing or decreasing because average is found out in the valuation.

Illustration 16: From the following details prepare statement of equivalent production, statement of cost, statement of valuation and process account through average method.

Opening work in progress:

(2000 units)

Material (100% Complete) = ₹7500

Labour (60% complete) = ₹3000

Overhead (60% complete) = ₹1500

Units introduced into the process = 8000

There are 200 units in process and the stage of completion is estimated to be

Material = 100%

Labour = 50%

Overheads = 50%

8000 units are transferred to the next to the next process.

The process costs for the period are

₹

Material = 100000

Labour = 78000

Overheads = 39000

Solution:

Statement of equivalent production

Production	Units	Material		Labour		Overheads	
		% of completion	units	% of completion	units	% of completion	units
Finished and transferred	8000	100	8000	100	8000	100	8000
Closing WIP	2000	100	2000	50	1000	50	1000
	10000		10000		9000		9000

Statement of cost

	Material ₹	Labour ₹	Overheads ₹
Cost of opening WIP	7500	3000	1500
Cost incurred in the process	100000	78000	39000
Total cost	107500	81000	40500
Equivalent units	10000	9000	9000
Cost per unit	10.75	9.00	4.5

Total cost per unit = 10.75+9+4.5
= ₹24.25

Statement of valuation

	₹
Value of units transferred to next process (8000@24.25)	194000
Value of WIP	
Material 2000 @ 10.75 = 21500	35000
Labour 1000 @ 9.00 = 9000	
Overheads 1000 @ 4.5 = 4500	
	229000

Process account

Dr			Cr		
	Units	₹		Units	₹
To opening WIP	2000	12000	By finished stock account	8000	194000
To material	8000	100000	By W.I.P. A/c	2000	35000
To labour	----	78000			
To over heads	----	39000			
	10000	229000		10000	229000

(d) Weighted average method: Whenever in a process two or more different products are produced then simple average method may give misleading results may not be able to compare the efficiency or performance of the products. In these cases a weighted average method is applied. Weights are attached to the products according to their importance, usefulness, value in the market etc. In order to find cost of

production under weighted average method, statement of weighted average production in terms of points and cost for each type of product should be prepared. The computation will become easy if due consideration to weights or points are given.

Illustration: 17 X company Ltd. Produces three products P, Q and R. Two types of processes are applied as Process I and Process II. Following statement shows the relative importance of P, Q and R in each process I and II.

	Process I (Points)	Process II (Points)
Product P	3	2
Product Q	2	4
Product R	4	3

Production and cost for the product are given as

Production of P = 500

Production of Q = 300

Production of R = 400

Cost is incurred in the processes are:

	Process I (₹)	Process II (₹)
Material	22000	8000
Labour	9000	6000
Overheads	6000	3000
	<u>37000</u>	<u>17000</u>

You are required to:-

- Prepare a statement showing weighted average production for each process.
- Compute the cost for each type of product.

Solution:

Statement showing the weighted average production

Items	Production (units)	Weighted Production	
		Process I	Process II
Product P	500	1500	1000
Product Q	300	600	1200
Product R	400	1600	1200
TOTAL	1200	3700	3400

(i)	Total cost of the process	37000	17000
(ii)	Weighted production	10	5

Statement of cost for each type of product

	Weighted unit	Cost per unit	Total Cost
Product P	(units)	₹	₹
Process I	1500	10	15000
Process II	1000	5	5000
			<u>20000</u>
Product Q			
Process I	600	10	6000
Process II	1200	5	6000
			<u>12000</u>
Product R			
Process I	1600	10	16000
Process II	1200	5	6000
			<u>22000</u>

Total cost allocated = ₹(20000+12000+22000)
= ₹54000

When there is opening as well as closing work in progress and process losses.

In such cases process losses are treated same as discussed in this chapter earlier. The normal losses are charged to other units, scrap value if any is deducted from the total cost incurred and the

balance is divided by rest of units (Units introduced – normal lost units). The same rate is charged to abnormal units as is charged to good units. Equivalent production statement is prepared.

Abnormal units are treated to be same as good units and the degree of completion is taken to be 100% in respect to each element of cost. Abnormal gain if any is also taken to be 100% completed in each element of cost while preparing the equivalent production statement.

Illustration 18: In a process of a company for the production of a product 3500 units were in the opening work in progress whose degree of completion in respect of material was 100% and 60% in the other factors i.e. labour and overheads.

The other information was given was:

Opening W.I.P. = 3500 units (₹35000)

No. of units introduced in the process = 18500

Material cost incurred in the process = ₹100300

Labour cost incurred the process = ₹42600

Overhead incurred = ₹28400

Units in W.I.P. in the end were 5000.

Degree of completion material 90% and labour and overheads 30%

17000 units were transferred to next process.

Normal loss of the process was 10% of total units and scrap value of normal unit lost was ₹2.5 per unit. You are required to prepare

- Equivalent production statement
- Compute cost per unit for each element of cost
- Compute the value of finished stock and the closing W.I.P.
- Prepare process and other accounts

Solution:

Statement of equivalent production

Input units	Output units		Material		Labour		Overheads	
			%	Units	%	Units	%	units
3500	W.I.P. (opening)	3500	-----	-----	40 %	1400	40%	1400
18500	Normal loss	2200	-	- -	---	----	-----	-----
	Finished goods	13500	100	13500	100	13500	100	13500
	Closing W.I.P..	5000	90%	4500	30%	1500	30%	1500
		24200		18000		16400		16400
	Abnormal gain	2200	100	2200	100	2200	100	2200
		22000		15800		14200		14200
	Material cost	100300		94800		42600		28400
	Less scrap value	-5500						
		94800		Per unit ₹6		Per unit ₹3		Per unit ₹2
22000								

Opening W.I.P.	₹	₹
Material	-	
Labour 1400×3	= 4200	
Overheads 1400×2	= 2800	
		7000
Finished goods	13500×11	= 148500
Abnormal gain	2200×11	= 24200
Closing W.I.P. Material 4500×6	= 27000	
Labour 1500×3	= 4500	
Overhead 1500×2	= 3000	
		= 34500

Process Account

Dr			Cr		
	Units	Amount ₹		Units	Amount ₹
To opening W.I.P.	3500	35000	By normal losses	2200	5500
To material	18500	100300	By finished goods		
To direct labour	-	42600	Units 3500 ₹42000**	17000	190500
To overheads	-	28400	Units 13500 ₹148500	5000	34500
To abnormal gain	2200	24200	By closing W.I.P.	----	
Total	24200	230500	Total	24200	230500

Abnormal gain

	Units	₹		Units	₹
To normal loss	2200	5500	By process a/c	2200	24200
By costing P&L a/c		18700			
	2200	24200		2200	24200

Normal loss a/c

	Units	₹		units	₹
To process a/c	2200	5500	By abnormal loss a/c	2200	5500

Illustration 19:

Product X processed by passing the chemical C through four processes where the output of the earlier process becomes the input of the subsequent process. The loss of material expressed as percentage of input is as follows.

Process I – 20%, Process II – 10%, Process III- $16\frac{2}{3}\%$, Process IV- $8\frac{1}{3}\%$. The material lost in each process does not have any resale value.

Calculate: (a) The cost per kg of product X if the cost of chemical 'C' is ₹8 per kg and (b) The capacity of process plants for process I, II, III and IV to hold the material for process expressed in metric tons of input of each process.

If two conditions viz. (i) 20% of the space is to be allowed for chemical reactions and (ii) the output of product X from the final process (Process IV) is expected to be 5 metric tons.

Solution:

(a) Calculation of cost per kg of product X

Cost of chemical C introduced in process I = ₹8 per kg

Process I loss = 20%

$$\text{So cost of output after 1}^{\text{st}} \text{ process} = \frac{\text{₹}8}{(1-20\%)} = \frac{8}{0.8} = \text{₹}10 \text{ per kg}$$

Process II

Input cost of process II ₹ 10

Process loss = 10%

$$\text{Output cost} = \frac{10}{1-10\%} = \frac{10}{0.9} = \text{₹} 11.11$$

Process III

Input cost of process III = ₹11.11

Process loss = $16\frac{2}{3}\%$

$$\text{output cost} = \frac{11.11}{(1-16\frac{2}{3}\%)} = \frac{11.11}{0.833} = \text{₹}13.34$$

Process IV

Input cost of Process IV = ₹13.34

Process loss = $8\frac{1}{3}\%$

$$\text{output cost} = \frac{13.34}{(1-8\frac{1}{3}\%)} = \frac{13.34}{0.916} = \text{₹}14.56$$

(b) Capacity of the plant

Process IV plant

Output from process IV = 5 Tones

Loss = $8\frac{1}{3}\%$

$$\text{Input III} = \frac{5}{(1-8\frac{1}{3}\%)} = \frac{5}{0.9167} = 5.454 \text{ tones}$$

Extra space for chemical reaction 20% = 1.090 tones

Total = 6.544 tones

Plant process III

Output from process plant III = 5.454 Tons

Loss = $16\frac{2}{3}\%$

$$\text{Input from process II} = \frac{5.454}{(1-16\frac{2}{3}\%)} = \frac{5.454}{0.833} = 6.547 \text{ Tons}$$

Extra space 20% = 1.309 Tons

Total = 7.856 Tons

Plant process II

Output from process plant II = 6.547 Tons

Loss = 10%

$$\text{Input from I} = \frac{6.547}{(1-10\%)} = \frac{6.547}{0.9} = 7.274 \text{ Tons}$$

Extra space 20% = 1.455 Tons

Total = 8.729 Tons

Plant process I

Output from process plant I = 7.274 Tons

Loss = 20%

$$\text{Input in plant} = \frac{7.274}{(1-20\%)} = \frac{7.274}{0.8} = 9.093 \text{ Tons}$$

Extra space 20% = 1.819 Tons

Total = 10.912 Tons

Illustration 20: From the information given below regarding the three processes in which the material has to pass through, for completion. Prepare process and other relevant accounts.

Element of cost	Process I	Process II	Process III	Total
Material	5200	3960	5924	15084
Labour	4000	6000	8000	18000
Production overheads	-----	-----	-----	18000

1000 units are entered into process I @ ₹6. Production overheads are absorbed on the basis of labour cost. Information about the normal loss, output and scrap value of normal loss is given as;

Process	Output (units)	Normal loss (units)	Scrap value per unit (₹)
I	950	50	4
II	866	84	8
III	740	126	10

Solution:

Process I account

Dr.			Cr.		
	Total units	Amount ₹		Units	Amount ₹
To material entered	1000	6000	By normal loss	50	200
To material	-	5200	By process II a/c	950	1900
To labour	-	4000			
To production overheads	-	4000			
Total	1000	19200	Total	1000	19200

Process II a/c

Dr.			Cr.		
	units	Amount ₹		Units	Amount ₹
To process I a/c	950	1900	By normal loss a/c	84	672
To material	-	3960	By process II a/c	866	34288
To labour	-	6000			
To production overheads	-	6000			
Total	950	34960	Total	950	34960

Process III a/c

Dr.			Cr.		
	units	Amount ₹		Units	Amount ₹
To process II a/c	866	34288	By normal loss a/c	126	1260
To material	-	5924	By Finished goods stock	740	54952
To labour	-	8000			
To production overheads	-	8000			
Total	866	56212	Total	866	56212

Normal loss a/c

Dr.			Cr.		
	units	Amount ₹		Units	Amount ₹

To process I a/c	50	200	By closing P&L		
To process II a/c	84	672	a/c	260	2132
To process III a/c	126	1260			
Total	260	2132	Total	260	2132

Illustration 21: The product of a company passes through three distinct processes to completion. The processes are A, B and C. From past experience it is ascertained that the loss is incurred in each process as Process A-20%, Process B-5% and Process C-10%.

In each case the percentage of loss is computed on the numbers of units entering the process concerned.

The loss of each process has a scrap value. The loss of process A and B are sold @ ₹5 per 100 units and that of process C @ ₹20 per 100 units.

The output of each process passes immediately to the next process and the finished units are passed from process C into stock

	Process A (₹)	Process B (₹)	Process C (₹)
Material consumed	7000	2500	7000
Direct labour	2000	1000	8000
Manufacturing expenses	1650	760	2710

25000 units have been issued to process A at a cost of ₹20000` the output of each process has been as under:

Process A- 24000 Process B-23000 Process C-20500

There is no work in progress in any process. Prepare process accounts. Calculations should be to the next rupee.

Solution:

Process A account

Dr.

Cr.

	Units	Amount ₹		Units	Amount ₹
To raw material entered	25000	20000	By normal loss a/c	500	25
To material consumed	-	7000	By abnormal loss	500	625
To labour cost direct	--	2000	To process B a/c	24000	30000
To manufacturing expenses	--	1650			
Total	25000	30650	Total	25000	30650

Process B a/c

Dr.

Cr.

	Units	Amount ₹		Units	Amount ₹
To process A a/c	24000	30000	By normal loss a/c	1200	60
To material consumed	-	2500	To process C a/c	23000	34500
To labour cost direct	--	1000			
To manufacturing expenses	--	760			
Abnormal gain A/C	200	300			

Total	24200	34560	Total	24200	34560

Process C a/c

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To process B a/c	23000	34500	By normal loss a/c	2300	460
To material consumed	-	7000	By abnormal loss		
To Direct labour	-	8000	To finished goods a/c	200	500
To Manufacturing exp.	-	2710		20500	51250
Total	23000	52210	Total	23000	52210

Abnormal loss a/c

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To process A a/c	500	625	By cash		
To process C a/c	200	500	a/c $(500 \times \frac{5}{100} + 200 \times \frac{20}{100})(25+40)$	700	65
			By costing P&L a/c		1060
Total	700	1125	Total	700	1125

Normal loss a/c

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To process A a/c	500	25	By normal gain a/c	200	10
To process B a/c	1200	60	By cash a/c	3800	535
To process C a/c	2300	460			
Total	4000	545	TOTAL	4000	545

Normal gain a/c

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To normal loss a/c	200	10	By process B a/c	200	300
To costing P&L a/c	-	290			
Total	200	300	Total	200	300

Illustration 22: Following data relates to process I for a month of a year of ABC Ltd.
Opening WI Progress = 2500 units for ₹25000

Degree of completion Material 100%, Labour and overheads 80%

Input material 24500 units at = ₹90000

Direct labour = ₹60000

Overheads = ₹20000

Closing W.I Progress = 5000 units

Degree of completion material 80%, labour and overheads 40%

Normal process loss 2000 units

Scrap value ₹2.00 per unit

Units transferred to next process (19500+2500) = 22000 units

You are required to:

- Compute equivalent units of production
- Compute cost per unit for each cost element
- Compute cost of finished output and closing W.I.P.
- Prepare process and other accounts

Assume FIFO method is used by the company.

Solution:

Statement of equivalent production and cost

Input units	Output	Units	Material		Labour and over heads	
			%	Units	%	Units
2500	Opening W.I.P.	2500	-	-	20	500
24500	Normal loss	2000	-	-	-	-
	Finished goods	19500	100%	19500	100%	19500
	Closing W.I.P.	5000	80%	4000	40%	2000
		29000		23500		22000
	Less abnormal gain	2000	100%	2000	100%	2000
		27000				
			Cost:90000	21500	Labour	20000
			Less :4000	₹ 86000	60000	₹3perunit
			scrap:86000	₹ 21500	Overheads	₹1perunit
27000				=₹ 4	20000	
				per unit		

Process a/c			Dr			Cr		
	Units	₹				Units	₹	
To opening W.I.P.	2500	25000			By normal loss			
To material	24500	90000			By finished goods	2000	4000	
To direct labour	----	60000			2500 27000			
To overheads	----	20000			19500 156000			
To abnormal gain	2000	16000				22000	183000	
					By closing W.I.P.	5000	24000	
Total	29000	211000	Total			29000	211000	

Normal loss a/c

Dr			Cr		
	Units	₹		Units	₹
To process a/c	2000	4000	By abnormal gain a/c	2000	4000
Total	2000	4000	Total	2000	4000

Abnormal gain a/c

Dr			Cr		
	Units	₹		Units	₹
To normal loss a/c	2000	4000	By process a/c	2000	16000

By costing P&L a/c		12000			
Total	2000	16000	Total	2000	16000

Closing W.I.P.

	Units	Completion	Equivalent Units	Cost per unit ₹	Total ₹
Material	5000	80%	4000	4	16000
Labour	5000	40%	2000	3	6000
Overheads	5000	40%	2000	1	2000
					Total: <u>24000</u>

Cost incurred on opening W.I.P.

	Units	Completion	Equivalent units	Cost per unit ₹	Total
Material	25000	-----	-	-	-
Labour	25000	20%	500	3	1500
Overheads	25000	20%	500	1	500
			Total + opening value		2000 25000
			Total value transferred		<u>27000</u>

Product completely finished and transferred	₹
19500 from present input 19500×8	= 156000
2500 opening W.I.P. completed and transferred	= 27000
Total	<u>22000</u> = <u>183000</u>

Illustration 23: In a manufacturing unit, raw material passes through four processes I, II, III and IV and the output of each process is the input of the subsequent process. The loss in four processes I, II, III and IV are respectively 25%, 20%, 20% and $16\frac{2}{3}\%$ of the input. If the end product at the end of the process IV is 40000 kg, what is the quantity of raw material required to be fed at the beginning of process I and the cost of the same @ ₹5 per kg.

Find out also the effect of increase or decrease in the material cost of the end product for variation of every rupee in the cost of the raw material.

[B. Com. (Hons) Delhi and C.A. inter]

Solution:

Process	Input kg	% of Loss	Loss kg	Output kg
Process I	100	25%	25	75
Process II	75	20%	15	60
Process III	60	20%	12	48
Process IV	48	$16\frac{2}{3}\%$	8	40

Or

Let x be the original input material (quantity) then output after the fourth process taking loss at each process together.

$$X \times (1-0.25)(1-0.2)(1-0.2)(1-0.167) = 0.4X$$

The actual output = 40000 kg

$$\therefore 0.4x = 40000$$

$$X = \frac{40000}{0.4} = 100000 \text{ kg}$$

When cost is ₹5 per kg then the total cost of the raw material fed into the process I will be = 5×100000
= ₹500000

The end product material cost = $500000 \div 40000$
 $= ₹12.5$

So for every rupee unit of input = $\frac{12.5}{5} = ₹ 2.5$ of output

We can say for every rupee increase or decrease in the cost of the raw material the end product cost will increase or decrease by ₹2.5.

Illustration 24: from the data given below calculate:

(a) Equivalent production (b) Cost per unit of equivalent production (c) Prepare the process and other necessary accounts.

Units entered in the process = 6000

Units completed and transferred to next process = 5500

Units in work in progress = 500

Stage or degree of completion in respect to

(i) Material 80%

(ii) Labour 60%

(iii) Overheads 60%

Normal process losses in units = 500

Scrap value of normal loss = ₹1 per unit

Raw material value entered in process = 27500

Direct labour = 15900

Overheads = 10600

Solution:

Statement of equivalent production

Input units	Output		Material		Labour		overheads	
	Item	Units	%	Units	%	Units	%	units
Raw material 6000 units	Normal loss	500	-	-	-	-	-	-
	Units completed and transferred	5500	100%	5500	100	5500	100	5500
	w.i. progress	500	80%	400	60	300	60	300
		6500	-	5900	-	5800	-	5800
	Abnormal gain	500	100	500	100	500	100	500
		6000		5400		5300		5300

Statement of cost

- (i) Cost of material entered = ₹ 27500
Less scrap value of normal loss = 500
Balance cost of raw material used = ₹ 27000
Equivalent production in respect of material = 5400 units
Cost per unit of material obtained = $\frac{27000}{5400} = ₹5$
- (ii) Cost of direct material = 15900
Equivalent production in respect of labour = 5300 unit
Cost per unit labour = $\frac{15900}{5300} = ₹3$
- (iii) Cost of overheads = 10600
Equivalent production in respect of overheads = 5300 units
Cost per unit of overheads = $\frac{10600}{5300} = ₹2$
Total per unit of finished output = (5+3+2)
= ₹10

Process account

Dr			Cr		
	Units	Amount		Units	Amount
		₹			₹

To material	6000	27500	By normal loss	500	500
To labour	-	15900	By finished goods	5500	55000
To overheads	-	10600	By W.I.P. a/c	500	3500
To abnormal gain	500	5000			
Total	6500	59000	Total	6500	59000

Normal loss a/c

	Units	Amount ₹		Units	Amount ₹
To process account	500	500	By cash a/c	-	-
			By abnormal gain a/c	500	500
Total	500	500	Total	500	500

Abnormal gain a/c

	Units	Amount ₹		Units	Amount ₹
To normal loss account	500	500	By process a/c	500	5000
To costing P&L a/c	-	4500	-	-	-
Total	500	5000	Total	500	5000

Valuation of WIP at the end = $\frac{\text{equivalent production}}{\text{units}\times\%\text{completion}}$

Material cost incurred = $500 \times 80\% = 400 \times \text{cost per unit}$
 $= 400 \times 5$

= ₹2000

Labour cost incurred = $500 \times 60\% = 300 \times 3$

= ₹900

Overhead cost = $500 \times 60\% = 300 \times 2$

= ₹600

Total = ₹3500

Valuation of finished goods = $\text{unit} \times \text{cost per unit}$
 $= 5500 \times 10$

= ₹55000

Illustration 25: Following information is submitted for process I of a manufacturing company. The average method of pricing work in process is used.

Work in process on April 1

Material on 1000 units = ₹1800

Labour on 1000 units = ₹2000

Factory overheads on 1000 units = ₹800

Total = ₹4600

Production cost for April :

Material = ₹15600

Labour = ₹18300

Factory overheads = ₹12250

Total = ₹46150

Production completed during April:

1000 units for April 1 work in process

4000 units from products received during April

5000 Total units completed

Work in process on April 30:

800 units --- 25% completed as to material, labour and overheads.

Prepare process account for April.

Solution:Statement of equivalent production

Input		Output		Material labour overheads	
Item	Units	Item	Units	% of Compl.	Units
Work in progress	1000	Opening W.I.P.	1000	-	1000
Units introduced	4800	Units introduced and completed	4000	--	4000
		W.I.P.	800	25%	200
	5800		5800		5200

Statement of cost

Material:

₹

$$\begin{aligned}\text{Total cost} &= 1800 + 15600 \\ &= 17400\end{aligned}$$

Equivalent production = 5200 unit

$$\text{Cost per unit of material} = \frac{17400}{5200} = ₹3.3462$$

Labour:

$$\begin{aligned}\text{Total cost} &= 2000 + 18300 \\ &= ₹20300\end{aligned}$$

Equivalent production = 5200 units

$$\text{Cost per unit for labour} = \frac{20300}{5200} ₹3.9038$$

Overheads:

$$\begin{aligned}\text{Total cost} &= 800 + 12250 \\ &= ₹13050\end{aligned}$$

Equivalent production = 5200 units

$$\text{Cost per unit for overheads} = \frac{13050}{5200} ₹2.5096$$

Total cost per unit = 3.3462 + 3.9038 + 2.5096

$$\begin{aligned}\text{Value of W.I.P.} &= 800 \times 0.25 \times 9.7596 \\ &= ₹1952\end{aligned}$$

$$\begin{aligned}\text{Value of finished goods} &= 5000 \times 9.7596 \\ &= ₹48798\end{aligned}$$

Process account

	Units	Amount ₹		Units	Amount ₹
To opening W.I.P.	1000	4600	By finished stock a/c	5000	48798
To material	4800	15600	By w.ip. progress	800	1952
Labour	-	18300			
Overheads	-	12250			
	5800	50750		5800	50750

Illustration 26: a product passes through processes viz. Process-I, Process-II and Process-III. The normal wastage of each process is:

Process-I 3%, Process-II 6% Process-III 10%

The percentage of normal wastage in each case is computed on the basis of the number of units entering the process concerned. The wastage of Process-I is sold @ 25 paise per unit, that of Process-II sold @ 50 paise per unit and that of Process-III is sold @ ₹1 per unit. 15000 units of crude material were introduced in Process-I @ ₹1 per unit. The other expenses are:

	Process-I ₹	Process-II ₹	Process-III ₹

Material consumed	1500	2250	750
Direct labour	7500	12000	9750
Manufacturing exp.	1575	1425	3015

The output of each process has been as follows:

Process-I = 14250

Process-II = 13650

Process-III = 12012

Prepare process cost accounts and abnormal wastage and abnormal effective accounts.

Solution:

Process-I account

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To raw material	15000	15000.00	By normal	450	112.50
To material	-	1500.00	wastage 3%		
To labour	-	7500.00	value @0.25		
To manufacturing			per unit		
Exp.	-----	1575.00	By abnormal	300	525.00
			loss a/c		
			By process-II	14250	24937.50
			a/c		
Total	15000	25575.00		15000	25575.00

Process-II account

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To Process-I a/c	14250	24937.50	By normal loss a/c		
To material	-	2250.00	@ 3% of 14250 sale	855	427.50
To labour	-	12000.00	value @₹0.50 per		
To manufacturing exp.			unit		
To abnormal gain	-	1425.00	By process-III a/c	13650	40950.00
	255	765.00			
Total	14505	41377.50		14505	41377.50

Process-III account

Dr.			Cr.		
	Units	Amount ₹		Units	Amount ₹
To Process-II a/c	13650	40950.00	By normal loss a/c		
To material	-	750.00	@ 10% of 13650	1365	1365.00
To labour	-	9750.00	sale value @₹1 per		
To manufacturing exp.	-	3015.00	unit		
			By abnormal loss	273	1180.00
			a/c		
			By finished goods	12012	51920.00
			a/c		
Total	13650	54465.00	Total	13650	54465.00

Abnormal wastage a/c

Dr.			Cr.		
	Unit	Amount ₹		Units	Amount ₹
To process-I a/c	300	525.00	By cash		
To process-III a/c	273	1180.00	300@	573	348.00
			0.25=75		
			273@		
			₹1=273		
			By closing	---	1357.00
			P&L a/c		

Total	573	1705.00		573	1705.00

Normal wastage account

Dr.

Cr.

	Unit	Amount ₹		Units	Amount ₹
To process-I a/c	450	112.50	By normal effectiveness a/c	255	127.50
To process-II a/c	855	427.50	By bank a/c	2415	1777.50
To process-III a/c	1365	1365.00			
Total	2670	1905.00		2670	1905.00

Abnormal Effectiveness A/C (gain)

Dr.

Cr.

	Units	Amount ₹		Units	Amount ₹
To normal wastage a/c	255	127.50	By Process a/c	255	765.00
By costing P&L a/c	-	637.50			
Total	255	765.00		255	765.00

Illustration 27: A product passes through three processes A, B and C. 10000 units at the cost of ₹1.10 per unit issued to Process-A. the other direct expenses were as follows:

	Process-A	Process-B	Process-C
Sundry material (₹)	1500	1500	1500
Direct labour (₹)	4500	8000	6500
Direct expenses (₹)	1000	1000	1503

The wastage of Process-A was 5%, Process-B 4%. The wastage of Process-A was sold @ ₹0.25 per unit and that of B @ ₹0.50 per unit and that of C @ ₹1.0 per unit.

The overhead charges were 160% of direct labour. Final product was sold @ ₹10.0 per unit fetching profit of 20% on sales. Find out percentage of wastage in Process-C.

(ICWAI Final, June 1985)

Solution:

Process-A account

Dr.

Cr.

	Units	Amount ₹		Units	Amount ₹
To raw material	10000	11000	By normal loss a/c	500	125
To sundry material	-	1500	By Process-B a/c	9500	25075
To Direct labour	-	4500			
To direct exp.	-	1000			
To overhead charges (4500×1.6)	-	7200			
Total	10000	25200	Total	10000	25200

Process –B a/c

Dr.

Cr.

	Units	Amount ₹		Units	Amount ₹
To Process-A a/c	9500	25075	By normal loss a/c	380	190
To sundry material	-	1500	By Process-C a/c	9120	48185
To Direct labour	-	8000			
To direct exp.	-	1000			
To overhead charges (8000×1.6)	-	12800			
Total	9500	48375	Total	9500	48375

Process-C a/c

Dr.

Cr.

To Process-B a/c	9120	48185	By normal loss a/c = 7.63%	696	696
To direct material	-	1500	By finished stock a/c	8424	67392
To Direct labour	-	6500			
To direct exp.	-	1503			
To overhead charges (6500×1.6)	-	10400			
Total	9120	68088	Total	9120	68088

Normal loss at Process-C is calculated as under:

Let x be the number of good units produced.

Selling price of one unit of a good product = ₹10 (given)

Profit @ 20% on sale price = ₹2

Cost price = ₹8 per unit

$$\therefore x \times 8 + (9120 - x)1 = 68088$$

$$\therefore 7x = 68088 - 9120$$

$$7x = 58968$$

$$X = \frac{58968}{7} = 8424 \text{ units}$$

So good units = 8424

Normal loss = 9120 - 8424 = 696 units

$$\% \text{ of normal loss in Process-C} = \frac{696}{9120} \times 100 = 7.63\% \text{ (app.)}$$

Illustration 28:

RP Ltd. Furnishes you the following information relating to Process-B for the month of October 86:

- Opening work in progress NIL
- Units introduced – 10000 unit @ ₹3 per unit
- Expenses debited to the Process:

₹

- Direct material = 14650
 Labour = 21148
 Overheads = 42000
 (iv) Normal loss in Process- one percent of input
 (v) Closing work in progress – 350 units – degree of completion of material 100% - labour and overheads – 50%
 (vi) Finished output – 9500 units
 (vii) Degree of completion of normal loss: Material 100%, Labour and Overheads 80%
 (viii) Units scrapped as normal loss were sold at ₹1.0 per unit
 (ix) All the units of abnormal loss sold at ₹2.50 per unit

Prepare:

- (i) Statement of Equivalent production
 (ii) Statement of cost of finished goods, abnormal loss and closing work in progress.
 (iii) Process B account

(ICWA inter Dec.1988)

Solution:

Statement of Equivalent Production

Particular	Output	Material		Labour		Overheads	
		%completion	Units	%completion	Units	%completion	Units
Finished goods	9500	100	9500	100	9500	100	9500
Normal loss 1% of input	100	-	-	-	-	-	-
Closing W.I.P.	350	100	350	50	175	50	175
Abnormal loss (balancing)	50	100	50	80	40	80	40
	10000		9900		9715		9715

Cost per unit incurred on factors of production i.e. material, labour and overheads:

Material:

$$\begin{aligned}
 \text{Cost: units introduced } 10000 @ ₹3 &= ₹30000 \\
 \text{Direct material} &= ₹14650 \\
 \text{Total} &= 44650 \\
 \text{Less scrap value of normal loss } (100 \times ₹1) &= 100 \\
 \text{Balance} &= 44550
 \end{aligned}$$

Equivalent production in respect of material = 10000 units

Less normal loss = – 100 units

Balance = 9900 units

Cost incurred per unit of material produced = $\frac{44550}{9900} = ₹ 4.5$

Labour:

Cost incurred = ₹21148

Equivalent production in respect to labour = 9715 units

Cost per unit labour = $\frac{21148}{9715} = ₹2.1768$

Overheads:

Cost incurred = ₹42000

Equivalent production in respect to overheads = 9715 units

Cost per unit overheads = $\frac{42000}{9715} = ₹4.3232$

Total cost per unit = $4.5 + 2.1768 + 4.3232 = ₹11.00$

Statement of cost

- (i) Finished goods = $9500 \times 11 = ₹104500$
(ii) Abnormal loss: Material = $50 \times 4.5 = 225$
Labour = 40×2.1768
Overheads = 40×4.3232 } = 260 = ₹485

(iii) Closing work in progress:

$$\begin{aligned} & \text{Material} = 350 \times 4.5 = 1575 \\ & \text{Labour and overheads} = 175 \times (2.1768 + 4.3232) = 1138 \end{aligned} \quad \left. \vphantom{\begin{aligned} & \text{Material} = 350 \times 4.5 = 1575 \\ & \text{Labour and overheads} = 175 \times (2.1768 + 4.3232) = 1138 \end{aligned}} \right\} = ₹2713$$

Process B account

	Units	Amount ₹		Units	Amount ₹
To units introduced	10000	30000	By normal loss	100	100
To direct material	-	14650	By finished goods a/c	9500	104500
To labour	-	21148	By abnormal loss a/c	50	485
To overheads	-	42000	By closing WIP	350	2713
Total	10000	107798		10000	107798

Abnormal loss account

	Units	Amount ₹		Units	Amount ₹
To process B a/c	50	485	By cash a/c (50 × 2.5)	50	125
			By closing P&L a/c	-	360
Total	50	485	Total	50	485

Practical Problems

Q.1 11000 units of raw material are entered into a process @ ₹1.00 per unit

The other cost incurred in the process are:

- (i) Direct material worth ₹4000
(ii) Direct labour worth ₹5000
(iii) Overhead cost worth ₹4500

Prepare the Process a/c if the output in the process is transferred to the next process as input.

Ans. $\left(\text{Output worth ₹24500 transferred to the next process.} \right)$

Q.2 2000 units of material costing ₹2 per unit are introduced in the Process-I. The past experience record show that 5% of the input in the process are every time wasted. The other cost incurred for completion as a final product are:

$$\begin{aligned} & \text{Direct material} = 1000 \\ & \text{Direct labour} = 1500 \\ & \text{Production overheads} = 1100 \end{aligned}$$

You are required to prepare the Process-I account and find out the cost per unit of the finished product.

Ans. $\left(1900 \text{ units at total cost ₹7600, cost per unit ₹4.} \right)$

Q.3 A product passes through two distinct processes for completion. These processes are P and Process Q. During a month 600 units of the product were produced. The following is the information regarding the cost incurred on various factors of production:

	Process P	Process Q
Direct material	6000	4200
Direct labour	5000	3000

The overhead expenses for the period were ₹4000 apportioned to the process on the basis of wages.

There was no work in progress or process stock at the beginning or at the end. Prepare process accounts.

Ans. (i) overhead expenses apportion Process P = ₹ 2500, Q = ₹ 1500 (ii) output in process valued @ ₹ 22.5 per unit (iii) output in process valued at ₹ 37 per unit

Q4. A product for completion has to pass through three different Processes in the sequence named A, B, C. 1000 units were produced during a month with following expenditure on different processes:

	Process A	Process B	Process C
Direct material (₹)	4500	3500	2500
Direct wages (₹)	3500	2500	1500

Overhead expenses amounted to ₹7500 and were apportioned on the basis of the direct wages incurred in the processes. Main raw material from which the end product is produced was having the value ₹6500. Ignoring the stock at the beginning and at the end prepare process accounts concerned.

Ans. {Cost per unit Process A- ₹18.00, Process B- ₹26.50, Process C- ₹32.00 }

Q.5 The following data is give in respect of Production of 900 units of a product passing through three different processes I, II and III respectively. Output of process I is transferred to process II and the output of II is transferred to process III. The output of Process III which is final, is transferred to the stock for sale.

	Process I	Process II	Process III
	₹	₹	₹
Direct material	7000	6000	4000
Direct labour	7500	4500	3000

Production overheads are apportioned on the basis of the direct material entered in each process and are ₹8500.

The raw material to the value of ₹9000 is entered in Process-I. No opening and closing W.I.P., no loss or gain in the production process is calculated.

Prepare process accounts showing the cost of production per unit at each process level taking input cost into consideration while calculating the cost per unit.

Ans. {Cost per unit of Product Process-I = ₹30.00, Process-II = ₹45.00, Process-III = ₹55.00 }

Q.6. Prepare process account in which input material 5000 units valued @ ₹10 is introduced and there is always a normal loss @ 5% of the quantity of material entered. The other cost information incurred in the process is given as below.

Direct material used ₹10000
Direct wages spent ₹7000
Production overheads ₹6500

Normal loss of material has a sale value in the market and is sold @ ₹2.00 per unit.

Ans. [Finished product per unit = ₹14.6, Norma loss = 250 units, Normal loss units sold = ₹500]

Q.7 Bengal Chemical Co. Ltd. Produced three chemicals during the month of July, 2010 by three consecutive processes. In each process 2% of total weight put in is lost and and 10% is scrap which from Process-I and II realizes ₹100 a ton and from process III ₹20 a ton.

The products of three processes are dealt with as follows:

	Process-I	Process-II	Process-III
Passed on to next process	75%	50%	-
Sent to warehouse for sale	25%	50%	100%

Expenses incurred:

	Process-I		Process-II		Process-III	
	₹	Ton	₹	Ton	₹	Ton
Raw material	120000	1000	28000	140	107840	1348
Manufacturing wages	20500	-	18520	-	15000	-

General expenses	10300	-	7240	-	3100	-

Prepare process cost accounts showing the cost per ton of each product.

[B.Com. (Hons)]

Ans. [Process-I = ₹160 per ton, Process-II = ₹215, Process-III = ₹132.50]

Q. 8 A product is finished in three stages I, II and III. At the first stage quantity of 72000 kg was delivered at a cost of ₹2.50 per kg. The entire material was consumed.

The production particulars along with the allocated expenses were as indicated in the table below:

Stage	Input kg	Output kg	Direct wages ₹	Fixed overhead %	Varying overhead %
I	72000	67680	7500	150	200
II	65000	60125	12000	125	150
III	55600	50000	14500	200 (on direct wages)	250

The producer as was his usual practice assessed his cost at ₹6.77 per kg based on his input expenditure and the finished output. With a selling price of ₹7.50 per kg he estimated his profit at ₹36500. If you do not approve of his assessment of the end results of the operation, convince him of real end results in a tabular form. You should assume the normal wastage as only 5% of input at each stage and any excess wastage should not be allowed to inflate the cost of the end product.

[ICWA Inter Dec, 1989]

Ans.

Cost per unit at stage I-₹3.125, stage II-₹4.0182, Stage III-₹5.7395(aprox.) Selling price-₹7.50, Net profit- ₹63053 Abnormal loss Stage I-₹2250, Stage II-₹6530, Stage III-₹16186

Q.9 Post experience shows that there is always a 5% loss in process A of the company which is needed for the production of 'x'. In a particular period 5000 units of material entered into the process. 4900 good units were produced and transferred to the next process. The other information regarding the cost on the other factors required is given as under:

Direct material = ₹20000
Direct labour = ₹26250
Production overheads = ₹20000

The raw material 5000 units were purchased @ ₹6 per unit.

Prepare the process account if the units wasted as normal loss realized ₹1250 at the rate of ₹5 per unit.

Ans.

Normal loss of material @ 5% = 250 units Transferred to next process 4900 units @ 20 = ₹98000 Abnormal gain in the process = ₹3000 (4900+250 – 5000) = 150 units

Q. 10. The product of a company has to pass through two processes named 'S' and 'T' for completion. From past experience it is ascertained that a normal loss is incurred in each process as Process S - 8%, Process T-10%.

In each case the percentage of loss is computed on the number of units entering the process. The loss of each process possesses a scrap value. The loss of Process S and T are sold at ₹10 per 100 units.

The output of Process S is transferred to Process T and the output of Process T is transferred to stock for sale.

	Process S	Process T
Material consumed (₹)	4500	9000
Direct labour (₹)	3500	7500
Manufacturing expenses (₹)	3350	6540

25000 units have been issued to Process S at the cost of ₹18750. The output of each process is given as under:

Process S : 24000

Process T : 21000

There is no work in progress in any process.

Prepare process accounts.

Ans

Abnormal gain in process S 1000 units, valued at ₹1300.
Normal loss in process S 2000 units, sold at ₹200
Normal loss in process T 2400 units, sold at ₹240
Abnormal loss in process T 600 units, valued at ₹1500
Units produced in process T 21000 units, valued at ₹52500

Q. 11. The product of a company passes through three different processes A, B and C. It is ascertained from past experience that loss in each process is incurred as under:

Process A-2%, Process B-5% Process C-10%

The percentage of loss in each case is computed on the basis of number of units entering the process concerned. The loss of each process has a scrap value. The loss of process A and B is sold @ ₹1 per unit and that of process C at ₹4 per unit.

The company gives you the following information for the month of July, 2010.

2000 units of crude material were introduced in the process A at a cost of ₹8 per unit. Besides this the following were other expenses:

	Process A (₹)	Process B (₹)	Process C (₹)
Material consumed	8000	3000	2000
Direct labour	12000	8000	6000
Works expenses	2000	1000	3000
Output	1950 units	1925 units	1590 units
Stock July 1	200 units	300 units	500 units
Stock July 31	150 units	400 units	---
Stock valuation on July 1, per unit	₹19	₹27	₹36.5

Stock on 31st July, 2010 are to be valued at cost as shown by month's production accounts. Prepare the process accounts.

Ans.	Process A- abnormal loss-10 units, valued at ₹194.
	Process B-abnormal gain-25 units, valued at ₹665.
	Process C-abnormal loss- 52 units, valued at ₹1867.
	Process cost per unit, Process A-₹19.368, Process B-₹26.611, Process C-₹35.90

Q. 12. A product is finally obtained after it passes through three distinct processes. Following information is available from the cost records.

	Process I(₹)	Process II (₹)	Process III (₹)	Total (₹)
Direct material	2600	2000	1025	5625
Direct wages	2250	3680	1400	7330
Production overheads	-	-	-	7330

500 units @ ₹4 per unit were introduced in Process I. Production overheads are absorbed as a percentage of direct wages. The actual output and normal loss of the respective processes are given below:

Process	Output (units)	Normal loss as a percentage of input	Value of scrap (per unit)
Process-I	450	10%	₹2
Process-II	340	20%	₹4
Process-III	270	25%	₹5

Prepare the process accounts and the abnormal gain/loss accounts.

Ans. [Process-I transferred to Process II ₹9000, Process II: Abnormal loss-20 units valued at ₹1000;
Transferred to process III ₹ 17000 : Process III abnormal gain – 15 units valued at ₹ 1200,
Transferred to Finished goods ₹ 21600]

Q.13 A product 'Z' before its production as a final product to be sold in the market, has to pass through three distinct processes L, M, and N the following is the complete information regarding the production of "Z".

5000 units of raw material is supplied to the Process L and in each process there is a normal loss of 4%, 6% and 10% respectively in processes L, M and N. The normal loss at each process has a scrap value and sold at the rate of ₹2, ₹3 and ₹4 in each respective process. There is neither a work in progress in the opening nor closing and opening and closing stock. The output at each process is as it is transferred to next and then to final stock.

Raw material supplied is valued @ ₹10 per unit. The other costs in each process are incurred as under:

	Process L (₹)	Process M (₹)	Process N (₹)
Direct material	5500	8000	4000
Direct labour	3500	3100	3260
Production overheads	1400	1140	3300

Prepare process accounts and other relating accounts.

Ans. [Process L: Normal loss 200 units valued at ₹400, Abnormal loss 300 units valued at ₹3750.
Finished transferred to M 4500 units valued at ₹ 56250
Process M: Normal loss 270 units valued at ₹810, Abnormal gain 170 units at ₹2720.
Output transferred to N 4400 units valued at ₹70400.
Process N: Normal loss 440 units valued at ₹1760, Abnormal loss 460 units valued
at ₹9200, transferred to stock 3500 units valued at ₹70000.]

Q.14 A product passes through three processes A, B and C. The normal loss of each process is as follows:

Process A-3%, Process B-5% and Process C - 8%

Loss of process A was sold at 25 paise per unit, process B at 50 paise per unit and process C at ₹1 per unit. 10000 units were introduced to process A at ₹1.0 per unit. The other expenses were as follows:

	Process		
	A	B	C
Material	2050	2688	2509
Labour	5000	8000	6500
Actual output (in units)	9500	9100	8100

Prepare the process accounts assuming that there were no opening or closing stocks.

Ans. Process A- transfer 9500 units at ₹16625, Abnormal loss 200 units at ₹350
 Process B- transfer 9100 units at ₹27300, Abnormal gain 75 units at ₹225
 Process C-Transfer to finished stock 8100 units at ₹34425, Abnormal loss 272 units at ₹1156

Q. 15 Product 'X' passes through three processes before it is transferred to finished stock. Following is information of the three processes:

	Process			Finished stock
	I (₹)	II (₹)	III (₹)	(₹)
Opening stock	5000	7500	6500	-
Direct material	30000	15000	25000	-
Direct wages	25000	10000	18100	-
Production overheads	25000	16800	14000	-
Closing stock	15000	24000	25000	46000
Profit on transfer price(to next process)	20%	25%	10%	-
Inter process profit for opening stock	-	1500	1000	5000

Stock in process are valued at prime cost and finished stock has been valued at price at which it is received from process III. Sales during the period were ₹250000.

Prepare and compute;

- Process cost accounts showing profit element at each stage.
- Actual realized profit and
- Stock valuation for balance sheet purpose.

Ans. Process-I ₹17500, Process-II ₹37600, Process-III ₹21000
 Finished stock: ₹66000, (b) ₹124435, (c) ₹84860

Q. 16 A certain product passes through three processes before it is completed. The output of each process is charged to next process at a price calculated to give a profit of Process I 20%, Process II 25% and process III $16\frac{2}{3}\%$ on transfer price. The output of process III is charged to finished stock account on a similar basis. There was no WIP progress in the beginning of the year and at the end of any process. Stock in each process has been valued at prime cost of the process. Following data are obtained at the end of 30th September of a year.

	Process I (₹)	Process II (₹)	Process III (₹)	Finished stock(₹)
Direct material	15000	15000	13250	-
Direct wages	8500	7750	6750	-
Production overheads	7850	6900	5000	-
Stock on 30 th Sep.	2350	5900	20000	30000
Sale during the period	-	-	-	90000

From the above information prepare

- Process cost accounts showing the profit element at each stage.
- Actual realized profit
- Stock valuation as would appear in the balance sheet

Ans. [Process-I ₹7250, Process-II ₹20000, Process-III ₹17000
Finished stock - ₹18000, (b) ₹44979 (c) ₹40979]

Q.17 Product 'O' passes through three processes before completion. Processes are named as Process A, Process B and Process C. the other information regarding the processes and the stock is given as under:

	Process A ₹	Process B ₹	Process C ₹	Finished stock ₹
Opening stock	3000	4500	5500	10000
Direct material	23000	18750	12460	-
Direct labour	11000	10750	9540	-
Production overheads	8700	9000	8000	-
Closing sock	3700	9000	28000	-
Profit % on transfers to next process	25%	20%	16 $\frac{2}{3}$ %	-
Inter process profit for opening stock	-	500	600	2000

Stock in process are valued at prime cost and finished stock at the price at which received from Process C. Sales during the period were ₹192500. Prepare and compute:

- Process cost accounts showing profit element at each stage.
- Actual realized profit and
- Stock valuation for balance sheet purposes.

Ans. [Process A-₹14000, B-₹22500, C-₹24000, Finished stock-₹38500 (b) ₹93420 (c) ₹32020]

Q. 18 A product has to go through three distinct processes named P, Q and R before completion. There is no opening or closing W.I.P. in any process. the closing stock kept in any process is valued at prime cost. The produce of the process is passed on to the next one on profit basis on transfer value. The rate of profit on transfer value is at the rate:

Process P-20%, Process Q-25%, Process R- 20%.

The cost incurred in each process is given as under:

	Process P ₹	Process Q ₹	Process R ₹	Finished stock ₹
Opening stock	5000	4000	4500	16000
Material used	25000	15250	13180	-
Direct wages	10000	7750	8520	-
Overhead cost	7500	6380	7220	-
Closing stock	3500	7380	13420	8800
Inter process profit for opening stock	-	300	467	2525

Sales during the period were ₹200000

Prepare:

- Process cost accounts and value profit earned by each process
- Actual realized profit
- Actual stock at the end of the period to be taken to balance sheet

Ans. [(a) Process P-₹11000, Q-₹27000, R-₹32000, finished stock-₹32800
(b) ₹97875
(c) ₹24883]

Reconciliation of Profit –

Dr		Cr	
To opening stock cost –P	5000	By sales	200000
- Q	3700	By closing stock	24883
- R	4033		
Finished stock	13475		
Purchase material – P	25000		
- Q	15250		
- R	13180		
Labour cost – P	10000		
- Q	7750		
- R	8520		

Overhead cost – P	7500		
- Q	6380		
- R	7220		
Net	127008		
Profit	97875		
Total	224883	Total	224883

Q 19. Product B passes through three processes before it is transferred to finished stock. Following information is obtained for the month of march:

	Process			Finished stock (₹)
	I (₹)	II (₹)	III (₹)	
Opening stock	6500	5800	5100	10000
Direct material	27000	23200	13300	-
Direct wages	13000	10000	8800	-
Production overheads	9500	6380	7380	-
Closing stock	3500	10900	15780	8800
Profit on transfer price (to next process)	25%	20%	10%	--
Inter process profit for opening stock	-	1000	1020	1489

Stocks in process are valued at prime cost and finished stock has been valued at the price at which it is received from process III. Sales during the period were ₹ 200000

You are required to

- Prepare cost accounts showing profit element at each stage
- Actual realized profit and
- Value the closing stock for the balance sheet

Ans. [(a) Profit: Process-I ₹17500, II-₹26120, III-₹16600, finished goods-₹32800
(b) ₹87425 (c) ₹29876]

Hint:

Process I A/C

Dr.				Cr.			
Particulars	Total ₹	Cost ₹	Profit ₹	Particulars	Total ₹	Cost ₹	Profit ₹
To Opening stock	6500	6500	----	By process II	70000	52500	17500
“ Direct Material	27000	27000	----				
“ Direct wages	13000	13000	----				
	46500	46500	----				
C. Stock	3500	3500	----				
	43000	43000	-----				
Pro. Overheads	9500	9500	----				
	52500	52500	----				
Profit	17500	-----	17500				
Total	70000	52500	17500				

Process II A/C

Dr.				Cr.			
Particulars	Total	Cost	Profit	Particulars	Total	Cost	Profit
₹	₹	₹			₹	₹	₹
To Opening stock	5800	4800	1000	By process III	130600	87830	42770
“ Process II A/C	70000	52500	17500				
“ Direct Material	23200	23200	----				
“ Direct wages	10000	10000	----				
	109000	90500	18500				
C Stock	10900	9050	1850				
	98100	81450	16650				
Pro. Overheads	6380	6380	----				
	104480	87830	16650				
Profit	26120	-----	26120				
Total	130600	87830	42770	Total	130600	87830	42770

Process III A/C

Dr.				Cr.			
Particulars	Total	Cost	Profit	Particulars	Total	Cost	Profit
₹	₹	₹			₹	₹	₹
To Opening stock	5100	4080	1020	Finished Stock			
“ Process II A/C	130600	87830	42770	A/C	166000	109989	56011
“ Direct Material	13300	13300	----				
“ Direct wages	8800	8800	----				
	157800	114010	43790				
C Stock	15780	11401	4380				
	142020	102609	39411				
Pro. Overheads	16600	7380	----				
	149400	109989	39411				
Profit	16600	-----	16600				
Total	166000	109989	56011	Total	166000	109989	56011

Finished Stock A/C

Dr.				Cr.			
Particulars	Total ₹	Cost ₹	Profit ₹	Particulars	Total ₹	Cost ₹	Profit ₹
To Opening Stock	10000	8511	1489	By Sales A/C	200000	112575	87425
“ Process III A/C	166000	109989	56011				
Total	176000	118500	57500				
C Stock	8800	5925	2875				
	167200	112575	54625				
Profit	32800	-----	32800				
Total	200000	112575	87425	Total	200000	112575	87425

Closing stock for Balance sheet Cost ₹

Closing stock in Process I	= 3500
Closing stock in Process II	= 9050
Closing stock in Process III	= 11401
Finished goods	= 5925
Total	= 29876

Calculation of actual profit:

	Apparent profit (₹)	Opening profit (₹)	Closing profit (unearned) (₹)	Transfer	Actual profit (₹)
Process I	17500	-	-	-	17500
Process II	26120	+1000	-1850	-(850)	25270
Process III	16600	+1020	-4379	-(3359)	13241
Finished goods	32800	+1489	-2875	-(1386)	31414
Total	93020	+3509	-9104	-(5595)	87425

Q. 20. 4000 units of material are put into a process. After a certain period 3500 units are prepared completed in all respects while 500 units are in process which are 90% complete from the point of material preparation, 30% in respect of labour and overheads.

The costs incurred in the process are

Material ₹19750

Labour ₹10950

Production overheads ₹7300

Find out (a) Equivalent production

(b) cost per unit of equivalent production

(c) Prepare Process A account assuming that there is no opening work in progress and process loss.

Ans. $\left[\begin{array}{l} \text{(a) effective units (i) Material: 3950 (ii) labour: 3650 (iii) Overheads: 3650} \\ \text{(b) Cost per unit of equivalent production (i) Material: ₹5, Labour ₹3, Overheads ₹2} \\ \text{(c) Finished stock value: ₹35000, W.I.P.: ₹3000} \end{array} \right]$

Q. 21 15000 units are fed into a particular process where there was no work in process opening nor opening stock of any kind. 10000 units are completed and transferred to next process while 5000 units are still there on which 100% work has been completed in respect to material, 60% work with respect to other costs incurred.

You are required to find out the equivalent production units w.r.t. material and other costs (Labour & overheads). Cost incurred in the process:

Material : ₹96000

Other (Labour & overheads) = ₹390000

Ans. $\left[\begin{array}{l} \text{(a) Effective units: Material- 15000, Other costs – 13000} \\ \text{(b) Cost per unit: Material - ₹6.4, Other costs - ₹30} \\ \text{(c) Goods transferred to the next process: ₹376400, W.I.Process - ₹122000} \end{array} \right]$

Q. 22 In a process ₹62500, ₹34500, ₹22000 has been spent on material, labour and overheads respectively. 12500 units were fed into the process for completion, but at the end of the accounting period It is found that only 10000 units have been completed while 2500 units are incomplete on which more work 40% w.r.t labour, 60% w.r.t. overhead is required to be done.

Please calculate the equivalent production, cost per unit of equivalent production and prepare the process accounts and evaluate the cost of completed units transferred to the next process.

Ans. $\left[\begin{array}{l} \text{(a) Material: 12500, Labour: 11500, Overhead: 11000} \\ \text{(b) Material: ₹5, Labour: ₹3, Overhead ₹2} \\ \text{(c) cost of material transferred = ₹100000, W.I.P. = ₹19000} \end{array} \right]$

Q. 23 3400 units of material were entered in a process for production. 2990 units completed in all respects were produced while 200 units were still in the process and work in progress on which 75% work w.r.t. material, 60% w.r.t. labour and 50% w.r.t. overhead were complete.

5% of the input material was normal loss and having a scrap value and was sold @ ₹2 per unit. The cost incurred during the process was:

Material = ₹9880, Labour = ₹6300, Overhead = ₹3130

You are required to prepare the process account and value the normal loss, finished goods transferred to next process and the work in progress.

Ans. $\left[\begin{array}{l} \text{(a) Equivalent production (i) Material – 3180 units (ii) Labour- 3150 (iii) Overhead – 3130} \\ \text{(b) Value of normal loss 40 units @ ₹6 = ₹240} \\ \text{(c) Finished stock } 2990 \times 6 = 17940, \text{ W.I.P.} = ₹790 \end{array} \right]$

Q. 24 5% of material entering the process is the pre-estimated normal loss having a scrap value ₹2 per unit. No opening work in progress is there but at the close of the process period 300 units are such that on which some work is required to be done for completion.

The completion rate of W.I.P. is material-75%, Labour- 60%, Overhead cost- 50%

The cost incurred on the various elements of cost is:

Material- ₹11010, Labour- ₹7905, Overheads- ₹7815,

Normal production = 2415 units, Units put into process = 2900

Find out the cost of work in progress at the end, the cost of finished goods and abnormal loss if any.

Ans.	W.I.P. = ₹1890	Material 225 units @ ₹4 = ₹900	} = ₹ 1890
		Labour 180 units @ ₹3 = ₹540	
		Overheads 150 @ ₹3 = ₹450)	
	Finished goods – 2415 units = ₹ 24150		
	Abnormal loss = ₹400.		

Q. 25 In a process the expenses on the factors of production are:

Material- ₹ 66710, Labour- ₹ 39300, Overheads- ₹ 26100

14000 units of material are issued for production and the former estimates show that 5% loss is inevitable and each unit normally can be sold @ ₹3 per unit. 12300 good units are produced, but work could not be finished within the period and there are 500 units in the process completed with respect to: Material- 100%, Labour- 60%, Overheads- 50%.

Prepare the cost account for the period showing the value of abnormal loss if any, the finished goods and w.i. progress in the accounts.

Ans.	Equivalent production Material: 13300 units, Labour: 13100 units, Overheads: 13050 units
	Abnormal loss: 500 units @ ₹5000, Finished goods: ₹123000, W.I.P.: ₹3900

Q. 26 During a month 18750 units were introduced into Process-I. The normal loss was estimated at 4%. At the end of the month 16000 units had been produced and transferred to the next process. 1000 units were incomplete and 1000 units had been scrapped. It was estimated that incomplete units had reached a stage in production as follows:

Material – 100% completed

Labour – 75% completed

Overheads – 60% completed

The cost of 18750 units was ₹ 73500

Direct wages amounted to ₹ 53250 Production overheads incurred were ₹ 73500

Units scrapped realized ₹ 2 each

Units scrapped passed through the process, so were 100% completed as regards material, labour and overhead.

Find out (a) Equivalent production

(b) Cost per unit and

(c) Show the necessary accounts

- Ans.** [(a) Material: 18000, Labour: 17750, Overheads: 17600
(b) Material - ₹4, Labour - ₹3, Overheads - ₹2
(c) Abnormal loss - ₹ 9000, Finished goods - ₹ 14400, W.I.P. – 7450]

Q. 27 Find out the equivalent production for the following data under the FIFO method:

Opening work in progress – 2000 units

Degree of completion: Material- 80%, Labour- 60%, Overheads- 60%

Units introduced – 8000 units

Closing work in progress – 3000 units

Degree of completion: Material- 80%, Labour- 60%, Overheads- 60%

Assume there is no process losses.

[B.Com.(hons.) Delhi]

Ans. [Effective units; Material- 7800, Labour and Overheads – 7600 units. each]

Q. 28 The finished products have to pass through the process before completion. There is no process loss but there is opening as well as closing work in progress. FIFO method is used in valuation of the closing stock.

The opening work in progress is valued at ₹ 17900 for 2250 units. The completion percentage is: Material - 100%, Labour - 60%, Overheads - 70%.

18750 units are put into process and at the end 1000 units were still in the process and were incomplete. The degree of completion is: Material-100%, Labour-75%, Overheads-60%.

The information regarding the cost of various factors of production is given as under:

Material- ₹ 75000, Labour- ₹ 58200, Overheads- ₹ 57075

You are required to:

- (i) Find out Equivalent production during the process w.r.t. various elements of cost
- (ii) Value the finished goods transferred to next process
- (iii) Value the work in progress at the end of the process.

- Ans.** [(i) Material: 18750, Labour: 19400, Overheads: 19025
(ii) ₹182225+2250 (opening) = ₹ 184475
(iii) W.I.P. = ₹ 8050]

Q. 29 Using FIFO method, from the data given below compute: (i) The value of finished material transferred to the next process (ii) the value of closing work in progress (iii) Equivalent production regarding material, labour and overheads.

Assume there is no process loss. 400 units are there in opening work in progress. Degree of completion regarding opening W.I.P. : Material – 100%, Labour - 40%, Overheads – 40% valued at ₹ 28000

New units introduced in the process – 2600 units

Closing W.I.P. – 500 units

Completion rate: Material-80%, Labour-60%, Overheads-60%

Cost incurred in the process on Material: ₹ 75000, Labour: ₹ 66000, Overheads: ₹ 52800

- Ans.** [(i) Finished goods = ₹ 196300 (ii) W.I.P. (Closing) = ₹ 25500
(iii) Material- 2500, Labour- 2640, Overheads- 2640]

Q. 30 In a process there were 870 units in the opening which were 100%, 80%, 60% complete from the point of view of Material, Labour and Overheads and were valued at ₹ 10179.

9500 units of material were introduced into the process and the expenses incurred amounted to ₹ 60720 on material, ₹ 41733 on labour and ₹ 32718 on overheads. No normal or abnormal loss occurred but 1000 units were still in process and the degree of completion was 75% from material, 60% from labour and 50% from overheads.

Value the finished goods to be transferred to next process, work in process at the end. Find out the equivalent units of production from the point of view of material, labour and overheads using FIFO method of valuation.

Ans.

Finished goods transferred: ₹ 131180
Work in Progress: ₹ 8950
Equivalent production: Material- 9250, Labour- 9274, Overhead- 9348
Cost incurred per unit: Material- ₹ 6, Labour- ₹ 4.5, Overheads- ₹ 3.5

Q. 31 Roy & Johnson (P) Ltd. Gives the following particulars relating to Process-A in its plant for the month of December, 2010:

Work in progress (opening balance) on 1.12.2010 = 100 units

Cost	₹
Material	9600
Labour	6400
Overheads	12800
Total	<u>28800</u>

Units introduced during the month. ----- 20000

Processing cost incurred during the month:

Material	192000
Labour	72700
Overheads	105850
Total	<u>370550</u>

Output units transferred to process B: 19200

Units scrapped normal @ 5% = 1050

Abnormal = 400

W.I. Progress = 350

Degree of completion:

Material = 100%

Labour and overheads = 50%

The scrapped units fetch ₹ 2 per unit.

Prepare the following statement for Process A for December, 2010 using average method.

(a) Statement of equivalent production

(b) Statement of cost

(c) Statement of evaluation

(d) Process A account.

Ans.

(a) Effective units Material-19950, Labour-19775, Overheads-19775
(b) Cost per equivalent unit: Material-₹10, Labour-₹4, Overheads-₹6
(c) Value of finished goods transferred = ₹ 38400, Abnormal loss = ₹ 8000
Value of W.I. Progress = ₹ 5250

Q. 32 Following information is available regarding Process-A for the month of Feb., 2010:

Production record:

Units in process as on 01.02.2010 = 4000

(All material used, 25% complete for labour and overhead)

Units completed = 14000

New units introduced = 16000

Units in process as on 28.02.2010 = 6000

(All material used, $33\frac{1}{3}\%$ complete for labour and overheads)

Cost records:

Work in progress as on 01.02.2010 –	Material	= ₹ 6000
	- Labour	= ₹ 1000
	- Overheads	= ₹ 1000
	Total	= ₹ 8000

Cost during the month:

	Material	= ₹ 25600
	Labour	= ₹ 15000
	Overheads	= ₹ 15000
	Total	= ₹ 55600

Presuming that average method of inventory is used, Prepare:

- Statement of equivalent production
- Statement showing cost for each element
- Statement of apportionment of cost
- Process accounts for the Process-A

[C.A. Inter]

Ans. [Effective units: Material- 20000, Labour and overheads – 16000
Cost per equivalent unit: Material- ₹1.58, Labour and overhead- ₹1 each
Value of finished stock: ₹50120, Closing W.I.P.: ₹13480, Total of Process-A a/c = ₹63600]

- Q. 33** The following data relates to Process A
Opening work in progress: 3500 units @ ₹ 35000
Degree of completion- Material = 100%
- Labour = 60%
- Overheads = 60%
New units introduced = 36500
Normal loss on units introduced @ 5% = 1825
Abnormal loss = 975
Goods transferred to next process = 33500
Closing work in progress = 3700

Degree of completion:

	Material %	Labour %	Overheads %
Normal Loss	100	80	80
Work in process	100	50	50

Scrap of normal loss sold @ ₹4 per unit

Cost during the process:	₹
Material	350650
Labour	102090
Overheads	102090

Find out under FIFO method:

- Equivalent production w.r.t. material, labour and overheads
- Cost per unit w.r.t. material, labour, overheads units produced
- Value the normal loss, Finished goods transferred to next process, closing W.I.P.
- Prepare the process account

Ans. [(i) Material: 34675, Labour: 34030, Overheads: 34030
(ii) Material: ₹10, Labour: ₹3, Overheads: ₹3
(iii) Normal loss: ₹ 14430, Finished goods: ₹ 523400, W.I.P.: ₹ 48100
(iv) Process account total: ₹ 585930]

- Q.34** The following data relates to Process Q:

- Opening work in process = 4000 units
Degree of Completion – Material 100% ₹ 24000
- Labour 60% ₹ 14400
- Overheads 60% ₹ 7200
- Received during the month of April, 2010 from Process P
40000 units ₹ 171000
- Expenses incurred in Process Q during the month
Material ₹ 79000

- Labour ₹ 138230
Overheads ₹ 69120
- (iv) Closing work in Process: 3000 units
Degree of completion – Material = 100%
Labour & Overheads = 50%
- (v) Units scrapped = 4000 units
Degree of completion – Material = 100%
- Labour and overheads = 80%
- (vi) Normal loss = 5% of current input
- (vii) Special goods realized ₹1.50 each on sale
- (viii) Completed units are transferred to warehouse.

Required: (i) Equivalent unit statement
(ii) Statement of cost per equivalent unit and total cost
(iii) Process Q statement (iv) Any other account necessary
Use FIFO method

[C.A.Inter]

Ans. (i) Equivalent units: Material-38000, Labour and overheads-37700
(ii) Cost per equivalent unit: Material-₹6.50, Labour & overheads-₹5.50,
Total cost of units transferred ₹ 450400, Value of W.I.P.-₹ 27750, Abnormal loss-₹ 21800
Total of Process Q account-₹ 502950

Q. 35 From the following information relating to the month of September of a year, calculate the equivalent production units and the value of finished production and work in progress. Using LIFO method.

Opening work in progress on 1st September = 7500 units

Degree of completion – 50%

Cost ₹

Material = 30000

Labour = 10000

Overheads = 9000

Total = 49000

Units introduced into the process = 18000 units

Cost ₹

Material = 102000

Labour = 68000

Overheads = 51000

Total = 221000

During the period 16000 units were completed and transferred to the next process. Closing W.I.P. on 30th September: 9500 units which were 50% complete.

Ans. [Equivalent units produced: Material-17000, Labour-17000, overhead-17000
Finished goods transferred = 16000 × 13 = 208000
Closing work in process = ₹ 62000
Cost per equivalent unit: Material-₹ 6, Labour-₹ 4, Overhead-₹ 3

Q. 36. Use LIFO method in the process and find out:

- (i) Equivalent production from the point of view of Material, Labour and Overhead.
(ii) Evaluate the value of finished goods produced and transferred to the next process
(iii) The closing work in progress at the end of the period.

The data regarding the process for the specific period is as under:

Opening W.I.P. = 7500 units 50% complete

Cost of opening W.I.P. Material = ₹ 15000,

Labour = ₹10500,

Overheads = ₹8250

Total = ₹33750

Fresh units put into the process: 28000

Cost incurred ₹

Material = 101000

Labour = 75750

Overheads = 50500

Units completed and transferred to next process: 22500

Closing work in progress 5500 units: 50% complete

Ans. [Equivalent units produced, Material, Labour and overheads = 25250
Cost per unit Material: ₹4, Labour: ₹3, Overhead: ₹2
Finished goods transferred: ₹202500, W.I.P.: ₹58500

Q.37 Following data are available in respect of Process-I for February, 2010

- (i) Opening stock of work in progress: 800 units at total cost: ₹4000
- (ii) Degree of completion of opening work in progress:
 - Material – 100%
 - Labour – 60%
 - Overheads – 60%
- (iii) Input of material at a total cost of ₹ 36800 for 9200 units
- (iv) Direct wages incurred: ₹ 16740
- (v) Production overheads: ₹ 8340
- (vi) Units scrapped: 1200. The stage of completion of these units was:
 - Material: 100%
 - Labour: 80%
 - Overhead: 80%
- (vii) Closing work in progress: 900 units. The stage of completion of these units was:
 - Material: 100%
 - Labour: 70%
 - Overhead: 70%
- (viii) 7900 units were complete and transferred to next process.
- (ix) Normal loss is 8% of the total input (opening stock plus units put in).
- (x) Scrap value is ₹4

You are required to: (a) Compute equivalent production.

(b) Calculate the cost per equivalent unit for each element.

(c) Calculate the value of abnormal loss or gain, closing W.I.P. and the units transferred to next process using the FIFO method.

(d) Show the process account for February, 2010.

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Ans. [Equivalent production Material: 8400 units, Labour and overheads: 8370 units
Cost per Equivalent units: Material: ₹4, Labour: ₹2, Overhead: ₹1
Value of finished goods transferred: ₹ 54660, Abnormal loss: ₹2560, Closing W.I.P.: ₹ 5490.]

Q. 38. Product B is obtained After it passes through three distinct processes I, II and III. The following information is obtained from the accounts for the year ending May 30, 1980.

	Total (₹)	I (₹)	II (₹)	III (₹)
Direct material	7542	2600	1980	2962
Direct wages	9000	2000	3000	4000
Production overheads	9000	-	-	-

1000 units at ₹3 each were introduced to Process-I. there is no stock of material or work in process at the beginning or at the end of the period. The output of each process passes direct to the next process and finally to the finished stores.

Production overhead is recovered on 100% of direct wages. The following additional data are obtained:

Process	Output during the week (units)	Percentage of normal loss to input	Value of scrap per unit ₹
I	950	5%	2
II	840	10%	4
III	750	15%	5

Prepare process cost accounts and abnormal loss or gain accounts.

Ans. [Process-I output: 950 units valued at ₹ 9500.
Process-II output 840 units valued at ₹ 16800, abnormal loss 15 units valued at ₹ 300
Process-III output 750 units valued at ₹ 28500, Abnormal gain 36 units valued at ₹1368.]

Q. 39 A product passes through three processes viz. Process-I, Process-II and Process-III. The normal wastage of each process is: Process-I - 3%, Process-II - 6% and Process-III - 10%.

The percentage of normal wastage in each case is computed on the basis of the number of units entering the process concerned. The wastage of Process-I is sold @ ₹0.25 per unit, that of Process-II @ ₹0.50 per unit and that of Process-III @ ₹1.00 per unit. 15000 units of crude material were introduced in Process-I @ ₹1.0 per unit. The other expenses are:

	Process-I (₹)	Process-II (₹)	Process-III (₹)
Material consumed	1500	2250	750
Direct labour	7500	12000	9750
Manufacturing expenses	1575	1425	3015

The output of each process has been as follows:

Process-I: 14250 units; Process-II: 13650 units; Process-III: 12012 units

Prepare process cost accounts and abnormal wastage and abnormal effective accounts.

[A.C.S. Inter]

Ans. [Process-I units transferred to Process-II: 14250, valued at ₹24937.50, abnormal wastage 300 units at ₹ 525.
Process-II: 13650 units transferred at ₹40950. Abnormal gain 255 units at ₹765.
Process-III: Finished goods 12012 units at ₹ 51920, Abnormal wastage 273 units valued at ₹ 1180.

Q. 40 M/S AB Co. Ltd. engaged Process in engineering industry. During the month of April, 2000 units were introduced in Process 'X'. The normal loss was estimated at 5% of input. At the end of the month, 1400 units have been produced and transferred to process 'Y'; 460 units were completed and 140 units after passing through the process fully had to be scrapped in full. The incomplete units had reached the following stage of completion.

Material- 75% complete, Labour and overhead – 50% complete

Following further information is available relating to the product 'X'

Cost of 2000 units = ₹58000

Additional direct material = ₹14400

Direct Labour = ₹33500

Production overheads = ₹16700

Units scrapped realized ₹10 each. Prepare statement of equivalent production, statement of cost, statement of evaluation and Process 'X' account.

[ICWA Inter.]

Ans. [Equivalent Production: Material – 1785 units, Labour & overheads – 1670 units
Cost per equivalent unit: Material ₹ 40, Labour - ₹ 20.06, Overheads - ₹ 10
Abnormal loss 40 units at ₹ 2802. Closing W.I.P. = ₹ 20714, finished goods = ₹ 98084,
Total Process account = ₹122600

Q. 41 A certain product passes through three processes desired before it is transferred to finished stock. The following information is obtained for the month of March, 2010.

Items	Process-I (₹)	Process-II (₹)	Process-III (₹)	Finished stock (₹)
Opening stock	7100	6000	6000	10000
Direct material	29000	23200	13300	-
Direct wages	13000	10800	8825	-
Production overheads	9810	6380	7381	-
Closing stock	4910	11200	32420	16229
Profit % on transfer price to the next process	25%	20%	10%	-
Inter process profits for opening stock	-	1200	600	1921

Stocks in the processes are valued at prime cost and finished stock has been valued at the price at which it was received from Process-III. Sales during the period were ₹ 200000.

Prepare and compute:

(a) Process cost accounts showing profit element at each stage.

(b) Actual realized profit and

(c) stock valuation for balance sheet purposes.

Ans. [(b) ₹101540
(c) ₹48615
Process-I = ₹ 4910, Process-II = ₹ 9280, Process-III = ₹ 23485, Finished stock = ₹ 10940
i.e. 4910+9280+23485+10940 = ₹ 48615.



5. Joint Products and By – Products

When two or more products are produced in the course of processing and each having a considerable high saleable value, then these products are called joint products. In the fractional distillation of crude oil in the oil refinery we get various products that are used as fuel such as petrol diesel, kerosene, gasoline Gas etc. These are equally important and so known as joint products.

By-products: By-products are outputs of some value produced incidentally in manufacturing something else (main product). Examples of by product can be in a timber industry main product is timber and in the process sawdust and bark are produced and are called by-products. These products (sawdust and bark) have a relatively low value in comparison with the timber. In sugar industry molasses produced is a god example of by product.

Split –off point: The point at which these several products emerge as separable individual units is a split off point. Before this point, the product forms a homogeneous whole. After the split off point i.e. the points where these products are separated from the main material in a process, these products may or may not go further processing depending upon its utility at this point or a further processing point.

Joint Cost: The cost which is incurred before the point of separation are known as joint costs. As these costs are heavy and separate joint products have to bear it separately in order to know profitability or for other managerial decision making purposes. These costs are also called as pre – separation costs or common costs. These costs are shared by the joint products alone. The by –products do not pick up a share of the costs, like normal loss.

Objective of joint cost analysis: As already discussed in order to know the profitability of different joint products the joint cost, separately allocation to these becomes necessary and also taking various type of managerial decision the separation of the joint cost becomes necessary. The various main objectives of the joint cost analysis and allocation are summaries below.

1. **For determining product profitability:** It is very important at managerial level to know that profitability of the different products. Though overall profits remains the same but in order to allocate the cost at the split office point cost analysis is necessary and to know the contribution made by each product to the overall profit.
2. **For valuation of stock and work in progress:** Cost analysis and its allocation (i.e. joint costs) is also necessary for the valuation of the stock and work in progress at the end of the period of the different products emerging as joint in a process.
3. **For setting selling prices of the product:** Price fixation of a product demands to know the cost incurred on the product. Hence the allocation of the joint cost to the products to be priced in the market becomes necessary.
4. **For setting cost plus contracts:** For cost plus pricing contracts the allocation of the joint costs becomes essential.
5. For determining the impact to change in the product mix and output variations.
6. **For cost control and decision making:** Cost control being the ultimate aim of the organization for survival and capture of the market through presenting the quality product at minimum price, it becomes necessary to allocate the joint cost to the product. Regarding process further and sell at the split off point i.e. taking decision at the management level also made it necessary to allocate the common costs to the products.

Methods of apportionment of joint costs: Following methods are commonly used for apportionment of the joint costs among the joint products up to the point of separation:

- 1. Average unit cost method :** Under this method the total cost up to the point of separation is ascertained and is divided by the number of total units of the products produced. This method can be used when the joint product can be expressed in the same common unit. One of two major drawbacks in this method is that this cannot be applied if the joint products cannot be measured in the same unit such as one may be measured in mass i.e. kilograms and the other may be in volume or litres. All the products under this method if can be measured in same common unit will be priced same though of the different grades in quality. In this case the customers will be benefitted by purchasing the product of high quality at the same price.

Merits of Average unit cost method:

1. It is very simple to use.
2. It is logical because all the products measured in same units are prepared from the same material.
3. Under this method all the joint products will have the uniform cost.

Demerit of Average unit cost method:

1. It is not useful and cannot be applied in a situation where joint products cannot be measured in the same common unit.
2. Illogical from the point of view of the quality of the joint product. Different grades products will have the same cost which is not fair.
3. Method cannot be used for setting prices in the highly competitive market.

Illustration I: From the particulars given below find out the cost of joint products A, B and C under average unit cost method.

Pre – separation Cost ₹ 80,000

Products	Unit produced
A	1,000
B	600
C	400
Total	2000

Solution:

Pre separation Cost = ₹ 80,000

Unit produced = 2,000

Average cost per unit = $\frac{80000}{2000} = ₹ 40$

Products	Units	Average unit Cost (₹)	Total Cost (₹)
A	1000	40	40,000
B	600	40	24,000
C	400	40	16,000
	Total		80,000

Illustration 2:

In a timber industry, the milling operating to the split off point during a period amounted to ₹ 9,000 with the following production.

	Unit
First Grade timber	700
Second Grade timber	600
Third Grade timber	500
	1800

You are required to apportion the joint costs on average unit cost method.

Solution: Apportionment of joint cost in Average unit cost method.

Items (1)	Units (2)	Average unit cost (₹) (3)	Apportioned joint cost (₹) (4)
First Grade	700	$\frac{9000}{1800} = ₹ 5$	3500
Second Grade	600	₹ 5	3000
Third Grade	500	₹ 5	2500
Total	1800	-----	9,000

2. **Physical unit method:** This method can be used for separation of joint costs and its apportionment if the joint products are capable of being measure in the same units. For example if the products are in liquid form then a common unit for the products can be the volume of the product produced. In such cases the joint costs can be apportioned in the ratio of the joint products and loss if any in the process of production is also apportioned in the same ratio.

Merits:

1. The method is easy to operate.
2. It is technically sound and logical to understand.

Demerits:

1. The method is based on the assumption that the by products can be measured in the same units but situation are not always the same. Situation may arise e.g. one product is in liquid from and another in the solid form. Solids can be measured in units of mass and the liquids in the units of volume. So in some situations method cannot be used.
2. Though the joint products can be measured in the same units still the method of apportionment on physical unit method base is not logical because quality concept is ignored. Some unit cost is allocated to different quality joint products. If the joint products are to be sold at the split off point then market value of all the products will be same irrespective of the quality. Which is not fair for the consumers.

Illustration 3:

A company is using 10,000 kgs of a raw material to produce four different products A, B, C and D. The joint cost up to the point of separation is ₹ 1,80,000. You are required to apportion the common costs on the physical unit basis. The production record of the products is as under:

Product A	3500 Kgs
Product B	2500 Kgs
Product C	1800 Kgs
Product D	1200 Kgs

Solution:

	Products			
	A	B	C	D
Output (Kgs)	3500 kg	2500 kg	1800 kg	1200 kg
Joint Cost (Apportioned)	₹ 70,000	₹ 50,000	₹ 36,000	₹ 24,000
				= ₹ 180,000
$A = \frac{180000}{9000} \times 3500$ $@ ₹ 20$				

Illustration 4:

A coke manufacturing company produces following products by using 6000 Tons of Coal.

Coke	4100 Tons	Tar	1000 Tons
Sulphate of ammonia	52 Tons	Benzol	48 Tons
Gas	800 Tons		

Apportion the joint cost to the products which is ₹ 42000 on the basis of physical unit method.

Solution:

Products	Production in Tons	Percentage	Apportioned common cost (joint cost) (₹)
Coke	4100	$68\frac{1}{3}\%$	28,700
Tar	1000	$16\frac{2}{3}\%$	7,000
Sulphate of ammonia	52	$0.8\frac{2}{3}\%$	364
Benzol	48	0.8%	336
Gas	800	$13\frac{1}{3}\%$	5,600
Total	6,000	100%	42,000

3. **Survey method:** This method has a merit over the above mentioned two methods. It is based on the technical survey of all the factors involved in production technical of the products. This method is also known as point method under this method joint cost is apportioned on the basis of percentage/ point value assigned to the

products according to their relative imparlance. This method is more acceptable depending upon the advice of the technical experts in the production side.

Illustration 5:

X company is producing three product M, N and O in a single process and ₹ 85,000 is incurred up to the point of separation. The technical experts taking into various relative considerations are of the view that M is of high quality. N is of medium and O is low quality product and have attached 5, 4 and 3 points to the products respectively. Production: Product M= 2300 units, product N= 1000 units, product O= 500 units.

Allocate the joint cost to the products taking into account the technical experts consideration.

Solution:

Allocation of joint costs to joint products

Products	Units produced	Points attached	Equivalent units	Apportioned cost	Cost Per unit
M	2300	5	11500	* ₹57500	₹ 25
N	1000	4	4000	₹ 20000	₹ 20
O	500	3	1500	₹ 7500	₹ 15
Total	3800	---	17000	₹ 85,000	—

$$* ₹ \frac{85000}{17000} \times 11500 = ₹57500$$

Merits of survey method:

1. Allocation of joint cost is based on the survey depending upon the advice of the expert and so more acceptable and nearer to reality.
2. High quality products have to bear more cost as compared to the low quality products.

Demerits of survey method:

1. The points attached to the different quality or grades of joint products is arbitrary so the cost allocated to the joint cost will also be arbitrary.
2. When weights are attached once, the points or weight attached becomes standard in future and situations may arise where the allocated joint costs may be for away from reality in future.

Illustration: 6:

A canning merchant supplies you the following production data during the year 2012.

Graders	Units Produced
A	5,000
B	8,000
C	10,000

The pre-separation cost incurred was ₹ 2,07,000. The joint cost is apportioned on technical evaluation based on proportion of 5:3:2 to three grades respectively. Apportion the joint cost.

Solution:

Apportionment joint cash by survey method

Items	Units	Points attached	Equivalent units	Cost per equivalent ₹	Apportioned cost ₹	Cost per unit
Grade A	5000	5	25000	3*	75,000	₹ 15
Grade B	8000	3	24000	3	72,000	₹ 9
Grade C	10000	2	20000	3	60,000	₹ 6
Total	23000	—	69,000	—	2,07,000	—

$$* = \frac{207000}{69000} = 3$$

4. Contribution method: Under this method joint costs are apportioned to the products on the basis of the contribution of the products. Variable cost up to the point of separation is allocated to the products on the basis of the units produced or the weights of the product. If the products are further processed after separation then variable cost after separation is also found out and contribution is calculated and the fixed cost before separation is calculated and apportioned on the basis of the contribution made by each of the products.

Merits of contribution method:

1. This method is easy to operate.
2. Sales value less variable cost is the contribution. So this method of allocating the joint cost on the basis of contribution is the best way of allocation.
3. Various other managerial decision under this method are possible to be taken at the management level such as maximizing the profitability, product mix etc.

Demerits of the method:

1. Separating the joint cost into variable and fixed cost is a cumbersome problem. So method becomes difficult to operate.
2. Applicable in situations where marginal cost technique is applied.

Illustration 7:

From the information given below apportion the joint cost to the products X and Y incurred in a production process.

Number of units of X produced	=	4000
Number of units of Y produced	=	2000
Selling price of X (₹)	=	40
Selling price of Y (₹)	=	25
Joint variable cost (₹)	=	60,000
Joint fixed cost (₹)	=	50,000

Solution:

Apportionment of variable cost to the products

(On the basis of Units produced)

$$\text{Product X} = ₹ \frac{60000}{6000} \times 4000 = ₹ 40,000$$

$$\text{Product Y} = ₹ \frac{60000}{6000} \times 2000 = ₹ 20,000$$

Total contribution in respect of product X = sales value – variable cost

$$= (4000 \times 40) - 40000 = ₹ 120,000$$

Total contribution in respect of product Y

$$= (2000 \times 25) - 20000 = ₹ 30,000$$

Ratio of total contribution = X: Y = 120000 : 30000

$$= 4:1$$

$$\text{Apportioned fixed cost on product X} = \frac{50000}{5} \times 4$$

$$= 40,000$$

$$\text{Product Y} = \frac{50000}{5} \times 1 = 10,000$$

Total joint cost apportioned

$$\text{Product X} = ₹ 40000 + 40000 = ₹ 80,000$$

$$\text{Product Y} = ₹ 20000 + 10000 = ₹ 30,000$$

Illustration: 8

A firm produces 3 grades A, B and C of pickles at a total cost of ₹ 2,095 of which fixed costs are ₹ 975. The quantity produced and sold are 50kg, 30 Kg and 60kg and the selling price respectively are ₹ 18, ₹ 16 and ₹ 15 per kg. Apportion the joint costs on a suitable method.

$$\begin{aligned} \text{Joint variable cost} &= ₹ (2095 - 975) \\ &= ₹ 1120 \end{aligned}$$

$$\begin{aligned} \text{Total Production} &= 50 \text{ kg} + 30 \text{ kg} + 60 \text{ kg} \\ &= 140 \text{ kg} \end{aligned}$$

$$\begin{aligned} \text{Joint Variable cost per unit} &= \frac{1120}{140} \\ &= ₹ 8 \end{aligned}$$

Products	Sales Value ₹	Variable cost ₹	Contribution ₹	Fixed Cost ₹	Total joint Cost Appportioned ₹
Grade A	50 × 18 = 900	50 × 8 = 400	500	*420	820
Grade B	16 × 30 = 480	30 × 8 = 240	240	202	442
Grade C	15 × 60 = 900	60 × 8 = 480	420	353	833
Total	₹ 2280	1120	1160	975	2095

$$* ₹ \frac{975}{1160} \times ₹ 500 = ₹ 420$$

5. **Market Value method:** In this method of apportionment of joint cost market value of the products is taken to be the basis. Some of the cost accountants are in favour of this method of apportionment. They are of the

view that the product with higher sales value should get the higher share in the joint cost and that with lower sales value should get the lower share of the joint cost.

The supporters of this method are of the view that cost would not be incurred unless joint products generate enough revenue to cover all costs plus a reasonable return. In this method every product will contribute a certain amount to the overall profit.

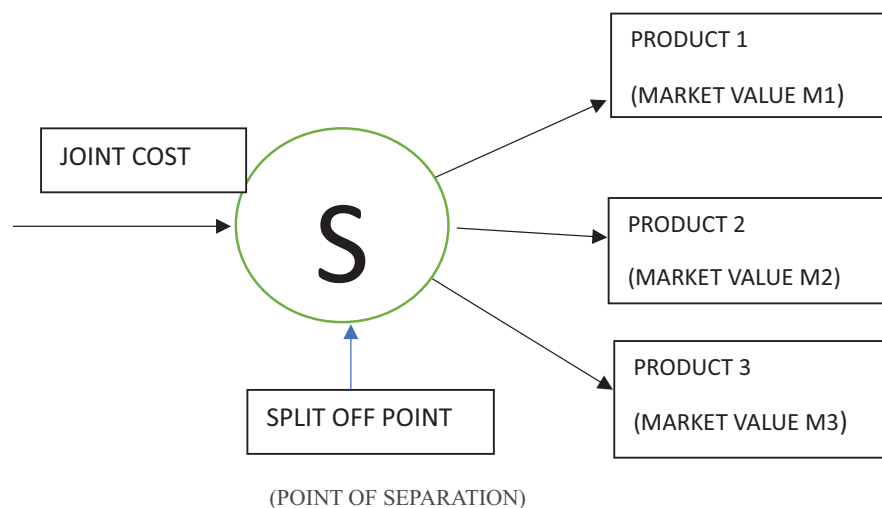
There are certain limitations:

1. Selling prices of certain products may be stable but in general selling prices do not remain stable and get changing in competitive market or otherwise in a changing selling price situation the method becomes very difficult to operate.
2. Determination of selling price at the split off point is another problem in this method. Determination of selling price at split off point is difficult as well as time consuming process.

Two methods are used in apportionment of joint costs to joint products under market value method. One is market value at split off point and another is market value after incurring further cost i.e. post separation cost.

(a) Market value at the split off point:

In this method as already discussed the joint costs are allocated on the basis of market value or saleable value of the product at the split off point.



$$\begin{aligned}
 \text{JOINT COST APPORTIONED TO PRODUCTS} &= \text{JOINT COST APPORTIONED TO PRODUCT 1} + \text{JOINT COST APPORTIONED TO PRODUCT 2} + \dots \\
 &= \left[\frac{\text{Joint Cost}}{M1+M2+\dots} \times M1 \right] + \left[\frac{\text{Joint Cost}}{M1+M2+\dots} \times M2 \right] + \dots
 \end{aligned}$$

This method is generally used in the timber industry and oil refinery. The main difficulty faced is the determination of the selling price of the products at the split off point. Another difficulty that is faced if we know the selling price the selling price go on changing regularly. So method is though not impossible but difficult in practical.

Illustration: 9

A company is producing three products M, N and Q. A joint cost of ₹ 67,500 is incurred in the process at the point of separation. Allocate the joint cost of the product on the bases of sales value if the products selling price of sold in the market after split off is ₹ 30, ₹ 40 and ₹ 45 respectively. The number of units of the products M, N and Q produced at the split off point are 200, 300, 350 respectively.

Solution:

Apportionment of Joint Cost

Product	Number of units produced (units)	Selling Price per unit ₹	Sales Value ₹	Apportioned Joint Cost to Products ₹
M	200	30	6,000	*12,000
N	300	40	12,000	24,000
O	350	45	15,750	31,500
Total	850	—	33,750	67,500

Hint * $\frac{67500}{33750} \times 6000 = ₹ 12000$

- (b) **Market Value after split off point:** This method of appointment of joint costs to the products is easy to operate because the market price after further processing cost and ready to sale is easily available from the market. The drawback in this method is that it is sometimes though not always unfair, because in situations where further processing costs of the products are of too much difference. The joint cost is apportioned on the basis of the sales value of the product. Let us take an example to clear this point.

Illustration 10:

Joint products X, Y, and Z are separated at a split off point S in a process. The cost incurred up to the point S i.e. separation is :

Raw Material Used	Units		Value (₹)
M (1)	1000	@ ₹ 1.5	1500
M (2)	1500	@ ₹ 2	3000
Direct Labour :	₹ 500		
Manufacturing overheads:	₹ 1000		

The products X, y and Z are further processed and after completion are saleable in the market.

The selling price and other data regarding products is as under:

Product	Quantity produced (Units)	Selling price (₹)	Sales Value (₹)
X	500	15	7500
Y	400	10	4000
Z	250	14	3500
			15000

Joint costs are to be apportioned on the basis of market value. Show your working.

Solution: Let us first of all find out the total joint cost.

Raw material used		₹	₹
M (1) 1000 units @ 1.5	:	1500	
M (2) 1500 units @ 2	:	3000	4500
Direct Labour	:		500
Manufacturing overheads	:		1000
	Total:		6000

Apportionment of joint cost to products (market value basis)

Product	Quantity produced (Units)	Selling Price Per Unit: (₹)	Sales Value ₹	Joint cost apportioned ₹
X	500	15	7,500	3,000*
Y	400	10	4,000	1,600
Z	250	14	3,500	1400
Total	1150	—	15000	6000

$$* = \frac{6000}{15000} \times 7500 = 3000$$

- (c) **Net reliable value method:** Under this method net reliable value is found out after deducting the profit margin attached to the product, further processing cost, the distribution and selling cost from the total sales value of the product. This method is fair because there is an attempt to know the value of the product at the point of separation. We can clear the method from the following example.

Illustration: 11

From the information given below regarding the production of three products R, S and T prepare a statement for the company showing apportionment and allocation of joint costs to the products.

- (a) The products has to undergo a joint process in which two types of raw “MP” and “MS” are used. 2000 lbs of 'MP' @ ₹ 2.91 and 2300 lbs of 'ML' @ ₹ 2.6 are required in the process. The direct labour and other overheads absorbed in the process are ₹ 8000 and ₹ 4200 respectively.
- (b) After the point of separation, the products has to undergo further processing which is as under:

Product	Unit Produced	Further processing cost (₹)	Cost of finishing ₹	selling & Distribution cost (₹)	Total ₹
R	2800	9620	4100	6000	19720
S	2500	8690	3200	4090	15980
T	1700	5840	2700	2600	11140
Total	7,000	24,150	10,000	12,690	₹ 46840

(c) The products sale price in the market is

Product R: ₹ 15 per unit

Product S: ₹ 14 per unit

Product T: ₹ 12 per unit

Further allocate costs up to the point of separation on the basis of net reliable value if markup profit is 25% for R, 20% for S and 15% for T on the selling price.

Solution: Statement of apportionment of Joint cost

(Net realizable value method)

Particulars	Products			Total
	R	S	T	
Total value:	₹	₹	₹	₹
R: $2800 \times 15 = 42000$ S: $2500 \times 14 = 35000$ T: $1700 \times 12 = 20400$	42,000	35000	20400	97400
Less : Profit				
R @ 25% on S.P. = 3.75	10500	7,000	3,060	20,560
S @ 20% on S.P. = 2.80				
T @ 15% on S.P. = 1.80				
Total cost of sales	31,500	28000	17,340	76,840
Less cost of sales after split of point	19,720	15,980	11,140	46,840
Estimated cost at split off point	11,780	12,020	6200	30,000
Product	Join cost apportioned to Joint products			
R $\left(\frac{24000}{30000} \times 11780\right)$	₹ 9,424			
S	₹ 9616			
T	₹ 4960			
Total	₹ 24,000			
Joint cost				
Raw material	₹			
"MP" 2000lbs @ 2.91/ –	5820			
"ML" 2300 lbs @ 2.6/ –	5980			
Direct Labour :	8,000			
Other overheads :	4200			
Total :	24000			

Illustration12:

The sunrise oil company purchases crude vegetable oil. It does refining of the same. The refining process results in four products at the split off point: M, N, O and P.

Product O is fully processed at the split off point. Product M, N and P can be individually further refined into 'super M', 'Super N', and 'Super P'. In the most recent month (October 2006) the output at split off point was.

Product M	3,00,000 gallons
Product N	1,00,000 gallons
Product O	50,000 gallons
Product P	50,000 gallons

The joint cost of purchasing the crude vegetable oil and processing it was ₹ 40,00,000.

Sunrise has no beginning or ending inventories. Sales of product O in October were ₹ 20,00,000. Total output of Products M, N, and P was further refined and then sold. Data related to October, 2006 are as follows:

	Further processing costs to make super products	Sales
'Super M'	₹ 80,00,000	₹ 1,20,00,000
'Super N'	₹ 32,00,000	₹ 40,00,000
'Super P'	₹ 36,00,000	₹ 48,00,000

Sunrise had the option of selling products M, N and P at the split off point, This alternative would have yielded the following sales for the October, 2006 production:

Product M	₹ 20,00,000
Product N	₹ 12,00,000
Product P	₹ 28,00,000

You are required to answer:

- (i) How the joint cost of ₹ 40,00,000 would be allocated between each product under each of the following methods.
 - (a) Sales value of split off point. (b) Physical output (gallons) and (c) estimated net realizable value.
- (ii) Could sunrise have increased its October, 2006 operating profit by making different decision about the further refining of product M.N or P? Show the effect of any change you recommend on operating profits.

Solutions:

- (a) Statement showing allocation of joint costs to products on sales value at split off point basis.

October 2006

Product	Quantity Produced	Sales value at split off point	Allocated Joint cost to the products
	Quantity	₹	₹
M	3,00,000 gallons	20,00,000	10,00,000
N	1,00,000 gallons	12,00,000	6,00,000
O	50,000 gallons	20,00,000	10,00,000
P	50,000 gallons	28,00,000	14,00,000
Total	500,000 gallons	80,00,000	40,00,000

b) Statement showing allocation of joint cost to products on output (quantity) basis

October 2006		
Product	Quantity Produced	Allocated Joint cost to the products
	gallons	₹
M	3,00,000	24,00,000
N	1,00,000	8,00,000
O	50,000	4,00,000
P	50,000	4,00,000
Total	5,00,000	40,00,000

c) Statement showing allocation of joint cost to products on 'Net realizable value' method.

Product	Sales value after split off (₹)	Further processing cost (₹)	Net realizable value (₹)	Allocated Joint Cost to the products (₹)
'Super M'	120,00,000	80,00,000	40,00,000	20,00,000
'Super N'	40,00,000	32,00,000	8,00,000	4,00,000
'O'	20,00,000	— — — —	20,00,000	10,00,000
'Super P'	48,00,000	36,00,000	12,00,000	6,00,000
Total	228,00,000	148,00,000	80,00,000	40,00,000

(ii) For the decision whether the products should be processed further Differential cost. Differential revenue comparison will be helpful.

Product	Differential Cost ₹	Differential Revenue ₹	Profit/Loss in further Processing ₹
'Super M'	80,00,000	120,00,000 – 20,00,000 = ₹100,00,000	+20,00,000
'Super N'	32,00,000	40,00,000 – 12,00,000 = ₹28,00,000	– 4,00,000
'Super P'	36,00,000	48,00,000 – 28,00,000 = ₹20,00,000	– 16,00,000
Total	148,00,000	148,00,000	– Nil

From the above analysis it is clear that it is of no use to process Products N and P into 'Super N' and 'Super P' the company should process product M into Super M which will further increase the profit to be earned by selling all the other products at the split off point by ₹20,00,000.

Total Profit will be

Profit statement

Sales value		₹
"Super M" (Further Process)		120,00,000
Product N (Sold at split off)		12,00,000
Product O (Sold at Split off)		20,00,000
Product P (Sold at split off)		28,00,000
		1,80,00,000
Less cost:		
Joint cost	40,00,000	
Further Processing	80,00,000	
(Super M) cost	120,00,000	
Profit		60,00,000

Profit at split off point i.e. not processing further any of the product after split off point = (20,00,000 + 12,00,000 + 28,00,000 + 20,00,000) – (40,00,000)

= 80,00,000 – 40,00,000

= ₹40,00,000

Profit after taking the decision as per statement under C (ii) = ₹60,00,000

So increase in profit = 60,00,000 – 40,00,000 = ₹ 20,00,000

6. Standard Cost Method:

Under this method the joint costs are apportioned on the basis of the pre set standards for the various products. The method is very simple to use. For this, standard costs are determined in advance for all joint products based on past experience, technical aspects, operational efficiency and cost factors of each products etc. This method is very much useful in measuring the efficiencies of the products.

Illustration 13:

JB Limited produces four joint products A, B, C and D all of which emerge from the processing of one raw material. The following are the relevant data:

Production for the period:

Joint Products	Number of units	Selling price per unit
A	500	₹ 18.00
B	900	8.00
C	400	4.00
D	200	11.00

The company budgets for a profit of 10% of the sales value. The other estimated costs are:

₹

Carriage inwards	1,000
Direct wages	3,000
Manufacturing overhead	2,000
Administration overhead	10% of the sales value

You are required to:

- Calculate the maximum price that may be paid for the raw material.
- Prepare a comprehensive cost statement for each of the products allocating the materials and other costs based upon
 - number of units
 - Sales value
 - (CA inter)

Solution:

- Statement showing the maximum price that may be paid for material

Sales:

Product	Units sold	Selling Price (₹)	Sales value (₹)
A	500	18.00	9,000
B	900	8.00	7,200
C	400	4.00	1,600
D	200	11.00	2,200
Total			20,000
Profit margin 10% of sales value:			2,000
Cost of sales			18,000

Less other relating costs

Except material:

(i) Carriage inward :	₹1,000	
(ii) Direct wages	₹3,000	
(iii) Manufacturing	₹2,000	
(iv) Administration overheads	₹2,000	
(10% of sales value)		8,000
		₹ 10,000

Maximum price that can be paid for material

- (i) Cost statement (based on joint cost allocation number of units)

	Product				Total
	A	B	C	D	
No. of units	500	900	400	200	2,000
	₹	₹	₹	₹	₹

Raw material @ ₹5	2,500	4,500	2,000	1,000	10,000
Carriage in ward @ ₹0.50	250	450	200	100	1,000
Direct wages @ ₹1.50	750	1,350	600	300	3,000
Manufacturing overheads @ ₹1.00	500	900	400	200	2,000
Administration overheads @ ₹1.00	500	900	400	200	2,000
Total	4,500	8,100	3,600	1,800	18,000

(b) (ii) Cost statement (based on joint cost allocation on sales value)

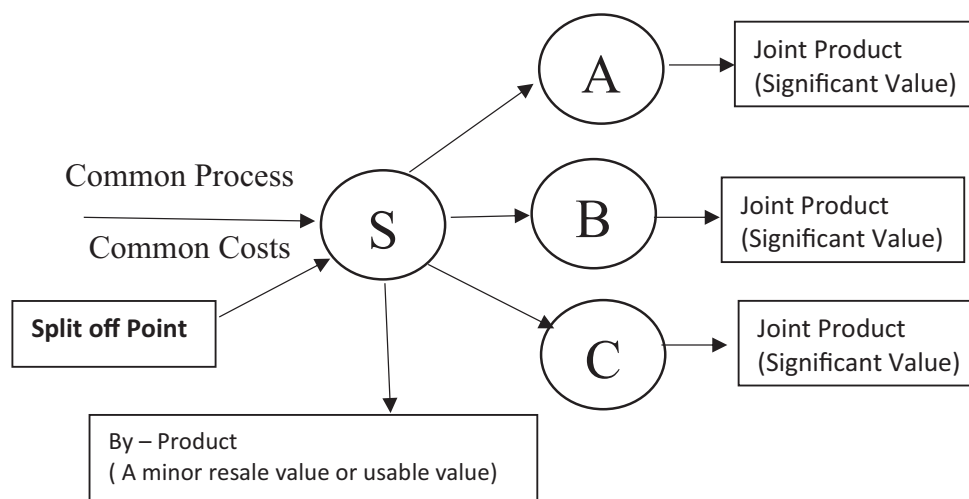
	Product				Total
	A	B	C	D	
No. of units	500	900	400	200	2,000
Selling price per unit (₹)	18	8	4	11	
Sales value ₹	9,000	7,200	1,600	2,200	20,000
	₹	₹	₹	₹	₹
Raw material @ ₹0.50	4,500	3,600	800	1100	10,000
Carriage in ward @ ₹0.05	450	360	80	110	1,000
Direct wages @ ₹0.15	1,350	1,080	240	330	3,000
Manufacturing overheads @ ₹0.10	900	720	160	220	2000
Administration overheads @ ₹0.10	900	720	160	220	2000
Total	8,100	6,480	1,440	1,980	18,000

By Product: –

A by –product is a product that is an ancillary part of the primary production process, having a minor resale value in comparison with the value of the primary product being manufactured.

By products are products with relatively small value that emerge from a common process along with the main products. The main products have significant value and are referred to as joint products. The point where joint products and by –products are separated is known as split off point.

Flow chart showing emergence of joint and by-products



It is clear from the above flow chart that in a production process the by product emerges along with the main products (May be single main or joint products). By product is a part and parcel of the production process. The by-product that emerges with the main products can have a resale value or a usable value.

According to CIMA Terminology by-product is "a product which is recovered incidentally from the material used in the manufacture of recognized main products such as having either net realizable value or a useable value which is relatively low in comparison with saleable value of the main products. By products may further be processed to increase their realizable value."

We can cite here an example to make it more clear eg in oil refinery, crude oil is processed and main product –refined oil is produced by along with this by product i.e. sulphur, bitumen are the by –products.

Classification of By –products:

By –products may be classified into two groups

- 1) The by –product that can be sold in its original form as produced in the common process at the split off point.
- 2) The by products that can be further processed before sale. The utility can be increased by incurring a cost on the by product and make it a usable product.

Accounting of By –products: By-product accounting depends upon the circumstances under which it is realized. By –product can be sold at the split off point or it may be processed further to make it useable.

The accounting treatment of the by products can be classified into.

- 1) Non-cost or sales value method
 - 2) Costs method.
- 1) Non cost or sales value method: In this method the common costs up to the split off point incurred on the common process from which it emerges is not apportioned to the by-product. Under this various method followed are:
 - (a) Other income or miscellaneous income method.
 - (b) By –product sale added to the main product sales.
 - (c) By –product sales value deducted from total cost.
 - (d) Credit of by-product sales value less selling and distribution expenses as well as cost-incurred after split – off.
 - (e) Credit of by-product sales value less selling and distribution costs incurred after split off and estimated profit or reverse cost method.

Let us take one by one.

- (a) Other income or Miscellaneous income method: Under this method the sales value of the by product is treated as other income and added to the miscellaneous income. The common costs of the process are apportioned to the main or the co-products. The closing stock of unsold by product is taken to be nil for balance sheet. There is a draw back in this method as there may be a time lag in its origin and its sale. So, clear picture of the profit and loss of the period cannot be found out. By product generated in one period may be sold in another period.
- (b) By product sale added to the main product sales: In this method sale proceeds of the by product is added to the sale of the main product the method is adopted where the by product is sold as it emerges in the common process. The closing stock if any at the end of the period is taken to be nil for balance sheet. Difficulty may arise to allocate the sale proceeds to the joint products in the efficiency measures.

- (c) By product sales value deducted from total cost: Under this method the by-product sales value is deducted from total cost of production. This method is favoured by some accountants, like waste and scrap, by product revenue reduces the cost of major products. By product in hand is valued at the market price of the product. One of the major drawback in this method is that the sales value of the by products fluctuates and so directly effects the cost of main product and so may encourage to conceal inefficiencies.
- (d) Sales value less selling and distribution cost: In this method selling & distribution cost incurred on the by product is first deducted from the sales value of the by product and balance is either deducted from the total cost or is credited to the process account.
- (e) Credit of by-product sales value less selling and distribution cost and estimated profit.

Under this method sales value of the product is reduced by the selling and distribution cost and an estimated profit and balance is credited to the process account or reduced from the total cost. This method is some what near reality and try to apportion actual cost to the joint products or the main product.

Illustration 14:

In manufacturing the main product, company processes the incidental waste into two by products A and B from the following data relating to the product you are required to prepare a comparative profit and loss statement showing the individual cost and other details. The total cost up to separation point was ₹3,10,400.

	Main Product	By Product A	By Product B
Sales	₹ 800,000	₹ 64,000	₹ 96,000
Cost after separation	₹80,000	₹12,800	₹14,400
Estimated net profit Percentage on sales value	—	20%	20%
Estimated selling expenses as percentage to sales value	20%	10%	15%

Reverse cost method to be followed for separation joint costs

(CA inter)

Solution:

Let us first of all find out the cost allocated to by products.

Particular	By Product A (₹)	By Product B (₹)	Total (₹)
Sales	64,000	96,000	1,60,000
Less: Estimated Profit	12,800	19,200	32,000
Cost after separation	12,800	14,400	27,200
Estimated selling expenses	6400 32,000	14,400 48,000	20,800 80,000
Cost allocated at split off point	32,000	48,000	80,000

Comparative Profit and Loss statement

Particular	Main Product (₹)	By –Product A (₹)	By –Product B(₹)
Joint cost up to separation:	3,10,400	–	–
Less cost allocated to by products	80,000	32,000	4,800
	230,400		
Cost after separation	80,000	12,800	14,400
Selling expenses	160,000	6,400	14,400
Total cost:	470,400	51,200	76,800
Net profit	329,600	12,800	19,200
Sales	800,000	64,000	96,000

Illustration 15:

The yield of a certain process is 80% as to the main product. 15% as to the by product and 5% as to the process Loss. The material put in process (5000 units) cost ₹23.75 per unit and all other charges are ₹14,250 of which power cost accounted for $33\frac{1}{3}\%$. It is ascertained that power is chargeable as to the main product and by product in the ratio of 10:9 Draw up a statement showing the cost of the by-product.

Solution: Statement showing the cost of by product

Particular	Main Product	By Product
Yield (units)	4,000 units	750 units
Main product: 80% of 5,000		
By Product: 15% of 5,000		
Material cost:	₹	₹
@23.75	1,18,750	
other charges excluding:	9500	
Power cost $66\frac{2}{3}\%$	=1,28,250	
Power cost:	4750	
Cost allocated	1,10,500	22,500

Cost: allocated to By Product	₹ 22,500
Total cost of production	₹ 1,33,000
Less cost allocated to by product	₹ 22,500

Cost allocated to main product

₹ 1,10,500

Illustration 16:

A factory is engaged in the manufacture of chemical X and in the course of its manufacture a by product Y is produced, which after a separate process has a commercial value. For 1 Jan, 1981 the following is the summarized costing data:

	Joint Expenses	Separate X	Expenses Y
Material	₹19200	₹7360	₹784
Labour	11,700	7,680	2,642
Other costs	3,452	1,500	544

The output for the month was 142 tons of X, 49 tons of Y and selling price of Y averaged ₹280 per ton.

Assuming that the profit on Y is estimated at 50% of selling price, prepare an account showing cost of X per ton.

(B.Com Agra)

Solution : Let us first of all find out the cost allocation at split off point to by product Y.

		By Product Y
	Sale (units)	49 tons
		₹
	Sales value @ 280 per ton	13,720
	Less: After separation cost	
(a) Material :	784	
(b) Labour :	2,642	
(c) Other costs :	544	
		: 3,970
Profit @ 50% of sales value		: <u>6,860</u>
Pre separation cost :		<u>10,830</u>
		<u>2,890</u>
Account Showing cost of X Per ton		
		Product X
	Units produced	142 ton
Joint cost:	₹	
Material :	19200	
Labour :	11700	
Other costs:	<u>3452</u>	
		34352
Less cost allocate to Y :	<u>2890</u>	
After separation cost:		31462

Material	:	7360	
Labour	:	7680	
Other cost	:	<u>1500</u>	
			16540
			48002
Total cost:			
Cost per Ton	:	₹ 338	
			$\text{₹ } \frac{48002}{142}$

2) Cost Methods:

(i) Replacement or opportunity cost method: If the by product is consumed in the undertaking as a raw material for the production of another product, then the by-product is valued at opportunity cost or replacement cost. It is the cost at which the product would have to be purchased from the market. The process account is credited with the amount that would have to spend in purchasing it from the outside. For example, in converting coal into coke, the coal gas obtained may be used in the organization for heating purpose. The gas obtained is valued at the cost at which it would have been purchased from the market.

(ii) Standard cost Method: Under this method the value of the by-product is obtained at pre-set standard rate. Standard cost is set taking into consideration the technical assessment. It is a pre-set rate and so constant.

The process account is credited with the amount (in value) of the by-product produced by calculating its value under the standard rate set. Because of availability of steady credit figure in respect of the by product under this method, effective cost control over the main product becomes possible.

(iii) Joint cost apportionment on a suitable basis: – Under this method joint costs (cost up to the point of separation) are apportioned to main and by product on a suitable acceptable basis. This method does not differentiate between the joint products. In a petroleum refinery where fractional distillation process is done in separating the various contents, gas is evolved which was considered as by product. Now it has assumed the importance like petrol, diesel etc. and it is being treated as joint-product. So joint costs incurred on the process is apportioned between the joint product and by product (having a significant value in the market).

By-product and Scrap: Sometimes it becomes difficult to distinguish between by-product and scrap. Because both the scrap and by-product have a small value as compared with the main or joint product. So, difficulty arises to differentiate both. The difference between by product and scrap is summarized below.

- 1) Firstly the main difference between by product and scrap is whether its utility can be increased by further processing or it is useable or consumable as the end-product after the split off. The by product has the above quality. The waste has no such quality i.e. cannot be further processed nor can be used as end product, though still may be having a saleable value. For example in a nut bolt manufacturing plant, the iron or steel scrap so obtained is not a by-product and it can be sold in the market as scrap and sent to the moulding where it is melted and given another shape rather used at split off.
- 2) Secondly the sale value of the by product is relatively more to the scrap. There is an opportunity cost of the by product.

Illustration 17:

A factory manufactures a commodity which passes through three processes A, B and C. The finished product of A becomes the raw material of Process B and the finished product of B forms the raw material of process C which delivers the end product. The by-product of process A and B are sold direct from the factory.

	A	B ₹	C ₹
Materials	1,000Tons @ ₹12	700	600
	per ton		
Wages	₹10,000	20,000	36,000
factory over heads (Percentage on wages)	75%	60%	50%
Wastage (of no sale value)	2 Tons	3 Tons	2 Tons
Sale proceeds of by-product produced	8Tons@ ₹30 per Ton	5Tons@ Ton	₹24 per

Draw up process accounts and by product recoveries account assuming that the by product are valued at estimated market price of ₹25 per Ton for process A and ₹20 per Ton for process B at the point of above separation.
(CA-inter)

Solution:

Process A Account

Dr			Cr.		
Particular	Units (Tons)	Amount ₹	Particular	Units (Tons)	Amount ₹
To material	1,000	12,000	By wastage	2	—
To wages		10,000	“ By product @ ₹25	8	200
Factory overheads		7,500	“ Process B account	990	29,300
Total	1,000	29,500	Total	1,000	29,500

Process B Account

Dr.			Cr.		
Particular	Units (Tons)	Amount ₹	Particular	Units (Tons)	Amount ₹
To Process A a/c	990	29,300	By wastage	3	—
To material		700	“ By product @ ₹20	5	100
To wages		20,000	“ Process a/c	982	61,900
To factory overhead					

		12000			
Total	990	62,000	Total	990	62,000

Process C Account

Dr.			Cr.		
Particular	Units (Tons)	Amount ₹	Particular	Units	Amount ₹
To Process B A/c	982	61,900	By wastage	2	–
To material		600	By finished stock a/c	980	116,500
To wages		36,000			
To Factory overhead		18,000			
Total	982	11,6,500	Total	982	1,16,500

By Product A/C

Dr.			Cr.		
Particular	Units (Tons)	Amount ₹	Particular	Units (Tons)	Amount ₹
To Process A a/c	8	200	By cash a/c 8 tons @ 30	8	240
To process B a/c	5	100	5 tons @ 24	5	120
P&L a/c		60			
Total	13	360	Total	13	360

Miscellaneous Examples

Illustration 18:

A factory producing article A also yields B and C as by products. The joint cost of manufacturing is:

	₹
Material	20,000
Labour	5,000
Overhead	15,000

Subsequent costs are as under:

	A ₹	B ₹	C ₹
Material:	8,000	3,000	2,500
Labour:	4,000	3,000	2,000
Overhead:	3,000	2,000	1,500
Sales:	40,000	30,000	30,000
Profit on sales:	40%	30%	20%

Show how would you propose to apportion the joint costs of manufacturing? and prepare the necessary statement in respect of A,B and C.

(B.Com –Punjab)

Solution:

Statement showing cost incurred at split off point –To apportion joint costs (Reverse cost method)

	A	B	C
	₹	₹	₹
Sales	40,000	30,000	30,000
Profit on sales	40%	30%	20%
Total estimated Profit	16000	9000	6000
Cost of sales:	24,000	21,000	24,000
Post separation costs:	₹	₹	₹
material:	8,000	3,000	2,500
Labour	4,000	3,000	2,000
Overheads:	3,000	2,000	1,500
	15,000	8,000	6,000
Estimated cost at split off	9,000	13,000	18,000

Ratio to apportion the joint costs A:B:C = 9:13:18

Apportioned joint costs:

$$\begin{aligned}
 A &= ₹ 40000 \times \frac{9}{40} = ₹ 9,000 \\
 B &= ₹ 40000 \times \frac{13}{40} = ₹ 13,000 \\
 C &= ₹ 40000 \times \frac{18}{40} = ₹ 18,000
 \end{aligned}$$

Illustration 19 :

In manufacturing the main product a company processes the incidental waste into two by products A and B. From the following data relating to the products you are required to prepare a comparative profit and Loss statement showing the individual costs and other details. The total costs up to separation point were ₹3,10,400.

	Main Product	By –Product A	by –Product B
Sales	₹5,00,000	₹64,000	₹96,000
Costs after separation	60,000	12,800	14,400
Estimated net profit percentage to sales value:	20%	20%	30%
Estimated selling expenses as percentage to sales value:	20%	10%	15%

(Reverse cost method to be followed for separation of joint costs).

(C.A. inter)

Solution: Statement showing cost incurred at split off point (Apportionment Joint cost) (Reverse cost method)

	Main Product	By Product A	By Product B
Sales:	₹5,00,000	₹64,000	₹96,000
Estimated net profit as percentage to sales value :	20%	20%	30%
Estimated net profit:	₹100,000	₹12,800	₹28,800
Estimated cost of Sales:			
(₹)	400,000	51,200	67,200
Post separation costs	₹	₹	₹
Cost after separation:	60,000	12,800	14,400
Estimated selling expenses	100,000	6,400	14,400
Estimated cost at split off point	₹2,40,000	₹32,000	₹38,400

Ratio of apportionment of Joint costs:

Main Product	:	By Product A	:	By Product B
240000	:	32000	:	38400
2400	:	320	:	384
75	:	10	:	12

Apportioned Joint costs to products

Main Product	=	₹ 310400 × $\frac{75}{97}$ = ₹ 2,40,000
By Product A	=	₹ 310400 × $\frac{10}{97}$ = ₹ 32,000
By Product B	=	₹ 310400 × $\frac{12}{97}$ = ₹ 38,400

Illustration 20:

If the products are truly joint products, the cost of process can be applied to these products:

- (1) On the basis of the weights or other physical quantity of each product.
- (2) In respect of the marginal cost of the process on the basis of physical quantities and in respect of fixed costs of the process on the basis of the contribution made by the various products.
- (3) On the basis of the selling values of the different products.

Using the following figures in respect of the Joint products of A and B for a month, show the apportionment of joint costs and profits made on the above three basis.

			₹
Total costs	—	Direct Materials	: 26,000
		Direct Labour	: 10,000
		Variable overhead	: 8000

Fixed overhead : 22000

Sales A 1000 tonnes ₹ 60 per ton

B 1200 tonnes ₹ 20 per ton (ICWA –Inter)

Solution: Let us first of all calculate the marginal cost and fixed cost.

Marginal cost = ₹ 2600 + 10,000 + 8,000

= ₹ 44,000

Fixed cost = ₹ 22,000

Total cost = ₹ 66,000

1) Apportionment of cost on the basis of physical quantity.

Total cost = ₹ 66,000

Apportioned cost to product A = $66000 \times \frac{10}{22} = ₹ 30,000$

product B = $66000 \times \frac{12}{22} = ₹ 36,000$

Profit:

Product A = $1000 \times 60 - 30,000$

= $60,000 - 30,000$

= ₹ 30,000

Product B = $1200 \times 20 - 36,000$

= $24,000 - 36,000$

= Loss ₹ 12,000

2) Apportion of marginal cost on physical quantity basis and fixed cost on contribution basis

	A	B
Sales	60,000	24,000
Marginal cost	20,000	24,000
A. $44000 \times \frac{10}{22}$:		
B. $44000 \times \frac{12}{22}$:		
Contribution	40,000	Nil
Fixed cost:	22,000	—
$22000 \times \frac{40}{40}$		
Profit	18,000	Nil

3) Joint cost apportioned on sales value basis

	A	B
Sales	₹ 60,000	₹ 24,000
Total cost apportioned		
A. $66000 \times \frac{60}{84}$	47143	18857
B. $66000 \times \frac{24}{84}$		

Profit:	12,857	5,143

Illustration 21 :

A company produces 400000; 60000; 50000; 40000 and 150000 units of its five products A.B.C.D and E respectively in a manufacturing process and sells them at ₹8.5, ₹6.5, ₹4, ₹5 and ₹7 per unit. Except product D remaining products can be further processed and then can be sold at ₹12.5, ₹8.5, ₹6 and ₹10 per unit in case of A,B,C and E respectively.

Raw material costs ₹35,90,000 and manufacturing expenses cost ₹5,47,000 in the manufacturing process which are absorbed on the products on the basis of their 'Net realizable value'. The further processing costs of A.B.C and E are ₹125,000; ₹1,50,000, ₹50,000 and ₹1,50,000 respectively. Fixed costs are ₹4,73,000. You are required to prepare the following in respect of coming year

- Statement showing income forecast of the company assuming that none of its products are to be further processed.
- Statement showing in come forecast of the company assuming that products A,B,C and E are to be processed further.

Can you suggest any other production plan whereby the company can maximize its profits? If yes, then submit a statement showing income forecast arising out of adoption of that plan.

Solution:

Joint cost:	₹
Raw material costs	35,90,000
Manufacturing expenses	5,47,000
Total	41,37,000

Statement showing apportionment of joint costs to products on the basis of “net realizable value” basis.

	A	B	C	D	E
	₹	₹	₹	₹	₹
Units produced	400,000	60,000	50,000	40,000	1,50,000
Sales value	50,00,000	5,10,000	300,000	200,000	15,00,000
Post separation costs	12,50,000	1,50,000	50,000	—	1,50,000
Net realizable value:	37,50,000	3,60,000	2,50,000	2,00,000	13,50,000
Apportioned Joint cost	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000
$\left(41,37,000 \times \frac{3750,000}{5910,000}\right)$					

- Statement showing profit assuming none of the products is processed further

Products

	A	B	C	D	E	Total
Sales revenue:	3400000	3,90,000	2,00,000	200,000	10,50,000	5,240,000
Less apportioned	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000	41,37,000
Joint cost;						
Excess of revenue over Joint cost:	7,75,000	1,38,000	25,000	60,000	1,05,000	11,03,000
Less Fixed cost:						473,000
Profit:						6,30,000

(b) Statement showing profits when products A,B,C and E are processed further

Products						
	A	B	C	D	E	Total
	₹	₹	₹	₹	₹	₹
Sales value:	50,00,000	5,10,000	3,00,000	2,00,000	15,00,000	₹75,10,000
Apportioned	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000	41,37,000
Joint costs						
Further Processing cost	12,50,000	1,50,000	50,000	—	1,50,000	16,00,000
Total cost	38,75,000	4,02,000	2,25,000	1,40,000	10,95,000	57,37,000
Excess of sales over total cost apportioned	11,25,000	1,08,000	75,000	60,000	4,05,000	17,73,000
Less fixed cost:						4,73,000
Profit ₹ 13,00,000						

(c) We can compare differential cost and increase in revenue for taking decision on process further or not analysis.

	A	B	C	D
Incremental revenue	₹ 16,00,000	₹ 1,20,000	₹ 100,000	₹ 4,50,000
Further processing cost	₹ 125,000	₹ 1,50,000	₹ 50,000	₹ 1,50,000
Profit or loss in case further processing	₹ 3,50,000	₹ (–30000)	₹ 50,000	₹ 3,00,000

The product B is not beneficial to process further so to increase the profit for another ₹ 30,000 the product B should be sold at the split off.

Then Total profit will be = ₹ 13,00,000+30,000

=₹ 13,30,000

Illustration: 22. Chem & Co. produces two joint products J and K in department 'A' from a basic raw material. The input–output ratio of Department A is 100:90. Product 'J' which becomes input of Department 'B' to make one of the most popular industrial product 'N'. The input output ratio of department B is 100:95. Alternatively product J can also be sold at the split off stage.

The selling prices are: –

Product	Rs/kg
J	29.40
K	26.00
N	31.50

The department expenses, production data and selling expenses envisaged in the budget for 1986 are as under:

(a) Department expenses:

	A	B
	₹ Lacs	₹ Lacs
Raw material ₹ 16 per kg		
Direct material	10.00	3.00
Direct wages	15.00	5.00
Variable overheads	20.00	7.00
Fixed overheads	25.00	10.00

(b) Production data:

Product	kg
N	4,75,000
K	8,50,000

(c) Selling expenses:

Product	₹
J	1,00,000
K	2,00,000
N	2,00,000

You are required to:

- Prepare a statement showing the apportionment of joint costs between 'J' and 'K'.
- Advise whether the company should process 'J' into product 'N' or not? Show workings.
- Present a statement of profitability based on your decision.

(CA –Final, ICWA Final)

Solution:**Working Note: –**

Final Production of Product 'N' in units (kg) = 4,75,000

Input–Output ratio of Department B = 100 : 95

Input units of product J = $\frac{475000}{0.95}$

= 500000 kg

Let us first of all the ratio in which the joint costs can be apportioned to product J and K.

Product	Output	Selling Price	Sales	Selling Distribution expenses	Sales value at split off point
	(kg)	₹	₹	₹	₹
J	5,00,000	29.40	147,00,000	1,00,000	146,00,000
K	8,50,000	26.00	221,00,000	2,00,000	219,00,000

Ratio of apportionment of Joint Cost:

J : K

146,00,000 : 219,00,000

2 : 3

(a) Statement showing apportionment of joint cost between 'J' & 'K'

	Product	
	J	K
	₹	₹
Raw material 15,00,000@₹16	96,00,000	1,44,00,000
=240,00,000		
$\left[\begin{array}{ll} \text{Output (kg)} & \text{Input Raw material} \\ J = 500000 & = \frac{1350000}{0.9} \\ K = \frac{850000}{13,50,000} & 15,00,000 \text{ kg} \end{array} \right]$		
Direct material:	4,00,000	6,00,000
Direct wages:	6,00,000	9,00,000
Variable overheads:	8,00,000	12,00,000
Fixed overheads:	10,00,000	15,00,000
Total apportioned Joint cost:	124,00,000	1,86,00,000

(b) Incremental cost and increment revenue analysis will be helpful in taking decision whether to process 'J' further or not.

₹

Further processing cost 15,00,000

(3.00+5.00+7.00) [variable cost] =

Selling expenses 'N' 2,00,000

		<u>₹ 17,00,000</u>
Increase in revenue:	₹	
Sales value of 'N'		
(475000x31.50)=	149,62,500	
Sales value of 'J'		
(5,00,000x29.40):	147,00,000	
		<u>₹ 2,62,500</u>

Increase in cost in further processing is more hence it is not advisable to process 'J' further.

(c) Profitability statement

Sales value J: 14700000	}	₹
K: 22100000		3,68,00,000
Less Joint Costs:		
₹ 3,10,00,000	}	
Selling Distribution		
Expenses ₹ 3,00,000		
Unabsorbed Fixed		
Expenses : ₹ 10,00,000		3,23,00,000
(Process B Department):		
Net Profit:		<u>45,00,000</u>

Illustration 23: A company produces X, Y and Z from a raw material M. For every 100 Tons of M put into production the following yield is obtained:

Product	Tons	Selling Price
		₹
X	50	40
Y	30	60
Z	15	80
Waste	5	—

Relevant costs per ton of input for the coming year are budgeted to be:

	₹
Raw material M	20
Variable processing costs	10

Variable marketing costs are budgeted to be at the rate of 10% of sales value.

Annual fixed overheads are budgeted to be as follows:

	Per annum (₹)
Manufacturing	40,000
Marketing	30,000
Administration	20,000

The company intends to process 10,000 Tons of material M in the coming year. Required:

- The expected results for the year based on the above data
- The breakeven point in terms of sales value and tons of material to be processed.
- The maximum price per ton which the company can pay for its raw material in order to achieve a return of 15% on the capital employed of ₹ 5,00,000 assuming an input of 10,000 Tons per year.

Solution: – Statement showing expected results for the year.

Sales value:

			₹
Product X:	$\frac{50}{100} \times 10,000$	=5000@₹40	200,000
Product Y:	$\frac{30}{100} \times 10,000$	=3000@₹60	180,000
Product Z:	$\frac{15}{100} \times 10,000$	=1500@₹80	120,000
			500,000
Less costs:		₹	
Raw material		200,000	
(10000 T@₹20)			
Variable processing cost @₹10		100,000	
Variable Selling cost			
10% of 5,00,000		50,000	
Annual fixed overheads			
manufacturing 40,000	}		
marketing 30,000			
administration 20,000			
		90,000	
		Net Profit:	4,40,000
			60,000

(b) Breakeven point:

$$\begin{aligned} \frac{*90,000}{30\%} &= ₹ 3,00,000 \text{ sales value} \\ \text{In units: } \frac{90,000}{**15} &= 6000 \text{ Tons} \\ * \text{Sales} & ₹ 5,00,000 \end{aligned}$$

$$\begin{aligned} \text{Variable cost manufacturing } 30 \times 10000 &= 3,00,000 \\ \text{Selling costs } 10\% \text{ of } 500,000 &= 50,000 \end{aligned}$$

$$\begin{aligned}
 \text{Contribution} &= \frac{350000}{150000} \\
 \text{P/v ratio} &= \frac{150000}{500000} \times 100 \\
 &= 30\% \\
 \text{** Total contribution} &= ₹ 1,50,000 \\
 \text{units processed} &= 10000 \text{ Tons} \\
 \text{Contribution per Ton} &= \frac{150000}{10000} \\
 &= ₹ 15 \\
 \text{(c) Return required} \quad 15\% \text{ of } 50000 &= ₹ 75,000 \\
 \text{Former profit as in (a)} &= 60000 \\
 \text{Balance} &= 15000 \\
 \text{Material used} &= 10000 \\
 \text{Desired Decrease in price (Purchase) rate to earn the desired profit} &= \frac{15000}{10000} \\
 &= ₹ 1.50 \\
 \text{Present rate per Ton} &= ₹ 20.00 \\
 \text{Get desired results} &= 20 - 1.50 \\
 &= ₹ 18.50 \text{ per Ton}
 \end{aligned}$$

Illustration 24. ABC Ltd. operates a simple chemical process to convert a single material into three separate items referred to here as X, Y and Z. All three end products are separated simultaneously at a single split off point.

Product X and Y are ready for sale immediately upon split of without further processing or any other additional costs, Product Z, however, is processed further before being sold. There is no available market price for Z at split off point.

The selling prices quoted here are expected to remain the same in the coming year. During 2009 –10, the selling prices of the items and the total amounts sold were:

X – 186 Tons sold for ₹ 1,500 per Ton

Y – 527 Tons sold for ₹ 1,125 per Ton

Z – 736 Tons sold for ₹ 750 per Ton

The total joint manufacturing costs for the year were ₹ 6,25,000. An additional ₹ 3,10,000 was spent to finish product Z.

There was no opening inventories of X.Y and Z. At the end of the year, the following inventories of complete units were on hand:

X –180 tons

Y –60 tons

Z –25 tons

There was no opening or closing work in progress.

Required:

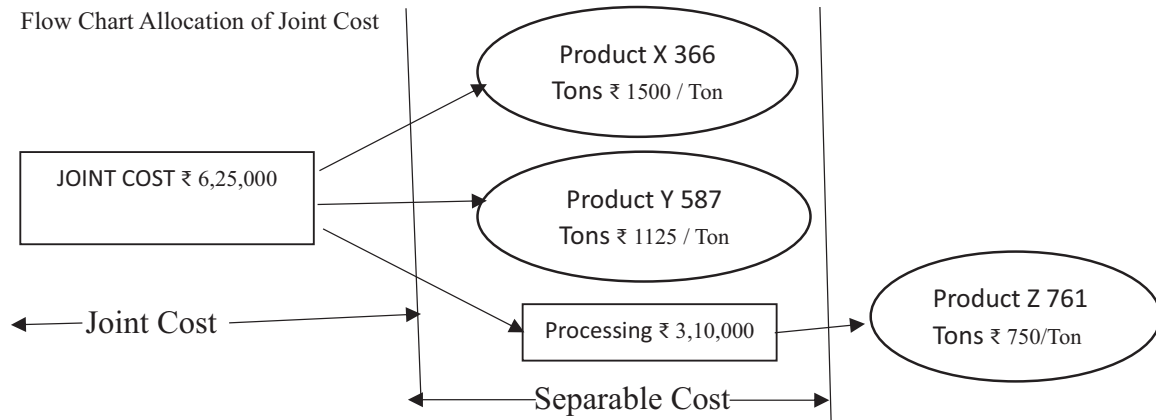
- (i) Complete the cost of inventories of X, Y and Z for Balance Sheet purposes and cost of goods sold for income statement purpose of March 31, 2010 using:
 - (a) Net realizable value (NRV) method of joint cost allocation.
 - (b) Constant gross-margin percentage NRV method of joint cost allocation.
- (ii) Compare the gross margin percentage for X,Y and Z using two methods given in requirement (i)
(CA –Modified)

Solution: –

Working Notes: –

- (1.) Total production for the year:

	Sold Tons	Ending inventories (Tons)	Total Production Tons
X	186	180	366
Y	527	60	587
Z	736	25	761



- (i)(a) Net realizable method of cost allocation

	Product			Total ₹
	X	Y	Z	
	₹	₹	₹	
Sales value ₹				
X 366×1500=549,000				
Y 587×1125=660,375	5,49,000	6,60,375	5,70,750	17,80,125
Z 761×750=5,70,750				
Less separable cost:	----	----	3,10,000	3,10,000

Net realized value at split off	5,49,000	6,60,375	2,60,750	14,70,125
Joint cost allocated:	2,33,399	2,80,748	1,10,853	6,25,000
Margin:	3,15,601	3,79,627	1,49,897	—
Gross margin (%)	57.49%	57.49%	26.26%	—

Closing inventories for Balance sheet purpose

Product	Units of inventories (Tons) at the end	Value of inventories ₹
X	180	1,14,786
Y	60	28,697
Z	25	13,826

Cost of goods sold statement

Product	Quantity sold Tons	Cost of goods sold (₹)
X	186	1,18,613
Y	527	2,52,051
Z [₹ 110853 + 310000 = 4,20,853]	736	4,07,027

(i)(b) Constant Gross margin value method of Joint cost allocation

$$\begin{aligned}
 \text{Gross sales value} &= ₹ 17,80,125 \\
 \text{Joint cost + cost of separation (625000+31000)} &= ₹ 9,35,500 \\
 \text{Gross margin} &= ₹ 8,45,125 \\
 \text{Gross margin (\%)} &= \frac{8,45,125}{17,80,125} \times 100 \\
 &= 47.4756(\text{approx.})
 \end{aligned}$$

Closing inventories statement

Product	Units (Tons) of inventories at the end	Value of inventories ₹
*X $(52.5244)\% \times \frac{180}{366}$	180	1,41,816
Y $(52.5244)\% \times \frac{60}{587}$	60	35,454
Z $(52.5244)\% \times \frac{25}{761}$	25	9,848

*in case of X

$$\begin{aligned}
 &= \text{Sales value} \times \text{cost of sales\%} \times \frac{180}{366} \\
 &= 5,49,000 \times 0.525244 \times \frac{180}{366} = 1,41,816 (\text{approx.})
 \end{aligned}$$

(ii) Statement of comparison of gross margin percentage

	Product		
	X	Y	Z
Net realizable value:	57.49%	57.49%	26.26%
Constant Gross margin (%) Method:	47.4756%	47.4756%	47.4756%

Illustration 25. (Decision Making)

Hawkins Ltd produces two joint products Boddie and Soull. A further product Threekeys is also made as a byproduct of one of the processes for making Soull. Each product is sold in bottles of one litre capacity.

It is now January, 1993. You are a cost accountant for Hawkins Ltd. You have been instructed to allocate the company's joint costs for 1992 between Boddie and Soull, but not to the by-product Threekeys.

During 1992, 20,00,000 litres of raw material, costing ₹ 30,00,000 were processed in Department Alpha with no wastage. The processing costs were ₹ 16,57,000. 50% of the output of department Alpha was unfinished Boddie for which there was no external market. It was transferred to Department Beta, where it was further processed at an additional cost of ₹ 81,00,000. Normal wastage by evaporation was 16% of the input of unfurnished Boddie. The remaining good output of finished Boddie was sold for ₹ 10 per litre in the outside market.

The other 50 % of the output from the joint process in Department Alpha was in the form of process Necktar. It was all transferred to Department Gamma as there was no outside market for processed Necktar. It was all transferred to Gamma, as there was no outside market for processed Necktar. In Department Gamma it was further processed, with no wastage, at a cost of ₹ 3,09,00,000. 72% of the output of Department Gamma was in the form of unfinished Soull, for which there was no external market. It was transferred to Department Delta, where it was subjected to finishing process at a further cost of ₹ 7,19,000. Normal spoilage of $16\frac{2}{3}\%$ of the input to the finishing process was experienced. The spoilage material was disposed of without charge, as effluent. The remaining finished soull was sold in the outside market for ₹ 60 per litre.

The remaining 28% of the output of Department Gamma was in the form of finished Threekeys, the by-product. It was sold in the outside market for ₹ 8 per litre, but due to its dangerous nature special delivery cost of ₹ 70,000 were incurred in respect of it.

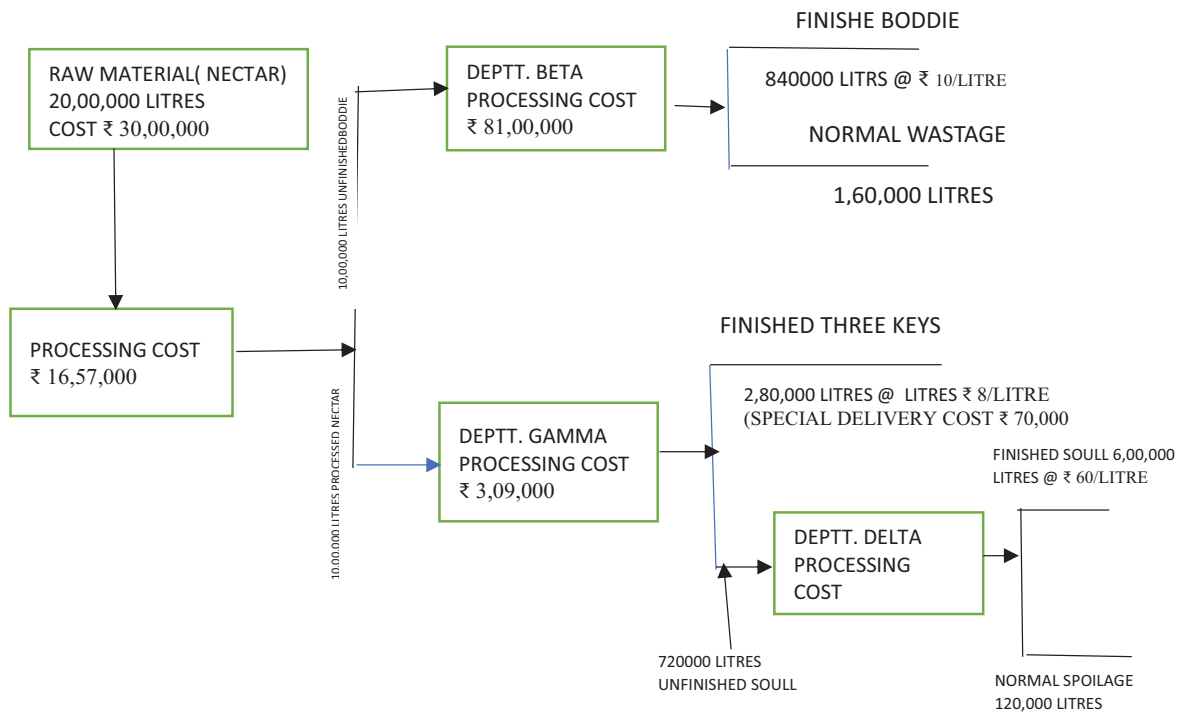
You are required

(a) to allocate the appropriate joint costs between Boddie and Soull on the basis of relative sales value, treating the net realizable value of Threekeys as an addition to sales value of soul.

(b) to prepare a statement showing the profit or loss attributed to each of the three products and the total profit or loss for 1992, on the basis of the information above and allocate joint costs as in (a) above.

(c) to show with reasons whether Hawkins Ltd should continue to produce all three products in 1993, assuming that input/output relationships, prices and sales volumes do not change. **(CIMA London-Adapted)**

Solution:



Flow chart showing the whole product process along with Department cost data.

(a) Statement showing allocation of joint cost between Boddie and Soull on the relative sales value.

	Product		(₹ in thousand)
	Boddie	Soull	Total
Total Sales value Boddie ₹ 840×10	₹ '000	₹ '000	₹ '000
Soull ₹ 600×60	8400	36,000	44,400
Add net realizable value of Threekeys (₹ 280×8 –7000)	—	2170	2170
= ₹ 2170			
Total Sales Value	8400	38170	46570
Joint cost allocated Boddie :	₹	₹	₹
$\frac{8400}{46570} \times 4657000$	840000	3817000	4657000

(b) Profit Loss Statement

	Product			
	Buddie	Soull	Threekey	Total
	₹ '000	₹ '000	₹ '000	₹ '000
Sales:	8400	36000	2240	46640
Less:				
Processing cost:				
Department Beta:	8100	----	—	8100
Department Gamma:	—	30900	—	30900
Department Delta:	—	719	—	719
Delivery cost:	-----	—	70	70
Revenue earned :	300	4381	2170	6851
Allocated Joint cost:	840	3817	—	4657
Profit/Loss	(-540)	564	2170	2194

(c) Hawkins Ltd. should continue to produce each of its product as in each case, incremental revenue is more than increase in cost. Each of the produce provides a positive contribution on further processing and bears a share of the joint cost.

Illustration:26 A chemical factory processes raw material R and produces three products P₁, P₂, P₃ out of a joint process. The joint cost of processing 5000 kgs of R are as under:

	₹
Labour cost:	6000
Overheads cost:	2000
Total:	8000

The raw material R is purchased at ₹ 2.40 per kg. This rate is after a trade discount of 20% on list price.

Normal process loss is estimated at 10% of the input weight. The scrap generated from processing R is recovered to the extent of 25% (by weight) and sold as such in the market at ₹ 4 per kg. The products P₁, P₂ and P₃ can be sold at ₹ 5.00, ₹ 6.00 and ₹ 6.50 per kg respectively without any further processing.

However products P₁, and P₂ can also be further jointly processed at an additional cost of ₹ 2 per kg of input to get product J₁. The further processing cost of J₁ will be ₹ 1 per kg of output weight.

Similarly products P₂, and P₃ can be jointly processed to get product J₂ at an additional cost of ₹ 5 per kg of input weight. The normal loss of processing J₁ out of P₁ & P₂ will be 5% of input weight. No process loss is expected on processing J₂.

The selling price of J₁ and J₂ including composition is given below:

Input	Output	
	J ₁	J ₂
P ₁	40%	—
P ₂	60%	50%
P ₃	—	50%
Price per kg ₹:	10.00	12.00

The output weights of P₁, P₂ and P₃ will be in the proportion 3:4:2.

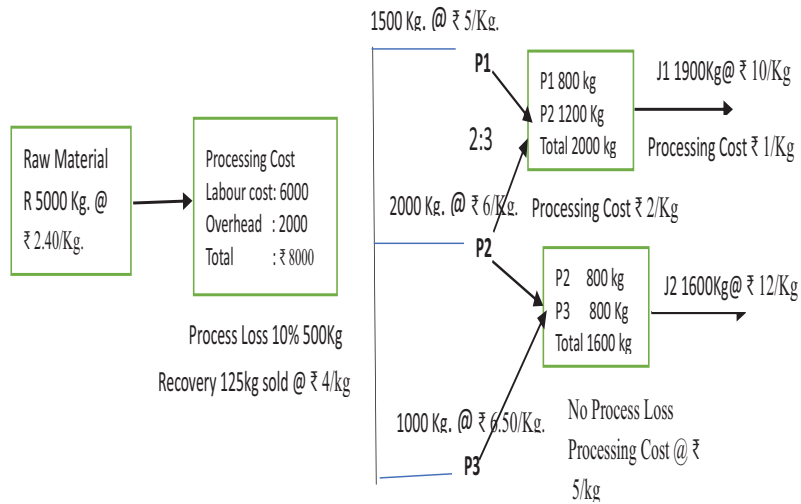
Required to: —

- Show profitability of processing P₁, P₂ and P₃ from 5000kg of R assuming sale at split off point.
- Profitability after both J₁ and J₂ are further processed and marketed using P₂ in the ration of 3:2 for J₁ and J₂ respectively.
- Recommend the processing decision among the alternatives i.e. to use whole output of P₂ for processing either J₁ and J₂ to yield maximum profit and the amount of such maximum profit.

(ICWA)

Solution:

Flow chart of production process: –



- a. Statement showing profitability at split off point
(Joint cost apportion on Sales –value at slit off point basis)

	Products			
	P ₁	P ₂	P ₃	Total
	₹	₹	₹	₹
Sales value	7500	12000	6500	26000
Joint cost allocated				
Raw material : 12000				
Labour cost: 6000				
overheads cost: 2000= 20000				
Less sales scrap				
125kg@4/- =	- 500			
	19500	5625	9000	4875
Profit:	1875	3000	1625	6500

- b. Profitability after further processing J₁ and J₂.

	Products				
	J ₁	J ₂	P ₁	P ₃	Total
Quantity (kg)	1900	1600	700	200	
Selling price (₹)	10	12	5	6.5	
Sales value (₹)	19000	19200	3500	1300	43000

Less cost:

P₁ (J₁; P₁::8:7) ₹ 5625P₂ (J₁; J₂::3:2) ₹ 9000

3000	—	2625	—
5400	3600	—	—

P ₃ (J ₂ ; P ₂ ::4:1) ₹ 4875		3900	—	,975	
Additional processing cost J ₁ (2000×2)	4000	—	—	—	
Other processing cost J ₁	1900	—	—	—	
Additional processing cost J ₂ (1600×5)	—	8000	—	—	
Other processing cost (1600×2)	—	3200	—	—	
Total cost: (₹)	14300	18700	2625	975	36600
Profit (₹):	4700	500	875	325	6400
Profit/kg	2.47	0.3125	—	—	

c. As profit per kg in respect of J₁ is higher, so it is recommended to produce maximum J₁ quantity by using all the available P₂ quantity.

Available P₂ quantity is = 2000 kg

Required P₁ quantity = 1333.33 kg

$$\left[\begin{array}{l} [P_1:P_2::4:6] \frac{x}{2000} = \frac{4}{6} \\ \Rightarrow x = \frac{8000}{6} \end{array} \right]$$

Total = $3333\frac{1}{3}$ kg

$$\begin{aligned} \text{Production of } J_1 &= \frac{10000}{3} \times 0.95 \\ &= \frac{9500}{3} = 3166\frac{2}{3} \text{ kg} \end{aligned}$$

Profitability Statement

	Products			
	J ₁	P ₁	P ₃	Total
Sales quantity	3166.67	166.67	1000	
Sales price (₹)	10	5	6.5	
Sales value (₹)	31667	833	6500	39000
Cost	*23833	625	4875	29333
Profit	7834	208	1625	9667

*J₁ input weight = $3333\frac{1}{3}$ kg

Output weight = $3166\frac{2}{3}$ kg

Additional cost @ ₹ 2 input kg = $6666\frac{2}{3}$

Other processing cost @ ₹ 1 output kg = $3166\frac{2}{3}$ kg

P₁ cost (5625 – 625) = 5000

P₂ cost ₹ = 9000

Total ₹ = 23,833

Exercise

1. What do you understand by joint products?
2. Define split off point.
3. What is the difference between main product and by product?
4. By-product and waste have different meanings. Explain.
5. What do you understand by joint costs?
6. What is the significance of apportioning joint cost to the joint products?

7. What are the different methods of apportioning the joint costs to joint products?
8. Illustration with an example, apportioning joint costs to joint products on number of unit basis.
9. Is total profit affected by selecting any of the method undertaken to apportion the joint costs to products? Justify your answer.
10. In sugar manufacturing, production of molasses is an example of:
 - (a) By –product
 - (b) Co –product
 - (c) Scrap
 - (d) Waste

Ans: – By –product

11. Choose True or False

- (a) It is essential to use same raw material or same process in the case of production of co –products?
 - (i) True
 - (ii) False
- (b) The same input material and same process is undergone in the production of joint products.
 - (i) True
 - (ii) False
- (c) The joint products are always saleable in the market at the split off point.
 - (i) True
 - (ii) False
- (d) When two products which are still in complete in term of their usage. The point where they emerge after undergoing the same process cannot be termed as point of Separation, because of their incompleteness.
 - (i) True
 - (ii) False
- (e) Waste and by –products are synonymous.
 - (i) True
 - (ii) False
- (f) In a furniture manufacturing unit, manufacture of chairs, tables, wooden is an example of by –products
 - (i) True
 - (ii) False

Ans: –

- (a) False
- (b) True
- (c) False
- (d) False
- (e) False
- (f) False

12. How would you deal with by –product in costing?

- (a) Where they are of small value.
- (b) Where they are of considerable total value.
- (c) Where they require further processing.

13. Explain the distinction between co –products, by product and waste

The method of accounting of by products can be grouped under two broad types: non – cost method which do not attempt to cost the by –products and cost methods which allocate cost to the by –products. Outline four methods of valuating and costing by –products, selecting two methods from each of the types mentioned above.

(ICWA Final)

14. Explain reverse cost method of apportionment of joint costs to the joint products.
15. Write down the merits and demerits of Average unit cost method of apportionment of joint costs to joint products.
16. What do you understand by split off point?
17. Why it becomes necessary to apportion joint cost to the joint products though overall profit of the production unit remains the same?
18. Draw a flow chart showing joint cost, split off point, emerging different joint products, Post separation costs and sales value.
19. Describe briefly, how joint costs, up to the point of separation may be apportioned amongst the joint products under the following methods:
 - (i) Average unit cost method
 - (ii) Contribution method
 - (iii) Market value at the point of separation
 - (iv) Market value after further processing
 - (v) Net realizable value method.

20. The following data relates to a production process where three products A, B and C are produced jointly.

A is a solid and its 1000 kgs are produced.

B is a liquid whose 1800 litres are produced.

C is a gas whose 500 lbs are evolved, collected and sold in the market.

The selling price is A : ₹ 12 per kg , B= ₹ 6 per litre and C = ₹ 26.4 per lb

Show a ratio which you consider to be suitable to apportion the joint costs of the process.

Numerical Problems

21. From the data regarding a process of production in which three products A, B and C are produced apportion the pre –separation cost on average unit cost method.

Pre –separation cost:	₹ 100,000
Product	Units Produced
A	800
B	700
C	500

Ans: $\begin{bmatrix} A: & 40,000 \\ B: & 35,000 \\ C: & 25,000 \end{bmatrix}$

22. 1000kg of raw material is fed into a process of production in which three joint products named Pink, Red and White are produced. The common costs incurred are given as under. You are required to allocate the common costs to the products on a suitable basis.

Raw material cost =	₹ 15 per kg
Direct labour =	₹ 8000
Indirect material =	₹ 3000
Other variable cost =	₹ 4000
Fixed cost apportioned to the process =	₹ 6000

The quantity of the products obtained is :

Pink: 400kg, Red= 300kg, White = 200kg

The balance is normal wastage of the process.

Ans: $\begin{bmatrix} \text{Pink:} & 16,000 \\ \text{Red:} & 12,000 \\ \text{White:} & 8,000 \end{bmatrix}$

23. In a production unit the technical experts have attached a weightage to the products on the basis of market demand which further depends upon the use and resale value. The unit (production unit) produces three joint products X, Y and Z. The weightage attached to the product is X=5 points, Y=3 points, Z=2 points You as an accountant asked to apportion the pre –separation cost taking weightage into consideration. The data presented by the production unit is given as under: –

Direct material used =	₹ 40,000
Direct labour cost =	₹ 25,000
Other variable =	₹ 20,000
Overhead Fixed =	₹ 23,000

Output: Product X= 200 units, Y=200 units, Z=100 units

Ans: $\begin{bmatrix} 60,000 & \text{for X} \\ 36,000 & \text{for Y} \\ 12,000 & \text{for Z} \end{bmatrix} \begin{matrix} X:Y:Z \\ (2 \times 5): (2 \times 3): (1 \times 2) \\ \text{Ratio } 10: 6: 2 \end{matrix}$

24. X, Y Ltd manufacturing three joint products – A, B and C. The actual joint expenses of manufacture for a period were ₹ 8,000.

It was estimated that the profit on each product as a percentage of sales would be 30%, 25% and 15% respectively. Subsequent expenses were as follows:

	A	B	C
	₹	₹	₹
Material	100	75	25
Direct Wages:	200	125	50
Overheads:	150	125	75
	<u>450</u>	<u>325</u>	<u>150</u>
Sales:	6,000	4,000	2,500

Prepare a statement showing the apportionment of the joint expenses of manufacture over different products.

(B.com – Punjab)

Ans: – $\left[\begin{array}{l} \text{Joint cost apportioned 3750 to A} \\ \text{2675 to B} \\ \text{1975 to C} \end{array} \right]$

25. Raw material P whose 10,000 kg is processed and a cost including the raw material and others ₹ 96,000 is incurred in a particular process. On the completion of the process two joint products, Product Q and Product R are produced which are having their saleable value at the split off point, but can be further processed to get Super Q and Super R. There is no process loss at any stage from the data given below, apportion the joint cost of ₹ 96,000 to the joint products under (a) Physical quantity method (b) Market value at split off point (c) Market value after further processing, methods:

	Q	R
	₹	₹
Selling Price at separation point:	14	9
Post separation cost:	15,000	12,000
Selling after further Processing:	19.5	17.5
Quantity of products produced (kg):	6,000 kg	4,000 kg

Ans: – $\left[\begin{array}{l} (a) P = 57,600, Q = 38,400 \\ (b) P = 67,200, Q = 28,800 \\ (c) P = 61,200, Q = 34,800 \end{array} \right]$

26. A factory is engaged in the manufacture of chemical X and in the course of its manufacture a by –product Y is produced which after a separate process has a commercial value. For 1 Jan, 1981 the following is the summarized costing data.

	Joint Expenses ₹	Separate Expenses ₹	
		X	Y
Material:	19,200	7,360	784
Labour:	11,700	7,680	2,642
Other costs:	3,452	1,500	544

The output for the month was 142 Tons of X and 49 Tons of Y. Selling price of Y averaged ₹ 280 per Ton.

Assuming that the profit on Y is estimated at 50% of the selling price, prepare an account showing cost of X per Ton.

(B.com Agra)

[Ans: – Cost X per Ton ₹ 338]

Hint: Cost per Ton of X = $\frac{(34352 - (0.5 \times 49 \times 280 - 3970)) + (16540)}{142}$
= ₹ 338 (approx.)

(Joint cost + X's post separation costs – Y's cost)/142 Tons.

27. From the data given below apportion the joint cost on a suitable basis between the three joint products product R, S and T.

	Joint cost	Post separation costs		
	₹	R	S	T
		₹	₹	₹
Direct material.				
Costumed.:	18000	35000	12000	6000
Direct Labour:	8000	25000	10000	5000
Production overheads	6000	10000	8000	5000

Assuming no wastage at any stage and producing to be R= 5000kg, S=3000kg, T= 2000kg. at final stage.
Selling price R=₹ 25/kg, S= ₹15/kg and T =₹ 13/kg

Ans.

Reverse cost method
R= ₹22000 Ratio:11:3:2
S= ₹6000
T= ₹4000

28. A company presents a data for your advise to prepare separate profit and loss statement for different product which are produced by the company. At one stage before being finally sold after incurring an extra cost, to be saleable as finished product, all have to undergo a common process.

While preparing the statement you are to apply a justifiable method of apportionment and allocation the cost incurred in the common process. The data presented to you is given as under.

Product of product in litres

X= 500 litres, Y = 200 litres Z= 100 litres

Selling price X=₹ 240 per litre, Y= ₹ 370 per litre, Z= ₹ 460 per litre

	Joint cost	Further processing cost		
		X	Y	Z
	₹	₹	₹	₹
Direct material cost:	50,000	15000	12000	6000
Direct labour cost:				

	30000	10000	5000	2000
Other costs	20000	5000	3000	2000
Total	100000	30000	20000	10000

Ans:

Profit
X: ₹40000
Y: ₹24000
Z: ₹ 16000

Note: method to be used is reverse cost method for the apportionment and allocation of joint cost.

Joint cost allocated	X: 50000
	Y: 30000
	Z: 20000

29. If the products are truly joint products, the cost of process applied to these products:

1. On the basis of the weights or other physical quantity of each product.
2. In respect of the marginal cost of the process on the basis of physical quantities and in respect of the fixed costs of the process on the basis of the contribution made by the various products.
3. On the basis of the selling value of the different products.

Using the following figures in respect of the joint products of A and B for a month, show the apportioned of joint costs and profit made on the above there basis.

Total costs –	₹
Direct material	26000
Direct labour	10000
Variable over head	8000
Fixed over head	22000

Sales	A 100 tone ₹ 60 per ton
	B 120 tones ₹ 20 per ton

(ICWA –inter)

Ans.

1. Cost A= ₹ 30000, B= ₹36000, Profit A= ₹30000, B= loss ₹ 12000
2. Cost A= 42000, B= ₹ 24000, Profit A= ₹18000 B= Nil

3. Cost A= 47143 B= ₹18857, Profit A=₹12857, B=₹5143

30. Beauty soap company manufactures four different brands of soaps namely Komal, Lovely, Makeup and Nice. The data on production and sale of these brander during 1984 is reported below.

BRAND NAME	KOMAL	LOVELY	MAKEUP	NICE
PRODUCTION AND SALE PER UNIT	300000	500000	70000	40000
SALE VALUE ₹ LACS	15	31	2.8	1.2

All the above soaps are manufacture jointly up to a particular process. At the split off point they are formed into cakes and packed. The annual cost data were as under.

Direct material cost ₹ 30 laces

Value added ₹ 20 lacs

(Including profit @ 25% on total cost)

Out of the above brands Make up is sold in unpacked condition without further processing while other 3 brands are further processed at an additional cost of:

Komal	₹ 120000
Lovely	₹ 130000
Nice	₹ 50000

You are required to: –

- Work out the profit and cost of each brand of soap after allocation of joint cost on 'Net realizable value' method
- Find out revised cost and profit on each brand if the company decides to sell all soaps at split off point, at following selling prices.

Komal: ₹4.50, Lovely = ₹6.00, Makeup = ₹4.00 and nice= ₹1.50per unit.

Assume that for allocation of joint cost net realizable value method is used.

- With the working results in (a) and (b) above advise Beauty soap company about the processing recessing decision as to which soap to be sold at split off point and which to be processed further so as to maximize profit. Substantiate your decision with suitable costing technique.

(ICMA –Final)

Ans.

(a)	Cost	Profit	Cost	Profit
	₹	₹	₹	₹
Komal	1086383	293617	1086383	263617
Lovely :	2338085	631915	2338085	661915
Makeup	220426	59574	220426	59574
nice	55106	14894	55106	4894

- (c) Incremental cost, incremental revenue analysis used in decision making whether to process further or not. Komal and Nice are beneficial to process further and Lovely and Makeup are beneficial to sell at split off point by doing so a total increase in profit can be to the tune of ₹ 40000 and total profit ₹ 1030000 [in comparison with (b)]

31. QR Ltd operates a chemical process which produces four different products Q, R, S and T from the input of one raw material plus water. Budget information for the forth coming financial year is as follows:

	₹' 000
Raw material cost	268
Initial processing cost	464

Product	Output in litres	Sales	Additional processing
Q	400000	768	160
R	90000	232	128
S	5000	32	—
T	9000	240	8

The company policy is to apportion the costs prior to the split off point on a method based on net sales value

Currently, the intention is to sell product S without further processing but to process the other three products after the split off point. However, it has been proposed that an alternative strategy would be to sell all four products at the split off point without further processing. If this were done, the selling prices obtained would be as follows –

	₹ Per litre
Q	1.28
R	1.60
S	6.40
T	20.00

You are required:

- To prepare a budgeted profit statement showing the profit or loss for each product, and in total, if current intention is proceeded with.
- To show the profit or loss by product wise, and in total if the alternative strategy were to be adopted .
- To recommend what should be done and why assuming that the is no more profitable alternative use for the plant

(CIMA –London)

Solution:

Let us first of all allocate joint cost on net sales value basis to the joint products

$$\text{Total cost} = 268 + 464$$

= 732 thousand rupees.

(in ₹' 000)

Product	Sales value	Add processing cost	Net sales value	Joint cost apportioned
Q	768	160	608	456
R	232	128	104	78
S	32	—	32	24
T	240	8	232	174
Total	1272	296	976	732

(a) Profit statement productwise

(in ₹ 000)

Product	Sales value	Pre separation cost	Cost Post separation	Total cost	Total profit
Q	768	456	160	616	152
R	232	78	128	206	26
S	32	24	----	24	8
T	240	174	8	182	58
Total	1272	732	296	1028	244

(b) Statement of profit at split off point

(₹'000)

Product	Sales value	Allocated joint cost	Profit
Q	512	456	56
R	144	78	66
S	32	24	8
T	180	174	6
Total	868	732	136

(c) Incremental cost and incremental revenue analysis on further processing as in question.
(₹'000)

Product	Additional revenue	Additional processing cost	Increase in revenue
Q	256	160	96
R	88	128	(40)
T	60	8	52
Total	404	296	108

The products Q and T should be processed further and product –R to be sold at split off point to earn overall maximum profit.

By doing so the total profit can be

$$Q = ₹ (56+96) = ₹ 152,000$$

$$R = ₹ (66) = ₹ 66,000$$

$$\text{Product S} = ₹ 8000$$

$$T = ₹(6+52) = ₹58000$$

$$\text{Total} = ₹284000$$

i.e a net increase of ₹40000 in profit in accepting the recommended strategy

32. The management team of Exe. Ltd is considering the possibility of under taking a single production process which jointly produces four products in standard proportion. The output from each 10kg batch of raw material put into the process, together with the net reliable value per kg of output immediately after the split off point is: –

Material	Output per 10kg in put Kg	Net realizable value per kg of out put (₹)
A	4	8
B	3	4
C	2	10
D	1	2

The cost of processing each 10kg input batch are ₹12 and the cost of the raw material input is ₹4 per kg.

For each of the four materials jointly produced there is the possibility of further processing before sale. The further processing will entail both manual operation and machine processing as well as incurred some costs directly attribution to each product. Details of the resources used in, and cost incurred by, the further processing as well as the final price per kg are: –

Material	Machine hours	Labour hours	Other direct costs ₹	Sales price ₹
A	2	1	4	17
B	6	1	2	13
C	4	5	3	36
D	2	2	2	9

‘Other direct costs’ are variable costs but exclude the cost of labour, also a variable cost at ₹3 per labour hour. Apart from Other direct costs and labour cost, all other costs of this further processing are fixed and are expected to amount to ₹340000 per annum.

Exe ltd has the opportunity to process 100000 kg of the basic raw material per year and machine capacity is capable of fully processing this amount.

The managing director feels that all products which are subjected to further processing must be treated as” joint products “ and all products sold immediately after the split off point without further processing are to be treated as by products of the original process. The net costs of the joint process are allocated to the joint products in proportion to the contribution of each product line, after considering the marginal costs after split off point and the sales revenue.

However the managing director is uncertain whether the ₹340000 fixed production costs of the further processing should be allocated to products in accordance with machine or labour hour.

Required:

- (a) Specify which of the jointly produced material should be subject to further processing if the joint process is carried out.
- (b) Produce a product profitability report for the joint products, utilizing the managing director's approach to the determination of joint and by-product, for each of the methods of allocating fixed production overhead has been mentioned. You may assume all production will be sold. (CA – final)

Hint Solution:

First of all find out the apportionment ratio for allocation of joint costs incurred at pre – separation. Find out contribution after separation.

Also the products which are not to be processed further and to become by – products.

Incremental cost and incremental revenue analysis for further processing

	<u>Products</u>			
	A	B	C	D
Direct costs : (₹)	4	2	3	2
Labour cost @ ₹3/-per hour (₹)	3	3	15	6
Merging cost (total)	7	5	18	8
Increment in revenue(₹)	9	9	26	7
Difference (₹)	2	4	8	-1

Product A,B and C positively contribute to the profits but product D has negative contribution so products A,B,C should be processed further and product D should be sold at split off point as by product.

Statement of apportionment of joint costs to joint products A,B and C

	A	B	C	Total
Sales value (₹)	680000	390000	720000	1790000
Further processing cost : (₹) (Excluding 340000 fixed)	280000	150000	360000	790000

$$A=(4+3) \times 40000$$

$$B=(2+3) \times 30000$$

$$C=(3+15) \times 20000$$

Contribution:

Further processing

Ratio:

i.e

400000	240000	360000	1000000
40 :	24 :	36	
10 :	6 :	9	
40%	24%	36%	

(i) Product profitability report after allocating fixed overheads on the basis of machine hour rate and joint cost on further contribution ratio basis:

	A	B	C	Total
	₹	₹	₹	
Joint cost Apportioned: [120000+400000–20000] ₹	200000	120000	180000	500000
500000				
Post separation:				
Variable cost (₹)	280000	150000	360000	790000
Fixed : (₹)	80000	180000	80000	340000
Total cost(₹)	560000	450000	620000	1630000
Sales value(₹)	680000	390000	720000	1790000
Profit (₹)	120000	–60000	100000	160000

(ii) Product profitability after allocating fixed overheads on labour hours basis.

	A	B	C	Total
Joint and post separation variable (₹)	480000	270000	540000	1290000
Fixed cost apportioned on labour hours basis (₹) (4:3:10)	80000	60000	200000	340000
Total cost (₹)	560000	330000	740000	1630000
Sales value	680000	390000	720000	1790000
Profit(₹)	120000	60000	(–20000)	160000

Machine hours are predominant to the labour hours. It is here by suggested to apportion the fixed costs on machine hours basis. It will be merely absorption method, the overall profit will remain the same.

33. A company re –apportions the cost incurred by two service centres, material handling and inspection, in the three production centres of machine, finishing and assembly.

The Following are the overheads costs which have been allocated and apportioned to the five cost centers:

	(₹'000)
Machining	400
Finishing	200
Assembly	100
Material handling	100
Inspection	50

Estimates of benefits received by each cost centre are as follows:

Machining	Finishing	Assembly	Material	Inspection
%	%	%	%	%

Material					
handling	30	25	35	—	10
Inspection	20	30	45	5	—

You are required to –

(a) Calculate the charge for overheads to each of the three production centres including the amounts re-apportioned from the two service centres using

(i) The continuous allotment (Repeated Distribution) method

And (ii) An algebraic method.

Ans.

<u>Allocated cost</u>
Machining 42965
Finishing 43844
Assembly 63191
<u>₹150000</u>

Hint :

Repeated distribution method of apportioning cost of service centres.

	Machining	Finishing	Assembly	material	Inspection
	₹ 000	₹ 000	₹	handling ₹	₹
Overheads cost					
:	400000	200000	100000	100000	50000
Material					
handling :	30000	25000	35000	–100000	10000
	430000	225000	135000	—	60000
Inspection					
centre:	12000	18000	27000	3000	–60000
	442000	243000	162000	3000	—
Material					
handling	900	750	1050	–3000	300
	442900	243750	163050	—	300
Inspection					
centre:	60	90	135	15	–300
	442960	243840	163185	15	—
Material					
handling	5	4	6	–15	—
Total	442965	243844	163191	—	—

Under algebraic method

Let X be the material handling over heads.

Y be the insertion canter over heads.

$$X = 100000 + 0.05Y$$

$$Y = 500000 + 0.1X$$

Solving $X = 100000 + 0.05Y$

$$10Y = 500000 + X$$

$$10Y - 0.05Y = 600000$$

$$Y = \frac{600000}{9.95} = ₹ 60301$$

$$\Rightarrow X = 100000 + 0.05 \times 60301$$

$$= 100000 + 3015$$

$$= ₹ 103015$$

Apportioned	Machine ₹	Finishing ₹	Assembly ₹
X Material handling	30905	25754	36056
Y inspecting centre	12060	18090	27136
Total	42965	43844	63192

34. A distillation plant which works continuously, process 1000 tons of raw material each day. The raw material costs ₹ 4 per ton and the plant operating costs per day are ₹ 2,600. From the input of raw material the following output is produced.

Distillate X	40 %
Distillate Y	30 %
Distillate Z	20 %
By-Product B	10 %

From the initial distillation process, distillate X passes through a heat process which costs ₹ 1500 per day and becomes product X which require blending before sale.

Distillate Y goes through a second distillation process costing ₹ 3300 per day and produces 75% of products Y and 25% of product X1

Distillate Z has a second distillation process costing ₹ 2400 per day and products 60% product Z and 40% of product X2.

The three streams of products X, X1 and X2 are blended at a cost of ₹ 1155 per day to become a sale able final product XXX.

There is no loss of material from any of the processes.

By-product B is sold for ₹ 3 per ton and such proceeds are credited to the process from which the by product is derived.

Joint costs are apportioned on a physical unit basis.

You are required to :

- Draw a flow chart, flowing from left to right to show for one day of production the flow of material and build-up of the operating costs for each product.
- Present a statement for management showing for each of the products XXX, Y and Z, the output for one day, the total cost and the unit cost per ton.
- Suggest an alternative method for the treatment of the income receivable for by – product B than that followed in this question (figures are not required)

(CIMA –Landon)

Ans.

X ₹ 8325, ₹ 15
Y ₹ 4050, ₹ 18
Z ₹ 2280, ₹ 19

Hint: let us solve for Y

$$\text{Sale proceeds of by-product B} = ₹ (1000 \times 0.1 \times 3) = ₹ 300$$

Cost before split off to be allocated to distillates X, Y and Z

$$= (1000 \times 4 + 2600 - 300) = ₹ 6300$$

$$\text{Cost allocated to distillate Y} = 6300 \times \frac{3}{9} = 2100$$

$$\text{Second distillation cost for product Y} = 0.75 \times (2100 + 3300)$$

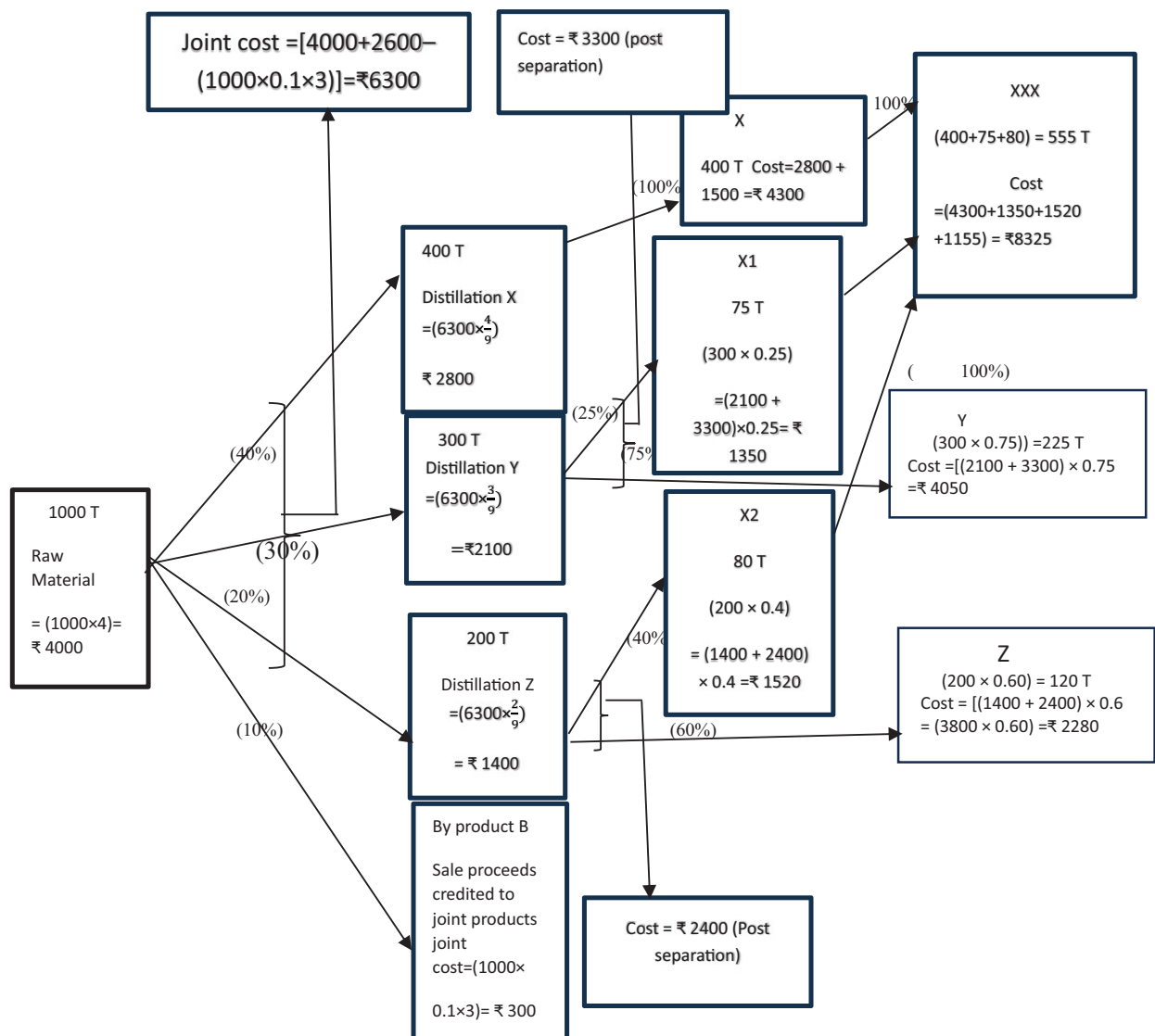
$$= ₹ 4050$$

$$\text{Number of tons of Y produced} = 1000 \times (0.3) \times (0.75) = 225 \text{ Tons}$$

$$\text{Per ton cost allocated to product Y} = \frac{4050}{225} = ₹ 18$$

similarly solve for others.

- Flow Chart Showing the flow of material and operating cost for each product



6. Budgetary Control

The target of every business organization is to earn maximum possible profits in the long term. For achieving the ultimate goal proper planning at upper level management is necessary. All planning depends upon the past market survey and possible future trends. So in any business organization a quantitative analysis of past and future trend is necessary.

For effective running of a business management must know

- i) Where it intends to go i.e. its objectives.
- ii) How it intends to accomplish its objectives i.e. plans.
- iii) Whether individual plans fit in the overall organizational objectives i.e. co-ordination.
- iv) Whether operations conform to the plan of operations relating to that period i.e. control.

Let us first of all define budget:

A budget is a detailed statement of expected revenue and expenses during a specific period of time. The revenue will include in any organization revenue from sales, interest, accounts receivable, rents and any other source of revenue. The expenditure includes costs such as purchasing raw material labour force, other fixed assets out flow and other terms of expenditure. Budgets are generally made for a specific time period generally a fiscal year and further may be broken into small time segments say quarterly or monthly. Merely making the statements does not solve the purpose or will lead the organization to the long term goals, but reviewing it at small intervals of time to keep it on the track is also very necessary.

Developing a good budgeting skill can help to:

- (i) Forecast future revenue and expenses.
- (ii) Identify opportunities of cost cutting.
- (iii) Ensure enough Cash in hand to cover upcoming expenses.
- (iv) Determine the break-even point.
- (v) Find opportunities to be more efficient and productive

In CIMA terminology, a budget is defined as follows:

“A plan expressed in money. It is prepared and approved prior to the budget period and may show income expenditure, and the capital to be employed. May be drawn up showing mere mental effects on former budgeted or actual figures, or be compiled by zero-base budgeting”.

A budget is "A quantitative expression of a plan for a defined period of time. It may include planned sales volumes and revenues, resource quantities, costs and expenses, assets, liabilities and cash flows:

Budgeting

Budgeting is the process of expressing the predicted costs and resources for a planned course of action over a specified period of time. Budgeting helps all types of organizations to plan and control their operations, and support their managerial strategies. A budget sets out the benchmark against which performance will be measured.

Performance against budget may be a part of the organization's appraisal system for individuals who are deemed accountable for such performance.

Purpose of Budgeting :-

Purpose of budgeting include

- a. Planning
- b. Resource allocation
- c. Coordination
- d. Control
- e. Communication
- f. Motivation
- g. Performance evaluation

Budgetary Control:

It is a technique of managerial control through budgets. It is designed to assist management in the allocation of various responsibilities. It is a system of achieving the firms objectives with minimum cost and provides a powerful tool to the management for efficient performance of managerial functions.

In CIMA terminology- "Budgetary control is the establishment of budgets relating to responsibilities of executives to the requirement of a policy and the continuous comparison of actual with budgeted results either to secure by individual action the objectives of that policy or to provide a basis of revision"

Forecasts and Budgets –

Forecasting is not an exact science but in normal circumstances extension of past. A forecast is a prediction of what is going to happen as a result of given set of circumstances. It is mere an assessment of future events. A budget is an approved plan of action expressed in figures relating to a specified period of time. Budget is prepared on the basis of the forecast made for the budget period and thus a forecast is not all that a budget is. A person competent to make judgment can depending upon the past happenings forecast the future. Budgeting is an expert exercise of the executives. Forecast can be made for purpose other than budgeting. Economic forecast of general business conditions may not have anything to do with budgeting. Forecasting ends after the assessment of prospective conditions. Budgets has to depend upon forecasting and lead to a control process, that continues even after budget preparation.

Objectives of Budgetary Control:

Budgets are merely forecast of the future events expressed in quantitative terms for a specified time period. Budgeting is a technique for formulating budgets. It indicates a right path for managing the business. Through budgeting management is helped to anticipate the problems and take corrective measures to overcome those. Budgetary Control is a sort of tool in the hands of management to keep the organization on the right track, any deviation after a proper information system is found out, responsibilities are allocated and early corrective measures are taken to meet the specified target leading to the achievement of long terms goals. It provides a powerful tool to the management for efficient performance of managerial functions. The general objectives of budgetary control are as follows:-

1. Planning:

It is an important managerial function. It helps the management to anticipate eventualities, prepare for contingencies for achieving the ultimate goals. It helps the managers to decide in advance, what to do, how to do, when to do and who to do. Without a formal procedure of budgetary control many operational managers will not find the time to plan ahead without a proper planning the budget would be much like a map without destination. The budget will meet its goals based on the current levels of income and expenses. Budgetary control will force management at all levels to plan in time all the activities to be done during the future periods. Thus budgeting is an important planning device.

2. Communication:

Every middle, lower level management should know the role they have to play for the success of the budgetary control and to achieve the ultimate goal of the organization. The Communication system from top to bottoms and from bottom to top should be strong enough to have a control over any deviation from the targets set and to take an early remedial action. This keeps different sections of the organization informed about the contribution of different sub-units in the attainment of overall organizational objectives.

3. Coordination:

Next and the most important objective of the budgetary control is coordination. Without the coordination of different sections at the organizational level, the success of the budgetary control is not possible.

Coordination will lead to the following results:—

- (a) Each department will work in harmony with others.
- (b) Each department will know the role it has to play in the attainment of the ultimate overall organizational objectives.
- (c) Activities of different department is that they are so governed that the chances of overlapping of activities and wastage of time, labour and other resources are minimized so far as possible and avoided.

For example when sales budget depending on the market forecasting are prepared, the production budget is so prepared that production could be kept under control, overproduction or underproduction are avoided to avoid the chances of wastage of resources or harming the organizational—customer relations in not fulfilling the supply. Similarly the purchase of raw material budget, labor budget, financial budgets and so on.

4. Motivation:

Through budgets and the budgetary control each and every member of the organization is physically and mentally motivated to work for the overall achievement of the long term goals of the organization. If the workers are informed that their personal interests are closely associated with the success of organization plan and properly motivated, then to arrive at the proper destination will become easier because each and every force in the organization work as motivated in the same direction.

5. Control:

From the very beginning of the overall budget, functional budgets their functioning in coordination with each other to achieve the ultimate goal control is necessary. Proper watch on organizational objectives at any time is necessary and for this a lot of 'Cuts' and adjustments are made to make functional budget fit in the organizational objectives. Proper feedback at every level at any time is necessary to keep watch on the deviations between the actual and budgeted standard and to take an early remedial action. An inbuilt mechanism of the routine of budgetary control is bound to precipitate to an operational control.

6. Reporting and Evaluating:

It is the most important segment of budgetary control. Continuous evaluation at all levels is necessary for the project effectiveness assessment and efficiency assessment. Any inefficiency detected at any level if evaluated in comparison with the standard if reported in time and timely action is taken to overcome any problem sought may take the organization on the track again and in the direction to meet the functional targets and so the overall goal of the organization.

Budgetary system integrates key managerial functions as it links top management planning functions with the control functions performed at all levels of the managerial hierarchy. For the success of meeting the organizational objectives a strong coordination and reporting system is necessary from the functional management to the top level management and vice-versa. When functional targets are properly defined and standard set at each level, the management at that level compare the actual with the standard and report any deviation through a proper reporting or communication system to the upper level management to take an early and possible action to eradicate any problem.

Essentials of Effective Budgetary Control System:–

- (i) The goals should be within the frame work of organizational Strategic and long–term plans.
- (ii) Organizational goals should be clearly stated and as far as possible should be quantified.
- (iii) The overall organizational goals must be divided in functional goals.
- (iv) These functional goals should not be in conflict with each other and overall organizational goals.
- (v) The system should be supported by all management levels.
- (vi) The person responsible at any level for effective control system should participate in the budget preparation.
- (vii) The budget should cover all phases of the organization.
- (viii) Constant vigilance is required so that continuous comparison between the budgeted and actual data and variance if any should be reported.
- (ix) Cost at any level should not be more than the revenue earned.
- (x) If standard costing system is in vogue, budgetary programmer should be prepared in coordination with the standard cost.

Advantages of Budgetary Control:

- (i) It helps in most economical use of the available resources.
- (ii) It is always helpful to lead the organization in the right– direction to meet the overall objectives.
- (iii) Proper coordination at various management levels is possible.
- (iv) All functional heads are compelled to make plans in harmony with the plans of other departments.
- (v) The lower level of management is helped as clear cut targets are fixed and achieved by comparison with the standard and actuals.
- (vi) A habit of timely, careful, adequate consideration of all factors before reaching important decision is build up.
- (vii) It facilitates periodic self–analysis of the organization.
- (viii) Management is forced to give a timely attention to the effect of changing business conditions.

Disadvantages of budgetary control system:–

Along with the advantages of the budgetary control system there are certain disadvantages of the system because sometimes the management whether top or lower level feels itself to pass through a water tight compartment

whose boundaries are rigid and fixed, limiting then to take any innovative actions at their own level. The following is a list of disadvantages of budgetary control system:–

1. The major problem occurs when budgets are applied mechanically and rigidly.
2. Budgets can demotivate employees because of lack of participation If the budgets are arbitrarily imposed top–down employees will not understand the reason for budgeted expenditure and will not be committed to them.
3. Budgets can cause perceptions of unfairness.
4. Budgets can create competition for resources and policies.
5. A rigid budget structure reduces initiative and innovations at lower levels, making it impossible to obtain money for new ideas.

Limitations of Budgetary control system.

There are certain limitations of budgetary control system because as we know budgets are prepared on the future estimates. Future estimates depends upon the past happenings. Future estimates are merely extension of the past events contingent happening in future are not taken into account while budgets are prepared. The following is list of limitations of budgetary control system.

1. Estimates: Budgetary or may not true as these are based on the estimates. The assumptions about future may or may not be true.
2. Rigidity: Budgets are considered to be a rigid document. Too much emphasis on budgets may effect day–to–day operations and ignores the dynamic state of organizational functioning.
3. False sense of security: Merely budgeting cannot lead to profitability. Budgets cannot be executed automatically. It may create a false sense of security that everything has been taken care of in the budgets.
4. Lack of coordination: Staff coordination is usually not available during the budgetary control exercise. This limits the budgetary control system to be effective.
5. Time and Cost: The cost factor also limits the preparation of the budgets and so implementation budgetary control system. So the introduction and implementation of the system may be expensive from the point of view of time taken and cost incurred.

Budget Manual

Budget manual is a detailed set of guidelines and information about the budget process typically including a calendar of budgetary events, specimen budget firms, a statement of budgetary objectives and desired results, listing budgetary activities and budget assumptions

It is a written document which guides the executives in preparing various budgets. Objectives at each stage are properly stated, standards are set. Responsibilities and functions of each executive in regard to budgeting are written down in the budget manual to avoid any duplication or overlapping of responsibilities. Method of developing various budgets and method of reporting performance against the budgets are written in the budget manual. Following are the important matters that a budget manual may contain:–

- (a) An explanation of the objectives of the budgetary process
 - (i) The purpose of budgetary planning and control.
 - (ii) The objectives of various stages of the budgetary process
 - (iii) The importance of budgets in the long term planning of the business.
- (b) Organizational Structure
 - (i) Organizational chart
 - (ii) A list of individuals holding budget responsibilities.
- (c) An outline of the Principle budgets and relationship between them.

- (d) Administrative details of budget preparation.
- (i) Membership and terms of reference of budget committee.
- (ii) The sequence in which budgets are to be prepared.
- (iii) A time table.
- (e) Procedural matters:
 - (i) Specimen forms and instructions of their completion.
 - (ii) Specimen reports.
 - (iii) Chart of accounts (Account codes)
 - (iv) The name of budget officers to whom enquiries must be sent to.

Advantages of Budget Manual

Budget manual is a very useful document. In any organization for the successful functioning of the budgetary control system.

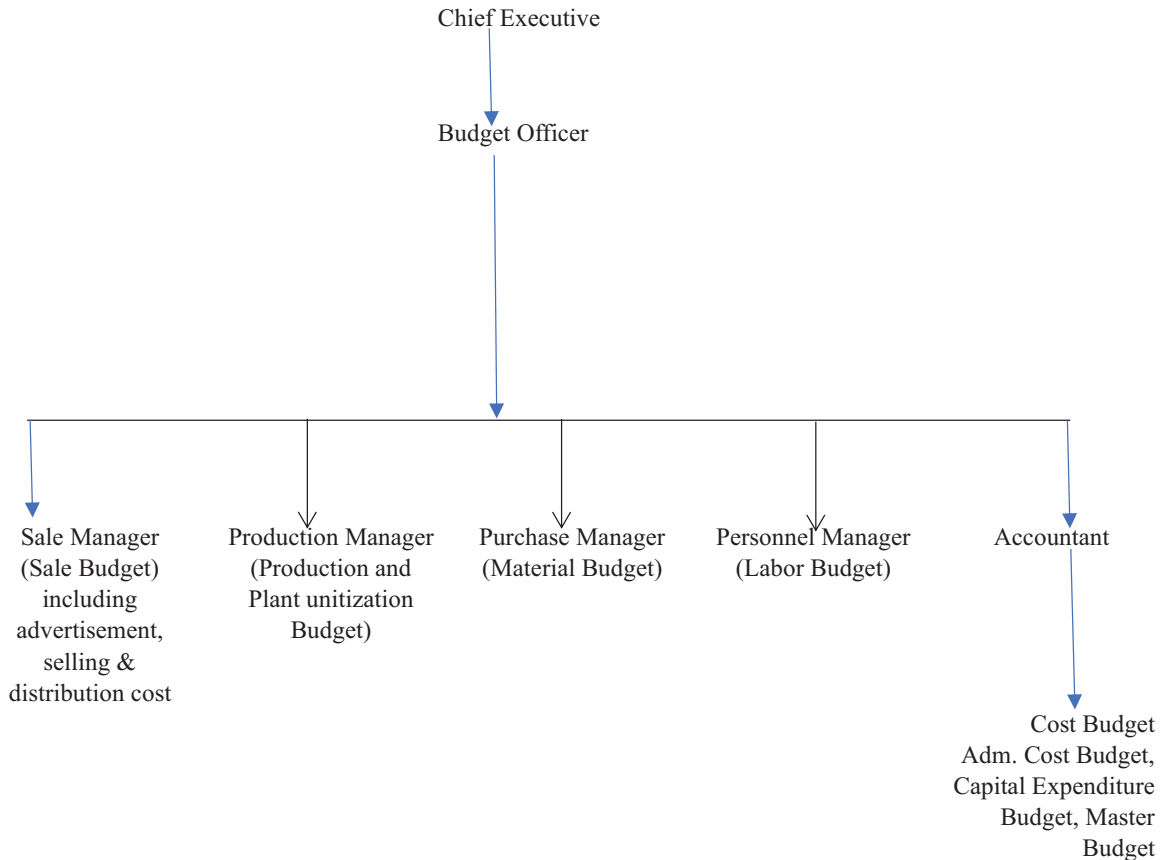
- (a) Everyone in the organization through budget manual recognizes his role, what is to be done, how is to be done in the budgetary control system.
- (b) Responsibilities are clearly stated in writing removing any chance of doubts at each stage to meet the organizational set targets.
- (c) Effort to standardize each activity is done, forms are standardized, and reports are standardized. So budget manual enables each member to evaluate his performance at any time and timely actions are possible to go in line with the desired results.

Sequence of Budget Preparation

In normal circumstances future is the extensions of past. Estimates are made depending on the forecasting of future. So we can say in the budget preparation forecasting plays an important or ultimate role, contingent happening are to some extent taken into consideration though uncertainty of these is always possible. The following is the sequence of budget preparation.

- 1 Sales Budget: Sales department collects the relating data from the market. Depending upon the present market share and future prospects, the department gets the idea regarding the sales in the coming period. Efforts are made to quantify sales in volume as well as in sales value.
- 2 .Finished Goods stock budget: Inventory budget showing the finished goods which are to be kept in stock is also prepared along with the sales budget in order to arrive at the production budget.
- 3 .Production Budget: How much quantity of the finished goods are to be produced in the budget–period are prepared depending upon the present stock, sales of the goods and the finished goods to be kept in stock.
- 4 Resources of Production Budget: After the preparation of the Production budget resources of production budgets are prepared these are:–
 - (i) Material usage budget.
 - (ii) Machine usage budget.
 - (iii) Labour budget.
5. Purchase budget: After preparing the material usage budget, material purchase budget is prepared. Material purchase budget is prepared after keeping into account the opening and closing stock and material required for the production.
- 6 .Overhead Cost Budget: Overhead cost budget is then prepared which is required for the present production.
- 7 Budgeted Income Statement: The budgeted income statement is prepared, It tells the income to be earned in budgeted period.
- 8 Other budgets such as (i) Cash budget. (ii) Capital expenditure budget
- (iii) Working Capital Budgets are prepared.

Organization Chart



Budget Period:–

Budget Period may be defined as the period (Time span) for which budget is prepared. It is generally of one year for majority of the organizations, but it differs on the basis of type of business cycle.

CIMA defines budget–period as "The period for which a budget is prepared and used, which may then be subdivided into control periods." Two aspects mainly determines the budget period

(i) The type of business (ii) The control aspect.

Seasonal business prepares the budget for the period of the business. For example, in case of seasonal industries i.e. in clothing, the budget period should be which covers the season. In non–seasonal businesses it may be very short or may be of one or more than one year. The second aspects i.e. the control aspect also play an important role in period determination. If control is possible for a very long period then long period budget can be chosen and if control is very difficult for the long period then short budget period should be chosen.

The budget period should not be too long because the budgets are prepared on the basis of forecasting and future estimates. Things may not happen as desired, so the budget should be of adequate period. Similarly it should not be of too short period so as to have a sufficient time before budget implementation.

There should be a regular time plan for budget preparation. It may be on the following lines:—

1. Annual budget: These type budget period is the most popular as it coincides with the financial year. In most of the business units these budget period is selected for the operational activities such as sales, production, and purchase etc.
2. Short-term budgets: For control purpose such budgets are selected. There may be weekly, monthly, quarterly budgets. Short term budgets are very much in the events of uncertainty and continuous comparison of the performance i.e. actual and budget.
3. Long term budgets: These types of budgets may be for more than one year. In research and development, introduction of new products or new projects, it may be more than one year and extend to two, three or five years.

Fixed budget

A budget which is used unaltered during the budget period is a fixed budget. This type of budget does not highlight— activity variance i.e. un adjustable for higher and lower of activity. A budget may be prepared for say 100000 units. Actual activity level may be say 120000 units. In the fixed type of budget absolute differences of budgeted figures and actual figures will be found out without any type of adjustment for change in level of activity. These budgets are used where the future income and expenditure can be known with a higher degree of certainty and have been quite predictable over time. These types of budgets are commonly used by organizations that do not expect much variability in the business or economic environment. Fixed budgets are simple to prepare and less complicated. In addition, keeping track is easier with fixed budgets since the budget will not vary from time to time. One significant disadvantage of fixed budget is that it does not account for changes in expenditure and income over time. Thus during times of unexpected changes the actual scenario may turn out to be different from what is laid out in a fixed budget.

Flexible budget:

Flexible budgets are, as their names, suggest variable and flexible depending on the variability in the results expected in future. Such budgets are more useful for business that operate in an ever changing business environment and have the need to prepare budgets that are able to reflect the many outcomes that are possible. The use of flexible budget ensures that a firm is prepared to some extent to deal with the unexpected turn around in events, and able to better guard itself against losses arising from such scenario. A possible disadvantage of this form of budgeting is known to be the fact that they may be complicated to prepare, especially when scenario being considered are numerous in numbers and complex in nature.

Difference between Fixed Budget and Flexible Budget:

Fixed budgets and flexible budgets both are forms of budgeting that are essential for any business that wishes to exercise control, induce proper decision making and coordinate business activities. Fixed budgets are more suitable for businesses that operate in a less dynamic business environment whereas flexible budgets are best for firms that operate in turbulent market and having uncertainties. A fixed budget is much easier to prepare than a flexible budget since it does not require constant revision, whereas flexible budgets are much more complex since the scenario considered are greater in number.

The accuracy of a flexible budget can be easily affected owing to the variability of the business environment the firm is in. Flexible budgets are mostly preferred by firms because they allow the firm to conduct scenario planning and better adjust for unexpected situations.

Functional Budgets:

These budgets relate to the different functions of the organization. The different functions of the organization are sales, production, purchase, cash, manpower requirement and so on. Let us discuss all of these one by one:

1. Sales Budget:– The most important budget and the basis of preparation of all the other budgets. This budget further depends upon the market survey and future demand in the market. Sales manager is responsible for the preparation and execution of the sales budget. It is prepared in the form of volume (the units to be sold) as well as in the sales value. It is the basis of all the budgets, so every effort should be made to be as accurate as possible otherwise every other budget will deviate too far from reality and will lead to a futile exercise. Sales budgets can be prepared :
 - (i) Product wise i.e. how much volume of each of the products of the company will be sold in the budgeted period.
 - (ii) Time wise i.e. within month, quarter, half yearly and yearly.
 - (iii) Type of customers i.e. sales to the general customers, to the Government, sales to the foreign customers etc.
 - (iv) Area wise i.e. sales on the basis of the different areas and total sales by adding sales in different areas.

Sales budgets are prepared taking into consideration the following factors:

- (a) Salesmen estimates: Salesmen gets after a proper survey of the market and dealings with the customers, the estimated sales. As they are in the direct contact with the customers their sales estimates and data collected is considered to be accurate. They can be in the process of budget preparation made responsible for the data presented by them.
- (b) Past sales and Future trends: For preparing sales budget past sales should be kept in mind. In addition future trends depending upon the customer demands and market survey the compilers of sales budget should consider.
- (c) Seasonal fluctuations:– While preparing the sales budget seasonal functions should be kept in mind. Efforts should be made to minimize the effect of these functions. This can be done through giving off season incentives to the customers such as price–cuts and other schemes.
- (d) The plant capacity: Sales budget is prepared taking into consideration the plant capacity. The sales budget should be within the plant capacity.
- (e) The key limiting factors: The next thing to be kept in mind by the budget preparation is the availability of the resources. Production is limited by the availability of the resources of production and hence sales. If the supply of raw material is limited then production cannot be increased and so the sales.
- (f) Availability of finance: Availability of finance is another factor of consideration in the preparation of the sales budget. For a planned sales expansion, an adequate amount of finance should be arranged i.e. through raising capital or other means e.g. raising loans or selling securities.
- (g) Competition: Competition is another very important factor to be considered while preparing the sales budget. Sales promotion activities are affected by the reactions of the competitors.

(h) Other considerations: Other considerations such as government quota, export incentives, import possibilities in the budget period, advertisement, sensitivity of the market, price elasticity, future per capita income, Govt. policies, Bank rates, Govt. budget trend, incentives etc. should also be taken into account in preparing the sales budget.

Illustration 1.

From the data given below prepare a sales budget

A company in one of the business cycle is selling 10000 units of a product. The selling price of the product in the business cycle is ₹ 20 per unit.

The market surveyor reported at 10% increase in sales in the coming business cycle and can be sold in the market at 15% increase in selling price.

Solution: Sales budget:–

	Business Cycle	Sales (Units)	Selling Price (₹)	Sales Value (₹)
-	II	10000×(1.1) =11000	20×(1.15) =23	253,000

Illustration 2

Carryon Ltd. is producing and selling two products B and T. It is going to prepare. Its budget for the year ending 31st December.....

Expectations for the year.....are

Sales of product B is expected to be 5000 units.

Sales of product T is expected to be 1000 units.

Price is expected to be ₹30 per unit for B and ₹50 per unit for T.

As sales budget is the basic to prepare others, you are required to prepare sales budget

Solution:

Sales budget for the year

Product	Quantity Units	Selling Price ₹	Sales Value ₹
B	5000	30	150000
T	1000	50	50,000
		Total	200,000

2. Production Budget:

It is a schedule which shows the quantity of the product which should be produced or manufactured during a specific period (budgeted) to meet the expected market demand for the product. The equation regarding sales and production can be drawn as

Opening stock of the product + production (units produced of the product) – closing stock of the product = sales volume (units of the product sold).

i.e. Planned production in units

= Expected sales in units

+ Planned ending inventory of the product (units)

- Inventory of the product in the beginning

Production budget can be prepared if the expected sales are known i.e. data regarding the expected sales in the budgeted period is present. Sales budget is basic to prepare all other budgets.

The production budget is prepared by production manager and is based upon:

1. Key limiting factors
2. Sales budget
3. Budgeted closing inventory
4. Opening inventory
5. Policy of management regarding purchase or manufacturing components.

From the above discussion it is clear that sales budget prepared by the sales manager taking into account the market demand survey is basic for other budgets and independent of all the others. Other budgets taking production budget depends not only on the sales budget but also on other constraints such as availability of the raw material, labor, present plant– capacity etc. So it is very important to coordinate production budget and sales budget to avoid imbalances in production.

Format and example of production budget.

The following example illustrates the production budget format. The expected sales unit is obtained from the sales budget of the company. A planned ending units of 1st, 2nd, 3rd and 4th quarter are 210, 168, 213 and 225. The beginning units at the first quarter are 196. Sales department has estimated budgeted sales as 1320, 954, 1103 and 1766 respectively in the quarter sequence.

Production Budget of the company

For the year ending(Quarter wise)

	Quarter				
	1	2	3	4	Year
Budgeted Sales (units)	1320	954	1103	1766	5143
+Planned ending inventory units	210	168	213	225	225
–Beginning units	–196	–210	–168	–213	–196
Planned Production (units)	1334	912	1148	1778	5172

$$\begin{aligned} \text{or} &= (1320+954+1103+1766)+(210+168+213+225)-(196+210+168+213) \\ &= 5143+816-787=5172 \text{ units} \end{aligned}$$

Illustration 3 ABC Ltd.'s sales department plans the sales of the product X of the company in coming four quarters to be 100000 units, 108,000 units, 120000 units and 132000 units respectively. At the beginning of the budgeted year there are 20000 units and the company plans to keep inventory in hand at the end of each quarter to be one sixth of the sales of the next quarter. How much units of the product should be manufactured in each quarter of the year?

Prepare a statement if the company expects 1,38,000 units to be sold in the first quarter of next following year.

Solution:–

	ABC Ltd Production Budget				
	First quarter (units)	Second quarter (units)	Third quarter (units)	Fourth quarter (units)	Yearly Total (units)
Budgeted Sales (units)	1,00,000	1,08,000	1,20,000	132,000	4,60,000
+ Closing inventory (units)	18000	20,000	22,000	23,000	23,000
- Opening Stock	20000	18000	20000	22000	20,000

Budgeted Production (units)	98,000	11,000	122000	133,000	4,63,000

Production Budget Format

Department Production for the year.....

Months	Quantity of sales	Add Quantity of closing stock	Total quantity (2+3)	Less quantity of opening stock	Production units to be completed	Add Equivalent units in closing WIP	Less Equivalent units in opening WIP	Total Equivalent units to be completed
1	2	3	4	5	6	7	8	9
April								
May								
June								
July								
August								
September								
October								
November								
December								
January								
February								
March								
Total:								

3. Cost of Production Budget:

When production budget has been prepared then cost of production budget is prepared. The production budget depicts the number of units that are to be produced depending upon sales budget. When number of units which are to be produced as budgeted has been estimated, the next step is to estimate the cost that is to be incurred on production of these units. For preparation of the cost of production budget, purchase of material both in units and value budget, Labor cost budget, overhead cost budget is prepared. Let us take one by one:–

(a) **Material Budget:**– Material is the basis of production. As we know production is nothing but increasing or changing the utility of the available material. First and foremost work is to know what type of the material is required in production of the saleable product. The material which is mainly used in the production of product is known as direct material. The required material should be bifurcated into direct and indirect material. Its number of units required should be estimated.

The preparation of the material budget includes:–

1. Estimation of different types of raw material that is needed in the production of product.
2. Purchasing the required raw material in the required needed quantities at the required time.

In the preparation of the material budget the following factors should be considered:

- (a) Raw material required in the units for the budgeted production.
- (b) The companies policy for the inventories to be kept in stock is also kept in mind while preparing the raw material required budget because the company has to keep an adequate quantity in hand of raw material for an uninterrupted production.
- (c) The time lag between receiving demand, placing an order and receiving the raw material in the production units is also kept into consideration.
- (d) Seasonal nature of the availability of the raw material to be considered. In the Sugar Industry, the availability of sugarcane is seasonal and its procurement for a long period should be kept in mind so that the time period for the production can be increased to a desired level.
- (e) Next consideration is the price consideration. The quality raw material at the possible lowest price should be purchased. So while preparing the material budget the quality raw material at a lowest possible price factor should be considered.

Material budget serves following purposes:–

- (i) It forms the basis of the purchase budget.
 - (ii) It helps the purchase department to prepare purchase schedule to avoid any default in the delivery of material.
3. A basis of minimum and maximum inventory which are to be kept is formed.

Illustration 4:–

From the data given below prepare material requirement budget for the month of December 19xx depending upon the sale estimates 1,050 units of product A are budgeted to be produced in the budgeted month. Each unit of product A requires

10 units of material X
 8 units of material Y
 3 units of material Z

Solution:-

Material requirement budget of company

Name of product	Units to be product	Raw material required per unit of product	Total material required (units)
Product A	1,050	X : 10	X : 10500
		Y : 8	Y : 8400
		Z : 3	Z : 3150

Purchase Budget:

After the preparation of the material requirement budget the next step is to prepare the purchase budget. It is the budgeted statement for the purchase of the raw material. In preparing purchase budget the raw materials required for the budgeted production its opening inventory in hand and its closing stock is kept into account.

The following equation is helpful in this regard.

$$\begin{aligned}
 &\left[\begin{array}{c} \text{Opening stock of raw} \\ \text{material} \end{array} \right] + \left[\begin{array}{c} \text{Purchases of} \\ \text{raw material} \end{array} \right] - \left[\begin{array}{c} \text{Closing stock of} \\ \text{raw material} \end{array} \right] = \left[\begin{array}{c} \text{Raw material} \\ \text{consumed in} \\ \text{production} \end{array} \right] \\
 &\text{so Purchase of raw} \quad = \left[\begin{array}{c} \text{Raw material} \\ \text{required for} \\ \text{production} \\ \text{of product} \end{array} \right] + \left[\begin{array}{c} \text{Closing stock} \\ \text{of the raw} \\ \text{material} \end{array} \right] - \left[\begin{array}{c} \text{Opening stock} \\ \text{of the} \\ \text{raw material} \end{array} \right] \\
 &\text{material} \\
 &\text{(of any type required)}
 \end{aligned}$$

The points which governs the preparation of the purchase budget are

- (i) Opening stock and closing stock of the raw material that is to be kept for an uninterrupted continuous production.
- (ii) Economic order quantity for minimizing cost
- (iii) The storage capacity available.
- (iv) Seasonal discounts.
- (v) The order which are already placed.
- (vi) Price of the material.
- (vii) Availability of finance with the company if bulk purchases are possible for the cost minimization.

Illustration 5:-

A company produces a product X. Each unit of the product requires 0.4 cubic feet of wood and 1.25 hours of direct labour. Cost of one cubic feet of wood is ₹1.40. The company desires to have 20% of the material needed for production during the next month in hand at the end of each month and 15% of the product to be sold the next month in hand at the end of each month. Labour cost per unit of product X is ₹18.75 (@₹15 per hour).

The budgeted sales and production of the product X is given as:

Budgeted Sales

Budgeted Production

December	4,200 units	4,100 units
January	4,500 units	4,700 units
February	5,200 units	5,300 units

Prepare a material purchases budget for the month of January and calculate budgeted raw material inventory on December 31st and January 31st.

Solution:—

(a) Material purchase budget for the month of January		
		Raw material (units)
Raw material required for production (4700 units x 0.4)		18,80
+ Closing inventory of raw material required (5300x20%x0.4)		424
– opening inventory of the raw material (4700x20%x0.4)		(376)
Raw material budgeted purchases (units)		1,928
Budgeted cost of raw material purchases : (1928x1.4)		₹2,699.20
(b) (i) Raw material inventory on 31 st December: (4700x20%x0.4)		376 units
Budgeted cost of raw material inventory on 31 st December (376x1.4)		₹526.40
(ii) Raw material budgeted inventory on 31 st January (5300x0.2x0.4)		424 units
Budgeted cost of raw material inventory on 31 st January (424x1.4)		₹593.60

(b) Direct Labour cost budget:

When production has been developed the next task is the preparation of the direct labour budget. The direct labour requirement for the budgeted production is estimated. Split on the basis of work to be performed by the workers per unit of the product such as molding, cutting, grinding, welding, painting, finishing and so on. On the basis of requirement of the skilled, semi-skilled and unskilled labour for the budgeted production. After the estimation of requirement of different types of labour in labour hour, the next step is preparation of labour cost budget. Labour cost budget can be made by multiplying different types of consolidated labour hours by different labour rates per hour. Let us take there is a budgeted production of 1000 units of a product and for this production 50 hours of skilled labour, 70 hours of unskilled and 60 hours of semiskilled labour is required and the market labour rate is ₹ 400 per skilled labour hour ₹ 325 for semiskilled and ₹ 275 per unskilled labour hour. The direct labour cost budget will be ₹ 58750 (50x400+70x275+60x325). In preparing labour cost budget efforts should be made to avoid overtime as far as possible within the plant capacity otherwise the workers will be paid at higher rates than the normal labour hour rate.

If standard cost system is prevailing then labour cost budget will be prepared by multiplying the budgeted production with the standard hours required per unit of the product and then by the labour rate. If there is no such system, the past records are helpful in calculating the budgeted labour hours required for the budgeted production and then by labour rates for different grades of labour hours are multiplied to get the labour cost.

Illustration 6:— SG Ltd manufactures two products A and B and gives you the following data:

Sales forecast	Product A	24000 units
	Product B	15000 units

Inventions:

Opening stock	
A:	600 units
B:	6000 units
Closing stock	
A:	6,600 units
B:	3,000 units

Two types of raw material are required for production of Product A and B whose information is given as under:—

	Products	
	A	B
Material x @ ₹ 3 per kg	2kg	4kgs
Material x @ ₹ 1 per kg	1kg	2kgs
Inventions:	(a) Raw material opening stock	
	X:	36000 kgs
	Y:	6000 kgs
	Closing Stock	
	X:	48,000 kgs
	Y:	12,000 kgs
Direct Labour:		
	Department P:	2 hours @ ₹ 1 per hour for A 1 hours @ ₹ 2 per hour for B
	Department Q:	1 hours @ ₹ 3 per hour for A 1 hours @ ₹ 3 per hour for B

Prepare from the above data material cost budget and the labour cost budget that is required for budgeted production.

Solution:

Particular	Product – A	Product – B	
Sales forecast (units)	24,000	15000	
+ Closing stock (units)	6600	3000	
	30,600	18000	
–Opening stock (units)	600	6000	
Budgeted Production	30,000	12,000	
(a)Raw material consumed			Total
Material X:	₹	₹	₹
Product A: 30000x2x3	1,80,000	1,44,000	
Product B: 12100x3x4			
Material Y:			
Product A: 30000x1x1	30,000		

Product B: 12000x1x2		24000	
Material Cost Budget	210,000	1,68,000	3,78,000
(b) Labour Cost:			
Department P:			
Product A: 30000x2x1	60,000		
Product B: 12000x1x2		24000	
Department Q:			
Product A: 30000x1x3	90,000		
Product B: 1200x1x3		36000	
Budgeted Labour Cost:	150,000	60,000	2,10,000

Man Power Budget:

For a proper control and effective budgetary control system manpower requirement budget is prepared, different departments of the organization for different types of work to be performed need different types of or grades of labour such as skilled, unskilled and semiskilled etc. The manpower budget— expresses the requirement of number of labour hours in different grade specification of workers. This budget— makes provision for overtime work and recruitment and training of new workers. This type of budget is very much needed by the personnel department of the company. The department will be able to recruit new labour force from the market. It is also needed to have a proper control over the labour cost through standard labour cost requirements. This is also helpful in preparing the cash requirement budget.

Manpower Budget Performa

Classification of Labour	Grade I	Grade II	Grade III	Total	Present Strength	To be recruited
I Direct Labour						
Department A						
B						
C						
Total						
II Indirect Labour						
a) Production						
b) Administration						
c) Selling & Distribution						
d) Research & Development						
e) _____						
Total						
G. Total						

Illustration 7:

From the data given below prepare direct wages budget for department F and G with labour cost for products A, C and E

		Labour Rate per hour	Product–A Hours per unit	Production C hours per unit	Production E hours per unit
Department F					
Grade	1	1.80	2.0	3.0	1.0
Grade	2	1.60	1.5	2.0	1.5
Department G					
Grade	1	2.00	3.0	1.0	1.0
Grade	2	1.80	2.0	1.5	2.5

Budgeted Production for products in unit is:

Product	A	:	150,000
Product	C	:	240,000
Product	E	:	400,000

Solution:

Direct wages budget

Products				
Department–F		A	C	E
		(₹'000)	(₹'000)	(₹'000)
Department F				
Grade I				
Product	A: (150× 1.8× 2)	540		
	C: (240 × 1.8 × 3)			
	E: (400 × 1.8 × 1)		1,296	
				720
				2,556
Grade 2				
Product	A: (150× 1.6× 2)	360		
	C: (240 × 1.6×2)			

	E: $(400 \times 1.6 \times 1.5)$		768		
				960	2,088
Department G					
Grade 1					
Product	A: $(150 \times 2 \times 3)$	900			
	C: $(240 \times 2 \times 1)$		480		
	E: $(400 \times 2 \times 1)$			800	2,1800
Grade 2					
Product	A: $(150 \times 1.8 \times 2)$	540			
	C: $(240 \times 1.8 \times 1.5)$		648		
	E: $(400 \times 1.8 \times 2.5)$			1800	2,988
Total		2340	3192	4280	9812

(C) Production Overhead budget:

For the production cost–budget Production overhead budget is required. It can be subdivided into fixed, semi fixed and variable production overheads. It can also be classified into department wise for a proper control. The budget includes the cost of indirect material, indirect labour and indirect works expenses. The manufacturing or production overhead budget contains all manufacturing costs other than the cost–of direct material and direct labour (which are itemized separately in the direct material and the direct labour budget).

The variable overhead may be calculated by multiplying estimated variable cost per unit and the budgeted production units. The variable cost per unit is also called variable overhead rate. How most business units prefer to prepare a detailed overhead budget showing individual variable cost such as electricity, fuel supplies etc. The fixed overhead costs are calculated as the sum of individual fixed overhead costs for example rent, depreciation, insurance, interests etc. There is also another type of production overheads which are not either wholly fixed or wholly variable. This type is included in semi–fixed or semi variable production overheads.

The following example illustrates the format of a simple overhead budget. The variable overhead per unit of company A during the first, second, third and four quarter is estimated to be ₹12, ₹15, ₹16 and ₹19 respectively. The production units figures are obtained from production budget of the Company as 1334 units, 912 units, 1148 units, 1,778 units respectively. The company also expects to incur monthly depreciation of ₹3000 and monthly rent ₹2,500. There is no other fixed cost.

Production Overhead Budget

Particular	Quarter				
	1	2	3	4	Total
Variable Production Overhead: (Budgeted Production × Variable overhead rate) =	₹	₹	₹	₹	₹
Total Variable Production overheads	16,008	13,680	18,368	33,782	8,838
Fixed Production Overheads					
(i) Depreciation	9,000	9,000	9,000	9,000	36,000
(ii) Rent	7,500	7,500	7,500	7,500	30,000
Total Fixed Production Overheads	16,500	16,500	16,500	16,500	66,000
Total Production overheads	32,508	30,180	34,868	50,282	1,47,838

illustration 8

A Company produces and sells a single product sales budget calendar year 19XX quarter wise is given as under:

Quarter	No. of Units to be sold
I.	12,000
II.	15,000
III.	16,500
IV.	18,000

The year 19XX is expected to open an inventory of 4,000 units of finished product and close with an inventory of 6,500 units.

Production is customarily scheduled to provide two–third of the current quarter's sales demand plus one–third of the following quarter's demand. Thus production anticipates sales volume by one month.

The standard cost details for one unit of the product is as follows:

Direct materials 10 liters @ ₹ 0.50 per liter.

Direct labour 1 hour 30 minutes @ ₹4 per hour.

variable overheads 1 hour 30 minutes @ ₹1 per hour

Fixed overheads 1 hour 30 minutes @ 2 per hour based on budgeted production volume of 90,000 direct labour hours for the year.

Prepare direct material cost, direct labour cost and variable and fixed overhead budget.

Solution:

Production budget for 19XX

Particular	Quarter				
	I	II	III	IV	Total
	(Units)	(Units)	(Units)	(Units)	(Units)
2/3 rd of present quarter's sale	8,000	10,000	11,000	12,000	41,000
1/3 rd of following quarter's sale demand	5,000	5,500	6,000	6500 (Closing Stock)	23,000
Budget Production for 19XX	13,000	15,500	17,000	18500	64,000
Direct Material cost (₹)					
Budget for 19XX (₹) (13000X 10X0.5)	65,000	77,500	85,000	92,500	3,20,000
Direct Labour cost budget for 19XX (₹) $(13000 \times \frac{3}{2} \times 4)$	78,000	93,000	1,02,000	1,11,000	3,84,000
Variable overhead cost budget for 19XX (₹) $(18000 \times \frac{3}{2} \times 2)$	19,500	23,250	25,500	27,750	96,000
Fixed overhead cost budget for 19XX (₹) (9000 × 2)	45,000	45,000	45,000	45,000	1,80,000
Total cost (₹)	2,07,500	2,38,750	2,57,500	2,76,250	9,80,000

4) Administration Expenses budget:

To proceed towards the master budget after preparing cost of production budget the next step is the preparation of the administration expenses budget. These type of expenses are considered to be fixed for a particular capacity level. This budget–includes the expenses incurred in framing policies for the organization, directing the organization and controlling the business operations. Past experience and forecasted changes becomes the basis of this budget

preparation. Forecast changes may change the administration expenses in the budgeted period. In normal circumstances and within a level of production and sale, these costs are fixed.

5) Research and development budget:

Investigative activities that a business chooses to conduct with the intention of making a discovery that can either lead to the development of new products or procedures or to improvement of existing products or procedures. Research and development is one of the means by which business can experience future growth by developing new products or processes to improve and expand their operations.

Research and development activity is very much necessary for survival in future and earn a long term profit through adequate market share. Sometimes if a company do not bother about new innovations in the product development and do not go in line with the industry may have to close its business unit and incur heavy losses in future, such as in the case black and white televisions and colour televisions and LCD's.

In an industry that is changing fast, firms must continually revise their design and range of products. This is necessary due to continuous technology change of development as well as other competitors and the changing preference of customers. Without an R&D program, a firm must rely on strategic alliances, acquisitions and networks to tap into the innovation of others.

Generally R&D activities are conducted by specialized units or centers belonging to a company, or can be outsource to a contract research organization, universities or state agencies. In the context of commerce R&D is much needed to stay for a long period in the market and earn an adequate marked share in future.

R&D expenditure though needed from the point of view of competitor, yet is too expensive as well as uncertain. The following is a list of items on which R&D expenditure is made.

1. Salaries and wages of staff engaged
2. Material and supplies
3. Equipment
4. Communication
5. Publication
6. Other indirect costs.

6) Selling and distribution overhead budget:

Selling overhead relates to expenses incurred for promoting the marketing of the products, securing and executing the orders. Distribution overhead is the cost of delivery and dispatch of finished products from the factory to warehouse and from warehouse to customers and includes the cost of bringing returnable contains, if any, to the factory till they are ready for reuse.

Example are carriage and freight, depreciation of delivery vans, repairs and maintenance and insurance of delivery vans, warehouse rent and expenses, transit insurance of finished goods.

Selling & Distribution are therefore two distinct functions, but in most of the organizations, they are grouped together as selling are distribution expenses for the purpose of accounting and control, Selling and distribution budget is prepared for selling and distribution expenses on the basis of anticipated sales. The expenses are classified into fixed and variable expenses. For control purposes actual expenses are compared against budgeted and deviations are analyzed and discussed for corrective action to be taken at the upper level management.

Standards may be set up in relation to the sales volume, which are helpful in the preparation of the selling and distribution expenses or overhead budget. The sales manager is responsible for selling and distribution budget preparation. He prepares this budget with the help of heads of sub-divisions of sales department. In some of the organizations advertisement budget is separately prepared, when spending on advertisement is quite heavy.

7) Capital Expenditure budget:

This budget symbolizes the expenditure in every fixed asset made during the budget period. Expenditure on the acquiring new building, land, machinery, patents are the examples of Capital expenditure.

Special Features: The capital expenditure budget provides certain characteristic features that distinguish it through other functional budgets. These are:

- a) Capital expenditure budget handles items not directly linked to P&L a/c. Expenses associated with capital expenditure such as repairs, maintenance and depreciation and so on, are however relating to this budget and these are a part of overhead budget.
- b) Capital expenditure is frequently planned a number of years in advance, perhaps five & to ten year, in which case it is broken down into convenient periods like years or months. As compared to this, other functional budgets are normally prepared for a shorter period say one year.
- c) This budget involves huge amount of expenditure that needs leading management approval. So it is subject to strict management control.

Purposes: The objectives of a capital expenditure budget are stated below:

- (i) To Correct Capacity imbalances: Different departments may function at different capacities in the company. Capital expenditure in some of the department will be able to remove their imbalances and to function at a maximum possible Capacity.
- (ii) To enable the company to establish a system of priorities in expenditure capital expenditure. Capital expenditure budget will enable the management to know the areas where such expenditure is urgent and which can be postponed in order to get good results.
- (iii) Enable the management to have a control over such expenditure. Budgeted figures can be compared with the actual and variance of any can be discussed and a proper remedial action to be taken. Because it needs a huge amount of money so strict control is always needed.
- (iv) Proper financial provisions to be made. For the capital expense a huge amount of money is needed, so the capital budget is helpful in making adequate financial provision to meet the planned expenditure
- (v) To provide budgets for depreciation and maintenance cost for inclusion in the departmental expenses budgets.

Illustration 9: Solo products Ltd. manufactures and sells single product and has estimated a sales revenue of ₹ 126 Lakhs this year based on a 20% profit on selling price. Each unit of the product requires 3 lbs of material P and $1\frac{1}{2}$ lbs of material Q for manufacture as well as processing time of 7 hours in the Machine shop and $2\frac{1}{2}$ hours in the Assembly section. Overheads are absorbed at a blanket rate of $33\frac{1}{2}\%$ on direct labour. The factory works 5 days of 8 hours, a week in a normal 52 weeks a year on an average statutory holidays. Leave and absenteeism and idle time amount to 96 hours, 80 hours and 64 hours respectively in a year.

The Other details are as under:

₹			
Purchase Price	Material P	6 per Lb.	
	Material Q	4 per Lb.	
Comprehensive } Labour rate }	Machine shop	4 per hour	
	Assembly	3.20 per hour	
No. of employees	Machine shop	600	30
	Assembly	180	30
	Finished Goods	Material P	Material Q
Opening Stock	20,000 units	54,000 lbs.	33,000 lbs.
Closing Stock (estimated)	25,000 units	30,000 lbs.	66,000 lbs.

You are required to calculate:

- The number of units of the product proposed to be sold.
- Purchases to be made of materials P and Q during the year in Rupees.
- Capacity utilization of Machine shop and Assembly section.

(C.A. – Inter)

Solution:

Statement of cost and selling price per unit

Raw material :	₹	₹
Material P 3 lbs. @ ₹ 6 per unit	18.00	
Material Q $1\frac{1}{2}$ lbs. @ ₹ 4 per unit	6.00	
Raw material (per unit)	24.00	24.00
Direct labour :		
Machine shop 7 hours @ ₹ 4 per hour	28.00	
Assembly $2\frac{1}{2}$ hours @ ₹ 3.2 per hour	8.00	
	36.00	36.00
Prime Cost		60.00

Overhead Cost @ $33\frac{1}{3}\%$ on labour cost($\frac{1}{3}$ of 36)	12.00
Total Cost	72.00
Profit (20 % of selling price or 25% of Cost price)	18.00
Selling Price	90.00
	₹ Lakhs
Estimated sales revenue =	126.00
Estimated sales volume (in units) =	1.40

(b) Production budget :

Sales in units =	1,40,000
+ Closing stock =	25,000
	1,65,000
– Opening stock =	20,000
Production during the budgeted period =	1,45,000

Purchase budget :

	Material		
	P (lbs.)	Q (lbs.)	Total (lbs.)
Material required for budgeted			
production	4,35,000	2,17,500	6,52,500
+ Closing stock	30,000	66,000	96,000
	4,65,000	2,83,500	7,48,500
– Opening Stock	54,000	33,000	87,000
Purchase of raw material	4,11,000	2,50,500	6,61,500
(during budgeted period)(lbs.)			

Purchase of material	(₹)
Material P (@ ₹ 6 per lb):	24,66,000
Material Q (@ ₹ 4 per lb):	10,02,000
Total material cost :	34,68,000

c)		Machine shop	Assembly section
Maximum hours :		8×5×52×600	8×5×52×180
		=12,48,000	=3,74,400

holding leave absenteeism		
$96 + 80 + 64 = 240 \times 600$	=144000	=43200
Hours available	11,04000	3,31,200
Hours worked for 1,45,000 units		
(145000×7)		
$(145000 \times \frac{5}{2})$	10,15,000	3,62,500
Capacity utilization	=81.33%	=96.82%
$(\frac{1015000}{1248000} \times 100)$		
$(\frac{3,62,500}{3,74,400} \times 100)$		

Cash Budget: Cash Budget can be defined as an estimation of the cash inflows and outflows for a business or individual for a specific period of time. Cash budget are often used to access whether the entity has sufficient cash to fulfill regular operations and/or whether too much cash is being left in unproductive capacities.

A cash budget is extremely important, for the business entities, because it allows to determine how much credit it can extend to customers for its smooth functioning and to avoid cash problems. A cash budget can protect a company from being unprepared for seasonal fluctuations in cash flow or prepare the company to take advantage of unexpected quantity discounts from supplies. A cash budget also allows you to evaluate and plan for year capital needs. It will help you to assess whether there are periods during your operations cycle when you might need short term borrowings. It will also help you to assess any long term borrowing needs.

Main components necessary for creating cash budget are as follows:

1. Time period.
 2. Desired cash position.
 3. Estimated sales are expenses.
- 1) In the preparation of cash budget time period for which it is prepared play an important role. Cash budget depend upon the time whether it is for a month, three months, six months, twelve months or for some other period?
 - 2) Desired cash position: The amount of cash you wish to keep on hand will depend on the nature of business you have, the predictability of accounts receivable and the probability of fast-happening opportunities that may require you to have a significant reserves of cash.
 - 3) Estimated sales and expenses: Estimated sales and expenses should also be considered in cash budget. Sales play the foremost and the main role in budget process. For example 10% increase in expected sales, will lead to similar increase in the other expenses such as raw material purchase, labour payment and other relating expenses to production. Instead of increasing every expense item by 10%, serious consideration needs to be given to certain economics of scale that might develop, such as bulk purchase, discounts offered current increased sales can be accommodated by present sales force. All these types of considerations must be taken into account before you start budgeting.

Expected cash receipts:

- (i) cash sales
- (ii) Collections of accounts receivables.
- (iii) Other incomes (Sales of assets, disinvestment)

Expected cash receipts:

- (i) Cash purchases
- (ii) Payment to the labour force
- (iii) Salaries and other benefit payments
- (iv) Other expenses (Increase in the assets, decrease in the liabilities, Advertisement, Selling expenses and so on)

Cash flow (budget work sheet (Quarterly))

Particulars	Month			Total
	January	February	March	
Cash Balance (Opening)	—	—	—	—
Cash in flow				
(i) Accounts receivable collections				
(ii) Loan proceeds				
(iii) Cash sales & receipts				
(iv) Sales of asset if any				
(v) Other receipts				
Total cash inflows				
Cash out flows (Expenses)				
(i) Advertisement				
Purchases (Raw material)				
Payroll				
Capital purchases				
Interest				
Rent & Taxes				
Owner drawings				
decrease in liabilities				
Other payments				
Total Cash out flow				
Cash balance at the end of period.				

Advantages of cash budget

- (i) Helpful in determining whether sufficient cash balance is with the organization to fulfill its regular obligations.
- (ii) To determine whether there is an idle too much cash balance with the business entity that could be otherwise used in other productive activities.
- (iii) In estimating the working capital which is required and useful for efficient functioning.
- (iv) Its capacity to offer credit periods which may be helpful in increasing, sales i.e. market share and hence the long term target attainments.
- (v) Whether the productive capacity which is under utilized could be utilized in future.
- (vi) Imbalances in the inter departmental capacities could be removed.
- (vii) Through bulk purchases if sufficient amount of cash is available can earn sufficient amount of discounts from the suppliers of material.
- (viii) Cash budget– will be helpful to finance capital expenditure.

Methods of preparing cash budget: There are three methods of preparing a cash budget.

1. Receipt and payment method: In this method all the receipt and payment which are be received or paid in cash are considered. Cash which can be received from cash sales, sale of assets, increase in liabilities, long term loan or otherwise are added to the opening cash balance. The expected cash payment such as cash purchases, purchase of assets, decrease in liabilities through payments and by other means are deducted and closing balance is arrived at. It is the very simple method is preparing the cash budget.

Illustration 10:

From the following given information prepare a cash budget in the cash balance as on 1st January 19XX is ₹ 110000 and sales for the month of previous December are ₹ 45000 and purchase ₹ 21000.

	January	February	March	April	May	June
Sales	44000	46000	48000	47000	65000	70,000
Material	20000	21000	36000	28000	31000	33,000
Wages	10000	12000	14000	13000	15000	17000
Production Cost	2500	2700	2900	2800	4600	5000
Admin Expenses	1100	1300	1500	1400	3200	3600
Selling & Dist. Expenses	1500	1700	1900	1800	2200	2600

50% of sales are assumed to be cash. A loan applied is expected to mature and received to the amount of ₹ 40000 in the month of May. Dividend amounting to ₹ 30000 is to be paid in June. Sales commission @20% is to be paid and creditors grant one month credit (For goods) and debtors are allowed the same one month credit.

Solution

Cash Budget

Particulars	Month					
	January	February	March	April	May	June
	₹	₹	₹	₹	₹	₹
<u>Receipts</u>						
Opening Balance	1,10,000	1,17,520	1,23,900	1,28,640	1,20,200	1,61,900
Cash Sales	22,000	23,000	24,000	23,500	32,500	35,000
Received from Debtors	22,500	22,000	23,000	24,000	23,500	32,500
Loan raised	—	—	—	—	40,000	
Total (A)	1,54,500	1,62,520	1,70,900	1,76,140	2,16,200	2,29,400
Payments						
Material	21,000	20,000	21,000	36,000	28,000	31,000
Wages	10,000	12,000	14,000	13,000	15,000	17,000
Production	2500	2700	2900	2800	4600	5000
Adman exp	1100	1300	1500	1400	3200	3600
Selling & Distt. Expenses	1500	1700	1900	800	2200	2600
Dividend Paid	—	—	—	—	—	30,000
Commission on sales	880	920	960	940	1300	1400
Total B	36,980	38620	42260	55940	54300	90600
Closing Balance	117520	123900	128640	120200	161900	138800

b) Adjusted Profit and Loss account method:

This method is less detailed method than receipt and payment method. opening cash balance is the starting point as in the other methods. Forecasted profit (loss deducted) is added to the opening balance and adjustment is made for the non-cash income or expenditure from it such as depreciation, accrued expenses.

Procedure to prepare cash budget under this method is detailed below.

- (i) Opening cash balance on the beginning of the budget period is taken.
- (ii) Net profit which is forecasted under the profit and loss account is added.
- (iii) Non-cash expenses such as depreciation, outstanding expenses income tax provisions, dividend provisional and other provisions which are though considered items of cost but not paid in cash are added to above.
- (iv) Capital expenditure which is not an item of profit and loss account is deducted.
- (v) Capital receipts are added.
- (vi) Increase in Current liabilities will be added and decrease in current liabilities will be deducted.

- (vii) Increase in Current assets will be deducted as it reduces the cash and decrease in current assets will be added because cash will increase in this case.

c) Balance Sheet Method:

In the balance sheet method the cash budget can be prepared by taking the forecasted balance sheet taking into account the forecasted profit and loss account and the balances shown in the balance sheet. For example in the forecasted balance sheet the assets are shown at the depreciated value and the depreciation which is a non-cash item is debited to the profit and loss account and all assets and liabilities are shown at the revalued balance. The difference in the two sides will show the cash balance it may be cash in hand or bank or overdraft depending upon the residual value.

Procedure followed under balance sheet method is detailed below:

- (i) Forecasted balance sheet is prepared for the budgeted period. Item wise figures are taken from the last year or period balance sheet and as per the information these values are adjusted to be presented in next period balance sheet. If the adjustment figure shows any purchase of new asset the last balance sheet figure in respect of the particular assets will be taken and increased by the amount so spent and the total value will be shown in the forecasted balance sheet. This information will be present in the P & L a/c
- (ii) Profit and loss account will be shown in the balance sheet as it is. It will take into account the non-cash expenses such as depreciation on assets. It is carried to the balance sheet without adjustment because such adjustment will be made to assets account and the assets will be shown at the depreciated value.
- (iii) After all items in the previous balance sheet have been presented after revision according to additional information available, difference of assets and liabilities of forecast balance sheet is found out. The balancing figure will represent closing balance of cash.

Master Budget :

Master budget is a consolidate summary of all the functional budgets such as sales purchase, material, production cost, selling and distribution cash budget etc.

Chartered Institute of Management accounts of England defined the Master budget as

"The summary budget incorporating its component functions budgets and which is finally approved, adopted and employed".

All the functional budgets are presented coordinated, shown in the master budget. We can say all the functional budgets are prepared to go ahead to prepare the master budget in order to have control and to arrive at the long term company goal and missions set.

Master Budget

Particular	Product A		Product B		Product C		Total	
	Current Year	Previous Year	Current Year	Previous Year	Current Year	Previous Year	Current Year	Previous Year
Sales	₹	₹	₹	₹	₹	₹	₹	₹
Less: Factory cost of sales								
Gross Profit								
Less: operating expenses Admin, selling & Dist. expenses: Researched develop expenses:								
Operating Profit								
Add other income								
Net profit before taxation Less provision for tax								
Net profit								
Less Appropriations								
Balance Profit								
Assets :								
Fixed:								
Current:								
Total capital Employed:								
Less Outstanding								
Liabilities								
Current								
Long term								
Shareholder's Fund								
Ratios:								
i. Profit / Turnover								
ii. Profit/ Capital employed								
iii. Sales/ Capital employed								
iv. Current assets/ Current liabilities (Current ratio)								
v. Quick ratio								

illustration11. A single product company estimated its sales for the next year quarter wise as under:

Quarter	Sales (in units)
I	30,000
II	37,500
III	41,250
IV	45,000

The opening stock of finished goods is 10,000 units and the company expects to maintain the closing stock of finished goods at 16,250 units at the end of the year. The production pattern in each quarter is based on 80% of the sales of current quarter and 20% of sales in the next quarter. The opening stock of raw material in the beginning of the year is 10000kgs and the closing at the end of the year is required to be maintained at 5000kgs. Each unit of finished output requires 2kgs of raw material.

The company proposes to purchase the entire annual requirement of raw materials in the first three quarters in the proportion and the price given below:

Quarter	Purchase of raw material % on total annual requirements in quantity	Price per Kg ₹
I	30%	2
II	50%	3
III	20%	4
IV	_____	_____

The value of the opening stock of raw material in the beginning of the year is ₹20,000

Required: Present the following for the next year quarter wise

- (i) Production budget in units.
- (ii) Raw material consumption budget in quantity.
- (iii) Raw material purchase budget in quantity and value.
- (iv) Price store ledger card of the raw material using first in first out method.

(B.Com. Hons Delhi)

Solution:

(i) Production Budget (Quarter wise)

	Quarter				
	I	II	III	IV (Units)	Total
	(Units)	(Units)	(Units)		(Units)
Sales	30,000	37,500	41,250	45,000	1,53,750
+ Closing Stock	11,500	12,250	13,000	16,250	16,250
Total	41,500	49,750	54,250	61,250	1,70,000
– Opening Stock	10,000	11,500	12,250	13,000	10,000
Production	31,500*	38,250**	42,000***	48,250	1,60,000
	*30000×80%	**37500× 80%	***41250×80%		
	+37500×20%	+41250× 20%	45000×20%		

**(ii) Raw Material Consumption Budget
(Quarter)**

	I	II	III	IV	Total
Production	31,500	38,250	42,000	48,250	1,60,000
(Units)					
Raw material consumed (Kgs)	63,000	76,500	84,000	96,500	3,20,000

(iii) Raw material Purchase Budget:

Consumption	+ Closing stock	–	Opening stock = Purchases
3,20,000	+ 5000	–	10,000 = 3,15,000 Kgs

Quarter wise statement

	Quarter				
	I	II	III	IV	Total
	Kgs.	Kgs.	Kgs.	Kgs.	Kgs.
Opening Stock	10,000	41,500	1,22,500	10,1500	10,000

+ Purchases	94,500	1,57,500	63,000	—	315,000
Total	1,04,500	1,99,000	1,85,500	1,01,500	3,25,000
–Closing Stock	41,500	1,22,500	1,01,500	5,000	5,000
Consumed	63,000	76,500	84,000	96,500	3,20,000

(iv) Store Leger (Value wise FIFO Method)

QuarterI

Dr.			Cr.		
Particular	Quantity	₹ Value	Particular	Quantity	Value ₹
To opening stock	10,000	20,000	Issued to production	63,000	1,26,000
To Purchases	94,500	1,89,000	By closing stock	41,500	93,000
Total	1,04,500	2,09,000	Total	1,04,500	2,09,000

Quarter II

Dr.			Cr.		
Particular	Quantity	₹ Value	Particular	Quantity	Value ₹
To opening stock	41,500	83,000	Issued to production 41500×2 =83000 35000×3 =105000	76,500	1,88,000
To Purchases	1,57,500	4,72,500	By closing stock	1,22,500	3,67,500
Total	1,99,000	5,55,500	Total	1,99,000	5,55,500

Quarter III

Dr.			Cr.		
Particular	Quantity Kgs	Value ₹	Particular	Quantity	Value ₹
To opening stock			Issued to production	84,000	2,52,080

(Balance)	1,22,500	3,67,500	84000×3 =252000		
To Purchases	63,000	2,52,000	By closing stock (Balance)	101,500	3,67,500
Total	1,85,500	6,19,500	Total	1,85,500	6,19,500

Quarter IV

Dr.			Cr.		
Particular	Quantity Kgs	Value ₹	Particular	Quantity	Value ₹
To opening stock (Balance)	1,01,500	3,67,500	By Issued to production 38500 ×3 =115500 58000 ×4 = 2,32,000	96,500	3,47,500
To Purchases	—	—	By closing stock (Balance)	5000	20000
Total	1,01,500	3,67,500	Total	1,01,500	3,67,500

illustration 12: The budget manager of Alankar cosmetics limited is preparing a budget for the accounting year starting from 1st July 1984.

As part of budget– operations, some items of factory overhead costs have been estimated by him under specific conditions of volume as follows:

Volume of production	1,20,000	1,50,000
(in units)	₹	₹
Indirect material	2,64,000	3,30,000
Indirect labour	1,50,000	1,87,500
Maintenance	84,000	1,02,000
Supervision	1,98,000	2,34,000
Engineering Service	94,000	94,000

Calculate the cost of factory overhead items given above at 1,40,000 units of production.

Solution:

	Volume of production (Units)		
	1,20,000	1,50,000	1,40,000
Indirect material (Variable @ ₹2.2)	₹ 2,64,000	₹ 3,30,000	₹ 3,08,000
Indirect Labour variable (@₹1.25)	1,50,000	1,87,500	1,75,000
Maintenance Fixed 12000 Variable ₹ 0.6	84,000	1,02,000	96,000
Supervision Fixed 54000 Variable @ ₹1.2	1,98,000	2,34,000	2,22,000
Engineering Services Fixed: 94000	94,000	94,000	94,000
Total	7,90,000	9,47,500	8,95,000

Working Note:

Factory overheads at 1,40,000 units of production ₹ 895,000 method of separating maintenance cost into fixed and variable portion

		₹
Maintenance cost at 1,50,000 units of production	=	1,02,000
Maintenance cost at 1,20,000 units of production	=	84,000
For 30,000 units of production	=	18,000
(Variable)		
For one unit	=	₹ $\frac{18000}{30000}$
		= ₹0.6

Total Maintenance Cost :

at 1,20,000 units	=	84,000
Variable @ 0.60 per unit	=	72,000
Fixed maintenance cost	=	<u>12,000</u>

Supervision Cost

		₹
Supervision cost at 1,50,000 units	=	2,34,000
Supervision cost at 1,20,000 units	=	1,98,000
For 30,000 units of production	=	<u>36,000</u>
(Variable)		
For One unit	=	$\frac{₹36000}{30000}$
	=	₹1.2
Total supervision cost at 1,20,000 units	=	₹ 1,98,000
Variable @₹1.20 per unit	=	₹1,44,000
Fixed Supervision Cost	=	<u>₹54,000</u>

Zero base budgeting:

A method of budgeting in which all expenses must be justified for each new period. Zero base budgeting starts from a "zero-base" and every function within an organization is analyzed for its needs and costs. Budgets are then built around what is needed for the upcoming period, regardless of whether the budget is higher or lower than the previous one.

ZBB allows top level strategic goals to be implemented into the budgeting process by tying them to specific functional areas of the organization, where costs can be first grouped, then measured against previous results and current expectations.

A zero-base budget requires managers to justify all their budgeted expenditure, rather than the more common approach of only requiring justification for incremental changes to be budget or the actual results from the preceding year. Thus a manager is theoretically assumed to have an expenditure base line of zero (hence the name of budgeting method).

Unlike the traditional (incremental) budgeting in which past sales and expenditure trends are assumed to continue, ZBB require each activity to be justified on the basis of cost-benefit analysis, assumes that no present commitment exists and that there is no balance to be carried forward. By forcing the activities to be ranked according to priority, ZBB provides a systematic basis for resources allocation.

The basic process flow under ZBB is:

1. Identify business objectives.

2. Create and evaluate alternative method for accomplishing each objective.
3. Evaluate alternative funding levels, depending on planned performance levels.
4. Setting priorities.

Advantages of Zero–base budgeting

The following are the various objectives of ZBB

- a) Alternative analysis: Managers are required to analyze the alternative ways to perform an activity and the effect of different levels of spending upon them. Development of the alternatives, it makes managers to consider various other ways to run business.
- b) Eliminate non–key activities: In ZBB different activities are analyzed and ranked according to priority or urgency. Manager decide which activities are most critical to the company. They are able to eliminate the non key activities.
- c) Mission–focus: Managers are forced to define the various missions of their department since ZBB concept requires managers to think expenditure to activities.
- d) Require review: Using Zero budgeting on regular basis makes it more likely that all aspects of company will be examined periodically.
- e) Resource Allocation: If the process is conducted with the overall corporate mission and objectives in mind, an organization should end up with strong targeting to funds in those areas where they are most needed.
- f) Since manager must tie expenditure to activities, it becomes less likely that they can artificially inflate their budget the change is too easy to spot.
- g) It makes the management easy by review if same activities are conducted by multiple departments, leading to elimination of the activity outside of the area where the management wants it to be centered.
- h) A significant debate among the management team about the corporate mission and various ways to achieve those is started. It helps the communication process in the management to be strengthened and accelerate the process to achieve the targets.

Disadvantages of Zero–Base Budgeting:

The main down side of zero–base budgeting is the exceptionally high level of effort required to investigate and document department activities, This is difficult task even once a year, which causes some entities to only use the procedure once every few years, or when there are significant changes within the organization. Another alternative is to require the use of Zero–base budgeting on a rolling basis through different parts of a company over several years, so that management can deal with fewer such reviews per year. other draw backs are

- a) Creating zero–base budget from the ground up on a continuing basis calls for an enormous amount of analysis, meeting, and reports, all of which requires additional staff to manage of the process.
- b) Some managers may attempt to skew their budget reports to concentrate expenditure under the most vital activities, thereby ensuring that their budgets will not be reduced.
- c) The operational review mandated by zero– base budgeting requires a significant amount of management time.
- d) Managers requires significant training in the zero–base budgeting process, which further increases the time required each years.
- e) The extra–effort required to create a zero base budget makes it even less likely that the management team will revise the budget on a continuous basis to make it more relevant to the competitive situation.

- f) If can be difficult to determine or justify expenditure level for areas of a business that do not produce "concrete" tangible results. For example, what is the correct amount of marketing expenses, and how much should be invested in research and development activities?

Illustration 13

ABC firm manufactures cakes in three varieties—each requiring similar material, labour and production facilities. Trading result of the firm for the year ending March 1989 is as under:

	A (₹)	B (₹)	C (₹)	Total (₹)
Sales	21,44,000	17,20,000	10,40,000	49,04,000
Variable cost:				
Material	5,36,000	5,16,000	4,16,000	14,68,000
Wages	4,28,800	2,58,000	3,36,000	10,22,800
Overheads	4,28,800	2,58,000	3,36,000	10,22,800
Total	13,93,600	10,32,000	10,88,000	35,13,600
Contribution	7,50,400	6,88,000	(48,000)	13,90,400
Fixed Overheads	—	—	—	8,70,400
Profit				5,20,000

The Cake of variety C, despite best efforts, does not show any good to yield seasonable margins and since it is not possible to raise its price so as to make the product profitable, the form has decided to discontinue its production. However, other two varieties, A and B have good potential to grow and the market can easily absorb the increased production. The firm has therefore decided to raise the production of these varieties diverting labour and production facilities engaged in production of variety C.

It accordance with the above, it is now decided effective 1st April 1989 to transfer two third of the labour engaged in variety C to variety A and balance one third to variety B, thereby totally discontinuing production of variety C.

You are furnished following additional data for the year beginning April 1989.

- Total direct wage bill for the year would be at the same level as for the year ending march 1989.
- Similarly the variable cost per unit of production and the selling price are to be assumed not to change in the year beginning April 1989.
- Fixed overhead would increase by ₹55,200.

Required:

- To prepare budget for the year beginning April 1989 in the same form at as detailed above.
- To analyze and compare the budget for the year beginning April 1989 with that for the previous year highlighting main features.

- c) To advice the management on comparative profitability if two third of the workers engaged in C are transferred to B instead of A above the A above and balance one third is engaged in A instead of B giving detailed reasoning for your advise.

(1CWA–Final)

Solution:

(a) Budget for the year beginning April 1989

	A	B	Total
Sales (₹)	32,64,000	24,66,667	57,30,667
Variable Cost: material			
wages overheads	8,16,000	7,40,000	15,56,000
	652,800	3,70,000	10,22,800
	6,52,800	3,70,000	10,22,800
Total	21,21,600	14,80,000	36,01,600
Contribution	11,42,400	9,86,667	21,29,067
Fixed over heads	–	–	9,25,600
Profit			12,03,467

(b) Comparison of the budget

	1988–1989	1989–1990	Different increase/decrease	
Sales	49,04,000	57,30,667	+8,26,667	16.86%
Contribution	13,90,400	21,29,067	+7,38,667	53.13%
Profit	5,20,000	12,03,467	+683467	131.44%

Sales have been increased by 16.86% resulting an increase in contribution by 53.13%

There is a tremendous increase in the overall profit of the firm which is 131.44%

- (c) P/v ratio in respect of A

$$= \frac{750400}{2144000} \times 100 = 35\%$$

P/v ratio in respect of B

$$= \frac{688000}{1720000} \times 100$$

$$= 40\%$$

P/v ratio of product B is more than that of product A so it will be profitable to divert labour force more to product B instead of product A. It will increase the overall profit of the company further.

So company is advised to divert $\frac{2}{3}$ rd of workers engaged in C to production of product B and $\frac{1}{3}$ rd of workers engaged in C to production of product B

Working Note: Two-third of wages (labour-hours) engaged in C

$$= \frac{2}{3} \times 336000 = ₹ 2,24,000$$

$$\frac{1}{3} \text{rd of wages (labour hours)} = \frac{1}{3} \times 3,36,000$$

$$= 1,12,000$$

$$\text{Sales of product A} = ₹ \frac{2144000}{428800} \times (428,800 + 224,000)$$

$$= \frac{2144000}{428800} \times 652800$$

$$= ₹ 32,64,000$$

$$\text{Product B} = ₹ \frac{1720000}{2,58,000} \times (258,000 + 1,12,000)$$

$$= \frac{1720000}{258000} \times 370,000$$

$$= ₹ 24,66,667$$

variable costs, material and overheads are increased in line with the sales.

Illustration 14: Alpha Ltd manufactures two models of its machines, the Ground and the Supreme and distributes them in three sales areas. The budgeted profit and loss account for the year ending 30th June 1962 is:

Sales area			Ground	Supreme	Total
			₹	₹	₹
X			25000	50000	75000
Y			50000	75000	125000
Z			75000	125000	200000
			150000	250000	4,00,000
Production costs			₹		
Ground (60% of sales)			90000		
Supreme (72% of sales)			180000		
Gross Profit (a):			130000		
Direct selling and distribution costs					
Salesmen's salaried and commissions:			Salesmen's expense		
Area	X	₹ 7,250	Area	X	₹ 2,250
	Y	₹ 8,000		Y	₹ 1,500

Z	₹3,750	(b)19,000	Z	₹ 1,250
				(c) 5,000
Sales officer costs		Advertisement		
Area	X ₹ 3500		Area X	₹ 700
	Y ₹ 3100		Y	₹ 1700
	Z ₹2400	(d) 9000	Z	₹ 600
				(e) 3000

Carriage				
Area	X ₹1350			
	Y ₹1200			
	Z ₹1450	(f)4000		
Indirect– selling and distribution costs				
Advertisement	₹ 12,000			
Carriage	₹ 2,200			
Warehousing	₹ 7,700			
Credit control	₹ 4,400			
G. administration	₹ 6,000	(g) 32,300	Total ₹ 72,300	
			(b to g)	

The budgeted analysis of sales is :

Sales Area	Ground		Supreme	
	Sales volume (Machine)	No. of orders	Sales volume (Machine)	no. of orders
X	4,000	600	4000	800
Y	8,000	1000	6000	1000
Z	12,000	400	10000	600

The cost manual of the company states that indirect selling and distribution costs are to be apportioned to sales areas as follow:

Advertisement	Sales values

Carriage	Sales volume
Ware housing	sales volume
credit control	No. of orders
General Administration	Sales values

The cost manual also states that selling and distribution costs of sales are to be apportioned to models on the basis of sales values.

You are required to:

- Prepare a comparative statement showing an analysis of budgeted selling and distribution costs by sales areas.
- Prepare a comparative budgeted profit and loss statement for each model by sales areas.
- Show the budgeted average net profit for each model sold in each sales area.

Solution (a)

Sales Area				
Particulars	X ₹	Y ₹	Z ₹	Total ₹
Salesman salaries & commission	7,250	8,000	3,750	19,000
Salesmen's Expenses	2,250	1,500	1,250	5,000
Sales office costs	3,500	3,100	2,400	9,000
Advertisement	700	1,700	600	3,000
Carriage	1,350	1,200	1,450	4,000
Indirect selling & Distribution costs				
Advertising (Sales values basis) (3:5:8)	2,250	3,750	6,000	12,000
Carriage (sales volume) (4:7:11)	400	700	1,100	2,200
Warehousing (4:7:11)	1,400	2,450	3,850	7,700
Credit control (7:10:5)	1,400	2,000	1,000	4,400
G. Administration sales value (3:5:8)	1,125	1,875	3,000	6,000
Total	21,625	26,275	24,400	72,300

(b) Comparative budgeted P & L statement Area and model wise

Particular	Area						Total(₹)
	X (₹)		Y (₹)		Z (₹)		
	Ground	Supreme	Ground	Supreme	Ground	Supreme	
Sales	25,000	50,000	50,000	75,000	75,000	1,25,000	4,00,000
Production costs	15,000	36,000	30,000	54,000	45,000	90,000	2,70,000
Gross Profit	10,000	14,000	20,000	21,000	30,000	35,000	1,30,000
Selling and distribution costs	7,208	14417	10,510	15765	9150	15250	72300
X (1:2)							
Y (2:3)							
Z (3:5)							
Net Profit	2,792	(−417)	9,490	5235	20,850	19,750	57,700

(c) Budgeted average net profit for each model sold in each sales area

Model	Area		
Ground	X	Y	Z
$X = \frac{2792}{4000}$	0.698	1.186	1.738
$Y = \frac{9490}{8000}$			
$Z = \frac{20850}{12000}$			
Supreme	Loss	0.8725	1.975
$X = \frac{Loss}{4000}$			
$Y = \frac{5235}{6000}$			
$Z = \frac{19750}{10000}$			

Performance Budgeting

Performance budgeting overcomes the limitations of traditional budgeting that focuses only on the financial aspects of budget. The first Hoover commission first used the term in 1949 when it suggested that budgets be prepared on the basis of programs, functions and activities and not only on a financial basis. A performance budgeting system is a management cycle that allocates resources after performance targets and objectives are set. The system measures and reports all goals and determines whether they have been adequately achieved. This information determines future

operations, funding and penalties or reward system. A performance budget is one which (i) presents the purposes and objectives for which funds are requested ; (ii) the costs of activities proposed for achieving these objectives (iii) The quantitative data measuring the accomplishments and (iv) work performance under each activity.

In program budgeting the main emphasis is on programs, identification of their elements and determination of cost for each program. In performance budgeting stress on activities approved by the company and determination of cost of each activity.

Benefits of Performance budgeting:

Performance budgeting systems are viable tools for improvement program, accountability and performance. They guide administration and management by providing greater detail on expenditure, resources and capacity. According to Anwar Shah, there are four benefits of performance budgeting systems; improved communication budget factors and beneficiaries: improved program management; informed budgetary decision making; and greater accountability and transparency.

Program objectives, goals and targets are clear and easier to communicate to budget stake holders, citizens and government. Program manager have better knowledge about program goals and expectations. The budget is prepared after all program-related information is taken into account.

A performance budget serves as an accountability and transparency tool for the public and the legislation by providing vital information about how resources are spent and whether program goals are met.

Purpose: The purpose of a performance budget is to track - how well a company or government entity is doing over a short term period?. Performance budget are commonly done on a quarterly or bi-annual basis. So the executives can continuously track the performance and budget with the result. The results of each performance report are compared to see if the performance has increased decreased or remained steady.

Performance budgeting vs Traditional Budgeting

- 1) Flow of decision: In performance budgeting the decision making is primarily downward. In traditional budgeting the flow of budgetary decision is primarily upward.
- 2) Emphasis on output: In performance budgeting the main emphasis is on output categories such a goals, purposes objectives and products or services. In traditional budgeting main emphasis is on inputs such as materials, salaries and other facilities.
- 3) Prospectively: The performance budgeting makes a prospective approach with its focus on future impacts of current-major decisions or choices. In traditional budgeting, approach is retrospective i.e. further is the extension of past, measuring what was done with current means in estimating the next budget year.

Steps in performance Budgeting:

1. Responsibility centers are defined where operations are to be performed
2. Expected performance in quantity of these responsibility centers is set which is to be achieved during the budget period e.g. In production department the number of units of the particular product to be produced in the budget period. In the sale department the number of units to be sold and similarly with the profit and other centers.
3. Allocation of the appropriate funds need to achieve the target of the centers.
4. Measuring the achieved targets with the budgeted targets in order to determine the extent of deviation between the actual and budgeted. Actual expenditure is also compared with the targeted and variation if any is found out.

5. Performance reporting indicating the result of analysis of variation from the budget is done like that of variance reporting.
6. Action taken such as appraisal for the favourable results and sought an explanation for unfavourable from the responsible for the responsibility centers.

Illustration 15:

A company is at present producing a product N. 5000 units of the product are produced and is selling at ₹ 80 per unit. The variable cost attached to production is ₹ 50 per unit and fixed costs including production, administration and selling to be ₹50,000. Due to shortage to labour in the market only 4000 units could be produced, but demand remaining up the price per unit was raised to ₹ 83, at the same time an increase in the fixed expenses to the extent of ₹5000 was reported prepare the performance budget and compare it with actual and prepare a summary report.

Solution: Performance budget of company

	Current production of 5000 units	Budgeted Production 4000 units	Actual Production 4000 units
Sales:	₹ 4,00,000	₹ 3,20,000	₹ 3,32,000
Production variable cost:\			
Fixed Production	2,50,000	2,00,000	2,00,000
Admn. S& Distribution	50,000	50,000	55,000
Profit	1,00,000	70,000	77,000

Summary Report–

Budgeted Profit:	₹ 100,000
Variances	
1) Sales price variance = $4000(83-80)=12000$ F	} 68000 A
Sales volume variance= $80(4000-5000)=80000$ A	
2) Variable Cost variance = $50(50000-4000)=50000$ F	50000 F
3) Fixed overhead variance= $50,000-55,000=$ 5000 A	
Profit (100000 +50000 – 68000 – 5000)	77000

Miscellaneous Illustrations:

Illustration 16.

From the following data, prepare a flexible budget for production of 40000 units and 75000 units, distinctly showing variable cost and fixed cost as well as total costs. Also indicate element wise cost per unit. Budget output is 1,00,000 units and budgeted cost per unit is as follows:

	₹		₹
Direct material	95	Selling overhead (10% fixed)	10

Direct labour	50	Distribution overhead (20% fixed)	15
Production overhead (variable)	40		
Productive overhead (fixed)	5		
Administration overhead (fixed)	5		

(B.Com Hons Delhi)

Solution

Flexible Budget

Particulars	Units of Production		
	100000 units	40,000 units	75,000 units
Direct material @ ₹95	₹ 95,00,000	₹ 38,00,000	₹ 71,25,000
Direct Labour @50	50,00,000	20,00,000	37,50,000
Production overhead (variable) @ ₹ 40	40,00,000	16,00,000	30,00,000
Selling over head 90% variable @ ₹ 9 per unit	9,00,000	3,60,000	6,75,000
Distribution overhead variable @ ₹ 12 per unit	12,00,000	4,80,000	9,00,000
Total variable cost @ 206 (95+50+40+9+12) Fixed cost :	206,00,000	82,40,000	154,50,000
Production overheads (fixed)	500,000	5,00,000	5,00,000
Administration overhead (Fixed)	500,000	500,000	5,00,000
Selling overhead (Fixed)	100,000	100,000	1,00,000
Distribution overhead Fixed	3,00,000	3,00,000	3,00,000
Total Fixed cost	14,00,000	14,00,000	14,00,000
Variable cost Per unit	206	206	206
Fixed cost Per unit	14	35	18.67

Illustration 16 Prepare a manufacturing overhead budget and also determine manufacturing overhead rate at 50% and 80% capacities. Following particulars are given at 60% capacity estimated labour hours are 1,12,000. Estimated labour hours are 1,20,000.

₹

Indirect material (variable) 72,000

Indirect labour (variable) 128,000

Semi variable overheads:

Electricity (35% fixed) 30,000

Repair and maintenance (25% fixed) 24,000

Fixed overheads:

Insurance 12,000

Salaries 36,000

Depreciation 24,000

Total 3,26,000

Solution:— Manufacturing overhead budget:

Manufacturing overheads	60% capacity	50% of capacity	80% of capacity
Indirect Material	72,000	60,000	96,000
Indirect labour	128,000	1,06,667	1,70,667
Semi variable			
Electricity (35% fixed)	30,000	26,750	36,500
Repair maintenance (25% fixed)	24,000	21,000	30,000
Fixed overheads:			
Insurance	12,000	12,000	12,000
Salaries	36,000	36,000	36,000
Depreciation	24,000	24,000	24,000
Total	3,26,000	2,86,417	4,05,167
Hours required	120,000	100,000	1,60,000
Overhead rate/hour	2.72	2.86	2.53

Working Note:

Semi variable overhead	60% capacity	50% capacity	80% capacity
Electricity:			
Fixed @35%	10,500	10,500	10,500

Variable @ 65%	19,500	16,250	26,000
Total	30,000	26,750	36,500
Repair and maintenance			
Fixed @25%	6,000	6,000	6,000
Variable @75%	18,000	15,000	24,000
	24,000	21,000	30,000

Illustration 17: Take it easy Ltd operates on a system of flexible budgets with the aid of the following information you are required to prepare flexible budget at 80% 90% and 100% level of activity showing the profits that would result at these levels.

- The present sale of 8,00,000 units at ₹ 10 each is at the normal level of 80%. If the output is increased to 90% the selling price would be reduced by $2\frac{1}{2}\%$ and if outputs is reached to 100% the original selling price would be reduced by 5% in order to reach a wider market.
- The prime cost per unit is ₹5 made up of Direct material ₹3.50, Direct Labour ₹1.25 and Direct expenses ₹0.25. If output reaches 90% level of activity and above, a saving of 5% can be effected in the purchase price of raw materials.
- Variable overhead–salesmen's commission will be 5% of the sales value.
- Semi–variable overhead at normal level of activity are:

₹

Supervision	80,000
Power	70,000
Heat and Light	40,000
Maintenance	50,000
Salesman Expenses	60,000
Indirect Labour	1,00,000
Transport cost	2,00,000

These are expected to increase by 5% if output reaches 90% level and by a further 10% if it reached the 100% level.

- Fixed overheads are:

₹

Rent and Rates	1,00,000
Depreciation	4,00,000
Advertisement	5,00,000
Administration	7,50,000
Sales Department	2,00,000
General	50,000

(CA Final)

Solution:

Flexible Budget

Capacity	80% level		90% level		100% level	
Production (units)	8,00,000		9,00,000		10,00,000	
	₹	₹	₹	₹	₹	₹
(i) Sales value		80,00,000		87,75,000(1)		95,00,000(1)
(ii) Prime cost:						
Direct material	28,00,000		29,92,500(2)		33,25,000(2)	
Direct Labour	10,00,000		11,25,000		12,50,000	
Direct expenses	<u>2,00,000</u>		<u>2,25,000</u>		<u>2,50,000</u>	
	<u>40,00,000</u>		<u>43,42,500</u>		<u>48,25,000</u>	
(iii) Variable overhead:						
Salesmen's commission	<u>400,000</u>		<u>4,38,750</u>		<u>4,75,000</u>	
(iv) Semi variable overheads						
Supervision	80,000		84,000		92,400	
Power	70,000		73,500		80,850	
Heater Light	40,000		42,000		46,200	
Maintenance	50,000		52,500		57,750	
Salesman Expenses	60,000		63,000		69,300	
Indirect Labour	1,00,000		1,05,000		1,15,500	
Transport costs	<u>2,00,000</u>		<u>2,10,000</u>		<u>2,31,000</u>	
	<u>6,00,000</u>		<u>6,30,000</u>		<u>6,93,000</u>	
(v) Fixed Overheads:						
Rent and Rates	1,00,000		1,00,000		1,00,000	
Depreciation	4,00,000		4,00,000		4,00,000	
Advertisement	5,00,000		5,00,000		5,00,000	
Administration	7,50,000		7,50,000		7,50,000	
Sales Department	2,00,000		2,00,000		2,00,000	
General	<u>50,000</u>		<u>50,000</u>		<u>50,000</u>	
	<u>20,00,000</u>		<u>20,00,000</u>		<u>20,00,000</u>	
Total cost:						
Prime cost	40,00,000		43,42,500		48,25,000	
Variable overhead	4,00,000		4,38,750		4,75,000	
Semi variable overheads						
	6,00,000		6,30,000		6,93,000	
Fixed overheads						

Profit	<u>20,00,000</u>		<u>20,00,000</u>		<u>20,00,000</u>	
		<u>70,00,000</u>		<u>74,11,250</u>		<u>79,93,000</u>
		<u>10,00,000</u>		<u>13,63,750</u>		<u>15,07,000</u>

Working Note (1)

At 80% capacity level

Production = 800,000 Units @ ₹10

Sales value = ₹ 80,00,000

At 90% capacity level

Production = 9,00,000 units

Selling price per unit = $10 \times (100 - 2.5)\%$

$$= 10 \times \frac{97.5}{100}$$

= ₹ 9.75

Sales value = $9.75 \times 900000 = ₹87,75,000$

At 100% capacity level

Production = 10,00,000 units

Selling price = $10 \times (100 - 5)\%$

Sales value = $10 \times \frac{95}{100} = ₹9.50$

Sales value = ₹95,00,000

Working Note (2)

Direct material per unit = ₹3.5

Saving in bulk purchase = 5%

New price of Direct material = $3.5 \times (100 - 5)\%$

$$= 3.5 \times \frac{95}{100}$$

= ₹3.325

At 90,00,000 units production = 3.325×900000

= ₹29,92,500

and At 10,00,000 units level = $3.325 \times 10,00,000$

= ₹33,25,000

Illustration: 18: Following data pertains to Mr Y for the month budget of November, 2010

	₹		₹
Direct Material used	847	Manufacturing overheads	?
Beginning finished goods inventory	?	Cost of goods manufactured	1,878
Ending finished inventory	94	Cost of goods sold	?
Direct manufacturing labour	389	Cost of goods available for sale	1949

Prepare the cost of goods sold budget for the month of November 2010 by filling the missing figures.

(B.Com Hons Delhi)

Solution: Cost of goods sold budget

	₹
Direct material used	= 847
Direct manufacturing labour	= 389
Prime cost	= 1236
Cost of goods manufactured	= 1,878
manufacturing overheads	= 1878–1236 = ₹642
Cost of goods manufactured	= 1,878
Cost of goods available for sale	= 1,949
Opening inventory of cost of goods manufactured	= 1949–1878= ₹71
Ending finished goods inventory	= ₹94
Cost of goods sold	= ₹1949–94 = ₹1855

Rescheduled cost sheet

	₹
Direct material used	= 847
Direct labour (manufacturing)	= <u>389</u>
Prime cost	= 1236
Manufacturing overheads	= <u>642</u>
cost of goods manufactures	= 1,878
+ Beginning finished goods	= <u>71</u>
Cost of goods available for Production	= 1949
– Ending finished goods inventory	= 94

Cost of goods sold = 1855

Illustration 19 Production cost of a factory for a year are as follows:

	₹		₹
Direct material	28,000	Production overheads fixed	15000
Direct labour	21,000	Variable	14000

During the forth coming year it is anticipated that:

- Production efficiency will be reduced by 5%
- Average rate for direct labour remuneration will fall form ₹0.30 to 0.25 per hour.
- Direct labour hours will increase by $33\frac{1}{3}\%$
- Price per unit for direct material and of other materials and services which comprises overheads will remain unchanged.

Draw a budget and compute factory overhead rate which are absorbed on a direct wage basis.

Solution:–

Direct labour = ₹21000
 Present wage rate = ₹0.30 per hour
 Labour hours = $\frac{21000}{0.3}$
 = 70,000 hours

Let the factory at present is functioning at 100% capacity

Increase in labour hours = $33\frac{1}{3}\%$

So increase in capacity = $33\frac{1}{3}\%$

Increased capacity = $133\frac{1}{3}\%$

but efficiency is reduced by 5%

So new capacity in comparison with assumed 100%

$$= 133\frac{1}{3} \times (100 - 5)\%$$

$$= \frac{400}{3} \times \frac{95}{100} = 126\frac{2}{6}\%$$

So net increase in capacity = $26\frac{2}{6}\%$

Budget for the forthcoming year

Direct material:	₹
$28000 \times \left(1 + 26\frac{2}{6}\%\right) = 28000 \times \frac{758}{600}$	35,373
Direct labour	
$\left(70000 + \frac{70000}{3}\right) \times 0.25$	23,333

Prime Cost	58,706
Production overheads:	
Fixed : 15,000	
Variable : 17687	32,687
(14000 + 14000 × 26 $\frac{2}{6}$ %)	
Factory works cost:	91,393
Factory overheads rate based on Direct wages:	
$\frac{\text{Production overheads}}{\text{wages}} \times 100$	
$= \frac{32687}{23333} \times 100 = 140\% (\text{approx})$	

Illustration 20:–

A company RS Ltd is facing a problem with the trade union who is in demand of 20% increase in the wage rate and case is pending with the company from a long time period. Management is not in a mood to agree with the demand and has offered to raise the wage rate by 6% and to give an incentive of ₹0.18 per hour produced on production and by doing so the production can be increased by 10% as estimated, but at the same time sales department reported that price will have to be decreased by 2% in order to sell the production (All the units are to be sold at the same price) in the market.

From the data given below you are required to present profitability report.

- If trade union demand is accepted by management.
- If management's proposed of wage increase linked to productivity is accepted by the trade union.
- Also work out the minimum output that is necessary for the managements proposal to be more rewarding to the labour force than a 20% wage increase.

		<u>₹ in lakhs</u>
Sales (14,00,000) units		70
Direct material :	12	
Direct wages :	18	
Variable production overheads :	4	
Fixed production overheads :	12	
Variable selling overheads (5% of sales) :		
	3.5	
Fixed selling overheads :	6.5	
Variable distribution overheads :	1.5	
Fixed Distribution overheads :	1.5	
Fixed Administration overheads :	2	
		61

Net Profit:

9

Solution:

(i) Profit statement when trade union demand is accepted by management

	₹ in lakhs	
Sales (1400000 units)		70
Direct material :	12.00	
Direct wages :	21.60	
variable production overheads :	4.00	
Fixed Production overheads :	12.00	
Variable selling overheads (5% of sales) :	3.50	
Fixed selling overheads :	6.50	
Variable Distribution overheads :	1.50	
Fixed Distribution overheads :	1.50	
Fixed Administration overheads :	<u>2.00</u>	<u>64.6</u>
Profit :		<u>5.4</u>

(ii) When management proposal is accepted :

	₹ in lakhs	
Sales (15,40,000 units) @ ₹4.9 :		75.46
Direct material :	13.200	
Direct wages :	21.852*	
Variable Production overheads :	4.400	
Fixed Production overheads :	12.000	
Variable selling overheads (@ 5% of sales) :		
	3.773	
Fixed selling overheads :	6.500	
Variable Distribution overheads :	1.650	
Fixed Distribution overheads :	1.500	
Fixed Administration overheads :	2.000	<u>66.875</u>
Profit:		<u>8.585</u>

(iii) If management proposal is accepted

₹ lakhs

Labour cost : 18.00

6% increase :	<u>1.08</u>
	19.080
Add ₹ 0.18 for every hour produced (15.40X0.18)	<u>2.772</u>
(assuming that one hour labour is consumed to produce one unit of the product)	<u>21.852</u>

B.E.P. sales where both are equally beneficial or an indifference point to both

$$= \frac{21.60 - 19.08}{0.18}$$

$$= \frac{2.52}{0.18} = 14 \text{ lakhs}$$

When Production increase from 14 lakhs, it is beneficial to both management and the trade union. Wage budget will increase and at the same time the overall profit will increase.

Comparison :

At 1400 000 units production

Trade union demand

₹ lakhs

Total wages :

$$18 \times (1.2)$$

$$= 21.60$$

Management Proposal

$$= 18 \times (1.06) + (14 \times 0.18)$$

$$= 19.08 + 2.52$$

$$= 21.60$$

Illustration 21. The following information about sales and the expenses for the year ending on 31st March, 2010 of a company is given as under:

Sales :	₹	₹
		20,00,000
Direct material :	7,50,000	
Direct wages :	4,10,000	
Direct expenses :	45,000	
Factory overheads :	1,60,000	
Administration overheads :	2,00,000	
Selling overheads :	<u>1,60,000</u>	<u>17,25,000</u>
Profit :		<u>2,75,000</u>

It is further stated that 40% of the factory overheads and 55% of the selling overheads are variable.

Forecasting for the next year ending 31st March, 2011 are as :

- Sales volume is likely to increase by 25% but at the same time selling price to be reduced by 5%.
- Due to bulk purchase the company is likely to get a purchase discount of material to the tune of 5%
- Wages and factory overheads (variable) are likely to increase by 10%.
- Administration overheads are likely to reduce by 4%.

There is no opening as well as closing work in progress keeping into consideration of above estimates prepare:

- 1) Budget for the next year ending 31st March 2011 showing the sales and the expenses in the same manner as shown above.
- 2) Rate of recovery of factory overheads, selling and administrative overheads.
- 3) Quote a minimum price for an export order which require 60,000 direct material, 50,000 direct wages and 10,000 direct expenses for a product.
- 4) Solution :

(1) Budgeted profit statement element wise for the year ending 31st March 2011

Sales	₹	₹ 23,75,000	Explanation (20,00,000 × 1.25 × 0.95)
Direct material : :	8,90,625		(750000 × 1.25 × 0.95)
Direct wages :	5,63,750		(410000 × 1.25 × 1.1)
Direct expenses :	56,250		
Factory overheads fixed : 96,000 variable : 88,000	1,84,000		$\left[\begin{array}{l} \text{Fixed: } 1600000 \times 0.6 \\ \text{variable : } 160000 \times 0.4 \\ 64000 \times 1.25 \times 1.1 \end{array} \right]$
Administration overheads: fixed :	1,92,000		(2,00,000 × 0.96)
Selling overheads : fixed : 72,000 variable : 110,000	<u>1,82,000</u>	<u>20,68,628</u>	(160000 × 0.55 × 1.25)
		<u>3,06,375</u>	

(2) Rate of recovery of overheads:

	Overheads	rate of recovery
Factory overheads		
Fixed :	96,000	$\frac{96,000}{563750} \times 100 = 17.03\%$
Variable :	88,000	$\frac{88000}{563750} \times 100 = 15.61\%$
Total :	<u>1,84,000</u>	$\frac{184000}{563750} \times 100 = 32.64\%$
Administration overheads :	192,00	$\frac{192000}{1694625} \times 100 = 11.33\%$
Selling overheads: Fixed:	72,000	$\frac{72000}{1694625} \times 100 = 4.25\%$
Variable :	110,000	
Total :	182,000	$\frac{182000}{1694625} \times 100 = 10.74\%$

(3) Minimum price that can be quoted: ₹

Direct material :	60,000	
Direct wages :	50,000	
Direct expenses :	10,000	
Factory overheads (variable) :	57,805	(15.61% of 50000)
variable factory cost :	1,77,805	= 50000X(1.1561)
selling overheads (variable) :	12235	$\left[\frac{177805 \times 11,0000}{1694625 - 96000} \right]$
Minimum Price (quoted)	1,89,040	

Illustration 22 : A company wants you to present a flexible budget for 75%, 90% and 100% capacity level and has forwarded you the following information for its functioning at 60% capacity level where it produces 7200 units of the product.

- Selling price per unit at present is ₹32 per unit.
- The selling price is likely to stay at ₹32 up to 75% production level but at 90% capacity it will reduce by 5% and at 100% capacity to reduce by 6%.
- At 90% capacity level material cost will raise by 10% and 100% capacity level both material cost and labour cost will increase by 10% each.
- Present – Semi variable expenses are ₹60,000 and it will raise by 20% on 90% capacity level and by 30% at 100% capacity level.
- Fixed expenses are ₹72000 which are likely to remain unchanged.
- Variables expenses are : 1) Direct material : ₹5 per unit
2) Direct labour ₹3 per unit 3) Direct expenses ₹1 per unit

Solution:

Flexible Budget

Particulars	Capacity level			
	60%	75%	90%	100%
Production (Units)	7200	9000	10800	12000
Sales :	₹ 230,400	₹ 2,88,000	₹ 3,28,320	₹ 3,60,960
Direct material:	36,000	45,000	59,400	66,000
Direct Labour:	21,600	27,00	32,400	39,600
Direct Expenses :	7,200	9,000	10,800	12,000
Semi variable expenses	60,000	60,000	72,000	78,000
Fixed expenses:	72,000	72,000	72,000	72,000

Total cost:	1,96,800	213,000	2,46,600	2,67,600
Total cost Profit:	33600	75000	81,720	93360

Illustration: 23 Carryon Ltd manufactures two products, B and T.

It is going to prepare its budget for the year ending 31st December 1988. Expectations for 1988 includes the following:

(i)	₹	₹	₹
Opening balance			
Fixed Assets			
Land	20000		
Building and plant	150000		
Cumulative depreciation	(60000)	110000	
Stocks: Raw material (P+Q) :	3000		
B :	3400		
T:	7200		
	<u>13600</u>		
Debtors	45000		
Cash/Bank	<u>10000</u>		
	68600		
Less: Current Liabilities			
Creditors :	29000		
Taxation :	<u>28000</u>		
	<u>57000</u>	11600	
		<u>121600</u>	
Represented by			
Share capital :	71600		
Retentions :	<u>50000</u>		
		<u>121600</u>	

(ii) Finished products :	B	T
Budgeted sales (units)	5000	1000
Budgeted selling price(per unit) (₹)	30	50
Opening stock of finished goods (units)	200	300
Budgeted closing stock of finished		
Goods (units)	1200	200

(iii) Production details	P	Q

(a) Direct material :

Raw material per unit of production:

B :	5 Kg	3 Kg
T :	2 Kg	4 Kg
Opening stock of raw material :	2000 Kg	2000 Kg

Budgeted closing stocks :	2500 Kg	1500 Kg
Cost per Kg of material purchased :	₹ 0.50	₹ 1.00

(a) Direct Labour:

Labour is paid @ ₹2 per hour, 3 direct labour hours are required to produce one unit of B and 5 labour hours are required for one unit of T.

(b) Factory overheads: It has been estimated that factory overheads will be ₹33,750 including ₹11,750 for depreciation. Factory overheads are absorbed on a direct labour hour basis.

(c) Work in progress: This is negligible and can be ignored (i.e. no opening or closing stocks)

(iv) Administrative overheads:

These are estimated to be ₹11,625. They are charged to goods leaving work in progress and entering finished goods stocks and are absorbed as a percentage of factory cost.

(v) Selling and Distribution overheads:

These are estimated to be ₹20000. They are charged to the cost of sales on the basis of percentage of the selling price.

(vi) Stock pricing :

Goods are priced on a FIFO basis. Opening stock of raw materials are 2000 kgs of Pat ₹0.50 (₹1000) and 2000 kgs of Q at ₹1 (₹2000)

(vii) Taxation on 1988 profit is estimated at ₹30000. Overdraft interest in 1988 is expected to be ₹595, ₹500 of which will be paid during the third quarter of the year.

You are required to prepare the following budgets for 1988 for carryon Ltd using absorption costing methods.

- Sales budget.
- Production budget (quantities only)
- Direct material budget (usage and purchases)
- Direct labour budget
- Overhead absorption rate
- Closing stock budget
- Cost of goods sold budget
- Budgeted profit and loss account.

(I.C.W.A. Final)

Solution: (a)

Sales Budget

Product	Quantity	Selling Price	Sales value (₹)
B	5000	₹ 30	1,50,000
T	1000	₹ 50	<u>50,000</u>
			<u>2,00,000</u>

(b)

Production Budget (Quantity)

B	T
(Units)	(Units)

Budget Sales:	5000	1000
Add closing stock :	1200	200
	6200	1200
Less opening stock :	200	300
Production Budgeted:	6000	900

(c)

Direct Material Budget

	P Kg	Q Kg
Direct Material required in Production		
$B: 6000 \times 5$	30,000	18,000
$T: 900 \times 2$	1800	3600
	31,800	21,600
Add closing stock:	2,500	1500
	34,300	23,100
Less opening stock :	2000	2000
Direct material Purchased		
	32,300	21,100
Cost per Kg	₹0.50	₹1.00
Cost of Purchases:	₹16,150	21100
		(₹37,250)

(d)

Direct labour Budget:

Product	Production (units)	Total hrs required	Total labour cost (₹)
B	6000	@ 3 hours 18000	@ ₹2 36,000
T	900	@ 5 hours 4500	@ ₹2 9,000
Total		22500	45000

(e)

Overhead absorption rates:

(i) Budgeted factory overhead: ₹33,750

Budgeted direct labour hours: 22,500

Budgeted Factory overhead absorption rate = $\frac{33750}{22500}$
= ₹1.5 per hour

(f) Closing stock Budget

Particular	Raw Material			
	P		Q	
	quantity kg	value ₹	quantity kg	value ₹
Opening stock	2,000	1,000	2,000	2,000
Add Purchases	32,300	16,150	21,100	21,100
	34,300	17,150	23,100	23,100
Less consumption	31,800	15,900	21,600	21,600
Closing stock:	2,500	1,250	1,500	1,500

(h) Cost of goods sold Budget (₹)

Particulars	B	T
Direct material consumed:	₹	₹
P: 30,000X0.5		
Q: 18,00X1	15,000	1800X0.5 = 900
	18,000	3600X1 = 3,600
	33,000	4,500
Labour cost	36,000	9,000
Prime cost :	69,000	13,500
Factory overhead cost :		
18000X1.5	27,000	4500X1.5 = 6,750
Factory cost of goods produced		
Administration overheads ₹	96,000	20,250
11625	9,600	2,025
Cost of Production	1,05,600	22,275
Cost of production per unit		
$= \frac{105600}{6000}$	17.60	$\frac{22275}{900} = ₹24.75$
Production	105,600	22,275
Add opening stock	3400	7200
	109,000	29,475
Less closing stock = 1200×17.60	21120	

		200×24.75= 4950
Cost of goods sold :	87,880	24,525
Selling and distribution overheads	15,000	5,000
20000 @ 10 %on sales		
Cost of sales	102,880	29,525

(i) Budgeted Profit and loss A/c

	Product		
	B	T	Total
Sales	1,50,000	50,000	2,00,000
Less: cost of sales	1,02,880	29,525	1,32,405
Profit before interest & Tax	47,120	20,475	67,595
Interest on over draft:			595
Profit before tax :			67,000
Estimated Tax for 1988 :			30,000
Net Profit after tax:			37,000

Illustration 24: PAC progressive enterprise manufacturing only two products and selling them under the brand names Rasina and Pipto, Prepares every month forecast of profit (or loss) and a budgeted cash flow statement for presentation to the Managing Director each of the products requires only two types of raw materials in the following proportions:

	Rasina (Per unit)	Pipto (Per unit)
Material (1)	2kg	4kg
Material (2)	4kg	2kg

The direct labour hours for R and P are 4 and 6 per unit respectively. For the month of November, sales forecast were as follows:

Product	Units	Price per unit
Resina	3,000	₹60
Pipto	6,000	₹80

The opening inventory on 1st November and the proposed closing inventory on 30th November were:

	Opening stocks	Budgeted closing stock
Material (1)	4000kg	5000kg

Material (2)	2500kg	4000kg
Rasina	200 units	250 units
Pipto	400 units	500 units

Standard cost data for the month of November were :

	₹
Material (1)	2 per kg
Material (2)	4 per kg
Direct Labour	4 per kg
Manufacturing overhead (Applicable rate)	2 per direct labour hour
Administration overhead	20,000
Selling and Distribution overhead	40,000

Sales are collected 50% in the month of sale and 25% in each of the next two months. Material (1) is purchased in cash but for material (2), the supplies allow a credit of one month i.e. all payments are cleared in the following month. Wage calculation are ready by the first week of the next month and payment is made on 9th and 10th. Relevant figures for three months are extracted below:

	Sept. (₹)	Oct (₹)	Nov (₹)
Sales	8,00,000	6,00,000	
Purchase material (2)		1,00,000	
Wages for the month		2,00,000	
Other next cash expenses			2,00,000 (Budgeted)
Opening balance of cash			20,000 (on 1st Nov.)

In addition to the above, advance tax estimated at 60% of the net profit in November was required to be paid in the month.

You are required to prepare the production budget, material and Direct Labour cost Budget, Budgeted Profit/Loss statement and Budgeted cash flow statement for November.

(ICWA Final)

Solution: (a) Production Budget:–

	Product (units)	
	Rasina	Pipto
Sales:	3,000	6,000
Add closing stock:	250	500

	3,250	6,500
Less opening stock:	200	400
Production(units)	3,050	6,100

(b) Material Budget:

	Material (1)	Material (2)
Required for Production:	kg	kg
Rasina (3050 units)	6,100	12,200
Pipto (6100 units)	24,4000	12,200
	30,500	24,400
Add closing stock	5,000	4,000
	35,500	28,400
Less opening stock	4,000	2,500
	31,500	25,900

Material Purchase budget:–

Material (1)	31,500×2	= ₹63000
Material (2)	25,900×4	= ₹103600
		<u>= ₹166600</u>

(c) Direct Labour cost Budget :

Labour hours required:	hours
Resina	3050×4 = 12,200
Pipto	6100×6 = 36,600
Total	<u>= 48,800</u>
Direct Labour cost	<u>= ₹48800X4</u>
(Required for production)	= ₹195,200

(d) Budgeted Profit/Loss statement:

Budgeted	Sales	₹
	3000 × 60 = 180,000	
	6000 × 80 = 480000	6,60,000
Direct material:	₹	
M(1) 30500×2	= 61,000	
(M(2) 24400×4	= <u>97,600</u>	

	1,58,600	
Direct Labour:		
Hours 48800		
rate @ 4 hours	1,95,200	
Manufacturing overheads:	97,600	
(48800×2)		
Administration overheads:	20,000	
Selling and Distribution overheads:		
	<u>40,000</u>	
		5,11,400
Profit:		<u>1,48,600</u>

(d)	<u>Cash Budget</u>	₹
	Opening balance cash	20,000
Add:		
Received from sales		
Sept. $\frac{1}{4} \times 800000 = 200000$		
Oct. $\frac{1}{4} \times 600000 = 150000$		
Nov. $\frac{1}{2} \times 66000 = 330000$		<u>6,80,000</u>
		7,00,000
Payments:	₹	
Material (1) Purchase : 31500×2	= 63,000	
Material (2) Purchase:	= 1,00,000	
(Last month)		
Wages paid (Last month)	= 2,00,000	
Other expenses	<u>= 2,00,000</u>	
(Net cash paid)		
	= 5,63,000	
Advance tax paid		
(60% of 1,48,600)	= 89,160	
	<u>= 6,52,160</u>	
		6,52,160
Cash (Budgeted on 30th Nov)		<u>47,840</u>

Illustration 25: SV Ltd., engaged in the manufacture of four products has prepared the following budget for 1989:

	Products			
	A	B	C	D
Production ₹units	20,000	5,000	25,000	15,000
Selling price ₹/unit	21.75	36.75	44.25	64.00
Direct material ₹/unit	6.00	13.50	10.50	24.00
Direct wages ₹ /unit	7.50	10.00	18.00	24.00
Variable overheads ₹/unit	2.25	5.00	6.00	6.50
Fixed overheads per annual	75,000	25,000	2,25,000	1,80,000

When the budget was discussed it was proposed that the production should be increased by 10,000 units for which capacity existed in 1989.

It was also decided that for the next year i.e. 1990 the production capacity should be further increased by 25,000 units over and above the increase of 10,000 units envisaged as above for 1989. The additional production capacity 25,000 units should be used for the manufacture of product B for which new production facilities were to be created at an annual fixed overhead cost of ₹35000. The direct material costs of all the four products were expected to increase by 10% in 1990. While the other costs and selling price would remain the same.

Required:–

- Find the profit of 1989 on the assumption that the existing capacity of 10,000 units is utilized to maximize the profit.
- Prepare a statement of profit for 1990.
- Assuming that the increase in the output of product B may not fully materialize in the year 1990, find the number of units of product B to be sold in 1990 to earn the same overall profit as in 1989.

(CA Final)

Solution:

Existing Position for 1989.

	Products			
	A	B	C	D
Direct material (₹/unit):	6.00	13.50	10.50	24.00
Direct wages (₹/unit):	7.50	10.00	18.00	24.00
Variable overheads (₹/unit):	2.25	5.00	6.00	6.50
Marginal cost: (₹/unit)	15.75	28.50	34.50	54.50
Selling Price (₹/unit)	21.75	36.75	44.25	64.00
Contribution (₹/unit)	6.00	8.25	9.75	9.50

- Profit for 1989. For maximizing the profit.

As contribution/unit in case of C is maximum so the existing capacity 10,000 units should be used to produce the products.

Total contribution			
Product	Units	Contribution	Total Contribution
A	20,000	6.00	1,20,000
B	5,000	8.25	41,250
C	35,000 (2500+10000)	9.75	3,41,250
D	15,000	9.50	1,42,500
Total			6,45,000
Fixed overheads		(₹)	5,05,000
Profit			<u>1,40,000</u>

(b) Statement of profit for 1990

Another increase in capacity of 25,000 units to be utilized for production of product B.

Products					
	A	B	C	D	Total ₹
Direct material (₹/unit)	6.60	14.85	11.55	26.40	7,26,000
Direct wages (₹/unit)	7.50	10.00	18.00	24.00	
Variable overheads (₹/unit)	2.25	5.00	6.00	6.50	
Marginal cost (₹/unit)	16.35	29.85	35.55	56.90	
Selling Price (₹/unit)	27.75	36.75	44.25	64.00	
Contribution (₹/unit)	5.40	6.90	8.70	7.1	
Production (units)	20,000	30,000	35,000	15,000	
Total contribution (₹)	108,000	207,000	304,500	106,500	
Fixed overheads (₹)	(5,05,000+35,000)				5,40,000
Profit (₹)					1,86,000

(c) To earn the same profit as in 1989

Profit or overall contribution to be reduced

$$= 1,86,000 - 1,40,000$$

$$= ₹46,000$$

Contribution per unit in respect of product B = ₹6.90

Reduction in the sales (units) of B

$$= \frac{46000}{6.90} = 6,666 \text{ units}$$

Units of product B that can be sold to earn over all

$$\text{same profit as in 1989} = 30000 - 6666$$

$$= 23,334 \text{ units}$$

Illustration 26: S.G. Ltd manufactures two products A and B. The summarized Balance sheet of the company as at 30th September 1988 is as under:

	₹	₹
Share Capital	1,20,000	
	96,000	
		12,96,000
Represented by		
Fixed Assets:	12,00,000	
Provision for depreciation:	3,00,000	
		9,00,000
Inventories:		
Raw material:	1,14,000	
Finished goods:	2,40,000	
		3,54,000
Debtors		90,000
Bank/cash		60,000
		14,04,000
Less: Creditors:	48,000	
Provisions for taxation:	60,000	
		1,08,000
		12,96,000

The following information has been furnished to you for the preparation of budget for the year ending 30th September, 1989.

(i) Sales fore cast:

Product A 24000 units at ₹30 per unit

Product B 15000 units at ₹40 per unit

(ii)

Products

	A	B
Material X @ ₹3 per kg	2kg	4kg
Material Y @ ₹1 per kg	1kg	2kg
(iii) Direct Labour :		
Dept. P:	2 hours @ ₹1 per hour for A	
	1 hour @ ₹2 per hour for B	
Dept. Q :	1 hour @ ₹3 per hour for A	
	1 hour @ ₹3 per hour for B	
(iv) Overheads:	Dept. P	Dept. Q
	₹	₹
Fixed overheads per annum		
Depreciation	48,000	12,000
Others	96,000	30,000
Variable overheads per hour	0.50	1.50
(v) Inventories:		
(a) Raw material:		
Opening stock		
X	36000 kg	
Y	6000 kg	
Closing stock		
X	48000kg	
Y	12000 kg	
(b) Finished goods:		
Product	opening stock	closing stock
A	600 units	6,600 units
B	6000 units	3,000 units

(vi) Selling and Distribution, and Administration expenses are estimated at ₹1,80,900 per annum.

(vii) The cost of raw material purchased, direct wages, factory overhead, selling, distribution and administration overheads of the year will be met in full in cash during the year. The estimated position of debtors and credits as on 30th September, 1989 is 1,50,000 and 48,000 respectively. Income tax provisions standing at the beginning of the year will be paid during the year. Rates of income tax is 50%. An equipment purchased at 1,20,000 will be paid during the year.

You are required to prepare for the year ended 30th September, 1989.

(a) Cost of goods sold.

(b) Cash budget.

(c) Projected Balance sheet as at 30th September, 1989 in the same form as given in the question.

The detailed working for each of above should be shown.

(CA Final)

Solution:

(a) Cost of goods sold Budget.

Particulars	Product		Total
	A	B	₹
Sales (units)	24,000	15,000	
Add closing stock:	6,600	3,000	
	30,600	18,000	
Less opening stock:	600	6000	
Production for the year ending 30th sept. 1989	30,000	12,000	
Raw material consumed: (kgs)			
material X: (kgs)	60,000	48,000	
Material Y : (kgs)	30,000	24,000	
Value of raw material consumed			
material X: @ ₹3/kg	180,000	144,000	
Material Y : ₹1/kg	30,000	24,000	
	210,000	168,000	378000
Direct Labour cost:			
Hours required			
Dept. P A B			
	60,000	12,000	
Dept Q 30,000 12,000	60,000	24,000	
	90,000	36,000	
	150000	60000	210000
Factory overheads:			
Fixed: Department P. Hrs. 72000			
Fixed overheads = ₹ 144000			
@ $\frac{144000}{72000} = ₹2$	120,000	24,000	
Department Q Hrs =42000			
Fixed overheads : 42000	30,000	12,000	
absorbed @ $\frac{42000}{42000} = ₹1$			
Variable overheads:			
Dep P @0.50 hour	30,000	6,000	
Dep Q @ 1.50 hour	45,000	18,000	
	2,25,000	60,000	2,85,000
Factory cost	5,85,000	288,000	8,73,000
Add opening cost of finished goods			2,40,000
Less closing stock:			11,13,000
A: $\frac{585000}{30000} \times 6600$	1,28,700	72000	200700
B: $\frac{288000}{12000} \times 3000$			
Cost of goods sold:			9,12,300

b) Cash Budget for the year ending 30th September, 1989.

	₹	
Opening balance	60000	
Sales A $24000 \times 30 = 720000$		
B $15000 \times 40 = 600000$	1320000	
Add opening debtors	90000	
	1410000	
Less closing debtors	150000	
Total collections	1260000	
Total	1320000	

Less : Payments

(a) Purchases:

Required material: 3,78,000

Add closing stock:

X $48000 @ 3 = 144000$	}	
Y $12000 @ 1 = 12000$		156000
		534000

Less opening stock 114000

X $36000 @ 3 = 108000$	}	
Y $6000 @ 1 = 6000$		4,20,000

Creditors remains the same
at ₹ 48,000

(b) Direct labour 210000

(c) Factory overheads = 2,85,000

Less Dep. 60,000 2,25,000

(d) Selling Distribution and administration
overheads 1,80,900

(e) Equipment Purchased: 1,20,000

(f) Tax Paid during the year: 60,000

12,15,900

Closing cash balance

1,04,100

(C) Balance sheet :

	₹	₹
Share Capital	12,00,000	

Retained earning *	2,09,400	
		14,09,400
Represented by :		
Fixed Assets	13,20,000	
(1200000+120000)		
Provision for depreciation	3,60,000	
		9,60,000
Inventories:		
Raw material	1,56,000	
Finished goods	200,700	3,56,700
Debtors		1,50,000
Cash Balance		1,04,100
		15,70,800
Less : Creditors	48000	
Provisions for tax	113400	161,400
		14,09,400
Working Note: *		₹
Cost of goods sold		9,12,300
S&D Adm exp		180900
Total cost		10,93,200
Sales:		13,20,000
Profit before tax:		2,26,800
Less provisions for tax @ 50%		1,13,400
Profit after provisions:		1,13,400
Add opening earning (retained)		96000
Total retained earning:		209,400

Exercises:

1. Define budget. What are the advantages of preparing a budget?
2. Define budget and budgeting.
3. What do you understand by budgetary control?
4. Differentiate between fixed budget and flexible budget.
5. What are the limitations of Budgetary control.

6. Explain the advantages of Budgetary control.
7. (a) Define Budget and Budgetary control.
(b) List down any five objectives of Budgetary control system?

(CA inter) 1990

8. Distinguish between
(a) Fixed budget and flexible budget.
(b) Contribution and Profit.
9. How flexible budget is drawn up and what difficulties would you expect to face in its compilation? Is flexible budget useful for management?

(ICWA inter 1985)

10. Distinguish among.
(a) budgetary control and standard costing.
(b) Cost control and cost reduction.
(c) Differential cost and Marginal cost.
11. Fill in the blanks:
(a) A system by which budgets are used as a means of planning and controlling all aspects of business is called _____.
(b) A document which sets out the responsibilities of the person engaged in the routine of and the forms and records required for budgetary control is called _____.
(c) Opening stock of raw material + purchase during the period – closing stock of raw material = _____
(d) Semi-fixed expenses at 60% capacity = ₹1,60,000
Semi-fixed expenses at 80% capacity = ₹1,80,000
Fixed expenses at 100% capacity = _____
(e) Budgetary control helps management to _____
(f) Sales (I units) + closing stock (units) – opening stock (units) = _____
(g) _____ is a budget which states the additional workers to be engaged in the factory.
(h) Type of budget which includes all the functional budgets is called _____
(i) The maximum possible production of firm functioning at 65% capacity level and producing 1,95,000 units is _____ units.
(j) Predetermined cost with which present cost can be compared to know the variation is called _____.
(k) A budget which consolidates the organizations overall plan is called _____

Ans. (a) Budgetary control (b) Budget manual (c) Issued to production (d) ₹100 000 (e) Plan control (f) Production
(g) Labour budget (h) Master Budget (i) 3,00,000 (j) Standard cost (k) Master Budget

12. Differentiate between budget and forecast.
13. Are Budget, Budgeting and Budgetary control same?
14. What do you understand by Budget manual?
15. What do you know about a budget period?
16. Write a short note on the sales budget.
17. Clear with an example the concept of production budget and method of its preparation.
18. Direct labour budget plays an important role in the smooth functioning of the company. Write few works relating to it.

19. What are implications is research and development expenditure thought it is necessary for survival in the daily changing environment.
20. Write a note on the Master Budget.
21. What are the different situations where fixed or flexible budget are beneficial?
22. What is significance of Budgetary control and reporting?
23. Summarize Zero–base–Budgeting. What are its advantages?
24. What are limitations of budgetary control system?
25. Discuss briefly the objectives and limitations of budgetary control.

or

Budget is an aid to management not a substitute for management comment.

What is budgeting? Explain its advantages and limitations (B.com Hons)

26. Prepare production budget from the following information.

Products	Expected Sales during the period (units)	Forecasted closing stock (units)	opening stock (units)
A	48,750	5,000	3,750
B	25,250	2,500	1,750
C	38,625	3,225	2,425
D	42,375	6,750	5,125
E	27,000	4,000	1,000

Ans: A: 50,000

B: 26,000

C: 39,425

D: 44,000

E: 30,000

27. From the information given below prepare raw material required budget when.

A company produces two products X and Y and for production requires two components M and N.

	Products	
	X units	Y units
Sales:	2,000	3,000
opening stock:	500	400
closing stock	500	600
Components required: (units)		
Component M:	3	2
Component N:	2	1

Ans: Component M: 12,400 units

Components N: 7,200 units

28. Prepare a material purchase budget (Quantity and value) from the information given below:

	Products	
	Luminous	Bright
Sales (in units)	15,750	32,475
opening stock (in units)	2,575	3,350
closing stock (in units)	1,825	2,875
Raw material: Required per unit of products		
Magic	8 kg	10 kg
Glow	7 kg	6 kg
	Raw material	
	Magic	Glow
	(Kg)	(Kg)
Opening stock:	40,000	27,000
Closing stock:	30,000	30,000
Price per kg: ₹	₹ 8	₹ 10

Ans:	Required (kg)	Purchase (kg)	Purchase value (₹)
	Magic : 4,40,000 kg	Magic: 4,30,000kg	magic: ₹34,40,000 Total
	Glow: 2,97,000 kg	Glow: 3,00,000	Glow: ₹30,00,000 ₹ 64,40,000

29 XYZ Ltd manufactures two products using one type of labour. From the information given by the company prepare wage budget.

	Products	
	A	B
Budgeted Production (units)	3840	4200
Standard hours allowed per product:	5.50	4.50

Normal wage rate is ₹ 12 per hour. 100 workers are engaged in production overtime premium is 50% and is payable if a worker works for more than 8 hours a day and 5 day week is prevailing.

The target productivity ratio for the productive hours worked by the workers in actual manufacturing the production is 80% in addition the non productive downtime is budgeted at 20% of the productive hours worked.

There are 12 weeks in the budgeted period.

Ans: [Wage budget ₹ 7,92,540]

$$\left[\begin{array}{l} \text{Normal hours} = 12 \times 5 \times 8 \times 100 = 48000 @ 12/- \\ \text{Overtime hours} := 60030 - 4800 = 12030 @ 18/- \end{array} \right]$$

$$\text{Total productive hours} [3240 \times 5.5 + 4200 \times 4.50] \times \frac{1}{0.8} \times (1.2) = 60030$$

30. There is a limited supply of labour force in the market so key consideration is given to labour while estimating the future profit to be maximum.

A company gives you the following information regarding its cost and sale. You are required to set the available labour hours in such a way as to get maximum profit.

Available labour hours : 2,32,000 paid @ ₹2 per hour

	Products		
	A	B	C
Maximum units	20,000	30,000	25,000
Minimum units	10,000	10,000	10,000
Cost per unit:			
Direct material cost:	₹8	₹16	₹15
Direct labour cost:	₹8	₹8	₹8
Other variable costs:	₹3	₹8	₹7
Fixed cost:	₹80,000	₹120,000	₹100,000
Selling price per unit	₹25	₹40	₹35

It is further assumed that the labour force can be shifted from the production of one product to another.

Ans:		Contribution	maximum profit
A: 18000 units	₹ 108000		₹ 98000
B: 30000 units	₹ 240000		
C: 10000 units	₹ 50000		

31. A department of company X attains sales of ₹ 6,00,000 at 80% of the normal capacity and its expenses are given below

Administration costs Fixed :		Selling costs:	
Office salaries	: 90,000	Salaries	: 8 percentage of sales
General expenses	: 2 percentage of sales	Travelling expenses	: 2 percentage of sales
Depreciation (₹)	: 7,500	Sales office	: 1 percentage of sales
Rates and taxes(₹)	: 8,750	General experience	: 1 percentage of sales
Distribution Cost: Wages (fixed)			
Rent			
Other expenses			

Draw up flexible administration, selling and distribution costs budget, operating at 90% and 100% and 110% of normal capacity

(B.Com Hons Delhi)

32. Solo products Ltd manufactures and sells a single product and has estimated a sales revenue of 126 lakhs this year based on 20 percent profit on selling price. Each unit of product requires 3 lbs. of material P and $1\frac{1}{2}$ lbs of material Q for manufacture as well as a processing time of 7 hours in machine shop and $2\frac{1}{2}$ hours in assembly section. Overheads are absorbed at a blanket rate of $33\frac{1}{3}\%$ of on Direct labour. The factory works 5 days of 8 hours a week in a normal 52 weeks a year on an average statutory holidays, leave and absenteeism and idle time amount to 96 hours, 80 hours and 64 hours respectively, in a year.

The other details are as under:

		₹	
Purchase Price	Material	6 per lb	
	Material Q	4 per lb	
Comprehensive			
Labour rate	Machine shop	4 per hour	
	Assembly	3.2 per hour	
No. of employees	Machine shop	600	
	Assembly	180	
Opening stock	Finished goods	Material P	Material Q
	20000 units	54,000 lbs	33000 lbs
Closing stock:	25000 units	30,000 lbs	66,000 lbs
(estimated)			

You are required to calculate:

- The number of units of the product proposed to be sold.
- Purchase to be made of material P and Q during the year in value.
- Capacity utilization of machine shop and Assembly section along with your comments.

For answer see Illustration No 09 of the book.

33. The monthly budgets for manufacturing overhead of a concern for two levels of activity were as follows:

	60%	100%
Capacity		
Budgeted Production (units)	1200	2000
	₹	₹
Wages	2,400	4,000
Consumable stores:	1,800	3,000
Maintenance:	2,200	3,000
Power & fuel:	2,600	3,200

Depreciation:	6,000	6,000
Insurance:	1,500	1,500
Total	16,500	20,700

You are required to:–

- Indicate which of the items are fixed, variable and semi–variable.
- Prepare a budget for 80% capacity.
- Find total cost both fixed and variable per unit of output at 60%, 80% and 100% capacity.

Ans:	<u>Fixed</u>	<u>variable</u>	<u>Semi-variable</u>		Per unit cost		
					60%	80%	100%
	Depreciation	wages	maintenance	Fixed:	8.50	6.375	5.1
	Insurance	consumable store	power & fuel	Variable:	5.25	5.25	5.25
				Total fixed:	10200	10200	10200
				variable:	6,300	8,400	10500

34. The LMN & company is preparing budgets for the first quarter of 1991. The company has a single product, the details of which are:

	₹
Budgeted variable cost per unit	
Material	12
labour material (4 hours at ₹ 6)	24
Production overhead	8
Selling price per unit	90

Administrative overhead is ₹23,000 per month and the fixed production overhead is ₹15,000 per month, including ₹35000 depreciation.

The factory has a normal capacity of 1,500 units per month. Finished goods stocks are valued at full actual production cost and budgeted opening stock at 1st January 1991 is 1,200 units valued at ₹66,500. It is company's policy to keep finished stock at a constant ratio to the budgeted unit sales of the following month. Extra production over 1,500 units per month can be achieved by working overtime which means paying labour double time for the overtime.

<u>Expected sales</u>	<u>Units</u>
December, 1990	1,300
January, 1991	1,000

February, 1991	1,400
March, 1991	1,600
April, 1991	1,800
May, 1991	1,550

Materials are paid for in the month following delivery and enough stocks is kept to cover the next months budgeted production. Sales are on credit with 30% of debts collected in the month of sale and 67% in the following month, the balance being bad debts. All other costs are paid for in the month they are incurred and no capital expenditure is expected.

You are required:

- To prepare a single budgeted profit and loss account for the quarter (January, February, March).
- To prepare cash budgeted for each month of the quarter.
- To reconcile the net-cash movement for the quarter to the budgeted profit. (CIMA – London)

Ans. Budgeted net profit. ₹ 58594

Working Note:

Closing stock of finished goods.

	Jan	Feb	March	April
Expected sales (units)	1,000	1,400	1,600	1,800
Opening stock:	1,200 (given)	1400X1.2=1,680	1920	2,160
(ratio to expected sales 1.2)				
Closing stock: (To be equal	1,680	1920	2,160	
to opening stock of				
following month)	_____	_____	_____	
Production with in the	1480	1640	1840	
month:				
(Formula: (sales+c.stock–open stock) as Jan				
(1000+1680–1200)=1480				
[Production within month in	–	140	340	
excess of 1500 units				
Which is to be paid at twice		140+340=480 units		
the market rate				
Total units produced		= 4960		
[4960–480] paid @ ₹ 24		= ₹ 1,07,520		
480 paid @ ₹ 48		= ₹ 23040		
Expected wage bill		= ₹ 1,30,560		

35. A redundant manager who received compensation of 80,000 decided to commence business on 4th January 1988, manufacturing a product for which he knows there is a ready market. He intends to employ some of his former workers who were also made redundant but they will not all commence on 4th January.

Suitable premises have been found to rent and second hand machinery costing ₹ 80,000 has been bought for ₹ 60,000. This machinery has an estimated life of five years from January 1988 and no residual value.

Other data:

1. Production will begin on 4th January and 25% of the following months sales will be manufactured in January. Each month thereafter the production will consist of 75% of the current months sales and 25% of the following month's sales.

2. Estimated sales are:	Units	₹
January	Nil	Nil
February	3,200	80,000
March	3,600	90,000
April	4,000	1,00,000
May	4,000	1,00,000

3. Variable production cost per unit	₹
(i) Direct material	: 7
(ii) Direct wages	: 6
(iii) Variables overhead total	: 2

15

4. Raw material stocks costing 10,000 have been purchased (out of manager's ₹ 80,000) to enable production to commence and it is intended to buy, each month 50% of the material required for the following months production requirements. The other 50% will be purchased in the month of production. Payment will be made 30 days after purchase.
 5. Direct workers have agreed to have their wages paid into bank account on the seventh working day of each month in respect of the previous months earnings.
 6. Variable production overhead; 60% is to be paid in the month following the month it was incurred and 40% is to be paid one month later.
 7. Fixed overheads are ₹4,000 per month. One quarter of this is paid in the month incurred, one-half in the following month and the remainder represents depreciation on the second hand machinery.
 8. Amounts receivable: a 5% cash discount is allowed for payment in in the current month and 20 % of each month's sales quantity for this discount. 50% of each month's sales are received in the following month, 20% in the third month and 8% in the fourth month.
- The balance 2% represent anticipate and debts.

You are required to:

- (i) Prepare a cash budget for each of the first four months of 1988, assuming that overdraft facilities will be available.
- (ii) State the amount receivable from customers in May.

(CIMA–London–1987)

Ans. [amount payable to customer in May = ₹ 93400)

Numerical Problems:

(Solutions)

Q 26 Production Budget

	Product				
	A	B	C	D	E
Expected sales during the period	(units) 48,750	(units) 25,250	(units) 38,625	(units) 42,375	(units) 27,000
+ Closing Stock (Forecasted)	5,000	2,500	3,225	6,750	4,000
Total	53,750	27,750	41,850	49,125	31,000
–Opening Stock	3,750	1750	2425	5125	1000
Budgeted Production	50,000	26,000	39,425	44,000	30,000

Q.27

Production Budget of Products

	Product	
	X	Y
Sales	(units) 2000	(units) 3000
+ Closing stock	500	600
Total:	2500	3600
- Opening Stock	500	400
Production	<u>2000</u>	<u>3200</u>

Material requirement Budget

Product	Material	
	M (units)	N (units)
X : 2000 units	6000	4000
Y: 3200 units	6400	3200
Total material required	12,400	7,200

Q.28

Production Budget

	Product	
Particular	Luminous	Bright
Sales (units)	15,750	32,475
+ Closing Stock (units)	1,825	2875
Total :	<u>17575</u>	<u>35350</u>
–Opening Stock (units)	2575	3350
Production during the period (units)	15,000	32000

Material Required Budget

Product	Material

	Magic (units)	Glow (units)
Luminous (15000 units)	120,000	105,000
Bright (32000 units)	320,000	192,000
Total:	440,000	297,000

Material Purchase Budget

Particular	Material	
	Magic	Glow
Required for production (units)	440000	297000
Add: Closing Stock (units)	30000	30000
Total:	470000	327000
Less: Opening Stock (units)	40000	27000
Purchased during the period (units)	4,30,000	3,00,000
Purchase value (₹)	34,40,000	30,00,000

Q.29

Total Productive hours	=	$[(38400 \times 5.5) + (4200 \times 4.5)] \times \frac{1.2}{0.8}$	
	=	$[21120 + 18900] \times \frac{1.2}{0.8}$	
	=	$\frac{48024}{0.8}$	
	=	60030 hours	
Hours payable at normal rate	=	$12 \times 5 \times 8 \times 100$	
(Weeks x days per week x hours per day x workers)			48000
=		hours	
Hours Payable at premium of 50%	=	60030 - 48000	
	=	12030 hours	
Wage Budget	=	$[(48000 \times 12) + (12030 \times (12 \times 1.5))]$	
	=	576000 + 216540	
	=	₹792540	

Q.30

Comparative statement showing contribution per labour hour.

		Product		
		A	B	C
Selling price (₹ per unit)		25	40	35
Direct material (₹ per unit)	8		16	15
Direct labour	8		8	8

(₹per unit)			
Other variable cost	3	8	7
(₹per unit)			
Marginal Cost			
(₹per unit)	19	32	30
Contribution	6	8	5
(₹per unit)			
Hours required per unit	4	4	4
Contribution per hour	1.5	2	1.25
(₹per unit)			

Statement showing maximum possible profit depending upon labour constraint.

Product	Units of production	Labour hours required	Balance labour hours	Contribution (₹)
B	30,000(Max.)	120,000	232000–120000=112000	240,000
C	10,000(Mini.)	40,000	72,000	50,000
A	18,000	72,000	–	108,000
			Total contribution	3,98,000
			Fixed Cost	
			(80000+120000+100000)	300,000
			Profit	98,000

Q.31

Statement showing And., Selling and distribution cost Budget (Flexible)				
Flexible Expenses	Capacity Level			
	80%	90%	100%	110%
Sales :	(₹)600,000	(₹)6,75,000	(₹)7,50,000	(₹)8,25,000
	(₹)	(₹)	(₹)	(₹)
1.Admn. Cost				
General Exp.	12000	13500	15000	16500
2% of sales	12000	13500	15000	16500
2.Selling Cost:				
Salaries @ 8%of sales	48000	54000	60000	66000
Travelling Exp. @ 2% of sales	12000	13500	15000	16500
Sales office @ 1% of sales	6000	6750	7500	8250
General Exp. @ 1% of sale	6000	6750	7500	8250
	72000	81000	90000	99000
3.Distribution costs				
Rent @ 1% of sales	6000	6750	7500	8250
Other Expenses @ 4% of sales	24000	27000	30000	33000
	30000	33750	37500	41250

Q.33

Budget statement at different levels of capacity

Item of Expenditure	100% capacity (₹)	60% capacity (₹)	80% capacity (₹)
Wages (variable)	4,000	2,400	3,200
Consumable Store (variable)	3,000	1,800	2,400
Maintenance: Fixed:	1,000	1,000	1,000
Variable:	2,000	1,200	1,600
Power & Fuel: Fixed:	1,700	1,700	1,700
Variable:	1,500	900	1,200
Depreciation Fixed:	6,000	6,000	6,000
Insurance Fixed:	1,500	1,500	1,500
Total:	20,700	16,500	18,600
Fixed Cost per unit $(\frac{1000+1700+6000+1500}{2000})$	5.1	8.5	6.375
Variable Cost per unit $(\frac{4000+3000+2000+1500}{2000})$	5.25	5.25	5.25

Method of Separating Semi variable expenses into fixed and variable

(i)Maintenance Cost:	(₹)
At 100% capacity=	3000
At 60% capacity=	2200
Difference 40% capacity=	800
Variable expenses at 100%capacity=	$\frac{800}{0.4} = ₹2000$
Fixed expenses =	3000-2000
=	₹1000
(ii)Power & Fuel:	(₹)
At 100% capacity=	3200
At 60% capacity =	2600
Difference 40% capacity =	600
Variable expenses at 100% capacity=	$\frac{600}{0.4} = ₹ 1500$
Fixed expenses =	3200-1500
=	₹1700

Q.34.

Before preparing Profit and Loss budget we have to find out the production during the quarter and the closing stock of finished goods.

Production budget during the quarter ending march 1991.

	January	February	March	April
Expected Sales (units)	1,000	1,400	1,600	1,800
+ Closing Stock	<u>*1,680</u>	<u>1,920</u>	<u>2,160</u>	
	2680	3320	3760	
– Opening Stock	1200 (given)	1680	1920	2160
Production during the month	<u>1480</u>	<u>1640</u>	<u>1840</u>	

*It is given in the question the policy of company to keep the closing stock at a constant ratio to the budgeted units sales of the following month i.e. 1200 : 1000 or 1.2 : 1

$$\begin{aligned} \text{So, closing stock in January} &= 1.2 \times 1400 \text{ (Sales in February)} \\ &= 1680 \text{ units} \end{aligned}$$

Production in excess of normal production i.e. 1500 units which is given at twice the rate

$$\begin{aligned} \text{February: } 1640 - 1500 &= 140 \text{ units} \\ \text{March: } 1840 - 1500 &= 340 \text{ units} \\ \text{Total} &= 480 \text{ units} \end{aligned}$$

(a) Budgeted Profit and Loss A/c for the quarter ending 31st March 1991

		₹
	Sales (4000x90)	3,60,000
	Less cost of sales :	₹
	Opening Stock	66,500
	(1200 units)	
Add production cost: (1480+1640+1840)=		
4960 units		
Material: 4960×12	= 59520	
Labour: 4960×24=119040		
480×24 =11520	= 130560	
Variable overheads 4960×8=	39680	
Fixed Production cost	= 45000	
Total		<u>274760</u>
		341260
Less closing stock:		
[(274760 ÷ 4960) × 2160]		<u>119654</u>
		221606
	Gross Profit:	<u>138394</u>
Less:	₹	

Admn. overheads:	69000	
(2300x3)		
Bad debts	10800**	79800
Net Profit =		<u>58594</u>

(b) Cash Budget

Before preparing the cash budget let us find out the sales, purchases during the month, the previous and following month which are essential as per the conditions given in the question.

Data for sale and purchases

	December, 91	January, 91	February, 91	March, 91	April, 91
Sales (given) (units)	1300	1000	1400	1600	1800
Production (units)	940	1480	1640	1840	1500
Purchases (₹)	17760	19680	22080	18000	—
Sales (₹)	117000	90000	126000	144000	162000

Cash budget (Month wise) for the quarter ending 31st March, 1991

	January (₹)	February (₹)	March (₹)	Total (₹)
Receipt:				
Current months:	27000	37800	43200	
Previous months:	<u>78390</u>	<u>60300</u>	<u>84420</u>	
	105390	98100	127620	331110
Payments:				
Material:	17760	19680	22080	
Normal Labour:	35520	39360	44160	
Overtime payments:	—	3360	8160	
Productions overheads:				
Fixed:	11500	11500	11500	
Variable:	11840	13120	14720	
Admn. overheads:	<u>23000</u>	<u>23000</u>	<u>23000</u>	
	99620	110020	123620	
				333260
Closing balance	5770	(11920)	4000	<u>(2150)</u>

**Bad debt = 3% of (90000+126000+144000)
= 3% of 360000
= ₹ 10800

(c) Reconciliation of net cash flow to the budgeted profit.

	₹
	58594
Budget Profit	
Add: Depreciation (Non cash)	<u>10500</u>
	₹ 69094
Less: Increase in debtors 67% (144000-117000)	18090
Increase in stock (closing)	

(*119654–66500)	<u>53154</u>	(71244)
	Net Cash Outflow	<u>(2150)</u>

Q.35

(i) Cash Budget for the first four months

	January	February	March	April
	₹	₹	₹	₹
Receipt:				
Balance b/d	—	9000	3890	9090
Compensation received	80000	—	—	—
Sale receipts (1)	Nil	15200	57100	8000
any other receipt	<u>Nil</u>	<u>—</u>	<u>—</u>	<u>—</u>
Total	80000	24200	60990	89090
Payments:				
Machinery Purchased	60000	—	—	—
Purchases (2) (Material)	10000	11550	24500	26950
Direct wages (3)	—	4800	19800	22200
Variable overheads(4)	—	960	4600	7080
Fixed overheads(5)	<u>1000</u>	<u>3000</u>	<u>3000</u>	<u>3000</u>
Total	71000	20310	51900	59230
Closing balance	9000	3890	9090	29860

Working Notes: Sales for the four months has been given in the question. First of all let us find out the production during the months under reference.

	Jan.	Feb.	March	April	May
	(units)	(units)	(units)	(units)	(units)
Production :					
(Sales: Feb : 3200 units	800	2400			
March:3600 “ “		900	2700		
April: 4000 “ “			1000	3000	
May : 4000 “ “				1000	3000
and condition4)					
Total	800	3,300	3,700	4,000	3,000

Note:– (1)

Sales	Receipts			
	January	February	March	April
	(₹)	(₹)	(₹)	(₹)
Jan:				
Feb:(₹)80000	—	$80000 \times 0.2 \times 0.95 = 15200$	$80000 \times 0.5 = 40000$	$80000 \times 0.2 = 16000$
March: (₹)90000	—	—	$90000 \times 0.2 \times 0.95 = 17100$	$90000 \times 0.5 = 45000$
April: (₹)100000				$100000 \times 0.2 \times 0.95 = 19000$
Total	Nil	15200	57100	80000

Note (2)

Production	Purchases			
	January units	February units	March units	April units
February: 3300 units	1650	1650	—	—
March: 3700 units		1850	1850	—
April: 4000 units	—		2000	2000
Total	1650	3500	3850	2000

Payment for Purchases:

	₹
February: $1650 \times 7 =$	11550
March: $3500 \times 7 =$	24500
April: $3850 \times 7 =$	26950

Note (3) Wages:

	₹
February: $800 \times 6 =$	4800
March: $3300 \times 6 =$	19800
April: $3700 \times 6 =$	22200

Note (4) Variable overheads:

Increased in	February (₹)	March (₹)	April (₹)
January: $800 \times 2 = 1600$	960	640	—
February $3300 \times 2 = 6600$	—	3960	2640
March: $3700 \times 2 = 7400$	—	—	4440
Total	960	4600	7080

Note (5) Fixed overheads:

Increased in	January (₹)	Paid in February (₹)	March (₹)	April (₹)
January: (₹) 4000	1000	2000	—	—
February: (₹) 4000	—	1000	2000	—
March: (₹) 4000	—	—	1000	2000
April: (₹) 4000	—	—	—	1000
Total	1000	3000	3000	3000



7. Standard Costing

It is an effective cost control system. It is a measure of efficiency of various factors of production. Production costs are pre-estimated depending upon the normal working conditions. In this system of costing, consumption of various factors of production is determined and the same is compared to the standards required for the same level of production. The main purpose of standard costing is to have a check on the cost of production or we can say it is a cost control technique. We can say standard cost is a pre-determined cost in the production process depending upon the normal working conditions or otherwise. Standard costing has a wider meaning, the present standard in the normal working conditions or otherwise for the various factors of production consumable in the process are compared to the actual consumption. A variation in the standard required and actual is found out and is left out for decision maker to know the various reasons of such variations and then to take the required remedial measures.

In the term of Chartered Institute of Management Accountants of London the standard cost and standard costing has been defined as follows.

“A predetermined calculation of how much costs should be under specified working conditions. It is built up from an assessment of the value of cost elements and correlates technical specifications and quantification of material, labour and other costs to the prices and/or wages rates expected to apply during the period in which the standard cost is intended to be used. Its main purposes are to provide base for control through variance accounting for valuation of stock and work in progress and in some cases for fixing selling prices.”

It is very clear from the above definition that it is a system of predetermined calculation of costs required in the specific working conditions and comparing it with the actuals. The main purpose of standard costing is to control and to have a check on the actual cost incurred during production. It is also useful in valuation of stock, work in progress and estimating the selling prices.

Eric L. Kohler has defined standard cost as “Standard cost is a forecast or predetermination of what actual should be under projected conditions, serving as a cost control and as a measure of production efficiency or standard of comparison when ultimately aligned against actual cost. It furnishes a medium by which the effectiveness of current results can be measured and the responsibility for deviation can be placed.”

So from the above definition given by Eric L. Kohler it is clear that under specific working conditions what cost of production should be, what is actual cost and provide basis for control through variance analysis, fixing the responsibility of decision makers and taking remedial actions.

Standard costing is preparation of standard costs and applying them to measure variation from actual costs and analyzing the causes of variation with a view to maintain maximum efficiency in production. It is a technique which uses standard for cost and revenues for the purpose of control through variance analysis.

It is a system in which

1. In the production process standard costs i.e. for the factors of production (Material, labour, overheads etc.) are prepared.
2. Actual cost incurred are compared with the standard cost required and variation if any is determined.
3. Causes of variation in actual cost and standard cost required are found out in order to maintain maximum efficiency in the production process.

Standard costing is a technique which is complimentary to actual costing or historical costing system. It serves as a yard stick (measure) against which actual costs are compared. Variance in actual and standards if any is determined. Reason of variation are found out and for adverse variation i.e. if actual costs are more than required standards the remedial action is taken as early as possible. Actual costing system cannot be ignored even if standard costing system is adopted.

The system of standard costing is useful in industries producing standardized products which are repetitive in nature. Thus, standard costing is more widely applied in process and engineering industries and is not very much suitable for job order industries. Even in jobbing industries where jobs differs from one another, there is a scope for the use of this system of costing, though the product in such industries might not be of repetitive nature and standard nature, still the operation performed for the completion of the jobs, would be of a repetitive nature and standard can be laid down for the operation performed. Standard cost of the job can be found out by adding the standard cost of the operation involved in the job. Comparison of standard cost of the operation and its actual cost will be helpful in controlling the cost of operations and therefore, of job costs too.

Standard costing and Marginal costing

Marginal costing as it is clear from the word meaning is the additional cost required to produce another or the additional unit in the production process. It takes into account the variable costs only, whereas the standard costing is a system of accounting in which all expenses whether fixed or variable are taken into consideration for determination of standard cost in a prescribed set of working conditions. Marginal costing is important in decision taking in make or buy decisions, price fixation, Government supplies, in joint products and bye products etc. Both standard and marginal costing are independent of each other and may be installed jointly. The system of joint installation may be named as marginal standard costing or standard marginal costing system. Variances are calculated in the same manner as in standard costing system with the only difference that volume variances are absent because fixed expenses are charged in total in each period.

Standard Costs and Estimated Costs

Both standard costs and the estimated costs are predetermined costs, but their objectives are different. The point of difference among two are as follows.

1. Estimated costs are determined on the basis of the past performance keeping in view the anticipated changes in the future. On the other hand standard costs are determined on a scientific basis keeping in view certain factors and conditions of efficiency.
2. Estimated costs are useful in fixing selling prices of the products, for taking decision to manufacture or to buy, for quoting the selling price of the job etc. Standard costs on the other hand lay the emphasis on cost control, measuring the efficiency of the various factors and helps in taking the remedial action for variation if any.
3. Standard costs are used by those concerns which follows standard costing system. Estimated cost are used by the concerns which have adopted historical costing system to ascertain cost.
4. Estimated costs can be for a part of business whereas standard costs are to be fixed for each element of cost.
5. The object of estimated cost is to have a reasonable assessment of what the cost will be, on the other hand the objective of standard cost is what the cost should be.
6. Standard costs are used as a regular system of accounts from which variances are found out whereas the use of estimated costs is as a statistical data only.

Standard Costing and Budgetary Control

Standard costing and budgetary control, both serves the same purpose but budgetary control has a wider meaning than standard costing. Standard costing is mainly concerned with the element of cost, whereas the budgetary control is mainly concerned with the income and expenditure of the company depending upon the past actuals and future trends. The main points of differences can be summarized as below.

1. Standard costing is based on technical assessment of the various factors of production such as material, labour and overheads whereas in budgetary control system there is assessment of past happenings and future trends.
2. In standard costing standards are settled i.e. pre-set to compare with the actual happening whereas in budgetary control there are limits of income and expenditures within which the company has to function.
3. Budgetary control system is applied to the business as a whole whereas the standard costing system is limited to the techniques to minimize the cost at various levels through variances of actual cost and standard cost required.
4. Budgetary control system is a system applied to control the income and expenditure at higher level of management or we can say this system is not always as technical as in case of standard costing.
5. Lower level of management is made responsible in case of standard costing whereas in the case of budgetary control system though lower level of management is held responsible but degree of responsibility of upper level of management is much more than the lower level management.
6. Budgets are projections of financial accounts, standard costs are projections of cost accounts. Budgetary control adopts a more general approach of giving service to management. Financial accounting as we know is concerned with overall efficiency of business whereas cost accounting deals with individual products, ascertaining and controlling their costs. Standard costs aims at efficiency at every point. So these are the projections of cost accounts. On the other hand budgetary control aims at overall efficiency, so projections of financial accounts.

7. Standard costing system is based on the normal working conditions in which organization is functioning. It tell us what the cost should be under these conditions and what is actual cost and hence any variance and reason for the variation. On the other hand in budgetary control system there I forecasting what the cost should be depending upon future trends. Though both serves the same purpose but the technique used are different.

From the above discussion we see both the budgetary control and standard costing are complementary to each other. We can get better results if both are applied in the organization.

Standard Costing and marginal costing

Standard costing is a technique used in cost control process depending upon the pre set standards based on normal working conditions in which the organization function and comparing these et standards with the actual happenings and at the end finding ways to be close to the standards as for as possible in case of adverse happening. In standard costing both the costs fixed as well as variable are taken into consideration. In marginal costing the main emphasis or operation is on variable cost. The main target is maximizing the contribution i.e. difference in sales and the variable cost. The difference can be widened through raising the selling price or by minimizing the variable cost if possible. Both the techniques are helpful to increase the overall efficiency of the organization through cost minimization or we can say in the long run the profit maximization. Both the techniques should be applied jointly. The system in which the both are applied may be named as standard marginal costing system.

Establishment of standard costs

As we know in standard costing system the actual costs are compared with the standard costs. But how much is the standard cost with which the actual cost can be compared is a cumbersome problem. Setting the standard cost is not an easy job. It requires a lot of expertise in developing such standards. So, therefore establishing a standard costing system the following preliminaries should be gone through.

1. Establishment of Cost centers :

The first and foremost step required in the standard costing system is the establishment of the cost centers. It is necessary for fixing the responsibility in case of adverse happening. A cost center is a location, item of equipment for which cost may be ascertained and used for purpose of control. Various factors of production on which costs are incurred are the cost centers such as direct material, direct labour etc.

2. Types of standards : Three types of standards are there (a) Current standards (b) Basic standards and (c) Normal standards.
 - (a) (i) Current standards :- Current standards are those which depends upon the current working conditions of the organization. These are more accurate in current conditions. These are based on high degree of efficiency of the organization. As working conditions are changing though may not be always, their attainability sometimes becomes impossible. Yet these types of standards are desired. These types of standards are established by the organization though not very possible to be achieved to compare the performance and struggling always to be nearer to these standards as for as possible. These are we can say theoretical standards.
 - (ii) Attainable standards :- If some future trends or the changing conditions , in the very near future in which the organization is working are taken into consideration then the standards can be so set which are attainable in the near future. These are current type and attainable in the very near future because in the long run the conditions may change adversely, so standards set cannot function in the very long run. So attainable current standards take into consideration of expected short term changes in very near future. So these types of standards are desirable in the system of standard costing.
- (b) Basic standards :- These type of standards are those which are established taking into consideration the long term expected changing conditions of the organization. These types of standards are always desired because these are less expensive and function for a long time period. As the future is always uncertain and basic conditions basing on which the standards are prepared are expected to change, so these set standards do not solve the purpose of the organization of cost control.
- (c) Normal standards :- These standards are prepared keeping into consideration the average estimated performance of the organization. These standards are for a specified trade cycle. The standard operates well if the average conditions on which these are based when prepared, do not differ to a large extent. If this is so that is the market conditions changes in the trade cycle, then these standards when compared with the actual may lead to inaccurate result and hence wrong decisions

taken at the management level. So, normal standards may not be useful device for the purpose of cost control.

3. **Setting of standards :-** This is the most important phase of standard costing system. Once the standards are set, this will act as a yard stick to compare with. If yard stick so prepared is not accurate or inaccurate then comparison of actual with these will also not correct and so decision making. In the process of setting standards, cost accountant plays an important role as he is the technical expert in this regard. Just as budget committee, there should be a standard committee which be entrusted with the work of setting of standard costs. The standards set should not be too high or too low. If the standards set are too high, these cannot be attained and the comparison of actual and standard will always show adverse results. If the standards are too low then again it will not serve the purpose of cost control in actual practice. Low standards may lead to favorable results all the times, so may not induce the labour and management to put more efforts. So, the standards set should be the mid- way of low and high standards. It will always motivate management and labour to do utmost effort in achieving these.

Material Cost :

Material play an important role in the production process. Without material production is not possible. As we know production of a commodity is nothing but to change or increase the utility of the available material. The direct material required for production of a commodity should be predetermined in consultation with the engineering department depending upon the past experiences. Wastage should be given a due importance because when the commodities are manufactured a certain portion of the raw material put into the process go waste. Normal wastage should be allowed in setting the standards. We can calculate the standard quantity of the raw material required for the production of a certain quantity of the finished product under normal conditions.

The engineering department keeping into consideration the various contingencies should prepare a standard cost card showing the quantity of a unit of the final product.

Material requirement table

S. No.	Type of direct Material.	Quantity of the material Required per unit of the final product.	Remarks if any.
1.	Material A	_____	
2.	Material B	_____	
3.	Material C	_____	
4.	Material D	_____	
.	.		

The next task regarding material is the estimation of the standard rate of the material per unit. This again is not an easy task. Here costing department is consulted and every element of cost beginning from initiating the purchase and up to the time it is issued to the process of production, is taken into account. Cost accountants play an important role in its valuation and finding out the standard rate. Past experience and future expectations regarding prices are taken into consideration while setting the standard prices of the required material. Comparison of standard with the actual will increase the efficiency of the purchase department minimizing the material cost.

Direct labour cost

The next and the most important factor of production is labour. Labour is essential in manufacturing of the product and is a major part of cost of production. So, in the cost control process and standard costing its standardization is necessary. The standardization of labour cost can be made in terms of (i) Time of labour force consumed in manufacture (ii) Rate of wages given to the labour force. Standardization of direct labour cost required for comparison require standardization of labour time and wages given per unit time consumed in the process. As the time of labour force increases, it will increase the cost of production and similarly increase in wage per unit time will also increase the cost of production. A control over these is necessary to keep the cost of production low regarding labour cost. Time and motion study plays an important role in fixing the labour time required for production of a unit of the final product. Due allowances should be made for fatigue, tool setting, receiving instructions and normal idle time while fixing the standard time.

Though setting standard time required for production is not an easy job, yet past experiences and consultations with the engineering department can enable to arrive at the desired result. For new products standard time required can be set by taking trial runs. This method cannot give satisfactory results. So in setting the standards the management should try all the possible methods such as the trial run, time and motion study, the past experience etc.

The next job in labour cost standardization is the wage rate standardization. Here prevailing wage rate in the market are taken. Demand and supply method of wage rate setting is also another method of its standardization. The wage rate for various types of labour should be standardized because different categories men, women, skilled, semiskilled, unskilled etc. When wages are given on the piece rate then piece rate wage standardization should be done.

Overhead Cost

Another important element of cost which is required to be controlled is the overhead cost. For control purpose and for comparison standard overhead cost is desired. Overhead cost can be of two types mainly fixed and variable. Variable overhead costs are directly proportional to the units of production whereas the fixed overhead cost remain constant up to a certain level of production. For proper control, the overhead cost should be further separated into manufacturing, administration, selling and distribution etc. The standard overhead cost can be calculated through past experiences, present conditions and future trends. A common unit should be selected so that comparison of actual and the standard can be possible. The most common unit used is time i.e. the hours of work. Standard overhead cost separated into fixed and variable overhead per unit standard time. (i.e. The time required to produce one unit of final product)

Preparing a standard Cost sheet :

For a proper control over the cost of production there should be a ready standard cost sheet to compare the actual cost. The cost sheet (Standard) should be as for as possible separated in as many as possible elements of cost. The main are direct material, direct labour, overhead cost. It should be able to give information about the standard quantity (in units) of the material required for production of one unit of the finished product, the standard price of the direct material used in production. The standard labour time required for the production of one unit of the finished product, the standard wage rate per unit time. The overheads should be separated into fixed and variable, their standard rate of recovery per unit of time or output. A specimen standard cost sheet can be tabulated as below.

Specimen Cost Sheet

Product

Date of setting standard

Element of Cost	Quantity (units as Applicable)	Rate (₹)	Standard Cost (₹)
1. Direct material			
Material A	S_1 units	$S_{R1} \dots\dots\dots$	$S_1 \times S_{R1} \dots\dots\dots$
Material B	S_2 units	$S_{R2} \dots\dots\dots$	$S_2 \times S_{R2} \dots\dots\dots$
Material C	S_3 units	$S_{R3} \dots\dots\dots$	$S_3 \times S_{R3} \dots\dots\dots$
Total: -			
Less normal loss (..... %)	$\sum_{i=1}^n S_i = \dots\dots\dots$ $S_Y = \dots\dots\dots$		$\sum_{i=1}^n S_i \times S_{Ri} = \dots\dots\dots$
2. Direct Labour :			
Type	$N_1 T_1 = \dots\dots\dots$		
(Specification)	$N_2 T_2 = \dots\dots\dots$		
Type X	$N_3 T_3 = \dots\dots\dots$		
Type Y		$R_1 \dots\dots\dots$	$N_1 \times T_1 \times R_1 = \dots\dots\dots$
Type Z		$R_2 \dots\dots\dots$	$N_2 \times T_2 \times R_2 = \dots\dots\dots$
		$R_3 \dots\dots\dots$	$N_3 \times T_3 \times R_3 = \dots\dots\dots$
3. Overheads: -	ST		$\sum_{i=1}^n N_i T_i R_i = \dots\dots\dots$
	BT		
Variable:		$S_{RV} \dots\dots\dots$	$S_T \times S_{RV} \dots\dots\dots$
Fixed:		$S_{RF} \dots\dots\dots$	$B_T \times S_{RF} \dots\dots\dots$
Total Cost			.....
Profit :			.....
Total Sale			.....

Where S_i denotes standard quantity of direct material required for S_Y unit of the product.
 S_Y is the standard yield of the product.
 $N_i T_i$ in direct labour is the direct labour time of the particular type of labour consumed in the production.
 R_i is the standard wage rate per unit time of the particular type of labour.
 S_T is the standard time of variable overhead consumed in production.
 S_{RV} is the standard rate of the variable overheads per unit time.
 B_T is the budgeted time for fixed overheads.
 S_{RF} is the standard fixed overhead rate per unit time.

These costs are fixed up to a certain level of the output beyond which these costs changes become fixed for another level of output.

Whenever a cost sheet is prepared though very difficult to prepare, it will be used as a yard stick to compare the actual cost with it and to find out variances quantitatively. If there is any variation in the standard and the actual the management is accordingly informed to take an appropriate remedial action.

Advantages of Standard Costing System

Standard costing system is very helpful in cost minimization, pointing out the areas of inefficiencies, in fixing the responsibilities and an aid to upper level of management to take proper decisions at proper time. The various advantages of the system can be summarized as below.

1. The system when developed acts as a yard stick to compare the actual cost with the present standards. The standards are set depending upon the normal working conditions of the production unit. The every actual functioning i.e. from production factors point of view is compared with the set standards of the factor of production. So standard costing is a yard stick to compare the actual functioning and hence to find out the variances leading to the appropriate managerial decisions.
2. The variances so analyzed through the system is an aid to the management to know the inefficiency at any level. The inefficiency so found at any level will be helpful for management to take the desired action to overcome the inefficiency at that level.
3. The system will be helpful in fixing the responsibilities at various production levels. As responsibilities can be fixed through the system it will be helpful in increasing the production, reducing the cost at the desired quality of production.
4. Through standard costing system, the price fixation process will become easy. Quoting the price of the product to capture the market will become an easy task because future is only an extension of past in normal working circumstances.
5. Standard costing system is also helpful in planning and budgeting. Budgets and planning both are predetermined actions of an organization. Standard costing system also serves the same purpose.
6. The system helps the management in coordination, motivation and control inefficiencies. We know the overall success of the production unit i.e. earning long term profits in the market depend upon the joint action of the unit at various lower level and medium level management. The system will help the upper level management to coordinate the lower and medium level management for a joint positive action and further to motivate towards the real goal by suggesting ways to control inefficiency.
7. The system will be helpful to improve methods of production at minimum cost. As the main target of standard costing system is measuring the actual cost and comparing with the standard cost, so will be helpful to improve the method of production at minimum possible cost at consumers desired quality level.
8. Sometimes it is felt that the system is time consuming and costly which are beyond the reach of small and medium type of organizations, but once the system is adopted and developed the work in future will be reduced. It will help the organization and saving the time, in reducing the cost of production and hence to compete in the market with the other producers.

Limitations of Standard Costing system

Though the standard costing system helps the management of the company in taking various positive decisions in the organization in earning the profits in the long term, quoting the prices in capturing the market from the competitors, still it has so many limitations which can be discussed as under.

1. In the production units where the technique of work is such that it cannot be standardized, the system cannot function. In job system type of units, jobs sometimes differ from one another. When different jobs are worked standardization will not be possible, so in such units the system will have no worth.
2. In small production units it will be a costly venture and will tend to increase the cost of production. Developing the standard costing system needs high degree of skill and expertise, so it will be beyond the reach of the small units to develop it at their own level.
3. Some of the variances are controllable and the management will be competent to have a control over these variances. Some variances are uncontrollable and the management cannot take remedial action in any way due to their nature of uncontrollability. So, the system has the limitation in functioning in those uncontrollable situations.
4. Sometimes it may happen the standard set are not accurate, then the standard set will be a wrong yard stick to compare with the actuals. If a wrong yardstick is developed the variances so found in comparison with the actuals may lead to wrong management decisions and can hit the functioning of the unit adversely.
5. The system will also not function in the units where there is lack of joint action or cooperation at various level of management. For smooth functioning and getting the fruitful results cooperative type of management, a sense of seniority and subordination is needed at all level. So, it is another type of limitation in applying the standard costing system.

Though production is nothing but only the process to change and to increase the utility as desired and to the satisfaction of consumers, of the various available commodities. The main factors of production are material, labour, overheads etc. in the production process. Let us take one by one of these in cost control under standard costing technique. Let us take the material first and find its control through standard costing.

As material is the main and foremost factor of production, its control is necessary in the cost control process. In this regard let us understand the methods to find out various types of variances related to the material.

Material Cost Variance

The material cost variance tells us the variation in the standard cost of standard material required for the actual output or production.

Let us assume standards of shows that for the production of 1 Kg. of the output 2 Kg. of raw material is required and standard cost of material is ₹ 10 per Kg. The actual figure shows that 1000 Kg. of raw material is used to produce 450 Kg. of the product. Actual cost of raw material is ₹ 10.50 per Kg. Then the material cost variable will be ₹ 1500 unfavorable. i.e. Standard cost of standard material required for the actual production less actual cost of actual material used.

$$\begin{aligned}
 &= [450 \times 2 \times 10 - 1000 \times 10.50] \\
 &= [9000 - 10500] \\
 &= - 1500 \\
 &= 1500 \text{ A (adverse)}
 \end{aligned}$$

Material cost variance can be further subdivided into (a) Material price variance and (b) Material usage variance.

Material Price Variance: Material price variance is the part of material cost variance which is due to change in the price of the material. The difference in the standard price of the actual quantity of the material used and the actual cost of the material used.

$$\begin{aligned}
 &\text{In the above example we can find out the material price variance as} \\
 &= \text{Standard price of actual quantity of material used} - \text{Actual cost of the material used.} \\
 &= [(10 \times 1000) - (1000 \times 10.50)]
 \end{aligned}$$

$$\begin{aligned}
&= [10000 - 10500] \\
&= - 500 \\
&= 500 \text{ A (adverse)}
\end{aligned}$$

Material usage variance: Material usage variance is a part of material cost variance which is due to difference in standard cost of standard material required for actual output and standard cost of actual material used.

In the above example material usage variance can be found out as follows.

= Standard cost of standard quantity of material required for actual output less standard cost of actual quantity of material used.

$$= [(10 \times 450 \times 2) - (10 \times 1000)]$$

$$= [9000 - 10000]$$

$$= - 1000$$

$$= 1000 \text{ A (adverse)}$$

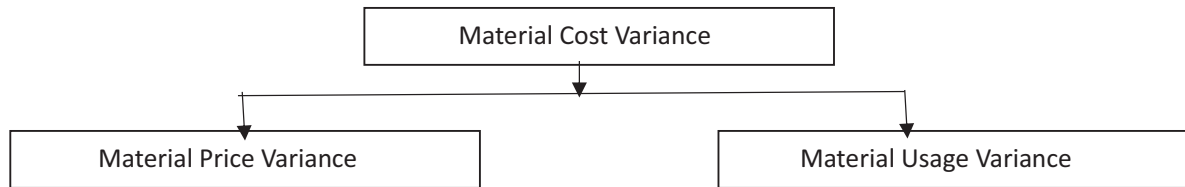
Material Cost variance = 1500 A

$$= 1000 \text{ A} + 500 \text{ A}$$

$$= \text{Material Cost Variance due to price} + \text{Material Cost variance due to}$$

usage.

$$= \text{Material price variance} + \text{Material usage variance}$$



Mathematically the above equation can be proved as

$$\begin{aligned}
\text{Material cost variance} &= \text{Standard cost of standard material required for actual production} \\
&\quad - \text{Actual cost of material used in actual production.}
\end{aligned}$$

adding and subtracting standard cost of actual quantity of material used

we get

$$\begin{aligned}
&= \text{Standard cost of standard material required for actual production} + \text{Standard cost} \\
&\text{of actual quantity of material used} - \text{Standard cost of actual quantity of material used} - \text{Actual cost of material used} \\
&\text{in actual production.}
\end{aligned}$$

$$\begin{aligned}
&= (\text{Standard cost of actual quantity of material used} - \text{Actual cost of material used} \\
&\text{for actual production}) + (\text{Standard cost of standard material required for actual production} - \text{Standard cost of actual} \\
&\text{quantity of material used})
\end{aligned}$$

$$= \text{Material Price variance} + \text{Material usage variance.}$$

or we can say

$$\text{MCV} = \text{MPV} + \text{MUV}$$

Where MCV = Material cost variance.

MPC = Material price variance.

MUV = Material usage variance.

$\text{MCV} = \text{Standard rate} \times \text{Standard quantity of material required} - \text{Actual rate} \times \text{Actual quantity of material used.}$

$$= (\text{St. rate} \times \text{St. quantity required}) - (\text{Act. Rate} \times \text{Act. quantity})$$

$$\begin{aligned}
&= (\text{St. rate} \times \text{St. quantity required}) + (\text{St. cost of actual quantity}) - (\text{St. cost of actual quantity}) - \\
&\quad (\text{Act. rate} \times \text{Act. quantity})
\end{aligned}$$

$$\begin{aligned}
&= [(St. \text{ rate} \times St. \text{ quantity}) - (St. \text{ rate} \times Act. \text{ quantity})] + [(St. \text{ rate} \times Act. \text{ quantity}) - (Act. \text{ rate} \times \\
&\quad Act. \text{ quantity})] \\
&= \text{Material usage variance} + \text{Material price variance.} \\
&= \text{Material price variance} + \text{Material usage variance.}
\end{aligned}$$

The equation can be further simplified as

$$\begin{aligned}
MCV &= (St. \text{ rate} \times St. \text{ quantity} - Act. \text{ rate} \times Act. \text{ quantity}) \\
&= (SR \times SQ - AR \times AQ) \quad \text{----- (i)}
\end{aligned}$$

$$\begin{aligned}
MPV &= (St. \text{ rate} \times Act. \text{ quantity} - Act. \text{ rate} \times Act. \text{ quantity}) \\
&= Act. \text{ quantity} (St. \text{ rate} - Act. \text{ rate}) \\
&= AQ (SR - AR) \quad \text{----- (ii)}
\end{aligned}$$

$$\begin{aligned}
MUV &= (St. \text{ rate} \times St. \text{ quantity} - St. \text{ rate} \times Act. \text{ quantity}) \\
&= St. \text{ rate} (St. \text{ quantity} - Act. \text{ quantity}) \\
&= SR (SQ - AQ) \quad \text{----- (iii)}
\end{aligned}$$

From (i), (ii) and (iii)

$$\begin{aligned}
MCV &= SR \times SQ - AR \times AQ \\
&= SR \times SQ + SR \times AQ - SR \times AQ - AR \times AQ \\
&= (SR \times AQ - AR \times AQ) + (SR \times SQ - SR \times AQ) \\
&= AQ(SR - AR) + SR(SQ - AQ) \\
&= MPV + MUV
\end{aligned}$$

So

$MCV = MPV + MUV$

Material mix variance: When more than one input material is required to produce the product, material mix variance is found out. It is the portion of material usage variance which is due to the difference in standard and actual composition of input material. Material mix variance is the difference in standard cost of standard composition or mix required for actual quantity of material and standard cost of actual composition or mix. If the standard yield of input material is the same as actual yield of input material or we can say, if there is no difference in standard and actual yield then material usage variance will be equal to material mix variance. [Here yield is the quantity (it may be in any unit of measurement) of output after mixing of different quantities of input materials].

The general equation to find out material mix variance is

$$MMV = \text{Standard cost of standard mix required for actual quantity of input material} - \text{Standard cost of actual mix.}$$

Let us clear it from an example.

Standard of the company for production of “C “ product requires

10 Tons of A material @ ₹ 9.00

20 Tons of B material @ ₹ 6.00

Actual of the company are

40 Tons of A material @ ₹ 10.00

60 Tons of B material @ ₹ 8.00

Then Material mix variance can be found out as

For material A

$$\begin{aligned} &= \left(\frac{100}{30} \times 10 \times 9\right) - (40 \times 9) \\ &= 300 - 360 \\ &= -60 \\ &= ₹ 60 \text{ A (adverse)} \end{aligned}$$

For material B

$$\begin{aligned} &= \left(\frac{100}{30} \times 20 \times 6\right) - (60 \times 6) \\ &= 400 - 360 \\ &= 40 \text{ F (Favourable)} \end{aligned}$$

Material mix variance MMV = - 60 + 40

$$= ₹ 20 \text{ A (adverse)}$$

From the example it is clear that to know the material mix variance standard mix of each type of material is found out w.r.t. the actual total quantity of the input material. Then the difference in the standard cost of the standard material required for each type of the material and the standard cost of actual quantity of material used is found out. In the above example let us take the case of input product A. Total standard mix is 30 Tons of material. Total actual mix is 100 Tons. For 30 Tons of the standard mix the standard requirement of material A is 10 Tons, so for 100 Tons of actual mix, the standard requirement of material A will be $\left(\frac{10}{30} \times 100\right)$ Tons, similar is the case with material B.

Example

Standard of the company shows for production of D product requires

10 Tons of material A @ ₹ 9.00
20 Tons of material B @ ₹ 8.00
30 Tons of material C @ ₹ 7.00

Actual performance of the company shows for the production of product D the following material mix is required.

10 Tons of material A ₹ 8.50
25 Tons of material B ₹ 10.00
25 Tons of material C ₹ 7.50

Then material mix variance

$$\begin{aligned} \text{For material A} &= \left(\frac{60}{60} \times 10 \times 9\right) - (10 \times 9) \\ &= 90 - 90 = ₹ 0 \end{aligned}$$

$$\begin{aligned} \text{For material B} &= \left(\frac{60}{60} \times 20 \times 8\right) - (25 \times 8) \\ &= 160 - 200 \\ &= ₹ 40 \text{ A (adverse)} \end{aligned}$$

$$\begin{aligned}\text{For material C} &= \left(\frac{60}{60} \times 30 \times 7\right) - (25 \times 7) \\ &= 210 - 175 \\ &= ₹ 35 \text{ F (Favourable)}\end{aligned}$$

$$\begin{aligned}\text{So, MMV} &= (0 - 40 + 35) \\ &= ₹ 5 \text{ A (adverse)}\end{aligned}$$

General or common formula to find out material mix variance is [where yield do not differ]

$$\begin{aligned}\text{MMV} &= \left[\frac{\text{Standard quantity of material A}}{\text{Standard total quantity of mix}} \times (\text{Actual quantity of mix}) \times \text{Standard rate of material A} \right] \\ &\quad - [\text{Standard rate of material A} \times \text{Actual quantity of material A}] \\ &\quad + \left[\frac{\text{Standard quantity of material B}}{\text{Standard total quantity of mix}} \times (\text{Actual quantity of mix}) \times \text{Standard rate of material B} \right] \\ &\quad - [\text{Standard rate of material B} \times \text{Actual quantity of material B}] \\ &\quad + \left[\frac{\text{Standard quantity of material C}}{\text{Standard total quantity of mix}} \times (\text{Actual quantity of mix}) \times \text{Standard rate of material C} \right] \\ &\quad - [\text{Standard rate of material C} \times \text{Actual quantity of material C}] \\ &\quad + \text{so on for each type of input material.}\end{aligned}$$

Material Yield Variance :-

Material yield as it is clear from the word meaning is the quantity of output (may be in various types of units i.e. in liters, meters, kilograms etc.) after the consumption of the input material. Material yield variances arises when there is a difference in the standard output and the actual output. There are various reasons of more or less wastage in the production process such as quality of material put in the process, bad or good workmanship, bad or good governance, control etc. Here we are not concerned with these but concerned to find out the particular variance i.e. material yield variance. To find out material yield variance first step is to find out the standard rate of the standard yield. Then difference in the actual yield and the standard yield is multiplied by the standard rate of standard yield which will be the material yield variance. If the actual yield is more than standard yield, the yield variance will be favourable otherwise unfavourable.

Example:

Standards of a company shows that 90 Kg of a product is obtained in the production from 100 Kg of the input material, standard rate of input material is ₹ 9.00 per Kg. Actual performance of the company shows 80 Kg of the product is obtained in production from 100 Kg of the input material. Actual rate of input material is ₹ 9.50 per Kg.

The material yield variance will be

$$\begin{aligned}&= \text{Standard rate of standard yield (Actual yield – standard yield)} \\ &= \frac{100 \times 9}{90} (80 - 90) \\ &= 10(80 - 90) \\ &= 10(-10) \\ &= 100 \text{ A (adverse)}\end{aligned}$$

Example:

Standards of a company shows that for production of 54 units of a product D requires

10 unit of material A @ ₹ 11.60

20 units of material B @ ₹ 8.00

30 units of material C @ ₹ 7.00

Actual performance shows that for the production of 48 units of the product D the input material used is

10 unit of material A @ ₹ 10.00

25 units of material B @ ₹ 9.00

25 units of material C @ ₹ 8.00

$$\begin{aligned}\text{Material yield variance} &= \frac{\text{Standard Cost of standard mix}}{\text{Standard yield of standard mix}} [\text{Actual yield} - \text{Standard yield of actual mix}] \\ &= \frac{(10 \times 11.60) + (20 \times 8) + (30 \times 7)}{54} \times [48 - 54] \\ &= \frac{(116 + 160 + 210)}{54} \times [-6] \\ &= \frac{486}{54} (-6) \\ &= 9 \times (-6) \\ &= ₹ 54 \text{ A (adverse)}\end{aligned}$$

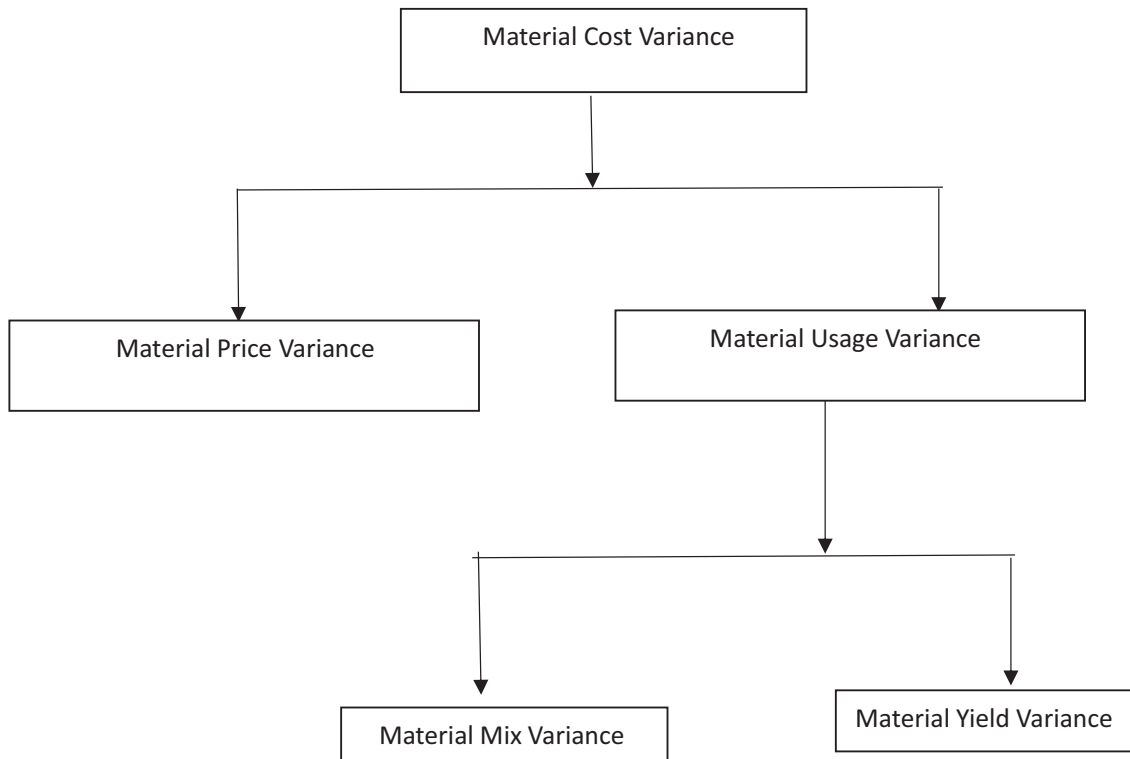
General formula to find out the material yield variance

$$\text{MYV} = \frac{\text{Standard cost of standard mix}}{\text{Standard yield of standard mix}} \times [\text{Actual yield} - (\frac{\text{Total quantity of actual mix}}{\text{Actual quantity of standard mix}} \times \text{Standard yield})]$$

Material Cost variance = Material price variance + material usage variance

= Material price variance + Material mix variance + Material yield variance

Flow chart showing the Material Variances



Formulae to calculate Material Variances

$$\text{Material Cost Variance (MCV)} = \sum_{i=j=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right]$$

$$\text{Material Price Variance (MPV)} = \sum_{i=j=1}^n A_j (S_{Ri} - A_{Rj})$$

$$\text{Material Usage Variance (MUV)} = \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$$

$$\text{Material Mix Variance (MMV)} = \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$\text{Material Yield Variance (MYV)} = \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right]$$

Where A_y = Actual yield

S_y = Standard yield

S_i = Standard quantity input shown by standards of company.

S_{Ri} = Standard rate of i th item as given in the standards of the company.

A_j = Actual quantity input shown in the sequence of actual inputs.

A_{Rj} = Actual quantity of j th item shown in the actuals of the company.

$\sum A_j$ = Sum total quantity of actual inputs.

$\sum S_i$ = Sum total quantity of standard inputs

Standard of the company			
Standard material (S_i)		Standard rate Per unit(S_{Ri})	Total standard Cost
Material type	units		
Material A	S_1	S_{R1}	$S_1 \times S_{R1}$
Material B	S_2	S_{R2}	$S_2 \times S_{R2}$
Material C	S_3	S_{R3}	$S_3 \times S_{R3}$
Material D	S_4	S_{R3}	$S_4 \times S_{R4}$
Total Standard Mix	$\sum S_i =$ -----	Total Standard Cost	$\sum (S_i \times S_{Ri}) =$ -----

Actual of the company		
Actual quantity of material (A_j)	Actual rate	

Material type	units	Per unit (A_{Rj})	Total Actual Cost
Material A	A_1	A_{R1}	$A_1 \times A_{R1}$
Material B	A_2	A_{R2}	$A_2 \times A_{R2}$
Material C	A_3	A_{R3}	$A_3 \times A_{R3}$
Material D	A_4	A_{R4}	$A_4 \times A_{R4}$
Total Actual Mix	$\sum A_j =$ -----	Total Standard Cost	$\sum (A_j \times A_{Rj}) =$ -----

Standard yield (Units) = ----- S_Y

Actual yield (Units) = ----- A_Y

$$\text{MCV} = \sum_{i=j=1}^n \left[\left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right]$$

$$= \sum_{i=j=1}^n \left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) - \sum_{i=j=1}^n (A_j \times A_{Rj})$$

Adding and subtracting $\sum_{i=j=1}^n (A_j \times S_{Ri})$ we get

$$= \sum_{i=j=1}^n \left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) + \sum_{i=j=1}^n (A_j \times S_{Ri}) - \sum_{i=j=1}^n (A_j \times S_{Ri}) - \sum_{i=j=1}^n (A_j \times A_{Rj})$$

$$= \left[\sum_{i=j=1}^n \left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) - \sum_{i=j=1}^n (A_j \times S_{Ri}) \right] + \left[\sum_{i=j=1}^n (A_j \times S_{Ri}) - \sum_{i=j=1}^n (A_j \times A_{Rj}) \right]$$

$$= \sum_{i=j=1}^n \left[\left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) - (A_j \times S_{Ri}) \right] + \sum_{i=j=1}^n \left[(A_j \times S_{Ri}) - (A_j \times A_{Rj}) \right]$$

$$= \sum_{i=j=1}^n S_{Ri} \left[\left(\frac{S_i \times A_Y}{S_Y} \right) - A_j \right] + \sum_{i=j=1}^n A_j (S_{Ri} - A_{Rj})$$

$$= \text{MUV} + \text{MPV}$$

$$= \text{MPV} + \text{MUV}$$

So, we can say

$\text{MCV} = \text{MPV} + \text{MUV}$

$$\text{MUV} = \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times A_Y}{S_Y} - A_j \right]$$

$$= \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times A_Y}{S_Y} \right) - \sum_{i=j=1}^n (S_{Ri} \times A_j)$$

adding and subtracting by $\sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right)$ we get

$$= \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times A_Y}{S_Y} \right) + \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right) - \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right) - \sum_{i=j=1}^n (S_{Ri} \times A_j)$$

$$= \left[\sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right) - \sum_{i=j=1}^n (S_{Ri} \times A_j) \right] + \left[\sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times A_Y}{S_Y} \right) - \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right) \right]$$

$$= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{(\sum S_i)} - A_j \right] + \left[\sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times A_Y}{S_Y} \right) - \sum_{i=j=1}^n S_{Ri} \left(\frac{S_i \times (\sum A_j)}{(\sum S_i)} \right) \times \frac{S_Y}{S_Y} \right]$$

$$\begin{aligned}
&= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{(\sum S_i)} - A_j \right] + \sum_{i=j=1}^n \frac{S_{Ri} \times S_i}{S_Y} \left[A_Y - \frac{(\sum A_j) \times S_Y}{(\sum S_i)} \right] \\
&= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{(\sum S_i)} - A_j \right] + \sum_{i=j=1}^n \frac{S_i \times S_{Ri}}{S_Y} \left[A_Y - \frac{S_Y \times (\sum A_j)}{(\sum S_i)} \right] \\
&= \text{MMV} + \text{MYV}
\end{aligned}$$

So, we can say

$\text{MUV} = \text{MMV} + \text{MYV}$

Illustration :

The standard material required to manufacture one unit of a product is 10 units of X at standard cost of ₹ 25 per unit. The cost account records shows that 11,500 units of material costing ₹ 2,76,000 were used for the manufacture of 1,000 units of the product.

Calculate the material variances.

Solution: Here $S_i = 10$

$$S_{Ri} = ₹ 25$$

$$S_Y = 1$$

$$A_j = 11,500$$

$$A_Y = 1,000$$

$$A_{Rj} = \frac{276000}{11500} = ₹ 24$$

$$\begin{aligned}
\text{MCV} &= \sum_{i=j=1}^n \left[\left(\frac{A_Y \times S_i}{S_Y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right] \\
&= \left[\frac{1000}{1} \times 10 \times 25 \right] - [11500 \times 24] \\
&= 250000 - 276000 \\
&= ₹ 26000 \text{ A (adverse)}
\end{aligned}$$

$$\begin{aligned}
\text{MPV} &= \sum_{i=j=1}^n A_j (S_{Ri} - A_{Rj}) \\
&= 11500 (25 - 24) \\
&= ₹ 11500 \text{ F (favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{MUV} &= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times A_Y}{S_Y} - A_j \right] \\
&= 25 \left[\frac{10 \times 1000}{1} - 11500 \right] \\
&= 25 [10000 - 11500] \\
&= 25 \times (-1500) \\
&= ₹ 37,500 \text{ A (adverse)}
\end{aligned}$$

$$\begin{aligned}
\text{MMV} &= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 25 \left[\frac{10 \times 11500}{10} - 11500 \right] \\
&= 25 \times (11500 - 11500) \\
&= 0
\end{aligned}$$

$$\begin{aligned}
 \text{MYV} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} [A_y - \frac{S_y \times (\sum A_j)}{(\sum S_i)}] \\
 &= \frac{25 \times 10}{1} [1000 - \frac{1 \times 11500}{10}] \\
 &= 250 [1000 - 11500] \\
 &= 250 (-150) \\
 &= ₹ 37,500 \text{ A (adverse)}
 \end{aligned}$$

Reconciliation: $\text{MPV} + \text{MUV} = 11500(\text{F}) + 37500 (\text{A}) = 26000 (\text{A}) = \text{MCV}$

$\text{MMV} + \text{MYV} = 0 + 37500 (\text{A}) = 37500 (\text{A}) = \text{MUV}$

Hence the result.

Illustration:

From the data of a company given below, you are required to calculate

- (i) Material cost variance (ii) Material price variance (iii) Material usage variance (iv) Material mix variance and (v) Material yield variance.

Standard			Actual	
Material type	Material consumed (units)	Price per unit (₹)	Material consumed (units)	Price per unit (₹)
Type A	35	50	35000	55
Type B	30	60	32000	53
Type C	25	70	26000	72
Type D	10	80	12000	78
Total	100	Total	105000	

Standards of the company shows that there is a loss @ 10 % of the total input in the production process. Actual output is 95400 units.

Solution:

Here $A_y = 95400$ units

$S_y = 90$ (100 – 10 % of 100)

$$\begin{aligned}
 \text{(i) Material cost variance MCV} &= \sum_{i=1}^n [(\frac{A_y \times S_i}{S_y} \times S_{Ri}) - (A_j \times A_{Rj})] \\
 &= [\frac{95400}{90} \times 35 \times 50 - 35000 \times 55] + [\frac{95400}{90} \times 30 \times 60 - 32000 \times 53] + [\frac{95400}{90} \times 25 \times 70 - 26000 \times 72] + [\frac{95400}{90} \times 10 \times 80 - 12000 \times 78] \\
 &= (1855000 - 1925000) + (1908000 - 1696000) + (1855000 - 1872000) + (848000 - 936000) \\
 &= (-70000 + 212000 - 17000 - 88000) \\
 &= 37000 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Material price variance MPV} &= \sum_{i=1}^n A_j (S_{Ri} - A_{Rj}) \\
 &= 35000(50 - 55) + 32000(60 - 53) + 26000(70 - 72) + 12000(80 - 78)
 \end{aligned}$$

$$= (-175000 + 224000 - 52000 + 24000)$$

$$= 21000 \text{ F (favourable)}$$

$$(iii) \text{ Material usage variance} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$$

$$= 50 \left[35 \times \frac{95400}{90} - 35000 \right] + 60 \left[30 \times \frac{95400}{90} - 32000 \right] + 70 \left[25 \times \frac{95400}{90} - 26000 \right] +$$

$$80 \left[10 \times \frac{95400}{90} - 12000 \right]$$

$$= 50 (37100 - 35000) + 60(31800 - 32000) + 70(26500 - 26000) + 80(10600 - 12000)$$

$$= 105000 - 12000 + 35000 - 112000$$

$$= 16000 \text{ F (favourable)}$$

$$(iv) \text{ Material mix variance MMV} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$= 50 \left[35 \times \frac{10500}{100} - 35000 \right] + 60 \left[30 \times \frac{10500}{100} - 32000 \right] + 70 \left[25 \times \frac{10500}{100} - 26000 \right] + 80 \left[10 \times \frac{10500}{100} \right.$$

$$\left. - 12000 \right]$$

$$= 50(36750 - 35000) + 60(31500 - 32000) + 70(26250 - 26000) + 80(10500 - 12000)$$

$$= 87500 - 30000 + 17500 - 120000$$

$$= 45000 \text{ A (adverse)}$$

$$(v) \text{ Material yield variance MYV} = \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right]$$

$$= \frac{(35 \times 50 + 30 \times 60 + 25 \times 70 + 10 \times 80)}{90} \left[95400 - \frac{90 \times 105000}{100} \right]$$

$$= \frac{6100}{90} (95400 - 94500)$$

$$= \frac{6100}{90} \times 900$$

$$= 61000 \text{ F (favourable)}$$

$$\text{Reconciliation: } \text{MPV} + \text{MUV} = 21000(\text{F}) + 16000(\text{F}) = 37000(\text{F}) = \text{MCV}$$

$$\text{MMV} + \text{MYV} = 45000(\text{A}) + 61000(\text{F}) = 16000(\text{F}) = \text{MUV}$$

Hence the result.

Illustration: SV. Ltd. Manufacture BXE by mixing three raw materials. For every batch of 100 Kgs of BXE, 125 Kgs of raw materials are used. In April, 1983, 60 batches were prepared to produce an output of 5600 Kgs of BXE. The standard of actual particular for April 1983 are as follows.

Raw Material:	Standard		Actual		Quantity of raw material
	Mix	Price/Kg	Mix	Price/Kg.	Purchased
					Kgs.
	%	(₹)	%	(₹)	
A	50	20	60	21	5000
B	30	10	20	8	2000
C	20	5	20	6	1200

Calculate all variances.

(CA inter, May 1983)

Solution: Here Actual material used = $125 \times 60 = 7500$ Kgs

Actual usage of material A = 4500 Kgs (60%)

Material B = 1500 Kgs (20%)

Material C = 1500 Kgs (20%)

$$\sum A_j = 7500$$

$$\sum S_i = 100$$

$$S_y = 80 \quad \left(\frac{100 \times 100}{125} \right)$$

$$A_y = 5600 \text{ Kg}$$

$$\begin{aligned} \text{(j) Material cost variance MCV} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right] \\ &= \left(\frac{5600}{80} \times 50 \times 20 - 4500 \times 21 \right) + \left(\frac{5600}{80} \times 30 \times 10 - 1500 \times 8 \right) + \left(\frac{5600}{80} \times 20 \times 5 - 1500 \times 6 \right) \\ &= (70000 - 94500) + (21000 - 12000) + (7000 - 9000) \\ &= (-24500 + 9000 - 2000) \\ &= 17500 \text{ A (adverse)} \end{aligned}$$

$$\begin{aligned} \text{(ii) Material price variance MPV} &= \sum_{i=1}^n A_j (S_{Ri} - A_{Rj}) \\ &= 4500(20 - 21) + 1500(10 - 8) + 1500(5 - 6) \\ &= (-4500 + 3000 - 1500) \\ &= 3000 \text{ A (adverse)} \end{aligned}$$

$$\begin{aligned} \text{(iii) Material usage variance MUV} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right] \\ &= 20 \left(\frac{50 \times 5600}{80} - 4500 \right) + 10 \left(\frac{30 \times 5600}{80} - 1500 \right) + 5 \left(\frac{20 \times 5600}{80} - 1500 \right) \\ &= (-20000 + 6000 - 1500) \\ &= 14500 \text{ A (adverse)} \end{aligned}$$

$$\begin{aligned} \text{(iv) Material mix variance} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\ &= 20 \left[\frac{50 \times 7500}{100} - 4500 \right] + 10 \left[\frac{30 \times 7500}{100} - 1500 \right] + 5 \left[\frac{20 \times 7500}{100} - 1500 \right] \\ &= 20(3750 - 4500) + 10(2250 - 1500) + 5(1500 - 1500) \\ &= (-15000 + 7500) \\ &= 7500 \text{ A (adverse)} \end{aligned}$$

$$\begin{aligned} \text{(v) Material yield variance MYV} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right] \\ &= \left(\frac{50 \times 20 + 30 \times 10 + 20 \times 5}{80} \right) \left[5600 - \frac{80 \times 7500}{100} \right] \\ &= \frac{1400}{80} (5600 - 6000) \\ &= \frac{1400}{80} (-400) \\ &= 7000 \text{ A (adverse)} \end{aligned}$$

Reconciliation: $MPV + MUV = 3000 \text{ A} + 14500 \text{ A} = 17500 \text{ A} = MCV$

$MMV + MYV = 7500 \text{ A} + 7000 \text{ A} = 14500 \text{ A} = MUV$

Hence the result.

Illustration:

Mixes Ltd. Is engaged in Producing a standard mix using 60 Kg of chemical X and 40 Kg of chemical Y. The standard loss of production is 30%. The standard price of X is ₹ 5 per Kg and of Y is ₹ 10 per Kg.

The actual mixture and yield were as follows.

X 80 Kgs @ ₹ 4.50 per Kg and

Y 70 Kgs @ ₹ 8.00 per Kg

Actual yield is 115 Kgs

Calculate material variances (price, usage, yield, mix and material cost variances)

(CS Final Dec, 1982)

Solution: $A_Y = 115$

$S_Y = 70$

$\sum A_j = 150$

$\sum S_i = 100$

(i) Material price variance $MPV = \sum_{i=j=1}^n A_j (S_{Ri} - A_{Rj})$

$= 80(5 - 4.50) + 70(10 - 8)$

$= (40 + 140)$

$= 180 \text{ F (favourable)}$

(ii) Material usage variance $MUV = \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$

$= 5 \left(\frac{60 \times 115}{70} - 80 \right) + 10 \left(\frac{40 \times 115}{70} - 70 \right)$

$= (92.86 - 42.86)$

$= 50 \text{ F (favourable)}$

(iii) Material mix variance $= \sum_{i=j=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$

$= 5 \left[\frac{60 \times 150}{100} - 80 \right] + 10 \left[\frac{40 \times 150}{100} - 70 \right]$

$= 5(90 - 80) + 10(60 - 70)$

$= (50 - 100)$

$= 50 \text{ A (adverse)}$

(iv) Material yield variance $MYV = \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_Y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right]$

$= \left(\frac{60 \times 5 + 40 \times 10}{70} \right) \left[115 - \frac{70 \times 150}{100} \right]$

$= \frac{300 + 400}{70} (115 - 105)$

$= \frac{700}{70} (10)$

= 100 F (favourable)

$$\begin{aligned}
 \text{(v) Material cost variance MCV} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right] \\
 &= \left(\frac{115}{70} \times 60 \times 5 - 80 \times 4.50 \right) + \left(\frac{115}{70} \times 40 \times 10 - 70 \times 8 \right) \\
 &= (492.86 - 360) + (657.14 - 560) \\
 &= (132.86 + 97.14) \\
 &= 230 \text{ F (favourable)}
 \end{aligned}$$

$$\text{Reconciliation: } \text{MPV} + \text{MUV} = 180 \text{ F} + 50 \text{ F} = 230 \text{ F} = \text{MCV}$$

$$\text{MMV} + \text{MYV} = 50 \text{ A} + 100 \text{ F} = 50 \text{ F} = \text{MUV}$$

Hence the result.

Illustration:

S. V. Ltd. Manufactures a simple product, the standard mix of which is

Material A 60 % @ ₹ 20 per Kg

Material B 40 % @ ₹ 10 per Kg

Normal loss in production is 20 % of the input. Due to shortage of material A, standard mix was changed. Actual results for March, 2010 were

Material A 105 Kg @ ₹ 20 per Kg

Material B 95 Kg @ ₹ 9 per Kg

Input 200 Kg

Loss 35 Kg

Output 165 Kg

Calculate (i) Material price variance, (ii) Material usage variance, (iii) Material mix variance, and (v) Material yield variance.

$$\begin{aligned}
 \text{Solution: Here } S_1 &= 0.60 \text{ Kg} & S_{R1} &= ₹ 20 \text{ per Kg} \\
 \text{Here } S_2 &= 0.40 \text{ Kg} & S_{R2} &= ₹ 10 \text{ per Kg} \\
 \sum S_i &= 1.00 \text{ Kg} & S_y &= 0.80 \text{ Kg} \\
 \text{And } A_1 &= 105 \text{ Kg} & A_{R1} &= ₹ 20 \text{ per Kg} \\
 A_2 &= 95 \text{ Kg} & A_{R2} &= ₹ 9 \text{ per Kg} \\
 \sum A_j &= 200 \text{ Kg} & A_y &= 165 \text{ Kg}
 \end{aligned}$$

$$\text{(i) Material price variance MPV} = \sum_{i=1}^n A_j (S_{Ri} - A_{Rj})$$

$$= 105(20 - 20) + 95(10 - 9)$$

$$= (0 + 95)$$

$$= ₹ 95 \text{ F (favourable)}$$

$$\text{(ii) Material usage variance MUV} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$$

$$= 20 \left(\frac{0.60 \times 165}{0.80} - 105 \right) + 10 \left(\frac{0.40 \times 165}{0.80} - 95 \right)$$

$$= 20 \left(\frac{99}{0.80} - 105 \right) + 10 \left(\frac{66}{0.80} - 95 \right)$$

$$= 20(123.75 - 105) + 10(82.50 - 95)$$

$$= 20(18.75) + 10(-12.50)$$

$$= 375 - 125 = ₹ 250 \text{ F (favourable)}$$

$$(iii) \text{ Material mix variance} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$= 20 \left[\frac{0.60 \times 200}{1} - 105 \right] + 10 \left[\frac{0.40 \times 200}{1} - 95 \right]$$

$$= 20(120 - 105) + 10(80 - 95)$$

$$= (300 - 150)$$

$$= 150 \text{ F (favourable)}$$

$$(iv) \text{ Material yield variance MYV} = \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right]$$

$$= \left(\frac{0.40 \times 10 + 0.60 \times 20}{0.80} \right) \left[165 - \frac{0.80 \times 200}{1} \right]$$

$$= \frac{(4+12)}{0.80} (165 - 160)$$

$$= \frac{16}{0.80} (5) = 20 \times 5$$

$$= ₹ 100 \text{ F (favourable)}$$

Illustration: Compute the missing data indicated by the question marks from the following.

Particular	A	B
Standard price/unit	₹ 12	₹ 15
Actual price/unit	₹ 15	₹ 20
Standard input (Kgs)	50	?
Actual input (Kgs)	?	70
Material price variance	?	?
Material usage variance	?	₹ 300 adverse
Material cost variance	?	?

Material mix variance was ₹ 45 adverse

Solution:

As S_y standard yield and actual yield are not given these are assumed to be equal or $S_y = A_y$

Let standard input of material B = y and Actual input of material A = x

$$\text{So } \text{MUV} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$$

$$-300 = 15 \left[\frac{y \times A_y}{A_y} - 70 \right]$$

$$-20 = y - 70$$

$$y = 70 - 20$$

$$y = 50$$

Standard input of material B = 50 ----- 1

$$\text{MMV} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$-45 = 12 \left[\frac{50 \times (x+70)}{50+50} - x \right] + 15 \left[\frac{50 \times (x+70)}{50+50} - 70 \right]$$

$$-45 = 12 \left[\frac{x+70}{2} - x \right] + 15 \left[\frac{x+70}{2} - 70 \right]$$

$$-45 = 12 \left[\frac{x+70-2x}{2} \right] + 15 \left[\frac{x+70-2x}{2} \right]$$

$$-90 = -12x + 840 + 15x - 1050$$

$$-90 + 1050 - 840 = 3x$$

$$3x = 120$$

$$X = \frac{120}{3}$$

$$X = 40$$

i.e. Actual input of material A = 40 ----- II

$$\text{MPV for A} = \sum_{i=1}^n A_j (S_{Ri} - A_{Rj})$$

$$= 40(12 - 15)$$

$$= 40(-3)$$

$$= 120 \text{ A (adverse)}$$

$$\text{MPV for B} = \sum_{i=1}^n A_j (S_{Ri} - A_{Rj})$$

$$= 70(15 - 20)$$

$$= 70(-5)$$

$$= 350 \text{ A (adverse)}$$

$$\text{Material usage variance for material A} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right]$$

$$= 12 \left(\frac{50 \times A_y}{A_y} - 40 \right)$$

$$= 12(50 - 40) = 12 \times 10 = 120 \text{ F (favourable)}$$

$$\text{Material cost variance} = \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right]$$

$$\text{For material A} = \left(\frac{A_y \times 50}{A_y} \times 12 \right) - (40 \times 15)$$

$$= 600 - 600$$

$$= 0$$

$$\text{For material B} = \left(\frac{A_y \times 50}{A_y} \times 15 \right) - (70 \times 20)$$

$$= 750 - 1400 = 650 \text{ A (adverse)}$$

$$\text{Material yield variance} = \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right]$$

$$= \frac{(12 \times 50 + 15 \times 50)}{S_y} \left[S_y - \frac{S_y(110)}{100} \right]$$

$$= (600 + 750) \frac{S_y}{S_y} \left[1 - \frac{110}{100} \right]$$

$$= 1350 \times -\frac{10}{100} = 135 \text{ A (adverse)}$$

Here MUV = MUV for material A + MUV for material B

$$= 120 \text{ F} + 300 \text{ A}$$

$$= 180 \text{ A (adverse)}$$

$$\text{MMV} + \text{MYV} = 45 \text{ A} + 135 \text{ A}$$

$$= 180 \text{ A (adverse)}$$

Hence the result

Particular	A	B
Standard price/unit	₹ 12	₹ 15
Actual price/unit	₹ 15	₹ 20
Standard input (Kgs)	50	50
Actual input (Kgs)	40	70
Material price variance	₹ 120 A	₹ 350 A
Material usage variance	₹ 120F	₹ 300 adverse
Material cost variance	0	₹ 650 A

Illustration: A company manufacturing distemper operates a costing system. The standard cost of the products of the company shows the following material standards.

Material	Quantity	Standard price (₹/kg.)	Total (₹)
A	40 Kg	75	3000
B	10 Kg	50	500
C	50 Kg	20	1000

			4500

The standard input mix is 100 Kg and standard output of the finished product is 90 Kg

The actual results for the period are:

Material used:

A = 2,40,000 Kg @ ₹ 80/Kg.

B = 40,000 Kg @ ₹ 52/Kg.

C = 2,20,000 Kg @ ₹ 21/Kg.

The actual output of the finished product = 4,20,000 Kg

You are required to calculate material mix and material yield variances.

(ICWAI Inter Dec, 89)

Solution:

$$S_1 = 40 \text{ Kg} \quad S_{R1} = ₹ 75/\text{Kg.}$$

$$S_2 = 10 \text{ Kg} \quad S_{R2} = ₹ 50/\text{Kg.}$$

$$S_3 = 50 \text{ Kg} \quad S_{R3} = ₹ 20/\text{Kg.}$$

$$\Sigma S_i = 100 \text{ Kg}$$

$$S_Y = 90 \text{ Kg}$$

$$A_1 = 2,40,000 \text{ Kg} \quad A_{R1} = ₹ 80/\text{Kg.}$$

$$A_2 = 40,000 \text{ Kg} \quad A_{R2} = ₹ 52/\text{Kg.}$$

$$A_3 = 2,20,000 \text{ Kg} \quad A_{R3} = ₹ 21/\text{Kg.}$$

$$\Sigma A_j = 5,00,000 \text{ Kg}$$

$$A_Y = 4,20,000 \text{ Kg}$$

$$\text{MMV} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\Sigma A_j)}{\Sigma S_i} - A_j \right]$$

$$\begin{aligned}
&= 75\left[\frac{40 \times 500000}{100} - 240000\right] + 50\left[\frac{10 \times 500000}{100} - 40000\right] + 20\left[\frac{50 \times 500000}{100} - 220000\right] \\
&= 75(200000 - 240000) + 50(50000 - 40000) + 20(250000 - 220000) \\
&= -3000000 + 500000 + 600000 \\
&= ₹ 1900000 \text{ A (adverse)}
\end{aligned}$$

$$\begin{aligned}
\text{Material yield variance} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_Y - \left(\frac{S_y \times (\sum A_j)}{(\sum S_i)} \right) \right] \\
&= \frac{(40 \times 75) + (10 \times 50) + (50 \times 20)}{90} \left[420000 - \left(\frac{90 \times 500000}{100} \right) \right] \\
&= \frac{3000 + 500 + 1000}{90} \times (420000 - 450000) \\
&= \frac{4500}{90} \times (-30000) \\
&= 50 \times (-30000) \\
&= 1500000 \text{ A (adverse)}
\end{aligned}$$

$$\begin{aligned}
\text{Reconciliation: MUV} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_y}{S_y} - A_j \right] \\
&= 75\left(\frac{40 \times 420000}{90} - 240000\right) + 50\left(\frac{10 \times 420000}{90} - 40000\right) + 20\left(\frac{50 \times 420000}{90} - 220000\right) \\
&= 75(186666.66 - 240000) + 50(46666.66 - 40000) + 20(233333.33 - 220000) \\
&= 75(-53333.34) + 50(6666.66) + 20(13333.33) \\
&= (-4000000) + 333333 + 266667 \\
&= (-4000000 + 600000) \\
&= 3400000 \text{ A} = 1900000 \text{ A} + 1500000 \text{ A} \\
&= \text{MMV} + \text{MYV}
\end{aligned}$$

Illustration:

The standard mix of product A_2 is as follows

Kgs	Material	Price per Kg (₹)
45	X	6.00
25	Y	4.50
30	Z	9.50

The standard loss in production is 10 % of the input. There is no scrap value. Actual production for a month was 7,425 Kg of A_2 from 80 mixes. Actual purchases and consumptions of material during the month were

Kgs	Material	Price per Kg (₹)
4200	X	6.50
1700	Y	4.25
2600	Z	9.75

You are required to calculate the following.

- (i) Material cost variance.
- (ii) Material price variance.
- (iii) Material mix variance.
- (iv) Material yield variance.

Solution:	$S_1 = 45 \text{ Kg}$	$S_{R1} = ₹ 6.00$
	$S_2 = 25 \text{ Kg}$	$S_{R2} = ₹ 4.50$
	$S_3 = 30 \text{ Kg}$	$S_{R3} = ₹ 9.50$
	$\Sigma S_i = 100 \text{ Kg}$	
	$S_Y = 90 \text{ Kg}$	
	$A_1 = 4200 \text{ Kg}$	$A_{R1} = ₹ 6.50$
	$A_2 = 1700 \text{ Kg}$	$A_{R2} = ₹ 4.25$
	$A_3 = 2600 \text{ Kg}$	$A_{R1} = ₹ 9.75$
	$\Sigma A_i = 8500$	
	$A_Y = 7425 \text{ Kg}$	

$$\begin{aligned}
 \text{Material cost variance MCV} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times A_{Rj}) \right] \\
 &= \left[\left(\frac{7425 \times 45}{90} \times 6 \right) - (4200 \times 6.50) \right] + \left[\left(\frac{7425 \times 25}{90} \times 4.50 \right) - (1700 \times 4.25) \right] + \left[\left(\frac{7425 \times 30}{90} \times 9.50 \right) - (2600 \times 9.75) \right] \\
 &= (22275 - 27300) + (9281.25 - 7225) + (23512.5 - 25350) \\
 &= (-5025 + 2056.25 - 1837.50) \\
 &= 4806.25 \text{ A (adverse)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Material price variance MPV} &= \sum_{i=1}^n A_j (S_{Ri} - A_{Rj}) \\
 &= 4200(6 - 6.50) + 1700(4.50 - 4.25) + 2600(9.50 - 9.75) \\
 &= (-2100 + 425 - 650) \\
 &= 2325 \text{ A (adverse)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Material mix variance MMV} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\Sigma A_j)}{\Sigma S_i} - A_j \right] \\
 &= 6 \left[\frac{45 \times 8500}{100} - 4200 \right] + 4.25 \left[\frac{25 \times 8500}{100} - 1700 \right] + 9.50 \left[\frac{30 \times 8500}{100} - 2600 \right] \\
 &= 6(3825 - 4200) + 4.50(2125 - 1700) + 9.50(2550 - 2600) \\
 &= (-2250 + 1912.50 - 475) \\
 &= 812.50 \text{ A (adverse)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Material yield variance MYV} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_Y - \left(\frac{S_y \times (\Sigma A_j)}{(\Sigma S_i)} \right) \right] \\
 &= \frac{(45 \times 6) + (25 \times 4.50) + (30 \times 9.50)}{90} \left[7425 - \frac{90 \times 8500}{100} \right] \\
 &= \frac{(270 + 112.50 + 285)}{90} [7425 - 7350] \\
 &= \frac{667.50}{90} [-225] \\
 &= 1668.75 \text{ A (adverse)}
 \end{aligned}$$

$$\text{Reconciliation:} \quad 4806.25 \text{ A} = 2325 \text{ A} + 812.50 \text{ A} + 1668.75 \text{ A}$$

$$\text{MCV} = \text{MPV} + \text{MMV} + \text{MYV}$$

Labour Cost Variance

The second and the most important source used in the production process i.e. to increase or change the utility of available material as desired, to the satisfaction of consumers, is labour. Without labour the available material is not possible to be converted into the desired consumable product. So, the labour plays an important role in the production process.

As it takes a major share as input cost in the process of production, control on this type of cost (Labour Cost) is desired as well as necessary. Through standard costing we can have a control on this important source of production and so on the total cost. In standard costing actual cost incurred on labour is compared with the standard labour cost required for the actual production. Variation if any in actual labour cost incurred and standard labour cost required is found out and same is forwarded to the decision makers to take an appropriate remedial action.

In standard costing technique of labour cost control, labour cost is seen from various angles may it be from rate point of view (i.e. variation in actual labour rate and standard labour rate) , labour efficiency point of view (i.e. variation in standard time required and actual time taken in production process) , labour yield point of view etc. Let us take each one by one and first of all talk about total labour cost variance.

(1) Labour Cost Variance :-

Labour cost variance is the difference in standard labour cost required for actual production and the actual labour cost incurred

Labour cost variance = (Standard labour cost required for actual production) – (Actual cost incurred)

Let us take following table to understand the method to find out the labour cost variance.

Standards of the company:

Worker type	No. Of workers = N_{Si}	Time in units paid for = T_{Si}	Rate per unit time = R_{Si} (Rs.)	Total labour cost ($N_{Si} \times T_{Si}$ $\times R_{Si}$) (Rs.)
Type A	N_{S1}	T_{S1}	R_{S1}	$(N_{S1} \times T_{S1} \times R_{S1})$
Type B	N_{S2}	T_{S2}	R_{S2}	$(N_{S2} \times T_{S2} \times R_{S2})$
Type C	N_{S3}	T_{S3}	R_{S3}	$(N_{S3} \times T_{S3} \times R_{S3})$
Type D	N_{S4}	T_{S4}	R_{S4}	$(N_{S4} \times T_{S4} \times R_{S4})$
Type E	N_{S5}	T_{S5}	R_{S5}	$(N_{S5} \times T_{S5} \times R_{S5})$
Total gang	$= \sum_{i=1}^n N_{Si}$			$= \sum_{i=1}^n (N_{Si} \times T_{Si} \times R_{Si})$
			Standard labour rate per unit output.	$= \sum_{i=1}^n \left(\frac{N_{Si} \times T_{Si} \times R_{Si}}{So} \right)$

Standard output = So =.....

Actual of the company :

Worker type	No. Of workers = N_{Aj}	Time in units paid for = T_{Aj}	Rate per unit time = R_{Aj} (Rs.)	Total labour cost = $(N_{Aj} \times$ $T_{Aj} \times R_{Aj})$ (Rs.)
Type A	N_{A1}	T_{A1}	R_{A1}	$(N_{A1} \times T_{A1} \times R_{A1})$

Type B	N_{A2}	T_{A2}	R_{A2}	$(N_{A2} \times T_{A2} \times R_{A2})$
Type C	N_{A3}	T_{A3}	R_{A3}	$(N_{A3} \times T_{A3} \times R_{A3})$
Type D	N_{A4}	T_{A4}	R_{A4}	$(N_{A4} \times T_{A4} \times R_{A4})$
Type E	N_{A5}	T_{A5}	R_{A5}	$(N_{A5} \times T_{A5} \times R_{A5})$
Total gang	$= \sum_{j=1}^n N_{Aj}$		Total actual labour Cost (Rs.)	$\sum_{j=1}^n (N_{Aj} \times T_{Aj} \times R_{Aj})$

Actual output = A_o =.....

Total Idle time = I_{Tj} =..... (i.e. Total time when labour is off the production process)

$$\text{Labour Cost Variance} = \sum_{i=j=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right]$$

(2) Labour rate variance :- Labour cost variance can be further divided and seen from two different angles i.e. labour rate variance and total labour efficiency variance. Labour rate variance is a part of labour cost variance which is due to difference in standard and actual wage rate paid to labour to complete the work.

Labour rate variance = Actual labour time taken (paid for) for actual production $\times$ (Standard wage rate – Actual wage rate)

$$\text{Labour rate variance} = \sum_{i=j=1}^n [N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})]$$

(3) Total Labour efficiency Variance :-

It is the part of labour cost variance which is due to difference in standard labour time required for actual production and actual labour time taken when both measured at standard wage rate.

Total Labour efficiency variance = (Standard labour cost required for actual production) - (Wages payable for actual time at standard wage rate).

$$\text{Total Labour efficiency variance} = \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]$$

(4) Labour efficiency Variance :-

Labour efficiency variance is a part of total labour efficiency variance which is due to difference in standard labour time required for actual production and the actual labour time worked (Excluding the wastage in labour time due to avoidable and unavoidable circumstances) when measured at standard wage rate .

Labour efficiency variance = (Standard labour cost required for actual production) – (Total labour time spent on production (Excluding Idle time) $\times$ Standard wage rate)

$$\text{Labour efficiency variance} = \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - N_{Aj} (T_{Aj} - I_{Tj}) \right\} \right]$$

Where I_{Tj} is the idle time .

(5) Labour idle time Variance :-

It is the part of total labour efficiency variance which is due to idle labour time paid at standard wage rate. As it is wastage in time rather to production, so it is taken to be –ve or unfavourable.

$$\text{Labour idle time Variance} = - \sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj})$$

(6) Labour Mix or Gang Variance :-

It is the part of labour efficiency variance which is due to the change in standard labour mix and actual labour mix in those situations where more than one type of labour force is used in the production process. It is also known as gang variance. It is the difference in standard cost of standard composition of labour force required for actual time worked (excluding idle time) and the standard cost of actual labour time taken.

Labour mix or gang variance = Standard rate per unit labour time ((Standard composition of labour required for actual time taken) – (Actual composition of labour for actual time worked)).

$$\begin{aligned}\text{Mathematically Labour mix variance} &= \sum_{i=1}^n R_{Si} \left[\frac{G_A}{G_S} \times N_{Si} (T_{Aj} - I_{Tj}) - N_{Aj} (T_{Aj} - I_{Tj}) \right] \\ &= \sum_{i=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left[\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right]\end{aligned}$$

Where G_S is the standard total number of workers or standard gang total and G_A is actual total number of workers or actual gang total.

This is because certain situation may arise where there is shortage of supply of certain type of labour force and we have to change the standard accordingly to compare with the actual situation and to find the variance, keeping in view its present and future availability depending upon the expectations.

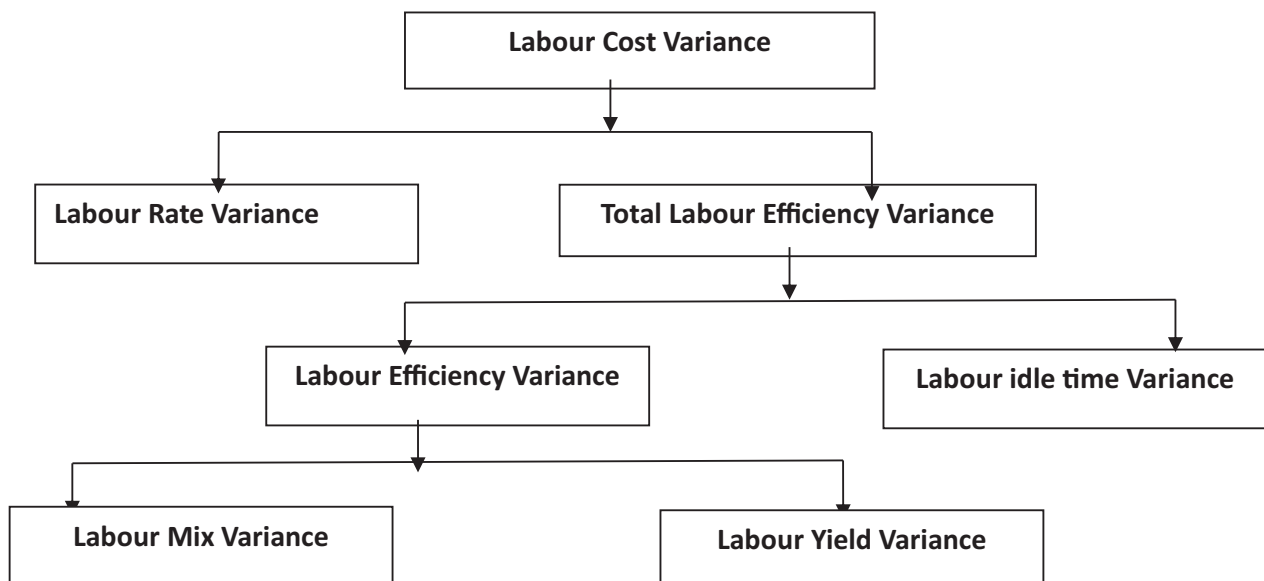
(7) Labour yield variance :- It is a part of labour efficiency variance and arises due to difference in the standard yield that should have been obtained by actual time worked on production and actual yield when both measured at standard labour cost per unit of the product.

It can be calculated as :-

Standard labour cost per unit (Actual yield in units – Standard yield required for actual time worked on production)

$$\text{Labour yield variance} = \frac{\sum_{i=1}^n N_{Si} \times T_{Si} \times R_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{\sum_{i=1}^n N_{Si} (T_{Aj} - I_{Tj})}{\sum_{i=1}^n N_{Si} \times T_{Si}} \times S_o \right] \text{ where 'A_o' is the actual output and 'S_o' is the standard output in units.}$$

Flow Chart showing relationship between various types of labour variances.



The above flow chart can be proved mathematically as under :

$$\begin{aligned}
 \text{Labour cost Variance} &= \sum_{i=j=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
 &= \sum_{i=j=1}^n \frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Aj}) \\
 \text{Adding and subtracting } \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Si}) \text{ we get} \\
 &= \sum_{i=j=1}^n \frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Si}) + \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Si}) - \\
 &\quad \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Aj}) \\
 &= \left[\sum_{i=j=1}^n \frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Si}) \right] + \left[\sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Si}) - \right. \\
 &\quad \left. \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
 &= \left[\sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \right] + \left[\sum_{i=j=1}^n N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj}) \right] \\
 &= (\text{Total labour efficiency Variance}) + (\text{Labour rate Variance})
 \end{aligned}$$

Labour Cost variance = Labour rate variance + Total labour efficiency Variance

Now take Total Labour efficiency variance

$$\begin{aligned}
 \text{Total Labour efficiency Variance} &= \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\
 &= \sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - \sum_{i=j=1}^n R_{Si} (N_{Aj} \times T_{Aj})
 \end{aligned}$$

By adding and subtracting $\sum_{i=j=1}^n R_{Si} \times I_{Tj} \times N_{Aj}$ where I_{Tj} is actual idle time i.e. the time whose wages are given but labour force is off the machine or the production process.

$$\begin{aligned}
 \text{We get} &= \sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) + \sum_{i=j=1}^n R_{Si} \times I_{Tj} \times N_{Aj} - \sum_{i=j=1}^n R_{Si} (N_{Aj} \times T_{Aj}) - \sum_{i=j=1}^n R_{Si} \times I_{Tj} \times N_{Aj} \\
 &= \left[\sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - \sum_{i=j=1}^n R_{Si} (N_{Aj} \times T_{Aj}) + \sum_{i=j=1}^n R_{Si} (I_{Tj} \times N_{Aj}) \right] - \sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj}) \\
 &= \sum_{i=j=1}^n R_{Si} \left[\left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) + (I_{Tj} \times N_{Aj}) \right] - \sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj}) \\
 &= \sum_{i=j=1}^n R_{Si} \left[\left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - N_{Aj} \times (T_{Aj} - I_{Tj}) \right] + \left[- \sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj}) \right] \\
 &= \text{Labour efficiency Variance} + \text{Labour Idle time Variance.}
 \end{aligned}$$

Total Labour Efficiency Variance = Labour Efficiency Variance + Labour Idle Time Variance.

Let us now prove that labour efficiency variance is the sum of labour mix and labour yield variance.

Take labour efficiency variance :

$$\begin{aligned}
 \text{Labour efficiency variance} &= \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - N_{Aj} (T_{Aj} - I_{Tj}) \right\} \right] \\
 &= \sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - \sum_{i=j=1}^n R_{Si} \times N_{Aj} (T_{Aj} - I_{Tj}) \\
 \text{Adding and subtracting } \sum_{i=j=1}^n \left[R_{Si} (T_{Aj} - I_{Tj}) N_{Si} \times \frac{G_A}{G_S} \right] \text{ we get} \\
 &= \sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - \sum_{i=j=1}^n R_{Si} \times N_{Aj} (T_{Aj} - I_{Tj}) + \sum_{i=j=1}^n \left[R_{Si} (T_{Aj} - I_{Tj}) N_{Si} \times \frac{G_A}{G_S} \right] - \\
 &\quad \sum_{i=j=1}^n \left[R_{Si} (T_{Aj} - I_{Tj}) N_{Si} \times \frac{G_A}{G_S} \right] \\
 &= \left[\sum_{i=j=1}^n \left[R_{Si} (T_{Aj} - I_{Tj}) N_{Si} \times \frac{G_A}{G_S} \right] - \sum_{i=j=1}^n R_{Si} \times N_{Aj} (T_{Aj} - I_{Tj}) \right] + \left[\sum_{i=j=1}^n R_{Si} \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - \right. \\
 &\quad \left. \sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) N_{Si} \times \frac{G_A}{G_S} \right] \\
 &= \sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left[\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right] + \sum_{i=j=1}^n (R_{Si} \times N_{Si} \times T_{Si}) \left[\frac{A_o}{S_o} - \frac{(T_{Aj} - I_{Tj})}{T_{Si}} \times \frac{G_A}{G_S} \right] \\
 &= \sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left[\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right] + \sum_{i=j=1}^n \frac{R_{Si} \times N_{Si} \times T_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{N_{Si} (T_{Aj} - I_{Tj})}{N_{Si} \times T_{Si}} \times S_o \right] \\
 &= \left[\sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left[\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right] \right] + \left[\frac{\sum_{i=1}^n N_{Si} \times T_{Si} \times R_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{\sum_{i=1}^n N_{Si} (T_{Aj} - I_{Tj})}{\sum_{i=1}^n N_{Si} \times T_{Si}} \times S_o \right] \right] = \\
 &\text{Labour Mix Variance} + \text{Labour yield Variance.}
 \end{aligned}$$

Labour Efficiency Variance = Labour Mix Variance + Labour Yield Variance

So the various formulae to find out labour variance from different angles needed to be controlled by the decision makers to curtail the labour cost can be summarised as under:

1. Labour Cost Variance = $\sum_{i=j=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right]$
2. Labour rate Variance = $\sum_{i=j=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj}))$
3. Total Labour Efficiency Variance = $\sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]$
4. Labour Efficiency Variance = $\sum_{i=j=1}^n \left(R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - N_{Aj} (T_{Aj} - I_{Tj}) \right\} \right)$
5. Labour Idle time Variance = $-\sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj})$
6. Labour Mix or Gang Variance = $\sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left(\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right)$
7. Labour Yield Variance = $\frac{\sum_{i=1}^n N_{Si} \times T_{Si} \times R_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{\sum_{i=1}^n N_{Si} (T_{Aj} - I_{Tj})}{\sum_{i=1}^n N_{Si} \times T_{Si}} \times S_o \right]$

Here (i) is used for standards of the company and (j) is used for actual of the company whether numbers of the labour force , time or rate etc. and other symbols used in the above formulae are (1) A_o = Actual output, (2) S_o = Standard output, (3) N_{Si} = Number of particular type of labour in the standard of the company, (4) T_{Si} = Time taken by the particular type of labour given in the standard, (5) R_{Si} = Rate per unit time given to the labour given in the standard, (6) N_{Aj} = Number of particular type of labour actually worked, (7) T_{Aj} = Time taken by the particular type of labour in actual production, (8) R_{Aj} = Rate per unit time actually paid to particular type of labour, (9) I_{Tj} = Idle time spent in

actual production process, (10) G_A = actual total number of labour force, (11) G_S = Standard total number of labour force.

Illustration : Data relating to a job is

Standard rate of wage per hour = ₹ 10

Standard hours = 300

Actual rate of wage per hour = ₹ 12

Actual hour worked = 200

You are required to calculate (i) Labour cost variance. (ii) Labour rate variance and (iii) Labour efficiency variance .
(B. Com. Delhi, 2004)

Solution :

Here $N_{S1} = 1$ (Number of labour force not mentioned considered as 1)

$$R_{S1} = 10 \quad \text{and} \quad T_{S1} = 300$$

$N_{A1} = 1$ (Number of labour force not mentioned considered as 1)

$$R_{A1} = 12 \quad \text{and} \quad T_{A1} = 200$$

As standard and actual output is not mentioned so considered as $A_o = S_o$

$$\begin{aligned} \text{(i) Labour cost variance} &= \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Ai} \times T_{Ai} \times R_{Ai}) \right] \\ &= \frac{A_o}{A_o} (N_{S1} \times T_{S1} \times R_{S1}) - (N_{A1} \times T_{A1} \times R_{A1}) \\ &= (1 \times 300 \times 10) - (1 \times 200 \times 12) \\ &= 3000 - 2400 \\ &= ₹ 600 \text{ (F)} \end{aligned}$$

$$\begin{aligned} \text{(ii) Labour rate variance} &= \sum_{i=1}^n (N_{Ai} \times T_{Ai} (R_{Si} - R_{Ai})) \\ &= 1 \times 200 (10 - 12) \\ &= 200 \times (-2) \\ &= -400 \\ &= ₹ 400 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{(iii) Labour efficiency variance} &= \sum_{i=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Ai} \times T_{Ai}) \right\} \right] \\ &= 10 \left[\left(\frac{A_o}{A_o} \times 1 \times 300 \right) - (1 \times 200) \right] \\ &= 10 (300 - 200) \\ &= 10 \times 100 \\ &= ₹ 1000 \text{ (F)} \end{aligned}$$

$$\begin{aligned} \text{Labour rate variance} + \text{Labour efficiency variance} &= (-400 + 1000) \\ &= ₹ 600 \\ &= \text{Labour cost variance} \end{aligned}$$

Illustration :

Calculate labour variances from standard for a particular month as disclosed from the following figures

	Standard	Actual
Number of workers	600	550
Average wages per worker per month	₹ 250	₹ 264
Number of working days in a month	25	24
Output in units	30,000	28,000

Solution :

$$\text{Here } N_{S1} = 600 \quad T_{S1} = 25 \quad R_{S1} = \frac{250}{25} = 10, \quad S_o = 30,000$$

$$N_{A1} = 550 \quad T_{A1} = 24 \quad R_{A1} = \frac{264}{24} = 11, \quad A_o = 28,000$$

$$\begin{aligned} \text{(i) Labour cost variance} &= \sum_{i=j=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\ &= \frac{28000}{30000} \times (600 \times 25 \times 10) - (550 \times 24 \times 11) \\ &= 140000 - 145200 \\ &= -5200 = ₹ 5200 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{(ii) Labour rate variance} &= \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\ &= 550 \times 24 \times (10 - 11) \\ &= -13200 = ₹ 13200 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{(iii) Labour efficiency variance} &= \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\ &= 10 \left[\frac{28000}{30000} \times (600 \times 25) - (550 \times 24) \right] \\ &= 10 (14000 - 13200) \\ &= 10 \times 800 = ₹ 8000 \text{ (F)} \end{aligned}$$

$$\begin{aligned} \text{Labour rate variance} + \text{Labour efficiency variance} &= -13200 + 8000 \\ &= -5200 = ₹ 5200 \text{ (A)} \\ &= \text{Labour cost variance} \end{aligned}$$

Illustration :

From the data given below calculate Labour variances

Standard			
	Labour force	Rate per hour	Standard hours
		₹ (per worker)	
Semi killed workers	30	0.75	40
Skilled workers	20	1.25	40
Actual			
Semi skilled workers	34	0.80	40
Skilled workers	16	1.20	40

Solution :

In the problem $N_{S1} = 30$ $R_{S1} = 0.75$ $T_{S1} = 40$

$N_{S2} = 20$ $R_{S2} = 1.25$ $T_{S2} = 40$

$N_{A1} = 34$ $R_{A1} = 0.80$ $T_{A1} = 40$

$N_{A2} = 16$ $R_{A2} = 1.20$ $T_{A2} = 40$

Output is not given in the problem, so it is considered to be equal i.e. $A_o = S_o$

$$\begin{aligned}
 \text{(i) Labour cost variance} &= \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
 &= \frac{A_o}{A_o} [\{ (30 \times 0.75 \times 40) + (20 \times 1.25 \times 40) \} - \{ (34 \times 0.8 \times 40) + (16 \times 1.2 \times 40) \}] \\
 &= [(900 + 1000) - (1088 + 768)] \\
 &= (1900 - 1856) \\
 &= ₹ 44 \text{ (F)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Labour rate variance} &= \sum_{i=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\
 &= (34 \times 40) (0.75 - 0.80) + (16 \times 40) (1.25 - 1.20) \\
 &= (1360) \times (-0.05) + (640) \times (0.05) \\
 &= -68 + 32 \\
 &= -36 = ₹ 36 \text{ (A)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii) Labour efficiency variance} &= \sum_{i=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\
 &= (0.75) \left[\left(\frac{A_o}{A_o} \times 30 \times 40 \right) - (34 \times 40) \right] + (1.25) \left[\left(\frac{A_o}{A_o} \times 20 \times 40 \right) - (16 \times 40) \right] \\
 &= (0.75)(1200 - 1360) + (1.25)(800 - 640) \\
 &= (0.75)(-160) + (1.25)(160) \\
 &= -120 + 200 \\
 &= 80 \\
 &= ₹ 80 \text{ (F)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv) Labour Idle time variance} &= - \sum_{i=1}^n (R_{Si} \times I_{Tj} \times N_{Aj}) \\
 \text{as idle time} &= 0 \quad \text{i.e. } (40 - 40)
 \end{aligned}$$

so Labour Idle time variance = 0

$$\begin{aligned}
 \text{(v) Labour Mix Variance} &= \sum_{i=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left(\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right) \\
 G_A &= (30 + 20) = 50 \\
 G_S &= (34 + 16) = 50 \\
 &= (0.75)(40 - 0) \left[\frac{50}{50} \times 30 - 34 \right] + (1.25)(40 - 0) \left[\frac{50}{50} \times 20 - 16 \right]
 \end{aligned}$$

$$\begin{aligned}
&= (0.75)(40)(30 - 34) + (1.25)(40)(20 - 16) \\
&= -120 + 200 = 80 \\
&= ₹ 80 (F)
\end{aligned}$$

Illustration :

A gang of workers consisting 10 men, 5 women, 5 boys in a factory are given standard hourly rate of ₹ 1.25, ₹ 0.80 and ₹ 0.70 respectively. In the normal working week of 40 hours, the gang is expected to produce 1000 units of a product.

In a certain week, the gang consisting of 13 men, 4 women and 3 boys, was paid actually ₹ 1.2, ₹ 0.85 and ₹ 0.65 respectively. Two hours per week were lost due to abnormal idle time and 960 units of the product were produced.

Calculate various labour variances.

The standards of the company are :

$N_{S1} = 10$	$T_{S1} = 40$	$R_{S1} = 1.25$
$N_{S2} = 5$	$T_{S2} = 40$	$R_{S2} = 0.80$
$N_{S3} = 5$	$T_{S3} = 40$	$R_{S3} = 0.70$

Actuals of company are :

$N_{A1} = 13$	$T_{A1} = 40$	$R_{A1} = 1.20$
$N_{A2} = 4$	$T_{A2} = 40$	$R_{A2} = 0.85$
$N_{A3} = 3$	$T_{A3} = 40$	$R_{A3} = 0.65$
$G_A = 20$	$I_{Tj} = 2$	$A_0 = 960$
$S_0 = 1000$	$G_S = 20$	

$$\begin{aligned}
\text{Labour cost variance} &= \sum_{i=j=1}^n \left[\frac{A_0}{S_0} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
&= \frac{960}{1000} [(10 \times 40 \times 1.25) + (5 \times 40 \times 0.80) + (5 \times 40 \times 0.70)] - [(13 \times 40 \times 1.20) + \\
&\quad (4 \times 40 \times 0.85) + (3 \times 40 \times 0.65)] \\
&= \frac{960}{1000} \times (500 + 160 + 140) - (624 + 136 + 78) \\
&= 768 - 838 \\
&= -70 = ₹ 70 (A)
\end{aligned}$$

$$\begin{aligned}
\text{Labour rate variance} &= \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\
&= (13 \times 40)(1.25 - 1.20) + (4 \times 40)(0.80 - 0.85) + (3 \times 40)(0.70 - 0.65) \\
&= (520)(0.05) + (160)(-0.05) + (120)(0.05)
\end{aligned}$$

$$= 26 - 8 + 6$$

$$= -24$$

$$= ₹ 24 \text{ (A)}$$

$$\text{Total Labour efficiency variance} = \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]$$

$$\begin{aligned} &= (1.25) \left[\frac{960}{1000} \times 10 \times 40 - 13 \times 40 \right] + (0.80) \left[\frac{960}{1000} \times 5 \times 40 - 4 \times 40 \right] \\ &+ (0.70) \left[\frac{960}{1000} \times 5 \times 40 - 3 \times 40 \right] \\ &= (1.25) (384 - 520) + (0.80) (192 - 160) + (0.70) (192 - 120) \\ &= (1.25) (-136) + (0.80) (32) + (0.70) (72) \\ &= -170 + 25.6 + 50.4 \\ &= -94 = ₹ 94 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{Labour efficiency variance} &= \sum_{i=j=1}^n \left(R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - N_{Aj} (T_{Aj} - I_{Tj}) \right\} \right) \\ &= (1.25) \left(\frac{960}{1000} \times 10 \times 40 - 13(40 - 2) \right) + (0.80) \left(\frac{960}{1000} \times 5 \times 40 - 4(40 - 2) \right) \\ &+ (0.70) \left(\frac{960}{1000} \times 5 \times 40 - 3(40 - 2) \right) \\ &= 1.25 (384 - 494) + 0.80 (192 - 152) + 0.70 (192 - 114) \\ &= -137.5 + 32 + 54.6 \\ &= -137.5 + 86.6 \\ &= -50.9 \\ &= ₹ 50.9 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{Labour Idle time variance} &= - \sum_{i=j=1}^n (R_{Si} \times I_{Tj} \times N_{Aj}) \\ &= - [(1.25 \times 2 \times 13) + (0.80 \times 2 \times 4) + (0.70 \times 2 \times 3)] \\ &= - (32.5 + 6.4 + 4.2) \\ &= -43.1 \\ &= 43.1 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{Labour Mix variance} &= \sum_{i=j=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left(\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right) \\ &= 1.25(40 - 2) \left[\frac{20}{20} \times 10 - 13 \right] + 0.80(40 - 2) \left[\frac{20}{20} \times 5 - 4 \right] \\ &+ 0.70(40 - 2) \left[\frac{20}{20} \times 5 - 3 \right] \\ &= 1.25 \times 38 \times (10 - 13) + 0.80 \times 38 \times (5 - 4) + 0.70 \times 38 \times (5 - 3) \end{aligned}$$

$$= -142.5 + 30.4 + 53.2$$

$$= -142.5 + 83.6$$

$$= -58.9$$

$$= 58.9 \text{ (A)}$$

$$\begin{aligned} \text{Labour Yield variance} &= \frac{\sum_{i=1}^n N_{Si} \times T_{Si} \times R_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{\sum_{i=1}^n N_{Si} (T_{Aj} - T_{Tj})}{\sum_{i=1}^n N_{Si} \times T_{Si}} \times S_o \right] \\ &= \frac{[(10 \times 40 \times 1.25) + (5 \times 40 \times 0.80) + (5 \times 40 \times 0.70)]}{1000} \times \left[960 - \frac{20}{20} \times \frac{[(10)(40-2) + 5 \times (40-2) + (5) \times (40-2)]}{(10 \times 40 + 5 \times 40 + 5 \times 40)} \times 1000 \right] \\ &= \frac{800}{1000} \left[960 - \frac{760}{800} \times 1000 \right] \\ &= 0.80 \times (960 - 950) \\ &= 0.80 \times 10 \\ &= 8 \text{ (F)} \end{aligned}$$

$$\text{Labour rate variance} + \text{Total Labour efficiency variance} = +24 + (-94)$$

$$= -70$$

$$= 70 \text{ (A)}$$

$$= \text{Labour Cost variance.}$$

$$\text{Labour efficiency variance} + \text{Labour Idle time variance} = (-50.9) + (-43.1)$$

$$= -94$$

$$= 94 \text{ (A)}$$

$$= \text{Total labour efficiency variance.}$$

$$\text{Labour Mix variance} + \text{Labour yield variance} = (-58.9) + 8$$

$$= -50.9$$

$$= 50.9 \text{ (A)}$$

$$= \text{Labour efficiency}$$

variance.

Illustration :

The direct labour strength of a section of an engineering factory is 100 workers paid at the rate of ₹ 6.00 per day of 8 hours each. The normal production is 1000 pieces per week of 48 hours. During the particular week an order for 1500 pieces was completed expending in all 7650 hours made up of 6300 hours at normal wages and 1350 hours at overtime wages at double rate. Total wages came to ₹ 6300. Calculate the average cost per piece during the week and analyse the labour cost variance for the week.

(ICWA, Inter, Dec. 1982 & June, 1986)

Solution :

$$\text{Here} \quad A_o = 1500 \text{ pieces} \quad R_i = ₹ \frac{6}{8} = ₹ 0.75 \quad \text{and} \quad S_o = 1000 \text{ pieces}$$

$$\text{Labour Cost variance} = \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right]$$

$$\begin{aligned}
&= \left[\frac{1500}{1000} \times 100 \times 48 \times (0.75) \right] - (6300) \\
&= 5400 - 6300 \\
&= -900 \\
&= 900 \text{ (A)}
\end{aligned}$$

$$\begin{aligned}
\text{Labour rate variance} &= \sum_{i=j=1}^n \left(N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj}) \right) \\
&= (7650 \times 0.75) - 6300 \\
&= 5737.5 - 6300 \\
&= -562.5 \\
&= 562.5 \text{ (A)}
\end{aligned}$$

$$\begin{aligned}
\text{Labour Efficiency variance} &= \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\
&= 0.75 \left(\frac{1500}{1000} \times 4800 - 7650 \right) \\
&= 0.75 (7200 - 7650) \\
&= 0.75 \times (-450) \\
&= -337.5 \\
&= 337.5 \text{ (A)}
\end{aligned}$$

Labour Mix variance = Nil (As there is no gang mix so it is zero)

$$\begin{aligned}
\text{Average labour cost per piece} &= \frac{\text{Total wage bill}}{\text{Pieces manufactured}} \\
&= \frac{6300}{1500} \\
&= ₹ 4.20
\end{aligned}$$

Illustration :

The following details are available from the records of ABC Ltd. Engaged in manufacturing article “A” for the week ended 28th September.

The standard labour hours and rates of payment per article “A” were as follows :

	Hours	Rate per hour	Total
		₹	₹
Skilled Labour	10	3.00	30
Semi Skilled Labour	8	1.50	12
Unskilled Labour	16	1.00	16

The actual production was 1000 article “A” for which the actual hours worked and rates are given below :

	Hours	Rate per hour	Total
		₹	₹
Skilled Labour	9000	4.00	36,000
Semi Skilled Labour	8400	1.50	12,600
Unskilled Labour	20,000	0.90	18,000

			66,600

From the above set of data you are asked to calculate

- (a) Labour Cost variance (b) Labour rate variance
(c) Labour efficiency variance (d) Labour mix variance

Solution :

$$\begin{aligned}
 \text{(i) Labour cost variance} &= \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
 &= \left[\frac{1000}{1} (10 \times 3) - 36000 \right] + \left[\frac{1000}{1} (8 \times 1.5) - 12600 \right] + \\
 &\quad \left[\frac{1000}{1} (16 \times 1) - 18000 \right] \\
 &= (30000 - 36000) + (12000 - 12600) + (16000 - 18000) \\
 &= (-6000) + (-600) + (-2000) \\
 &= -8600 = 8600 \text{ (A)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Labour rate variance} &= \sum_{i=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\
 &= 9000 (3 - 4) + 8400 (1.5 - 1.5) + (1 - 0.90) \\
 &= (-9000) + 0 + (2000) \\
 &= -7000 = 7000 \text{ (A)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(III) Labour efficiency variance} &= \sum_{i=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\
 &= 3 \left(\frac{1000}{1} \times 10 - 9000 \right) + 1.5 \left(\frac{1000}{1} \times 8 - 8400 \right) + \\
 &\quad 1 \left(\frac{1000}{1} \times 16 - 20000 \right) \\
 &= 3 (10000 - 9000) + 1.5 (8000 - 8400) + 1 (16000 - 20000) \\
 &= 3000 - 600 - 4000 \\
 &= -1600 = 1600 \text{ (A)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii) Labour Mix variance} &= \sum_{i=1}^n R_{Si} (T_{Aj} - I_{Tj}) \left(\frac{G_A}{G_S} \times N_{Si} - N_{Aj} \right) \\
 &= 3 (1 - 0) \left[\frac{37400}{34} \times 10 - 9000 \right] + 1.5 (1 - 0) \left[\frac{37400}{34} \times 8 - 8400 \right] \\
 &\quad + 1 (1 - 0) \left[\frac{37400}{34} \times 16 - 20000 \right] \\
 &= 3 (11000 - 9000) + 1.5 (8800 - 8400) + 1 (17600 - 20000) \\
 &= 3 (2000) + 1.5 (400) + 1 (-2400) \\
 &= 6000 + 600 + (-2400) \\
 &= 4200 \text{ (F)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv) Labour yield variance} &= \frac{\sum_{i=1}^n N_{Si} \times T_{Si} \times R_{Si}}{S_o} \left[A_o - \frac{G_A}{G_S} \times \frac{\sum_{i=1}^n N_{Si} (T_{Aj} - T_{Si})}{\sum_{i=1}^n N_{Si} \times T_{Si}} \times S_o \right] \\
 &= \frac{30+12+16}{1} \left[1000 - \frac{37400}{34} \times \frac{(10 \times 1 + 8 \times 1 + 16 \times 1)}{(10 \times 1 + 8 \times 1 + 16 \times 1)} \times 1 \right] \\
 &= 58 \times (1000 - 1100) \\
 &= -5800 = 5800 \text{ (A)}
 \end{aligned}$$

Reconciliation :

$$\begin{aligned}
 \text{Labour rate variance} + \text{Labour efficiency variance} &= 1600 \text{ (A)} + 7000 \text{ (A)} \\
 &= 8600 \text{ (A)} \\
 &= \text{Labour Cost variance.}
 \end{aligned}$$

$$\begin{aligned}
 \text{Labour mix variance} + \text{Labour yield variance} &= 4200 \text{ (F)} + 5800 \text{ (A)} \\
 &= 1600 \text{ (A)} \\
 &= \text{Labour efficiency variance.}
 \end{aligned}$$

Illustration :

The following detail relates to Product “ X “ during the month of March, 2010. You are required to compute the material and labour cost variances and also reconcile the standard and the actual cost with the help of such variances.

Standard cost per unit :

Material 50 Kgs @ ₹ 40 per Kg

Labour 400 hours @ ₹ 1.00 per hour

Actual cost for the month :

Material 4900 Kgs @ ₹ 42 per Kg

Labour 39600 hours @ ₹ 1.10 per hour

Actual production = 100 units.

(B. Com. Punjab)

Solution :

Here $N_{Si} T_{Si} = 400 \text{ hours}$ $S_o = 1$ $R_{Si} = ₹ 1.00 \text{ per hour}$

$N_{Aj} T_{Aj} = 39600$ $A_o = 100$ $R_{Aj} = ₹ 1.10 \text{ per hour}$

$$\begin{aligned}
 \text{(a) Labour Cost variance} &= \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
 &= \frac{100}{1} (400 \times 1) - (39600 \times 1.10) \\
 &= 40000 - 43560 \\
 &= -3560 = ₹ 3560 \text{ (A)} \\
 \text{(b) Labour rate variance} &= \sum_{i=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\
 &= 39600 (1 - 1.10) \\
 &= -3960 = 3960 \text{ (A)} \\
 \text{(c) Labour efficiency variance} &= \sum_{i=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]
 \end{aligned}$$

$$\begin{aligned}
&= 1 \left(\frac{100}{1} \times 400 - 39600 \right) \\
&= 40000 - 39600 \\
&= 400 \text{ (F)}
\end{aligned}$$

For Material variance :

$$A_Y = 100, \quad S_Y = 1$$

$$\begin{aligned}
\text{(a) Material cost variance} &= \sum_{i=1}^n \left[\left(\frac{A_Y}{S_Y} \times S_i \times S_{Ri} \right) - (A_j \times A_{Rj}) \right] \\
&= \left(\frac{100}{1} \times 50 \times 40 \right) - (4900 \times 42) \\
&= 200000 - 205800 \\
&= -5800 = 5800 \text{ (A)}
\end{aligned}$$

$$\begin{aligned}
\text{(b) Material Price variance} &= \sum_{i=1}^n A_j (S_{Ri} - A_{Rj}) \\
&= 4900 (40 - 42) \\
&= -9800 = 9800 \text{ (A)}
\end{aligned}$$

$$\begin{aligned}
\text{(c) Material usage variance} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times A_Y}{S_Y} - A_j \right] \\
&= 40 \left(\frac{50 \times 100}{1} - 4900 \right) \\
&= 40 (5000 - 4900) \\
&= 40 \times 100 \\
&= 4000 \text{ (F)}
\end{aligned}$$

Reconciliation of standard with Actual cost

For Material :

$$\text{Standard material cost for one unit of product} = ₹ (50 \times 40)$$

$$= ₹ 2000$$

$$\text{For 100 units (Actual units) Standard Material cost} = 100 \times 2000$$

$$= ₹ 2,00,000$$

$$\text{Standard cost variance} = 5800 \text{ (A)}$$

$$\text{So, Actual Material Cost} = 2,00,000 + 5800$$

$$= ₹ 2,05,800 (4900 \times 42)$$

For Labour :

$$\text{Standard Labour cost for one unit of the product} = ₹ (400 \times 1)$$

$$= ₹ 400$$

$$\text{For 100 units (actual output) Standard Labour cost} = 100 \times 400$$

$$= ₹ 40,000$$

$$\text{Labour cost variance} = ₹ 3560 \text{ (A)}$$

$$\text{So, Actual Labour cost} = 40,000 + 3560$$

$$= ₹ 43,560 (39600 \times 1.10)$$

Hence the result

Overhead Cost Variance : Overhead cost variance is another important factor of production which is required to complete the production process. To have a proper check or control over the total cost control, control over the overhead cost is necessary. For control or check over the overhead cost, the calculation regarding under or overabsorption of such cost is required. So, we can say overhead cost variance is calculated to control the overheads

and so the total cost. This variance is seen from various angles, may it be due to variation in production, may it be due to variation in the rate of recovery, may be due to change in efficiency of production or due to capacity or other such reasons. Let us try to calculate the variance due to various reasons as below.

1. Variable overhead cost variance :- First step to have a deep study is to separate the overheads into two parts, variable overheads and fixed overheads. Variable overheads are those which are directly related to the volume of production and fixed overheads are independent of the volume of production up to a certain capacity level.

- (i) Total variable overhead cost variance: It is the difference in the standard variable overheads required for actual output and the actual variable overhead incurred.

Variable overhead cost variance

= Standard variable overhead cost required for actual production – Actual variable overhead cost incurred.

It can also be calculated from production time required and the actual time taken. It is the difference in the standard overhead cost required for the standard time for the actual production and the actual variable overhead cost.

= Standard time required for the actual output × Standard rate per unit time – Actual overhead incurred.

From quantity of production point of view:

Variable overhead cost variance = $AQ \times SR - AQ \times AR$

Where AQ = Actual quantity of output.

SR = Standard rate of variable overhead cost.

AR = Actual rate of variable overhead cost.

From production time point of view:

Variable overhead cost variance = $ST \times SR - AT \times AR$

Where SR = Standard rate of variable overheads per unit time.

AR = Actual rate of variable overhead per unit time.

AT = Actual time.

ST = Standard time required for actual production.

- (ii) Variable overhead efficiency variance : The total variable overhead cost variance can be further analysed from efficiency point of view i.e. due to difference in standard and actual time when measured at standard rate.

Variable overhead efficiency variance = Standard cost of standard time required for actual output – standard cost of actual time taken.

= $SR \times (ST - AT)$

- (iii) Variable overhead expenditure variance : It is the portion of variable overhead cost variance which arises due to change in the standard and actual rate of variable overheads per unit time period.

Variable overhead expenditure variance = Actual time taken (Standard rate – Actual rate)

= $AT \times (SR - AR)$

Total variable cost variance = $ST \times SR - AT \times AR$

Adding and subtracting $SR \times AT$

= $ST \times SR - AT \times AR + SR \times AT - SR \times AT$

= $ST \times SR - SR \times AT + SR \times AT - AT \times AR$

= $SR (ST - AT) + AT (SR - AR)$

= V.O. Efficiency variance + V.O. Expenditure variance.

Fixed overhead cost variance:

Another part of the overhead cost variance is the fixed overhead variance. For proper control on overhead cost, control on fixed overheads is also desired. For deep analysis to have a control over such cost the following types of variances are calculated.

- (i) Fixed overhead cost variance : This variance is the difference in standard fixed overhead cost required or allowed for actual output and actual fixed overhead cost when seen from production quantity point of view and it is the difference in the standard fixed overhead cost allowed for standard time required for actual output and actual fixed overheads cost.

- (a) When calculated from quantity of production point of view.

- Fixed overhead cost variance = $AQ \times SR - AQ \times AR$
- (b) When calculated from production time point of view
Fixed overhead cost variance = $ST \times SR - AT \times AR$
- (ii) Fixed overhead expenditure variance:
- (a) When calculated from quantity of production point of view. It is the difference in fixed standard cost of budgeted quantity and actual fixed overhead cost.
Fixed overhead expenditure variance = $BQ \times SR - AQ \times AR$
Where BQ is the budgeted quantity.
SR is the standard rate of budgeted output.
- (b) When calculated from production time point of view.
Fixed overhead Expenditure variance = $SR \times BT - AR \times AT$
Where BT is the budgeted time and SR is the standard rate of fixed overhead per unit budgeted time period.

or we can say when calculated from production time point of view it is the difference in the budgeted cost measured at standard rate of the budgeted time period and the actual overhead cost.

- (iii) Fixed overhead volume variance:
- (a) When calculated from production quantity point of view : It is the difference in the cost of actual quantity produced measured at fixed standard rates and budgeted quantity cost measured at fixed standard rates.
Fixed overhead volume variance = $SR(AQ - BQ)$
- (b) When measured on production time basis : It is the difference in the cost of fixed standard time measured at fixed standard rates and cost of fixed budgeted time measured at fixed standard rates.
Fixed overhead volume variance = $SR(ST - BT)$

Let us try to understand the above working from the table given below.

Fixed Overhead variance	Quantity of production basis	Production time basis
(i) Fixed overhead cost variance.	$(AQ \times SR - AQ \times AR)$	$(ST \times SR - AT \times AR)$
(ii) Fixed overhead expenditure variance	$(BQ \times SR - AQ \times AR)$	$(SR \times BT - AR \times AT)$
(iii) Fixed overhead volume variance	$SR(AQ - BQ)$	$SR(ST - BT)$

Fixed overhead cost variance = Fixed overhead volume variance + Fixed overhead expenditure variance.

Let us prove on quantity of production basis.

Fixed overhead cost variance = $AQ \times SR - AQ \times AR$

Adding and subtracting fixed budgeted quantity cost measured at fixed standard rates.

i.e. $BQ \times SR$ we get

$$= AQ \times SR - BQ \times SR + BQ \times SR - AQ \times AR$$

$$= SR(AQ - BQ) + (BQ \times SR - AQ \times AR)$$

$$= \text{Fixed overhead volume variance} + \text{Fixed overhead expenditure variance.}$$

Let us prove on production time basis.

Fixed overhead cost variance = $ST \times SR - AT \times AR$

Adding and subtracting cost of budgeted time measured at fixed standard rate. i.e. $SR \times BT$ we get

$$\begin{aligned}
 &= ST \times SR - SR \times BT + SR \times BT - AT \times AR \\
 &= SR(ST - BT) + (SR \times BT - AT \times AR) \\
 &= \text{Fixed overhead volume variance} + \text{Fixed overhead expenditure variance}
 \end{aligned}$$

- (iv) Fixed overhead efficiency variance:

This type of variance arises when there is a difference in actual production and standard production or there is a difference in standard time required for actual production and actual time taken.

- (a) When measured on production quantity basis:

Fixed overhead efficiency variance = Fixed cost of actual production measured at standard rate – standard cost of standard production.

$$\begin{aligned}
 \text{Fixed overhead efficiency variance} &= SR \times AQ - SR \times SQ \\
 &= SR(AQ - SQ)
 \end{aligned}$$

- (b) When measured on production time basis.

Fixed overhead efficiency variance = Fixed cost of standard time required measured at standard rate – fixed cost of actual time measured at standard rate.

$$\begin{aligned}
 \text{Fixed overhead efficiency variance} &= SR \times ST - SR \times AT \\
 &= SR(ST - AT)
 \end{aligned}$$

- (v) Fixed overhead capacity variance: It is the part of fixed overhead efficiency variance which arise due to change in the production capacity. It may be due to under or overutilisation of the capacity because of so many avoidable or unavoidable reason. The cause may be strikes, lockouts, breakdown of machinery, idle time and such other relating reasons.

- (a) When measured on production quantity basis.

Fixed overhead capacity variance = Fixed overhead cost of standard quantity measured at standard rate – fixed overhead cost of revised budgeted quantity measured at standard rate.

$$\text{Fixed overhead capacity variance} = SR \times SQ - SR \times RBQ$$

Where RBQ is the revised budgeted quantity i.e. the actual time the production unit worked multiplied by the budgeted production units per unit time period.

- (b) When measured on production time basis.

$$\text{Fixed overhead capacity variance} = SR(AT - \frac{AD \times BT}{BD})$$

Where AD = Actual days of work of the production unit.

BD = Budgeted days of work of the production unit.

BT = Budgeted time for budgeted production.

- (vi) Calendar variance ; It is the portion of the volume variance which arises due to gap in measured and standard rate when measured at standard rate when production quantity basis is applied.

- (a) When measured on quantity basis.

$$\text{Fixed overhead calendar variance} = SR(RBQ - BQ)$$

- (b) When measured on time basis.

$$\text{Fixed overhead calendar variance} = SR \times BT(\frac{AD - BD}{BD})$$

Let us try to understand the above working through the table given below.

Fixed overhead cost variance	Quantity of production basis	Production time basis
Fixed overhead volume variance	$SR(AQ - BQ)$	$SR(ST - BT)$
Fixed overhead efficiency variance	$SR(AQ - SQ)$	$SR(ST - AT)$
Fixed overhead capacity variance	$SR(SQ - RBQ)$	$SR(AT - \frac{AD \times BT}{BD})$
Fixed overhead calendar variance	$SR(RBQ - BQ)$	$SR \times BT(\frac{AD - BD}{BD})$

Where RBQ= AD× Act. Production per day × Budgeted prod. Per Budgeted time.

Let us prove that Fixed overhead volume variance = Fixed overhead efficiency variance + Fixed overhead calendar variance.

(d) On quantity basis

$$\begin{aligned}\text{Fixed overhead volume variance} &= \text{SR}(\text{AQ} - \text{BQ}) \\ &= \text{SR} \times \text{AQ} - \text{SR} \times \text{BQ}\end{aligned}$$

Adding and subtracting (SR×SQ) and (SR×RBQ) we get

$$\begin{aligned}&= \text{SR} \times \text{AQ} + \text{SR} \times \text{SQ} + \text{SR} \times \text{RBQ} - \text{SR} \times \text{SQ} - \text{SR} \times \text{RBQ} - \text{SR} \times \text{BQ} \\ &= \text{SR} \times \text{AQ} - \text{SR} \times \text{SQ} + \text{SR} \times \text{SQ} - \text{SR} \times \text{RBQ} + \text{SR} \times \text{RBQ} - \text{SR} \times \text{BQ} \\ &= \text{SR}(\text{AQ} - \text{SQ}) + \text{SR}(\text{SQ} - \text{RBQ}) + \text{SR}(\text{RBQ} - \text{BQ}) \\ &= \text{F.O. Efficiency variance} + \text{F. O. capacity variance} + \text{F. O. calendar variance}.\end{aligned}$$

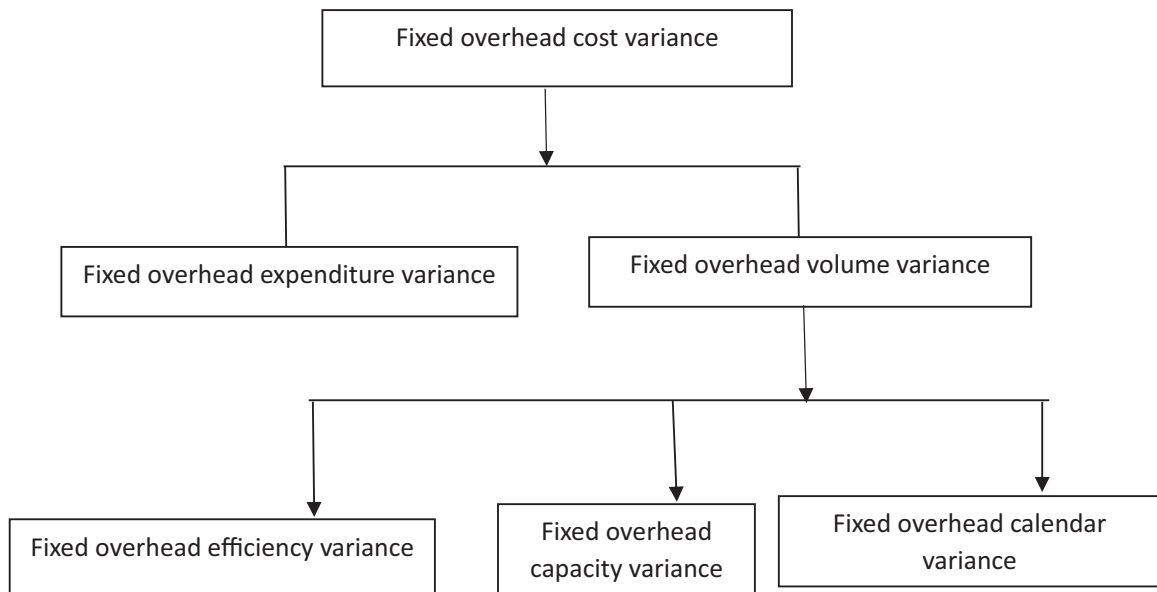
(e) On production time basis

$$\begin{aligned}\text{Fixed overhead volume variance} &= \text{SR}(\text{ST} - \text{BT}) \\ &= \text{SR} \times \text{ST} - \text{SR} \times \text{BT}\end{aligned}$$

Adding and subtracting (SR×AT) and $(\frac{\text{SR} \times \text{BT} \times \text{AD}}{\text{BD}})$ we get

$$\begin{aligned}&= \text{SR} \times \text{ST} + \text{SR} \times \text{AT} + \frac{\text{SR} \times \text{BT} \times \text{AD}}{\text{BD}} - \text{SR} \times \text{AT} - \frac{\text{SR} \times \text{BT} \times \text{AD}}{\text{BD}} - \text{SR} \times \text{BT} \\ &= \text{SR}(\text{ST} - \text{AT}) + \text{SR}(\text{AT} - \frac{\text{BT} \times \text{AD}}{\text{BD}}) + \frac{\text{SR} \times \text{BT} \times \text{AD}}{\text{BD}} - \text{SR} \times \text{BT} \\ &= \text{SR}(\text{ST} - \text{AT}) + \text{SR}(\text{AT} - \frac{\text{BT} \times \text{AD}}{\text{BD}}) + \text{SR} \times \text{BT}(\frac{\text{AD}}{\text{BD}} - 1) \\ &= \text{SR}(\text{ST} - \text{AT}) + \text{SR}(\text{AT} - \frac{\text{BT} \times \text{AD}}{\text{BD}}) + \text{SR} \times \text{BT}(\frac{\text{AD} - \text{BD}}{\text{BD}}) \\ &= \text{F.O. efficiency variance} + \text{F.O. capacity variance} + \text{F.O. calendar variance}.\end{aligned}$$

Flow chart showing Fixed overhead variance



Budgeted quantity (BQ) = Budgeted days × Budgeted time worked per day × Budgeted output (units) per unit time.

Standard quantity (SQ) = Actual day × actual time worked per day × budgeted output (units) per unit time.

Revised budgeted quantity (RBQ) = Actual days × budgeted time of work per day × budgeted output (units) per unit time.

Actual quantity (AQ) = Actual days worked × actual working time per day × actual output (units) per unit time.

Standard rate per unit (SR) (₹) = $\frac{(\text{Budgeted fixed overhead cost})}{(\text{Budgeted quantity})}$

Illustration:

From the data given below calculate (i) Fixed overhead variance (ii) Fixed overhead expenditure variance (iii) Fixed overhead volume variance and (iv) Fixed overhead efficiency variance. Apply both the methods.

Budgeted	Actual
budgeted quantity = 2,50,000 units	actual quantity = 2,60,000 units
budgeted fixed overheads = ₹ 2,50,000	actual fixed overheads = ₹ 2,75,000
working days = 25	working day = 25
working time/days = 1000 hrs.	working time/day = 1000 hrs.

Solution: (a) Let us solve the problem under time basis.

Here standard time = 26,000 hrs.	actual time = 25,000 hrs.
standard rate = ₹ 10	actual rate = ₹ 11
budgeted time = 25,000 hrs.	

- (i) Fixed overhead variance = $ST \times SR - AT \times AR$
 $= 26000 \times 10 - 25000 \times 11$
 $= 260000 - 275000$
 $= 15000 \text{ A (adverse)}$
- (ii) Fixed overhead expenditure variance = $SR \times BT - AR \times AT$
 $= 10 \times 25000 - 11 \times 25000$
 $= ₹ 25000 \text{ A (adverse)}$
- (iii) Fixed overhead volume variance = $SR(ST - BT)$
 $= 10(26000 - 25000)$
 $= ₹ 10000 \text{ F (favourable)}$
- (iv) Fixed overhead efficiency variance = $SR(ST - AT)$
 $= 10(26000 - 25000)$
 $= ₹ 10000 \text{ F (favourable)}$

(b) Let us try to solve the same problem through quantity basis.

Here budgeted quantity BQ = 2,50,000 units	actual quantity AQ = 2,60,000 units
Standard quantity SQ = 2,50,000 units	actual rate = ₹ $\frac{275000}{260000}$
Standard rate = ₹ 1	

- (i) Fixed overhead variance = $AQ(SR - AR)$
 $= 260000(1 - \frac{275000}{260000})$
 $= 260000 - 275000$
 $= ₹ 15000 \text{ A (adverse)}$

- (ii) Fixed overhead expenditure variance = $BQ \times SR - AQ \times AR$
 $= 250000 \times 1 - 260000 \times \frac{275000}{260000}$
 $= 250000 - 275000$
 $= ₹ 25000 \text{ A (adverse)}$
- (iii) Fixed overhead volume variance = $SR(AQ - BQ)$
 $= 1(260000 - 250000)$
 $= ₹ 10000 \text{ F (favourable)}$
- (iv) Fixed overhead efficiency variance = $SR(AQ - SQ)$
 $= 1(260000 - 250000)$
 $= ₹ 10000 \text{ F}$

Illustration: From the data given

Budgeted	Actual
fixed overheads = ₹ 24000	actual overheads = ₹ 25000
quantity = 2400 units	quantity = 2350 units
working days = 300	working days = 290
working hours/day = 8 hours	working hour/day = 8.5 hours

Calculate fixed overhead variances.

Solution:

$$\text{Budgeted time (BT)} = 300 \times 8 = 2400 \text{ hours}$$

$$\text{Standard time (ST)} = 2350 \text{ hours}$$

$$\text{Actual time (Actual time)} = 290 \times 8.5 = 2465 \text{ hours}$$

$$\text{Standard rate} = \frac{24000}{2400} = ₹ 10$$

$$\text{Actual rate} = ₹ \frac{25000}{2465}$$

- (i) Fixed overhead cost variance = $ST \times SR - AT \times AR$
 $= (2350 \times 10) - \left(\frac{25000}{2465} \times 2465\right)$
 $= 23500 - 25000 = 1500 \text{ A (adverse)}$
- (ii) Fixed overhead expenditure variance = $SR \times BT - AR \times AT$
 $= (10 \times 2400) - \left(\frac{25000}{2465} \times 2465\right)$
 $= 24000 - 25000 = 1000 \text{ A (adverse)}$
- (iii) Fixed overhead volume variance = $SR(ST - BT)$
 $= 10(2350 - 2400) = 500 \text{ A (adverse)}$
- (iv) Fixed overhead efficiency variance = $SR(ST - AT)$
 $= 10(2350 - 2465) = 1150 \text{ A (adverse)}$
- (v) Fixed overhead capacity variance = $SR(AT - \frac{AD \times BT}{BD})$
 $= 10(2465 - \frac{290 \times 2400}{300})$
 $= 10(2465 - 2320) = 1450 \text{ F (favourable)}$
- (vi) Fixed overhead calendar variance = $SR \times BT \left(\frac{AD - BD}{BD}\right)$
 $= 10 \times 2400 \left(\frac{290 - 300}{300}\right)$
 $= 800 \text{ A (adverse)}$

Reconciliation: (i) F.O. Expenditure variance + F.O. volume variance = 1000 A + 500 A

$$= 1500 \text{ A} = \text{Fixed overhead cost variance.}$$

(ii) F.O. efficiency variance + F.O. capacity variance + F.O. calendar variance.

$$= 1150 \text{ A} + 1450 \text{ F} + 800 \text{ A}$$

$$= 500 \text{ A}$$

= F.O. volume variance.

Illustration: Calculate F.O. variances from the following data.

Budgeted data:

Fixed budgeted overhead cost = ₹ 375000

Quantity produced = 250000 units

Working days = 25

Working hours per day = 5000 hours

Production per hour = 2 units

Actual data:

Fixed budgeted overhead cost = ₹ 377500

Actual quantity produced = 282150 units

Working days = 27

Working hours per day = 5500 hours

Production per hour = 1.9 units

Solution:

Here : Budgeted time (BT) = $25 \times 5000 = 125000$ hrs.

Actual time (AT) = $27 \times 5500 = 148500$ hours.

Standard rate (SR) = $\frac{375000}{125000} = ₹ 3$ per hour

Standard time(ST) = $\frac{282150}{2} = 141075$ hours

Actual rate (AR) = ₹ $\frac{377500}{148500}$

- (vii) Fixed overhead cost variance = $ST \times SR - AT \times AR$
 $= (141075 \times 3) - (148500 \times \frac{377500}{148500})$
 $= 423225 - 377500 = 45725 \text{ F (favourable)}$
- (viii) Fixed overhead expenditure variance = $SR \times BT - AR \times AT$
 $= (3 \times 125000) - (148500 \times \frac{377500}{148500})$
 $= 375000 - 377500 = 2500 \text{ A (adverse)}$
- (ix) Fixed overhead volume variance = $SR(ST - BT)$
 $= 3(141075 - 125000) = 3 \times 16075$
 $= 48225 \text{ F (favourable)}$
- (x) Fixed overhead efficiency variance = $SR(ST - AT)$

$$= 3(141075 - 148500) = 3(-7425)$$

$$= 22275 \text{ A (adverse)}$$

$$\begin{aligned} \text{(xi) Fixed overhead capacity variance} &= \text{SR} \left(\text{AT} - \frac{\text{AD} \times \text{BT}}{\text{BD}} \right) \\ &= 3 \left(148500 - \frac{27 \times 125000}{25} \right) \\ &= 3(148500 - 135000) = 40500 \text{ F (favourable)} \end{aligned}$$

$$\begin{aligned} \text{(xii) Fixed overhead calendar variance} &= \text{SR} \times \text{BT} \left(\frac{\text{AD} - \text{BD}}{\text{BD}} \right) \\ &= 3 \times 125000 \left(\frac{27 - 25}{25} \right) = 3 \times 5000 \times 2 \\ &= 30000 \text{ F (favourable)} \end{aligned}$$

Reconciliation: (i) F.O. Expenditure variance + F.O. volume variance = 2500 A + 48225 F

$$= 45725 \text{ F} = \text{Fixed overhead cost variance.}$$

(ii) F.O. efficiency variance + F.O. capacity variance + F.O. calendar variance.

$$\begin{aligned} &= 22275 \text{ A} + 40500 \text{ F} + 30000 \text{ F} \\ &= 48225 \text{ F} \\ &= \text{F.O. volume variance.} \end{aligned}$$

Illustration: From the information given, calculate (i) variable overhead variance (ii) variable Overhead efficiency variance (iii) variable overhead volume variance.

Standard data

Actual data

variable overhead cost variance = ₹ 45000

variable overhead cost variance = ₹ 47000

units produced = 15000

units produced = 16000

working days = 25

working days = 27

working hours per day = 8

working hours per day = 8

Solution:

$$\text{Standard rate per hour (SR)} = \frac{45000}{25 \times 8} = ₹ 225 \quad \text{actual time (AT)} = 27 \times 8 = 216 \text{ hours}$$

$$\text{standard time per unit} = \left(\frac{200}{15000} \times 16000 \right) \text{ hours} \quad \text{actual rate (AR)} = ₹ \frac{47000}{216}$$

$$\begin{aligned} \text{(i) Variable overhead cost variance} &= \text{ST} \times \text{SR} - \text{AT} \times \text{AR} \\ &= \left(\frac{200}{15000} \times 16000 \times 225 \right) - \left(216 \times \frac{47000}{216} \right) \\ &= 48000 - 47000 = 1000 \text{ F (favourable)} \end{aligned}$$

$$\begin{aligned} \text{(ii) Variable overhead efficiency variance} &= \text{AT}(\text{SR} - \text{AR}) \\ &= 216 \left(225 - \frac{47000}{216} \right) = 48600 - 47000 \\ &= 1600 \text{ F (favourable)} \end{aligned}$$

$$\begin{aligned} \text{(iv) Variable overhead volume variance} &= \text{SR}(\text{ST} - \text{AT}) \\ &= 225 \left(\frac{200 \times 16}{15} - 216 \right) \\ &= 48000 - 48600 \\ &= 600 \text{ A (adverse)} \end{aligned}$$

Illustration : The following information was obtained from the records of a manufacturing unit using standard costing system.

	Standard	Actual
Production	4000 units	3800 units
Working days	20	21
Fixed overheads	₹ 40000	₹ 39000
Variable overheads	₹ 12000	₹ 12000

You are required to calculate the following overhead variances

- (a) Variable overhead variance.
- (b) Fixed overhead variance :
 - (i) Expenditure variance
 - (ii) Volume variance
 - (iii) Efficiency variance
 - (iv) Calendar variance
- (c) Also prepare a reconciliation statement for standard fixed expenses worked out at standard fixed overhead rate and actual fixed overhead.
(CA Inter May, 1985)

Solution: (a) For variable overheads

Standard time (ST) = 19 days actual time (AT) = 21 days

standard rate (SR) = $\frac{12000}{20}$ = ₹ 600 per day actual rate (AR) = ₹ $\frac{12000}{21}$

- (i) Variable overhead cost variance = $SR \times ST - AR \times AT$
 $= 19 \times 600 - 21 \times \frac{12000}{21}$
 $= 11400 - 12000 = 600 \text{ A (adverse)}$
- (ii) Variable overhead expenditure variance = $AT(SR - AR)$
 $= 21(600 - \frac{12000}{21})$
 $= 12600 - 12000 = 600 \text{ F (favourable)}$
- (iii) Variable overhead volume variance = $SR(ST - AT)$
 $= 600(19 - 21) = 1200 \text{ A (adverse)}$

(b) for fixed overheads.

Standard time (AT) = 19 days Actual time (AT) = 21 days

standard rate (SR) = ₹ $\frac{40000}{20}$ actual rate (AR) = ₹ $\frac{39000}{21}$ per day
 = ₹ 2000 per day

budgeted time (BT) = 20 days

- (i) Fixed overhead cost variance = $ST \times SR - AT \times AR$
 $= 19 \times 2000 - 21 \times \frac{39000}{21}$
 $= 38000 - 39000 = ₹ 1000 \text{ A (adverse)}$
- (ii) Fixed overhead expenditure variance = $SR \times BT - AR \times AT$

$$= 2000 \times 20 - \frac{39000}{21} \times 21$$

$$= 40000 - 39000 = ₹ 1000 \text{ F (favourable)}$$

$$(iii) \text{ Fixed overhead volume variance} = SR(ST - BT)$$

$$= 2000(19 - 20) = ₹ 2000 \text{ A (adverse)}$$

$$(iv) \text{ Fixed overhead efficiency variance} = SR(ST - AT)$$

$$= 2000(19 - 21) = ₹ 4000 \text{ A (adverse)}$$

$$(v) \text{ Fixed overhead calendar variance} = SR \times BT \left(\frac{AD - BD}{BD} \right)$$

$$\text{here } AD = AT \quad \text{and} \quad BD = BT$$

$$\text{so, F.O. calendar variance} = SR \times BT \left(\frac{AT - BT}{BT} \right)$$

$$= SR(AT - BT) = 2000(21 - 20) = 2000 \text{ F (favourable)}$$

$$\text{F.O. cost variance} = 1000 \text{ A}$$

$$= 1000 \text{ F} + 2000 \text{ A}$$

$$= \text{F.O. expenditure variance} + \text{F.O. volume variance}$$

$$\text{F.O. volume variance} = 2000 \text{ A}$$

$$= 4000 \text{ A} + 2000 \text{ F}$$

$$= \text{F.O. efficiency variance} + \text{F.O. calendar variance}$$

(c) Reconciliation statement of Fixed overheads

$$\text{Standard fixed overheads} \quad \quad \quad = ₹ 38000$$

Variation in fixed overheads

$$(i) \text{ Fixed overhead expenditure variance} = ₹ 1000 \text{ F}$$

$$\text{and } (ii) \text{ Fixed overhead volume variance} \quad = ₹ 2000 \text{ A}$$

$$= ₹ 1000 \text{ A}$$

Fixed overhead volume variance

$$(i) \text{ F.O. efficiency variance} = ₹ 4000 \text{ A}$$

$$(ii) \text{ F.O. calendar variance} = ₹ 2000 \text{ F}$$

$$\text{Net F.O. vol. variance}$$

$$= ₹ 2000 \text{ A}$$

$$\text{Actual fixed overheads}$$

$$= ₹ 39000$$

Problem: A cost accountant of a company was given the following information regarding the

Overhead for February, 1987

$$(a) \text{ Overhead cost variance} = ₹ 1400 \text{ adverse}$$

$$(b) \text{ Overhead volume variance} = ₹ 1000 \text{ adverse}$$

(c) Budgeted hours for February, 1987 = 1200 hours

(d) Budgeted overheads for February, 1987 = ₹ 6000

(e) Actual rate of recovery of overheads = ₹ 8 per hour

You are required to assist him in computing the following for February, 1987

(1) Overhead expenditure variance.

(2) Actual overheads incurred.

(3) Actual hours for actual production.

(4) Overhead efficiency variance.

(5) Standard hours for actual production.

(CA inter, May 1987)

Solution: We are given here

Overhead cost variance = ₹ 1400 adverse

Overhead volume variance = ₹ 1000 adverse

so, overhead expenditure variance = 1400 A – (1000 A)

= 400 A

Budgeted overheads = ₹ 6000 (given)

So, actual overheads = 6000 + 400 = ₹ 6400

Actual rate of recovery = ₹ 8 per hour

So, actual hours = $\frac{6400}{8} = 800$ hours

Now Actual time (AT) = 800 hours

Budgeted time (BT) = 1200 hours

Actual rate (AR) = ₹ 8 per hour

Standard rate (SR) = $\frac{6000}{1200} = ₹ 5$ per hour

As F.O. volume variance = 1000 A

$SR(ST - BT) = - 1000$

$5(ST - 1200) = - 1000$

$ST = 1200 - \frac{1000}{5}$

$ST = 1200 - 200 = 1000$ hours

Now AT = 800 hours

BT = 1200 hour

ST = 1000 hours

AR = ₹ 8 per hour

SR = ₹ 5 per hour

(1) Overhead expenditure variance = $SR \times BT - AR \times AT$

$= 5 \times 1200 - 8 \times 800$

$= 6000 - 6400 = 400$ A (adverse)

(2) Actual overheads incurred = AR×AT

$$= 8 \times 800 = ₹ 6400$$

(3) Actual hours for actual production = AT

$$= 800 \text{ hours}$$

(4) Overhead capacity variance

As BT = BD there is no difference in capacity and calendar variance.

$$\text{So, Overhead capacity variance} = \text{SR} \times \text{BT} \left(\frac{\text{AD} - \text{BT}}{\text{BD}} \right)$$

$$= \text{SR}(\text{AT} - \text{BT})$$

$$= 5(800 - 1200) = ₹ 2000 \text{ A (adverse)}$$

(5) Fixed overhead efficiency variance = SR(ST – AT)

$$= 5(1000 - 800) = ₹ 1000 \text{ F (favourable)}$$

(6) Standard hours for actual production = ST

$$= 1000 \text{ hours}$$

Problem: The following information is available from the records of a factory

	Budgeted	Actual
Fixed overhead for June (₹)	10000	12000
Production in June (units)	2000	2100
Standard time per unit	10	_____
Actual hour worked in June	_____	22000

Compute:

(i) Fixed overhead cost variance.

(ii) Fixed overhead Expenditure variance.

(iii) Fixed overhead volume variance.

(iv) Fixed overhead capacity variance.

(v) Fixed overhead efficiency variance.

(CA Inter, Nov. 1989)

Solution: Here Standard time $\text{ST} = \frac{20000}{2000} \times 2100 = 21000 \text{ hours}$

Budgeted time $\text{BT} = 2000 \times 10 = 20000 \text{ hour}$

Actual time $\text{AT} = 22000 \text{ hours}$

Standard rate $\text{SR} = \frac{10000}{20000} = ₹ 0.50 \text{ per hour}$

$$\text{Actual rate AR} = \frac{12000}{22000} = ₹ \frac{12}{22} \text{ per hour}$$

$$(i) \text{ Fixed overhead cost variance} = ST \times SR - AT \times AR$$

$$= 21000 \times 0.50 - 22000 \times \frac{12}{22}$$

$$= 10500 - 12000 = ₹ 1500 \text{ A (adverse)}$$

$$(ii) \text{ Fixed overhead expenditure variance} = SR \times BT - AR \times AT$$

$$= 0.50 \times 20000 - \frac{12}{22} \times 22000$$

$$= 10000 - 12000 = ₹ 2000 \text{ A (adverse)}$$

$$(iii) \text{ Fixed overhead volume variance} = SR(ST - BT)$$

$$= 0.50(21000 - 20000)$$

$$= ₹ 500 \text{ F (favourable)}$$

$$(iv) \text{ Fixed overhead capacity variance} = SR(AT - BT)$$

$$= 0.50(22000 - 20000)$$

$$= ₹ 1000 \text{ F (favourable)}$$

$$(v) \text{ Fixed overhead efficiency variance} = SR(ST - AT)$$

$$= 0.50(21000 - 22000)$$

$$= ₹ 500 \text{ A (adverse)}$$

Reconciliation: (i) Fixed overhead expenditure variance + Fixed overhead volume variance

$$= 2000 \text{ A} + 500 \text{ F}$$

$$= 1500 \text{ A}$$

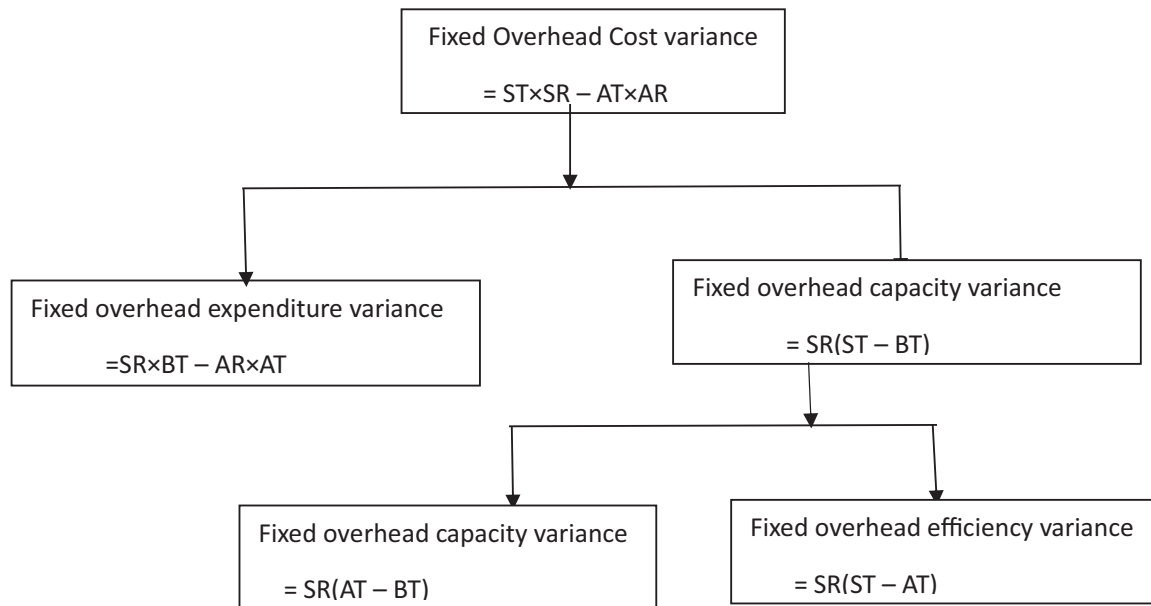
$$= \text{Fixed overhead Cost variance.}$$

(ii) Fixed overhead capacity variance + Fixed overhead efficiency variance

$$= 1000 \text{ F} + 500 \text{ A}$$

$$= 500 \text{ F}$$

$$= \text{Fixed overhead volume variance.}$$



Sales variance

The main target of any organisation which is established for business purposes is to earn profits in the long term. There are main two methods of earning maximum profit. One is to minimise the cost of production and the other is to maximise sales value or we can say the main emphasis is on maximising the gap between the total sales (value) and the total cost. There are various methods to have control over the costs up to the point the final product ready for sale or we can say control over the raw material which plays an important role in production, then other inputs required to convert it into final product i.e. labour and overhead costs. These costs and their control through standard costing methods have been discussed earlier in the chapter. After the cost control, to increase the overall profit the next and an important factor is sale value. There are two ways of increasing the sales value, one is to increase the sales volume i.e. the quantity of the products sold and the other is to increase the selling price i.e. the profit margin.

Let us take an example to understand the above discussion. Let there are two situations. In first, selling price is ₹ 10 per unit with cost price ₹ 5 per unit and sale quantity is 1000 units. In the second situation selling price is ₹ 13 per unit with cost price ₹ 5 per unit and sales quantity 625 unit.

$$\begin{aligned}\text{In the first case the total profit is} &= ₹ (10 - 5) \times 1000 \\ &= ₹ 5000\end{aligned}$$

$$\begin{aligned}\text{In second case the total profit} &= ₹ (13 - 5) \times 625 \\ &= ₹ 5000\end{aligned}$$

We see in both cases the total value of the profit is ₹ 5000. The profit margin in first case is ₹ 5 and in second case it is ₹ 8. As the quantity of sale in first case is though more than that in second case, due to more profit margin in second case, the total amount of profit is same. So, we can say there are two methods of increasing the total profit. One is to increase the sales volume and other is to increase the margin of profit. So, apart from the cost control, sales value or margin control is also very important. In the sales variance analysis we will try to find out numerically the various variances mentioned a below relating to sales.

2. Sales variances depending upon sales margin.

(i) Total sales margin variance:

It is the difference in actual sales margin and the standard sales margin.

$$\begin{aligned}\text{Sales margin variance} &= \text{Actual sales margin} - \text{Standard sales margin} \\ &= \sum_{i=1}^n [N_j \times (S_j - C_j) - N_i(S_i - C_i)]\end{aligned}$$

Where N_j, S_j, C_j denotes quantity of actual sales (in units), actual selling price per unit, and actual cost per unit respectively and N_i, S_i, C_i denotes the standard sales quantity (in units), standard selling price per unit, standard cost price per unit respectively. It may be cleared here that “j” is used for actual and “i” is used for standard.

(ii) Sales margin variance due to selling price

= Actual sales value – Standard sales value for actual quantity

$$= \sum_{j=1}^n N_j (S_j - S_i)$$

(iii) Sales margin variance due to volume

= Standard sales margin of actual sales volume – Standard sales margin of

standard sales volume.

$$= \sum_{i=1}^n (S_i - C_i) (N_j - N_i)$$

(iv) Sales margin variance due to sale mixture

It is the part of sales margin variance due to volume of sales, which is due to mixture of different actual and standard sales.

= Standard margin of actual sales mix – Standard margin of standard sales mix required for actual sales mix.

$$= \sum_{i=1}^n (S_i - C_i) \left(N_j - N_i \times \frac{\sum N_j}{\sum N_i} \right)$$

(v) Sales margin variance due to sales quantity

It is the part of sales margin volume variance which is due to difference in standard sales margin of standard sales mix required for actual sales mix and standard sales margin of standard sales mix.

Sales margin variance due to sales quantity

= Standard margin of standard sales mix required for actual sale mix –

Standard margin of standard sales mix.

$$= \sum_{i=1}^n (S_i - C_i) \left[\left(N_i \frac{\sum N_j}{\sum N_i} \right) - N_i \right]$$

Sales variance depending upon sales volume:

(i) Total sales value variance

It is the difference between the actual sales value and the standard sales value.

Total sales value variance = Actual sales value of actual sales – Standard sales value of Standard sales.

$$= \sum_{j=1}^n N_j \times S_j - \sum_{i=1}^n N_i \times S_i$$

$$= \sum_{j=1}^n (S_j \times N_j - S_i \times N_i)$$

Where S_j, N_j denotes actual sale price and actual sales quantity (in units) respectively. S_i, N_i denotes standard sale price and standard sale quantity (in units) respectively.

(ii) Sales value variance due to selling price.

Sales value variance can be subdivided into sales value variance due to

selling price and sales value variance due to sales volume. Sales value variance due

to selling price is the difference in actual sales value and standard sales value of actual

sale volume (in units).

Sales value variance due to selling price

$$= \sum_{j=1}^n N_j \times S_j - \sum_{i=1}^n N_j \times S_i$$

$$= \sum_{j=1}^n N_j (S_j - S_i)$$

(iii) Sales value variance due to sales volume

It is the part of sales value variance which is due to difference in standard

Sale value of actual sales and the total standard sales value.

$$= \sum_{i=1}^n S_i \times N_j - \sum_{i=1}^n S_i \times N_i$$

$$= \sum_{i=1}^n S_i (N_j - N_i)$$

(iv) Sales value variance due to sales mix: It may happen that the company produces and sells more than one product and their selling price and the quantities sold may differ. In such case sales mix variance is calculated to have a proper control on selling cost by the decision makers. It is the difference in standard sales value of actual sales mix and standard sales value of standard sales mix required for actual total sales mix.

$$= \sum_{i=1}^n S_i \times N_j - \sum_{i=1}^n S_i \times N_i \times \frac{\sum N_j}{\sum N_i}$$

$$= \sum_{i=1}^n S_i [N_j - (N_i \frac{\sum N_j}{\sum N_i})]$$

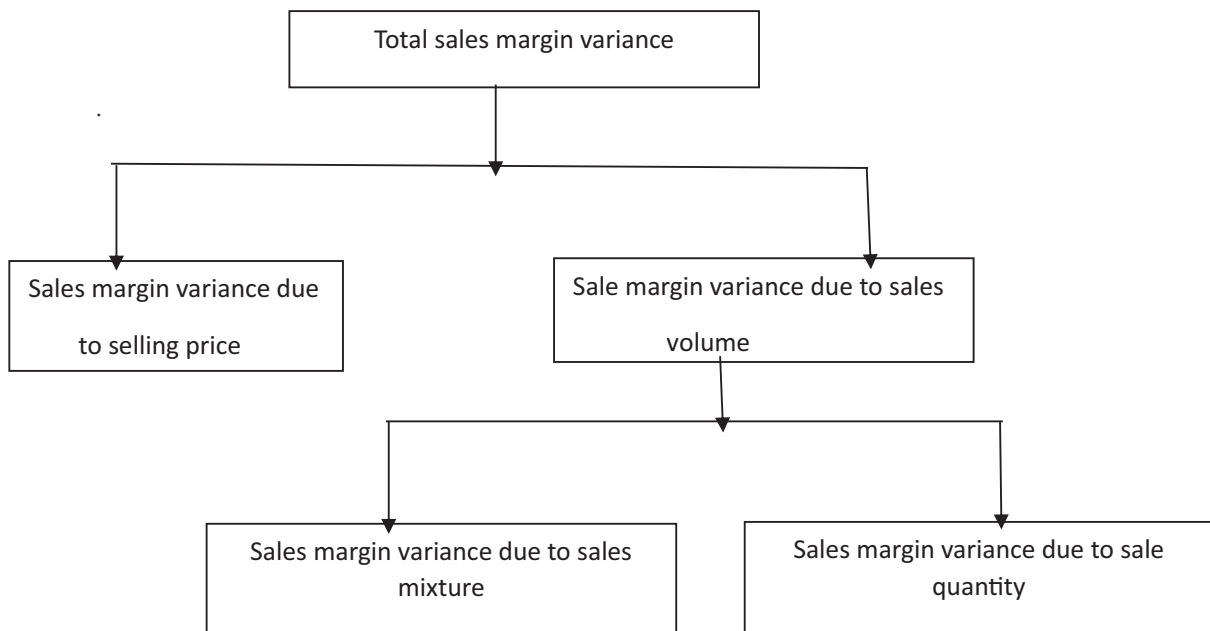
Here $\sum N_j$ = Total actual sales mix and $\sum N_i$ = Total standard sales mix

(v) Sales value variance due to sale quantity: It is the portion of sales value variance due to sales volume, which is due to difference in standard sales value of standard sales mix required for actual mix and standard sales value of standard sales mix.

$$= \sum_{i=1}^n S_i \times N_i \times \frac{\sum N_j}{\sum N_i} - \sum_{i=1}^n S_i \times N_i$$

$$= \sum_{i=1}^n [S_i (N_i \frac{\sum N_j}{\sum N_i} - N_i)]$$

Here $\sum N_j$ = Total actual sales mix and $\sum N_i$ = Total standard sales mix



The above flow chart can be proved as under

Total sales margin variance

$$= \sum_{j=1}^n N_j (S_j - C_j) - \sum_{i=1}^n N_i (S_i - C_i)$$

Here C_j and C_i is taken being cost factor to be equal because we are mainly concerned with the selling price and the quantity of the products sold and finding out any variations in them for a control at management level. i.e. $C_j = C_i$

$$= \sum_{j=1}^n N_j (S_j - C_i) - \sum_{i=1}^n N_i (S_i - C_i)$$

$$= \sum_{j=1}^n N_j S_j - \sum_{j=1}^n N_j C_i - \sum_{i=1}^n N_i S_i + \sum_{i=1}^n N_i C_i$$

Adding and subtracting $\sum_{i=1}^n N_j S_i$ we get

$$= \sum_{j=1}^n N_j S_j - \sum_{j=1}^n N_j C_i - \sum_{i=1}^n N_i S_i + \sum_{i=1}^n N_i C_i +$$

$$\sum_{i=1}^n N_j S_i - \sum_{i=1}^n N_j S_i$$

$$= \sum_{j=1}^n N_j S_j - \sum_{i=1}^n N_j S_i + \sum_{i=1}^n N_j S_i - \sum_{i=1}^n N_j C_i$$

$$- \sum_{i=1}^n N_i S_i + \sum_{i=1}^n N_i C_i$$

$$= \sum_{i=1}^n N_j (S_j - S_i) + \sum_{i=1}^n N_j (S_i - C_i) - \sum_{i=1}^n N_i (S_i - C_i)$$

$$= \sum_{i=1}^n N_j (S_j - S_i) + \sum_{i=j}^n [(S_i - C_i)(N_j - N_i)]$$

$$= [\text{Sales margin variance due to selling price}] + [\text{sales margin variance due to sales volume}]$$

Sales margin variance due to volume

$$= \sum_{i=j}^n [(S_i - C_i)(N_j - N_i)]$$

$$= \sum_{i=j}^n N_j (S_i - C_i) - \sum_{i=j}^n N_i (S_i - C_i)$$

Adding and subtracting $\sum_{i=1}^n N_i (S_i - C_i) \frac{\sum N_j}{\sum N_i}$ where $\sum N_j$ and $\sum N_i$ are total actual quantity

of sales mix and total standard quantity of sale mix.

$$\text{We get} = \sum_{i=j}^n N_j (S_i - C_i) - \sum_{i=j}^n N_i (S_i - C_i) + \sum_{i=j}^n N_i (S_i - C_i) \frac{\sum N_j}{\sum N_i} - \sum_{i=j}^n N_i (S_i - C_i) \frac{\sum N_j}{\sum N_i}$$

$$= \sum_{i=j}^n N_j (S_i - C_i) - \sum_{i=j}^n N_i (S_i - C_i) \frac{\sum N_j}{\sum N_i} + \sum_{i=j}^n N_i (S_i - C_i) \frac{\sum N_j}{\sum N_i} - \sum_{i=j}^n N_i (S_i - C_i)$$

$$= \sum_{i=j}^n [(S_i - C_i)(N_j - N_i \times \frac{\sum N_j}{\sum N_i})] + \sum_{i=j}^n (S_i - C_i) [(N_i \frac{\sum N_j}{\sum N_i}) - N_i]$$

$$= [\text{Sales margin variance due to sale mixture}] + [\text{Sales margin variance due to sales quantity}]$$

Similarly sales variance depending upon sales value can be proved as

Total sales variance depending upon sales can be proved as

Total sales value variance = [sales value variance due to selling price] + [Sales value variance due to sales volume]

$$\text{or } \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i) = \sum_{i=j=1}^n N_j (S_j - S_i) + \sum_{i=j=1}^n S_i (N_j - N_i)$$

and sales value variance due to sales volume = sales mix variance + sales quantity variance

$$\text{or } \sum_{i=j=1}^n S_i (N_j - N_i) = \sum_{i=j=1}^n S_i [N_j - (N_i \frac{\sum N_j}{\sum N_i})] + \sum_{i=j=1}^n [S_i (N_i \frac{\sum N_j}{\sum N_i} - N_i)]$$

The following table will be helpful to understand the operation of the formulae given above as well as to solve various problems of sales variance.

Sales Standard of the company						
Sales quantity of the product			Total sales Value (₹)	Standard Cost per Unit (₹)	Profit Margin Per unit (₹)	Total Profit margin (₹)
Product type	Number of unit (N_i)	Selling price per unit (S_i) (₹)	($N_i \times S_i$) (₹)	(C_i) (₹)	($S_i - C_i$)	$N_i (S_i - C_i)$
Product A	N_1	S_1	($N_1 \times S_1$)	C_1	$S_1 - C_1$	$N_1 (S_1 - C_1)$
Product B	N_2	S_2	($N_2 \times S_2$)	C_2	$S_2 - C_2$	$N_2 (S_2 - C_2)$
Product C	N_3	S_3	($N_3 \times S_3$)	C_3	$S_3 - C_3$	$N_3 (S_3 - C_3)$
Product D	N_4	S_4	($N_4 \times S_4$)	C_4	$S_4 - C_4$	$N_4 (S_4 - C_4)$
$\sum_{i=j=1}^n N_i S_i =$			-----	$\sum_{i=j=1}^n N_i (S_i - C_i) =$		-----

Actual Sales of the company				
Sales quantity of the product	Total sales Value (₹)	Cost per Unit (₹) Taking it as C_i	Profit Margin Per unit (₹)	Total Profit margin (₹)

Product type	Number of units (N_j)	Selling price per unit (S_j) (₹)	$(N_j \times S_j)$	Standard Cost (C_i) (₹)	$(S_j - C_i)$	$N_j (S_j - C_i)$
Product A	N_1	S_1	$(N_1 \times S_1)$	C_1	$S_1 - C_1$	$N_1 (S_1 - C_1)$
Product B	N_2	S_2	$(N_2 \times S_2)$	C_2	$S_2 - C_2$	$N_2 (S_2 - C_2)$
Product C	N_3	S_3	$(N_3 \times S_3)$	C_3	$S_3 - C_3$	$N_3 (S_3 - C_3)$
Product D	N_4	S_4	$(N_4 \times S_4)$	C_4	$S_4 - C_4$	$N_4 (S_4 - C_4)$
$\sum_{i=j=1}^n N_j S_j =$			-----	$\sum_{i=j=1}^n N_j (S_j - C_i) =$	-----	

Formulae to calculate the sales variance

(1) Total sales variance due to sales margin

(i) Total sales margin variance $= \sum_{i=j=1}^n [N_j \times (S_j - C_j) - N_i(S_i - C_i)]$

(ii) Sales margin variance due to selling price $= \sum_{i=j=1}^n [N_j(S_j - S_i)]$

(iii) Sales margin variance due to sales volume $= \sum_{i=j=1}^n [(S_i - C_i)(N_j - N_i)]$

(iv) Sales margin variance due to sale mix $= \sum_{i=j=1}^n [(S_i - C_i)(N_j - N_i \times \frac{\sum N_j}{\sum N_i})]$

(v) Sales margin variance due to sales quantity $= \sum_{i=j=1}^n (S_i - C_i)[(N_i \frac{\sum N_j}{\sum N_i}) - N_i]$

here $\sum N_j$ = Total actual sales mix and $\sum N_i$ = Total standard sales mix

(2) Sales variance depending upon sales volume

(i) Total sales value variance $= \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i)$

(ii) Sales value variance due to selling price $= \sum_{i=j=1}^n N_j (S_j - S_i)$

(iii) Sales value variance due to sales volume $= \sum_{i=j=1}^n S_i (N_j - N_i)$

(iv) Sales value variance due to sales mix $= \sum_{i=j=1}^n S_i [N_j - (N_i \frac{\sum N_j}{\sum N_i})]$

(v) Sales value variance due to sales quantity $= \sum_{i=j=1}^n [S_i (N_i \frac{\sum N_j}{\sum N_i} - N_i)]$

here $\sum N_j$ = Total actual sales mix and $\sum N_i$ = Total standard sales mix

Problem: From the data given below calculate

(i) Total sales margin variance (ii) Sales margin variance due to selling price (iii) Sale margin
Variance due to volume (iv) Total sales value variance (v) sales value variance due to selling
price (vi) Sales value variance due to sales volume.

	Units sold	Cost per unit (₹)	Selling price (₹)
Standard	1100	45	50
Actual	1300	45	55

Solution: Standard “i” $N_1 = 1$ $C_1 = 45,$ $S_1 = 50$
 Actual “j” $N_1 = 1$ $C_1 = 45,$ $S_1 = 50$

$$\begin{aligned}
 \text{(i) Total sales margin variance} &= \sum_{i=j=1}^n [N_j \times (S_j - C_j) - N_i(S_i - C_i)] \\
 &= 1300 \times (55 - 45) + 1100 \times (50 - 45) \\
 &= 1300 \times 10 - 1100 \times 5 \\
 &= 13000 - 5500 \\
 &= ₹ 7500 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Sales margin variance due to selling price} &= \sum_{i=j=1}^n N_j (S_j - S_i) \\
 &= 1300(55 - 50) \\
 &= 1300 \times 5 = ₹ 6500 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii) Sales margin variance due to volume} &= \sum_{i=j=1}^n (S_i - C_i)(N_j - N_i) \\
 &= (50 - 45) \times (1300 - 1100) \\
 &= 5 \times 200 = ₹ 1000 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(iv) Total sales value variance} &= \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i) \\
 &= 1300 \times 55 - 1100 \times 50 \\
 &= 71500 - 55000 = ₹ 16500 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(v) Sales value variance due to selling price} &= \sum_{i=j=1}^n N_j (S_j - S_i) \\
 &= 1300(55 - 50) \\
 &= 6500 \text{ F (favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(vi) Sales value variance due to sales volume} &= \sum_{i=j=1}^n S_i (N_j - N_i) \\
 &= 50(1300 - 1100) \\
 &= ₹ 10000 \text{ F (favourable)}
 \end{aligned}$$

Problem: Standards of a company towards sales are

Product (units)	Cost per unit (₹)	Selling price per unit (₹)
Product A = 1000	45	50
Product B = 300	55	65

Actual of the company are

Product (units)	Cost per unit (₹)	Selling price per unit (₹)

Product A = 1300	45	55
Product B = 400	55	75

Calculate (I) Total sales value variance.

(ii) Sales value variance due to selling price.

(iii) Sales value variance due to sales volume.

(iv) Sales mix variance.

(v) Sales quantity variance.

Solution :

(i) Total sales value variance

$$\begin{aligned}
 &= \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i) \\
 &= [(1300 \times 55) - (1000 \times 50)] + [(400 \times 75) - (300 \times 65)] \\
 &= [71500 - 50000] + [30000 - 19500] \\
 &= 21500 + 10500 \\
 &= ₹ 32000 \text{ (Favourable)}
 \end{aligned}$$

(ii) Sales value variance due to selling price

$$\begin{aligned}
 &= \sum_{i=j=1}^n N_j (S_j - S_i) \\
 &= [1300(55 - 50)] + [400(75 - 65)] \\
 &= (1300 \times 5) + (400 \times 10) \\
 &= 6500 + 4000 \\
 &= ₹ 10500 \text{ (Favourable)}
 \end{aligned}$$

(iii) Sales value variance due to sales volume

$$\begin{aligned}
 &= \sum_{i=j=1}^n S_i (N_j - N_i) \\
 &= [50(1300 - 1000)] + [65(400 - 300)] \\
 &= (50 \times 300) + (65 \times 100) \\
 &= 15000 + 6500 \\
 &= ₹ 21500 \text{ (Favourable)}
 \end{aligned}$$

(iv) Sales mix variance

$$\begin{aligned}
 &= \sum_{i=j=1}^n S_i \left[N_j - \left(N_i \frac{\sum N_j}{\sum N_i} \right) \right] \\
 &= 50 \left[1300 - \frac{1000 \times 1700}{1300} \right] + 65 \left[400 - \frac{300 \times 1700}{1300} \right] \\
 &= 50(1300 - 1307.69) + 65(400 - 392.31) \\
 &= (-384.6) + (500) \\
 &= ₹ 115.4 \text{ (Favourable)}
 \end{aligned}$$

(v) Sales quantity variance

$$\begin{aligned}
 &= \sum_{i=j=1}^n S_i \left(N_i \frac{\sum N_j}{\sum N_i} - N_i \right) \\
 &= 50 \left[\frac{1000 \times 1700}{1300} - 1000 \right] + 65 \left[\frac{300 \times 1700}{1300} - 300 \right] \\
 &= 15384.6 + 6000 \\
 &= 21384.6 \text{ (Favourable)}
 \end{aligned}$$

Problem : From the information given below regarding a company, Calculate sales value and Sales margin variances.

Standard

Products sold

Cost (₹)

Selling price (₹)

A = 1100	45	50
B = 1000	85	100
C = 1300	70	80
Actual		
Products sold	Selling price (₹)	
A = 1300	55	
B = 1000	95	
C = 1200	90	

Solution :

1. Sales value variances :

(i) Due to selling price

$$\begin{aligned}
 &= \sum_{i=1}^n N_j (S_j - S_i) \\
 &= [1300(55 - 50)] + [1000(95 - 100)] + [1200(90 - 80)] \\
 &= 6500 + (- 5000) + 12000 \\
 &= ₹ 13500 \text{ (Favourable)}
 \end{aligned}$$

(ii) Due to sales volume

$$\begin{aligned}
 &= \sum_{i=1}^n S_i (N_j - N_i) \\
 &= [50(1300 - 1100)] + [100(1000 - 1000)] + [80(1200 - 1300)] \\
 &= (10000) + 0 + (- 8000) \\
 &= ₹ 2000 \text{ (Favourable)}
 \end{aligned}$$

(iii) Due to sales mix

$$\begin{aligned}
 &= \sum_{i=1}^n S_i [N_j - (N_i \frac{\sum N_j}{\sum N_i})] \\
 &= 50[1300 - \frac{1100 \times 3500}{3400}] + 100[1000 - \frac{1000 \times 3500}{3400}] + 80[1200 - \frac{1300 \times 3500}{3400}] \\
 &= 50(1300 - 1132.035) + 100[1000 - 1029.40] + 80[1200 - 1338.2] \\
 &= (8382.5) + (-2940) + (-11056) \\
 &= 5613.5 \text{ (Adverse)}
 \end{aligned}$$

(iv) Due to sales quantity

$$\begin{aligned}
 &= \sum_{i=1}^n [S_i (N_i \frac{\sum N_j}{\sum N_i} - N_i)] \\
 &= 50(\frac{1100 \times 3500}{3400} - 1100) + 100(\frac{1000 \times 3500}{3400} - 1000) + 80(\frac{1300 \times 3500}{3400} - 1300) \\
 &= 50(1132.35 - 1100) + 100(1029.4 - 1000) + 80(1338.2 - 1300) \\
 &= 1617.5 + 2940 + 3056 \\
 &= 7613.5 \text{ (Favourable)}
 \end{aligned}$$

2. Sales margin variance

(i) Sales margin variance due to volume

$$\begin{aligned}
 &= \sum_{i=1}^n [(S_i - C_i)(N_j - N_i)] \\
 &= (50 - 45)(1300 - 1100) + (100 - 85)(1000 - 1000) + (80 - 70)(1200 - 1300) \\
 &= (5 \times 200) + (15 \times 0) + (10 \times (-100)) \\
 &= 1000 + 0 - 1000 \\
 &= 0
 \end{aligned}$$

(ii) Sales margin variance due to selling price

$$\begin{aligned}
 &= \sum_{i=1}^n [N_j (S_j - S_i)] \\
 &= 1300(55 - 50) + 1000(95 - 100) + 1200(90 - 80)
 \end{aligned}$$

$$\begin{aligned}
&= (1300 \times 5) + (1000(-5)) + (1200 \times 10) \\
&= 6500 + (-5000) + 12000 \\
&= 13500 \text{ (Favourable)}
\end{aligned}$$

(iii) Due to sales mixture

$$\begin{aligned}
&= \sum_{i=j=i}^n (S_i - C_i) \left(N_j - N_i \times \frac{\sum N_j}{\sum N_i} \right) \\
&= (50-45) \left(1300 - \frac{1100 \times 3500}{3400} \right) + (100-85) \left(1000 - \frac{1000 \times 3500}{3400} \right) + (80-70) \left(1200 - \frac{1200 \times 3500}{3400} \right) \\
&= 5(1300 - 1132.35) + 15(1000 - 1029.4) + 10(1200 - 1338.2) \\
&= 5(167.65) + 15(-29.4) + 10(-138.2) \\
&= 838 + (-29.4) + (-1382) \\
&= 985 \text{ (Adverse)}
\end{aligned}$$

(iv) Due to sales quantity

$$\begin{aligned}
&= \sum_{i=j=i}^n (S_i - C_i) \left[\left(N_i \frac{\sum N_j}{\sum N_i} \right) - N_i \right] \\
&= (50 - 45) \left(\frac{1100 \times 3500}{3400} - 1100 \right) + (100 - 85) \left(\frac{1000 \times 3500}{3400} - 1000 \right) + (80 - 70) \left(\frac{1200 \times 3500}{3400} - 1200 \right) \\
&= 5(1132.4 - 1100) + 15(1029.4 - 1000) + 10(1338.2 - 1200) \\
&= (5 \times 32.4) + (15 \times 29.4) + (10 \times 38.2) \\
&= 162 + 441 + 382 \\
&= 985 \text{ (Favourable)}
\end{aligned}$$

Problem : Standard data of a company regarding sales is given as under

Standard

Product	Quantity (units)	Cost per unit (₹)	Selling price per unit (₹)
A	4000	12	18
B	3000	13	19
C	2000	15	20

Actual data of the company regarding sales was

Product	Quantity	Actual sales (Units)	Selling price per unit (₹)
A	3000		17
B	4000		20
C	2500		21

From the above data you are required to calculate all the variances relating to sales.

Solution : (1) Let us first of all calculate sales variance depending upon sales value

$$\begin{aligned}
\text{(i) Total sales variance} &= \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i) \\
&= (3000 \times 17 - 4000 \times 18) + (4000 \times 20 - 3000 \times 19) + (2500 \times 21 - 2000 \times 20) \\
&= (51000 - 72000) + (80000 - 57000) + (52500 - 40000) \\
&= (-21000) + (23000) + (12500) \\
&= 14500 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(ii) Sales variance due to selling price} &= \sum_{i=j=1}^n N_j (S_j - S_i) \\
&= 3000(17-18) + 4000(20-19) + 2500(21-20) \\
&= (-3000) + (4000) + (2500) \\
&= 3500 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(iii) Sales value variance due to sales volume} &= \sum_{i=j=1}^n S_i (N_j - N_i) \\
&= 18(3000 - 4000) + 19(4000 - 3000) + 20(2500 - 2000) \\
&= (-18000) + (19000) + (10000) \\
&= 11000 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(iv) Sales value variance due to sales mix} &= \sum_{i=j=1}^n S_i \left[N_j - \left(N_i \frac{\sum N_j}{\sum N_i} \right) \right] \\
&= 18(3000 - \frac{9500}{9000} \times 4000) + 19(4000 - \frac{9500}{9000} \times 3000) + 20(2500 - \frac{9500}{9000} \times 2000) \\
&= 18(3000 - 4222) + 19(4000 - 3167) + 20(2500 - 2111) \\
&= (-21996) + (15827) + (7780) \\
&= 1611 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(v) Sales value variance due to sales quantity} &= \sum_{i=j=1}^n S_i \left(N_i \frac{\sum N_j}{\sum N_i} - N_i \right) \\
&= 18(4000 \times \frac{9500}{9000} - 4000) + 19(3000 \times \frac{9500}{9000} - 3000) + 20(2000 \times \frac{9500}{9000} - 2000) \\
&= 18 \times (222) + 19 \times (167) + 20 \times (111) \\
&= 3996 + 3173 + 2220 \\
&= 9389 \text{ (Favourable)}
\end{aligned}$$

(2) Let us find out sales variance due to sales margin

$$\begin{aligned}
\text{(i) Total sales margin variance} &= \sum_{i=j=1}^n [N_j \times (S_j - C_j) - N_i(S_i - C_i)] \\
&= [3000 \times (17 - 12) - 4000 \times (18 - 12)] + [4000 \times (20 - 13) - 3000 \times (19 - 13)] + \\
&\quad [2500 \times (21 - 15) - 2000 \times (20 - 15)] \\
&= (15000 - 24000) + (28000 - 18000) + (15000 - 10000) \\
&= (-9000) + (10000) + (5000) \\
&= 6000 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(ii) Due to sales price} &= \sum_{i=j=i}^n N_j (S_j - S_i) \\
&= 3000(17 - 18) + 4000(20 - 19) + 2500(21 - 20) \\
&= (-3000) + (4000) + (2500) \\
&= 3500 \text{ (Favourable)}
\end{aligned}$$

$$\begin{aligned}
\text{(iii) Due to sales volume} &= \sum_{i=j=i}^n (S_i - C_i)(N_j - N_i) \\
&= [(18-12)(3000 - 4000)] + [(19-13)(4000 - 3000)] + [(20-15)(2500 - 2000)] \\
&= 6 \times (-1000) + 6 \times (1000) + 5 \times (500)
\end{aligned}$$

$$= 2500 \text{ (Favourable)}$$

$$(\text{iv}) \text{ Due to sales mix} = \sum_{i=j=i}^n (S_i - C_i) \left(N_j - N_i \times \frac{\sum N_j}{\sum N_i} \right)$$

$$= [(18 - 12)(3000 - 4000 \times \frac{9500}{9000})] + [(19 - 13)(4000 - 3000 \times \frac{9500}{9000})] + [(20 - 15)(2500 - 2000 \times \frac{9500}{9000})]$$

$$= 6 \times (-1222) + 6 \times (1833) + 5 \times (389)$$

$$= -7332 + 4998 + 1945$$

$$= 389 \text{ (Adverse)}$$

$$(\text{v}) \text{ Due to sales quantity} = \sum_{i=j=i}^n (S_i - C_i) \left[\left(N_i \times \frac{\sum N_j}{\sum N_i} \right) - N_i \right]$$

$$= (18 - 12) \left[4000 \times \frac{9500}{9000} - 4000 \right] + (19 - 13) \left[3000 \times \frac{9500}{9000} - 3000 \right] + (20 - 15) \left[2000 \times \frac{9500}{9000} - 2000 \right]$$

$$= 2(222) + 6(167) + 5(111)$$

$$= 2889 \text{ (Favourable)}$$

Problem : From the following information about sales calculate

- (a) Total sales variance.
- (b) Sales price variance.
- (c) Sales volume variance.
- (d) Sales mix variance.
- (e) Sales quantity variance.

Standard				Actual		
Product	No's	Rate per unit	Total	No's	Rate per unit	Total
		(₹)	(₹)		(₹)	(₹)
A	5000	5	25000	6000	6	36000
B	4000	6	24000	5000	5	25000
C	3000	7	21000	4000	8	32000
Total	12000		70000	15000		93000

Solution :

$$\begin{aligned}
 \text{(a) Total sales variance} &= \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i) \\
 &= (36000 - 25000) + (25000 - 24000) + (32000 - 21000) \\
 &= 11000 + 1000 + 11000 \\
 &= 23000 \text{ (Favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(b) Sales price variance} &= \sum_{i=j=1}^n N_j (S_j - S_i) \\
 &= 6000(6 - 5) + 5000(5 - 6) + 4000(8 - 7) \\
 &= 6000 - 5000 + 4000 \\
 &= 5000 \text{ (Favourable)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) Sales Volume variance} &= \sum_{i=j=1}^n S_i (N_j - N_i) \\
 &= 5(6000 - 5000) + 6(5000 - 4000) + 7(4000 - 3000) \\
 &= 5000 + 6000 + 7000 \\
 &= ₹ 18000 \text{ (F)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(d) Sales Mix variance} &= \sum_{i=j=1}^n S_i \left[N_j - \left(\frac{N_i \times \sum_{j=1}^n N_j}{\sum_{i=1}^n N_i} \right) \right] \\
 &= 5 \left(6000 - 5000 \times \frac{15}{12} \right) + 6 \left(5000 - 4000 \times \frac{15}{12} \right) + 7 \left(4000 - 3000 \times \frac{15}{12} \right) \\
 &= 5(6000 - 6250) + 6(5000 - 5000) + 7(4000 - 3750) \\
 &= -1250 + 1750 \\
 &= 500 \text{ (F)}
 \end{aligned}$$

$$\begin{aligned}
 \text{(e) Sales quantity variance} &= \sum_{i=j=1}^n S_i \left(\frac{N_i \times \sum_{j=1}^n N_j}{\sum_{i=1}^n N_i} - N_i \right) \\
 &= 5 \left(\frac{5000 \times 15}{12} - 5000 \right) + 6 \left(\frac{4000 \times 15}{12} - 4000 \right) + 7 \left(\frac{3000 \times 15}{12} - 3000 \right) \\
 &= 5(6250 - 5000) + 6(5000 - 4000) + 7(3750 - 3000) \\
 &= 6250 + 6000 + 5250 \\
 &= 17500 \text{ (F)}
 \end{aligned}$$

Problem:

From the following data of A Co. Ltd relating to budgeted and actual performance for the month of March, 87, Compute the Direct material and Labour variances.

Budgeted Data for March:

Units to be manufactured	1,50,000
Units of Direct material required	4,95,000
(based on standard rate)	
Planned purchase of raw material (units)	5,40,000
Average unit cost of direct material	₹ 8

Direct labour hours per unit of

Finished goods $\frac{3}{4}$ hours

Direct labour cost (Total) 29,92,500

Actual Data for the month of March:

Units manufactured 1,60,000

Direct material cost (Purchase cost based

on units actually issued) ₹ 43,41,900

Direct material cost (Purchase cost based

on actually purchased) ₹ 45,10,000

Average unit cost of direct material ₹ 8.20

Total direct labour hours for March 1,25,000

Total direct labour cost for March ₹ 33,75,000

(ICWA inter Dec, 1988)

Solution :

Material : $A_Y = 1,60,000$, $S_i = 4,95,000$, $A_{Rj} \times A_j = 43,40,900$

$S_Y = 1,50,000$, $S_{Ri} = 8$, $A_j = \frac{4341900}{8.20} = 5,29,500$, $A_{Rj} = 8.20$

Labour : $N_{Si} \times T_{Si} = 150000 \times \frac{3}{4} = 1,12,500$ $N_{Aj} \times T_{Aj} = 1,25,000$

$R_{Si} = \frac{2992500}{112500} = 26.6$, $\frac{A_O}{S_O} = \frac{16000}{15000} = \frac{16}{15}$, $R_{Aj} = \frac{3375000}{125000} = 27$

- (a) Material Price variance = $\sum_{i=1}^n A_j(S_{Ri} - A_{Rj})$
 $= 529500 \times (8 - 8.20)$
 $= -105900 = ₹ 1,05,900 (A)$
- (b) Material usage variance = $\sum_{i=1}^n S_{Ri} (S_i \times \frac{A_Y}{S_Y} - A_j)$
 $= 8 (495000 \times \frac{16}{15} - 529500)$
 $= 8 \times (528000 - 529500)$
 $= 8 \times (-1500)$
 $= (-12000) = ₹ 12000 (A)$
- (c) Material Cost variance = $\sum_{i=1}^n [(\frac{A_Y}{S_Y} \times S_i \times S_{Ri}) - (A_j \times A_{Rj})]$
 $= (495000 \times \frac{16}{15} \times 8) - (529500 \times 8.20)$
 $= 4224000 - 4341900$
 $= (-117900) = ₹ 1,17,900 (A)$
- (d) Labour rate variance = $\sum_{i=1}^n (N_{Aj} \times T_{Aj}(R_{Si} - R_{Aj}))$
 $= 125000 (26.6 - 27)$
 $= (-50000) = ₹ 50,000 (A)$
- (e) Labour efficiency variance = $\sum_{i=1}^n [R_{Si} \{(\frac{A_O}{S_O} \times N_{Si} \times T_{Si}) - (N_{Aj} \times T_{Aj})\}]$
 $= 26.6 [(\frac{16}{15} \times 112500) - (125000)]$

$$\begin{aligned}
&= 26.6 (120000 - 125000) \\
&= 26.6 (-5000) \\
&= (-133000) = ₹ 1,33,000 (A) \\
\text{(f) Labour Cost variance} &= \sum_{i=1}^n \left[\frac{A_o}{S_o} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\
&= \left(\frac{16}{15} \times 112500 \times 26.6 \right) - (125000 \times 27) \\
&= 3192000 - 3375000 \\
&= (-183000) = ₹ 1,83,000 (A)
\end{aligned}$$

Problem :

You have been appointed as Management Accountant of SM Ltd. Given below is the company's operating P&L statement for the month of April, 1988.

	Standard and Variances (₹)	Actual (₹)
Budgeted sales :	90,000	
Variance due to :		
Volume of orders	5,000	
Selling price	2,000	97,000
Budgeted Profit :	19,000	
Variance due to :		
Sales volume	1,200	
Selling price	2,000	22,200
Production cost variance		
Material		
Price	750	
Usage	(300)	450
Labour		
Rate	(1250)	
Efficiency	(500)	(1750)
Overhead Expenditure		
Fixed	500	
Variable	(1250)	
Efficiency	1000	
Capacity	500	750
		(550)
		21650

The costing department provides you with the following information about sales and cost for the month of May, 1988

Product	Standard Cost Per unit (₹)	Budgeted sales		Actual sales	
		No of units	Sales value (₹)	No of units	Sales value
A	31	1250	50000	1400	54000
B	25	1000	30000	950	27500
C	15	750	15000	900	17500

Material:	₹
Standard cost of material actually used	26,150
Standard cost of material allowed	26,650
Actual cost of material used	27,150

Labour:	
Standard labour cost per hour	0.90
Actual clocked hours	22,000 hours
Actual labour cost (₹)	21,300
Budgeted hours	20,000 hours
Standard hours produced	22,500 hours

Overheads:	
Budgeted rates of overhead recovery per direct labour hour	
Variable ₹ 1.00	Fixed ₹ 0.50
Actual overhead cost	
Variable ₹ 21,500	Fixed ₹ 12,000

Prepare an operating P&L statement for May, 1988 in the same as for April, 1988

(ICWA Final June, 1988)

Solution:

Standard and variances (₹)	Actual (₹)

Budgeted sales 95,000

Variance due to

Volume of orders

$$40(1400-1250)+30(950-1000)+20(900-750)= 7500 \text{ F}$$

$$1400\left(\frac{54000}{1400}-40\right)+950\left(\frac{27500}{950}-30\right)+900\left(\frac{17500}{900}-20\right)= (3500)\text{A} \quad 99,000$$

Budgeted profit:

$$(1250 \times 9) + (1000 \times 5) + (750 \times 5) = 20,000$$

Variance due to

Sales volume:

$$9(1400-1250)+5(950-1000)+5(900-750)= 1850 \text{ F}$$

Selling price:

$$1400\left(\frac{54000}{1400}-40\right)+950\left(\frac{27500}{950}-30\right)+900\left(\frac{17500}{900}-20\right)= (3500)\text{A} \quad 18,350$$

Production cost variance

Material:

$$\text{Price} = \sum_{i=1}^n A_j (S_{Ri} - A_{Rj})$$

$$(26150 - 27150) = (1000)\text{A}$$

$$\text{Usage} = \sum_{i=1}^n S_{Ri} \left(S_i \times \frac{A_Y}{S_Y} - A_j \right)$$

$$(26650 - 26150) = 500 \text{ F} \quad (500)\text{A}$$

Labour:

$$\text{Rate} = 22000(0.90) - 21300 = (1500)\text{A}$$

Efficiency=

$$\sum_{i=1}^n \left[R_{Si} \left\{ \left(\frac{A_o}{S_o} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]$$

$$=(22500 \times 0.90 - 22000 \times 0.90) = 450 \text{ F} \quad (1050)\text{A}$$

Overhead Expenditure:

Fixed:

$$\text{Expenditure} = (2000 \times 0.50 - 12000) = (2000)\text{A}$$

$$\text{Efficiency} = 0.5(22500 - 22000) = 250 \text{ F}$$

$$\text{Capacity} = 0.5(22000 - 20000) = 1000 \text{ F}$$

Variable:

$$\text{Expenditure} = 22000 - 21500 = 500 \text{ F}$$

$$\text{Efficiency} = 22500 - 22000 = 500 \text{ F} \quad 250 \text{ F}$$

Operating Profit (₹) = 17,050

Problem: Budgeted and actual sales for the month of December, 1984 for two products A and B of Messer's XY Ltd. were as follows:

Product	Budgeted units	Sales price/unit (₹)	Actual	
			Units	Price/unit (₹)
A	6,000	5.00	5,000	5.00
			1,500	4.75
B	10,000	2.00	7,500	2.00
			1,750	1.90

Budgeted costs for products A and B were ₹ 4.00 and ₹ 1.50 per unit respectively. Work out from the above data the following variances.

(i) Sales value variance

(ii) Sales volume variance

(iii) Sales price variance

(iv) Sales mixture variance

(v) Sales quantity variance

(ICWA Inter June, 1985 & Dec, 1984)

Solution:

$$(i) \text{ Sales value variance} = \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i)$$

$$= [(5000 \times 5 + 1500 \times 4.75) - (6000 \times 5)] + [(7500 \times 2 + 1750 \times 1.9) - (10000 \times 2)]$$

$$= [(25000 + 7125) - 30000] + [(15000 + 3325) - 20000]$$

$$= (32125 - 30000) + (18325 - 20000)$$

$$= 2125 + (-1675)$$

$$= ₹ 450 (F)$$

$$(ii) \text{ Sales price variance} = \sum_{i=j=1}^n [N_j (S_j - S_i)]$$

$$= [5000(5 - 5) + 1500(4.75 - 5)] + [7500(2 - 2) + 1750(1.9 - 2)]$$

$$= (-375) + (-175)$$

$$= ₹ 550 (A)$$

$$(iii) \text{ Sales volume variance} = \sum_{i=j=1}^n S_i (N_j - N_i)$$

$$= [5(6500 - 6000)] + [2(9250 - 10000)]$$

$$= 5(500) + 2(-750)$$

$$= 2500 - 1500$$

$$= ₹ 1000 (F)$$

$$\begin{aligned}
 \text{(iv) Sales mixture variance} &= \sum_{i=j=1}^n Si [Nj - (\frac{Ni \times \sum_{j=1}^n Nj}{\sum_{i=1}^n Ni})] \\
 &= [5(6500 - 6000 \times (\frac{15750}{16000}))] + [2(92500 - 10000 \times (\frac{15750}{16000}))] \\
 &= 5(6500 - 5906) + 2(9250 - 9844) \\
 &= 2970 - 1188 \\
 &= ₹ 1782 (F)
 \end{aligned}$$

$$\begin{aligned}
 \text{(v) Sales quantity variance} &= \sum_{i=j=1}^n Si (\frac{Ni \times \sum_{j=1}^n Nj}{\sum_{i=1}^n Ni} - Ni)] \\
 &= [5(6000 \times \frac{15750}{16000} - 6000)] + [2(10000 \times \frac{15750}{16000} - 10000)] \\
 &= 5(5906 - 6000) + 2(9844 - 10000) \\
 &= (- 470) + (- 312) \\
 &= ₹ 782 (A)
 \end{aligned}$$

Reconciliation:

$$\begin{aligned}
 \text{Sales price variance} + \text{Sales volume variance} &= 550 (A) + 1000 (F) \\
 &= 450 (F) \\
 &= \text{Sales value variance} \\
 \text{Sales mix variance} + \text{Sales quantity variance} &= 1782 (F) + 782 (A) \\
 &= 1000 (F) \\
 &= \text{Sales volume variance}
 \end{aligned}$$

Problem:

X ltd. Operates a budgetary control and standard costing system. From the following data calculate.

- (i) Sales variance
- (ii) Sales price variance
- (iii) Sales volume variance

Product	Budgeted		Actual	
	Units to be	sales value	Units sold	Sales value
	Sold	(₹)		(₹)
A	100	1200	100	1100
B	50	600	50	600
C	100	900	200	1700
D	75	450	50	300

Total	325	3150	400	3700

(C.S. Final June, 1987)

Solution: Let us first of all find out the selling price of the various products per unit

Product	Budgeted selling per unit	Actual selling price per unit
A	$\frac{1200}{100} = ₹ 12$	$\frac{1100}{100} = ₹ 11$
B	$\frac{600}{50} = ₹ 12$	$\frac{600}{50} = ₹ 12$
C	$\frac{900}{100} = ₹ 9$	$\frac{1700}{200} = ₹ 8.50$
D	$\frac{450}{75} = ₹ 6$	$\frac{300}{50} = ₹ 6$

$$\sum_{i=1}^n N_i = 325 \quad \text{and} \quad \sum_{i=1}^n S_i \times N_i = ₹ 3150 \quad \sum_{j=1}^n S_j \times N_j = ₹ 3700$$

$$\sum_{i=1}^n N_j = 400$$

$$(i) \text{ Sales variance} = \sum_{i=j=1}^n (S_j \times N_j - S_i \times N_i)$$

$$= 3700 - 3150$$

$$= ₹ 550 (F)$$

$$(ii) \text{ Sales price variance} = \sum_{i=j=i}^n [N_j (S_j - S_i)]$$

$$= [100(11 - 12)] + [50(12 - 12)] + [200(8.5 - 9)] + [50(6 - 6)]$$

$$= (-100) + 0 + (-100) + 0$$

$$= 200 (A)$$

$$(iii) \text{ Sales volume variance} = \sum_{i=j=1}^n S_i (N_j - N_i)$$

$$= [12(100 - 100)] + [12(50 - 50)] + [9(200 - 100)] + [6(50 - 75)]$$

$$= (12 \times 0) + (12 \times 0) + 9(100) + 6(-25)$$

$$= 900 - 150$$

$$= 750 (F)$$

Problem: Compute the following variances from the data given below

- (1) Total sales margin variance.
- (2) Sales margin volume variance.
- (3) Sales margin price variance.
- (4) Sales margin quantity variance.

(5) Sales margin mix variance.

Product	Budgeted quantity (units)	Actual quantity (units)	Budgeted sales price per unit (₹)	Actual sales price per unit (₹)	Standard cost per unit (₹)
X	240	400	50	45	30
Y	160	200	25	20	15

Solution: Here $\sum_{i=1}^n N_i = 240 + 160 = 400$ and $\sum_{i=1}^n N_j = 400 + 200 = 600$

$$\begin{aligned}
 (1) \text{ Total sales margin variance} &= \sum_{i=j=1}^n [N_j \times (S_j - C_j) - N_i(S_i - C_i)] \\
 &= [400(45 - 30) - 240(50 - 30)] + [200(20 - 15) - 160(25 - 15)] \\
 &= [400 \times 15 - 240 \times 20] + [200 \times 5 - 160 \times 10] \\
 &= [6000 - 4800] + [1000 - 1600] \\
 &= 1200 - 600 \\
 &= ₹ 600 (F)
 \end{aligned}$$

$$\begin{aligned}
 (2) \text{ Sales margin volume variance} &= \sum_{i=j=i}^n [(S_i - C_i)(N_j - N_i)] \\
 &= [(50 - 30)(400 - 240)] + [(25 - 15)(200 - 160)] \\
 &= (20 \times 160) + (10 \times 40) \\
 &= 3200 + 400 \\
 &= ₹ 3600 (F)
 \end{aligned}$$

$$\begin{aligned}
 (3) \text{ Sales margin price variance} &= \sum_{i=j=i}^n [N_j(S_j - S_i)] \\
 &= [400 \times (45 - 50)] + [200 \times (20 - 25)] \\
 &= - 2000 - 1000 \\
 &= ₹ 3000 (A)
 \end{aligned}$$

$$\begin{aligned}
 (4) \text{ Sales margin quantity variance} &= \sum_{i=j=i}^n (S_i - C_i) [(N_i \frac{\sum N_j}{\sum N_i}) - N_i] \\
 &= [(50 - 30)(240 \times \frac{600}{400} - 240)] + [(25 - 15)(160 \times \frac{600}{400} - 160)] \\
 &= [20(360 - 240)] + [10(240 - 160)] \\
 &= 2400 + 800 \\
 &= ₹ 3200 (F)
 \end{aligned}$$

$$\begin{aligned}
 (5) \text{ Sales margin mix variance} &= \sum_{i=j=i}^n [(S_i - C_i)(N_j - N_i \times \frac{\sum N_j}{\sum N_i})] \\
 &= [(50 - 30)(400 - 240 \times \frac{600}{400})] + [(25 - 15)(200 - 160 \times \frac{600}{400})]
 \end{aligned}$$

$$\begin{aligned}
 &= 20(400 - 360) + 10(200 - 240) \\
 &= (20 \times 40) + (10 \times (-40)) \\
 &= 800 - 400 \\
 &= ₹ 400 (F)
 \end{aligned}$$

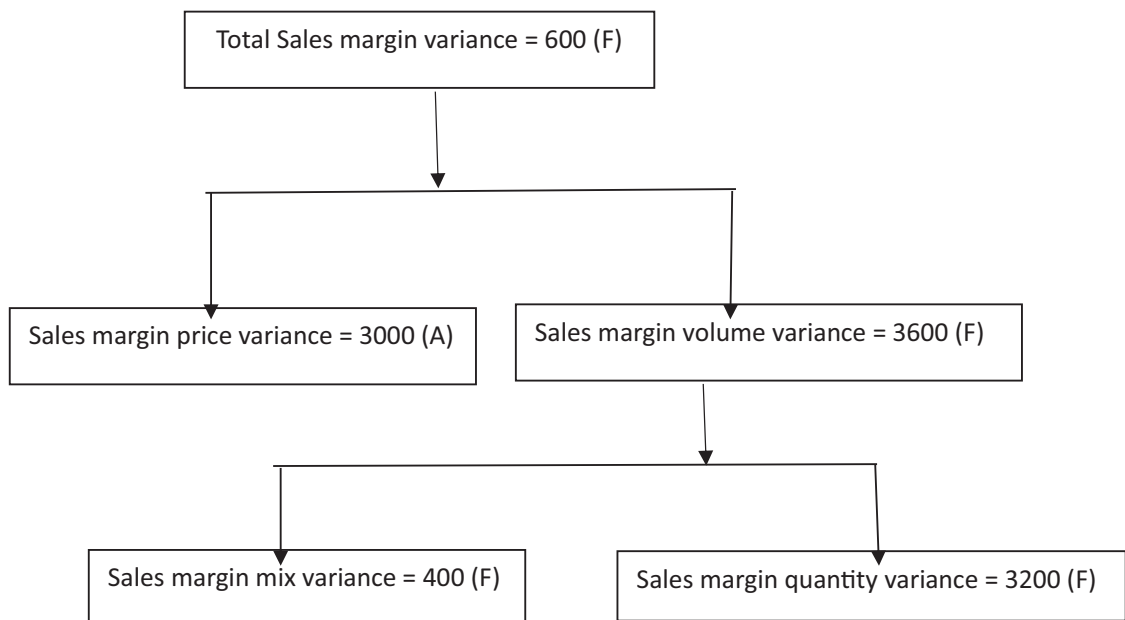
Reconciliation:

Sales margin volume variance + Sales margin price variance

$$\begin{aligned}
 &= 3600 (F) + 3000 (A) \\
 &= 600 (F) \\
 &= \text{Total sales margin variance}
 \end{aligned}$$

Sales margin quantity variance + Sales margin mix variance

$$\begin{aligned}
 &= 3200 (F) + 400 (F) \\
 &= 3600 (F) \\
 &= \text{Sales margin volume variance}
 \end{aligned}$$



Numerical problems for practice

Prob. 1 From the data given below for a production unit, calculate the material cost variances. Standard material 12500 units @ ₹20 per unit is required for an output of 1250 units. Actual data shows that for the same output the material used was 12600 units @ ₹19.5 per unit.

Ans. [MCV= 4300 F, MPV= 6300 F, MUV= 2000 A, MYV= 2000 A]

Prob. 2: Depending upon the past performances the management of the company prepared the following standard data to have a control over the material input cost.

Material type	Quantity required	Cost per Kg (₹)
Material A	1350 Kg	20.00
Material B	650 Kg	21.00
	<u>2000 Kg</u>	

Standard yield = 1800 Kg

In the particular production period the actual input and output of the material is:

Material type	Quantity	Cost per Kg (₹)
Material A	1500 Kg	19.5
Material B	500 Kg	22.00
	<u>2000 Kg</u>	

Actual output = 1850 Kg

Ans. [MCV= 1529(F), MPV = 250 (F), MUV = 1279 (F), MMV = 150(F), MYV =1129 (F)]

Prob. 3: You are required to calculate the possible material variances.

Standard			Actual		
Material	Input (Units)	Cost per unit (₹)	Material	Input (Units)	Cost per unit (₹)
A	1400	6	A	1500	5
B	400	5	B	300	5
C	200	4	C	350	3.8
	<u>2000</u>			<u>2150</u>	

Yield Standard = 1750

Yield Actual = 1800

Ans. [MPV = 1570(F), MUV = 380(A), MMV = 140(F), MYV = 520 (A), MCV = 1190(F)]

Q. 4 Standard cost of a chemical mixture is as:

40% of C @ ₹20 per Kg

60% of D @ ₹30 per Kg

Standard loss of 10% of input is expected in production. The actual records for a period showed the following usage:

90 Kg of C at a cost of ₹18 per Kg

110 Kg of D at a cost of ₹34 per Kg

The quantity produced was 182 Kg of good product. Calculate the all possible material variances.

(B.Com. Punjab)

Ans. [MCV = 102.22 (A), MPV = 260(A), MUV = 157.78(F), MMV = 100(F), MYV =57.78(F)]

Q 5. XYZ Ltd. manufacturers of product P, uses a standard cost system. Standard production and cost specification for 1000 Kg of product P are as follows.

Ingredients	Quantity (Kg)	Price per Kg (₹)	Cost (₹)
X	800	2.50	2000
Y	200	4.00	800
Z	200	1.00	200
Input	1200		3000 = ₹2.50/Kg
Output	1000		3000 = ₹3 /kg

Material records indicates:

Ingredients	Consumption in January	Price per Kg(₹)
X	157000 Kg	2.40
Y	38000 Kg	4.20
Z	36000 Kg	1.10

Actual finished production for the month is 200000 Kg. Calculate material variances.

Ans. [MCV = 24000 (F), MPV = 4500 (F), MUV = 19500 (F), MMV = 3000 (A), MYV = 22500(F)]

Q 6. A manufacturing unit is producing a product named cheerful. The standard and actual data relating to the production is given as under:

	<u>Standard Data</u>		<u>Actual Data</u>	
Material	Quantity of input (Liter)	Cost per liter	Quantity in units (Liter)	Cost per liter
Tender	1300	12	1400	11.50
Soft	500	11	400	10
Polite	200	10	200	11
	2000		2000	

Cheerful output = 1750

Actual Output = 1800

Ans. [MCV = 1460(F), MPV = 900(F), MUV = 560 (F), MMV = 100(A), MYV = 660(F)]

Q. 7 From the data given below calculate all variances.

Standard Data

Material	Required quantity (Volume) m ³	Price per m ³ (₹)
Type A	10	8
Type B	8	6
Type C	4	12

Standard Yield = 22 m³

Actual production

Material	Quantity used (Volume) m ³	Price per m ³ (₹)
Type A	10	7
Type B	9	7
Type C	5	11

Actual Yield = 22 m³

Ans. [MCV = 12 (A), MPV = 6(F), MUV = 18 (A), MMV = 2(A), MYV = 16(A)]

Q. 8 :From the following table you are required to fill the figures which are missing,

Input Material		
	A	B
Standard price per unit (₹)	12	15
Actual Price per unit (₹)	15	20
Standard input (Units)	50	-----
Actual input (units)	-----	70
Material price variance (₹)	-----	-----
Material usage (₹)	-----	300 A
Material Cost Variance (₹)	-----	-----

Material mix variance of the sample = ₹45 A

Ans. [Standard input of B= 50 units, Actual input of A = 40 units, MPV of A = 120 A, MPV of B = 350A, MUV of A= 120 F, MCV of A= Nil, MCV of B = 650 A]

Q 9. Standards of a company shows that 8 tons of X when mixed with 12 tons of Y, yield 18 tons of Z product whereas 26.5 tons of Z product was the actual outcome after mixing 10 tons of X and 20 tons of Y. The standard price of the input material X and Y per ton was ₹40 and ₹60 respectively and actual price was ₹30 and ₹68 respectively.

Calculate material variance to help the management.

Ans. [MCV = 129 A, MPV = 60A, MUV = 69A, MMV = 40A, MYV = 29 A]

Q. 10 25 kg of 'O' product is the standard output of two inputs 'M' 15 kg purchased at ₹5 per kg and 'N' 20 kg purchased at ₹6 per kg.

Actually 28 kg of 'O' product was produced from the same two inputs 'M' 22 kg purchased at ₹5 per kg and 'N' 20 kg purchased at ₹ 6.5 per kg.

For decision making process, quantitative analysis of relating variances as many as possible is required. Please calculate.

Ans. [MCV= ₹ 21.6 A, MPV = ₹ 10 A, MUV = ₹ 11.6 A, MMV = ₹ 4F, MYV= ₹15.6A]

Labour variance

Q. 11 In a production unit the past experience shows that 500 labour hours @ ₹10 per hour is needed for a particular production.

In the actual production only 300 labour hours @ ₹12 per hour produced the same units of finished product. You are required to calculate the labour variances as far as possible.

Ans. [LCV= ₹ 1400F, LRV= ₹ 600 A, L eff. variance= ₹2000 F]

Q. 12 Standards of a company and the actual position regarding the labour required for production is as under.

Standard: 500 men paid @ ₹250 per month working 25 days per month produced 32000 units.

Actual: 600 men paid @ ₹264 per month worked for 24 days in the month produced 40000 units. Please find out the total cost, rate and efficiency variance of the labour force.

Ans. [LCV= ₹2150 A, LRV= ₹14400 A, LEV= ₹12250 F]

Q. 13. In a factory section there are 80 workers and the average wages per worker is ₹0.50 per hour. Standard working hours per week are 45 and the standard performance is 6 units per hour.

During the four weeks in February wages paid for 40 workers were ₹0.50 per hour for 15 workers @ ₹0.60 per hour and for 25 workers @ ₹0.40 per hour. The section did not work for 4 hours due to breakdown of machinery. Workout the labour rate variance for the section for 4 weeks.

Ans. [Labour rate variance = ₹180 favourable]

Q. 14 The standard hours for manufacturing two products M and N are 15 hours per unit and 20 hours per unit respectively. Both products require identical kind of labour and the standard wage rate per hour is ₹5. In the year 2001, 10000 units of 'M' and 15000 units of 'N' were manufactured. The total labour actually worked were 450500 and the actual wage bill came to ₹2300000. This included 12000 hours paid for @ ₹7.50 per hour, the balance having been paid @ ₹5 per hour. You are required to compute the labour variances.

(B.Com. Hons. Delhi 2008 modified)

Ans. [LCV= ₹50000 A, LRV= ₹47500 A, LEV= ₹2500 A]

Q. 15 From the information regarding standard and actual labour required in a production unit given below. Calculate labour cost, rate, efficiency, mix and yield variances.

Standard:

Labour type	Number of labour hours	working hours per week	Rate per hour (₹)
A	20	40	0.75
B	20	40	1.25
C	10	40	1.50

Actual

Labour type	Number of labour hours	working hours per week	Rate per hour (₹)
A	22	40	0.8
B	21	40	1.2
C	7	40	1.4

During actual production 1 hour was wasted due to unavoidable reason.

Ans. [LCV= 96F, LRV= 26F, T.L.E.V. = 70 F, LEV= 123.25F, Idle time variance = 53.25A, LMV = 68.25F, LYV = 55 F]

Q. 16 A gang of labour consisting men, women and children with past experience numbers 40, 35 and 25 respectively working 48 hours in a week were given ₹6, ₹5 and ₹4 per hour of work in production. In a particular week of 48 hours of work 50 men, 30 women and 20 children were engaged at hourly wage of ₹5.5, ₹5.2 and ₹4.1 respectively in the same work. 2 hours were wasted due to some repair work. Calculate (i) Labour cost variance (ii) labour rate variance (iii) Labour efficiency variance (iv) idle time variance (v) Labour mix variance (vi) Labour yield variance.

An. [LCV= 96F, LRV = 816F, T.L.Eff. V. = 720A, LEV = 340F, idle time variance = 1060A, LMV= 690A, LYV = 1030F]

OVERHEAD VARIANCE

Q. 17 Production unit daily working for 8 hours and 25 days in a month produces 1000 finished unit of a product. The budgeted fixed overhead expenses incurred were ₹48000.

It was calculated in the month of January, 2010 that to maintain and utilize the same capacity the overhead actually incurred were ₹47500 for an output of 980 finished units. Find out the various relating variances to help the management.

Ans. [TF over variance= 460A, F exp. V = 500F, F vol. variance= 960A, Eff. variance= 960A]

Q. 18 The standard data developed through past experiences for cost control purposes shows that ₹ 250000 are needed for production of 500 units with 400 man hours working daily for 24 days.

In actual practice ₹260000 overhead cost incurred for production of 510 units with 400 man hours working daily for 25 days.

From above calculate the possible variances.

Ans. [F. O. cost V= ₹5000A, Exp. V= ₹10000A, Volume variance= ₹5000F, Eff. Variance= ₹5416.67A, Capa. V= NIL, Calendar V= 10416.67F]

Q. 19 A manufacturer operating a standard costing system had the following data in respect of a month:

	Standard	Actual
No. of working days	25	27
Man hours per day	5000	5400
Output units	500	525
Fixed overheads (₹)	2500	2400

Calculate fixed overhead variances for the month.

Ans. [T. F. O. cost variance= 225F, F. O. Exp. variance= 100F, F. O. Vol. variance= 125F, Eff. variance= 291A, Capacity V=216F, F. O. calendar variance= 200F]

Q. 20 A factory operates a system of standard costs for a given four week period budgeted for production of 2000 units. Actual production was 1800 units. Costs relating to the period were as under:

	Standard	Actual
Fixed overheads	80000	74000
Variable overheads	40000	38000
Semi variable overheads	15000	14700

Semi variable overheads are 60% fixed and 40% variable. Prepare a variance statement to be presented before the management.

Ans. [F. O. Vol. variance= 8000A, V. o. Exp. V. = 2000A, F. semi variable Exp. =180F, F. o. Exp. variance= 6000F, F. semi variable vol. = 900A, V. semi variable Exp. = 480A]

Q. 21 From the information about the standard and actual overhead cost of a unit is given and you are asked to calculate the various variances as far as possible.

Budgeted fixed overheads ₹ 400000

Budgeted days of work (monthly) 25

Budgeted hours of work per day 5000

Output in units 250000

Actual fixed overheads ₹ 440000

Actual days of working (Monthly) 27

Actual hours worked per day 5500

Output in units 255000

Ans. [TFO variance= 32000A, Efficiency Variance= 67200A, Exp. Var. = 40000A, Vol. Variance = 8000F, F. O. Capacity Variance =43200F, F.O.cal. Variance = 32000F]

Q. 22 You working as a cost accountant in a unit of production, assigned to quantitatively give the report on fixed overhead cost variance for a cost control purpose by the management of the unit. The data presented to you is as below:

	Budgeted	Actual
Units of production	10000	12000
Operating days in a month	24	28
working hours per day	4000	4100
Fixed overheads (₹)	550000	520000

Ans. [F. O. cost variance= ₹140000 F, F.O. variance= ₹2291.67 F, F.O. Exp. variance= ₹30000 F, F. O. Cap. variance= ₹16041.67 F, F.O. Vol. variance= 110000 F, F. o. Cal. Variance= ₹91666.67 F]

Sales Variance

Q. 23 Information:

Standard: 1100 units of product cost @ ₹45/- per unit. sold @ ₹50/-.

Actual 1300 units of product sold @ ₹55/- per unit. Calculate sales variance depending upon the sales value.

Ans. [Total sales value variance= 16500 F, Variance due to S. price= 6500F, Variance due to volume= 1000F]

Q. 24 Find out the sales margin variances from the following

standard 5000 units costing ₹20 per unit sold @ ₹25 per unit.

Actual 4800 units sold @ ₹26 per unit.

Ans. [T. Sales margin variance = ₹3800F, Sales margin variance due to selling price = ₹4800F, due to volume = ₹1000 A]

Q. 25 The following data has been taken from a unit of business selling two products S and T.

Standard

	Units sold	Cost per unit ₹	Selling Price per unit ₹
S	1500	20	30
T	1000	40	50

Actual

	Units sold	Cost per unit ₹	Selling Price per unit ₹
S	2000	-----	29
T	700	-----	50

Calculate various sales variance due to sales value.

Ans. [Sales value variance due to selling price = ₹2000A, due to volume = 0, due to sales mix = 7600A]

Q. 26. From the data given below you are required to quantitatively analyze the sales variances due to sales value.

Standard			Actual	
Product Name	Units sold	Selling Price	Units sold	Selling price
X	1200	15	880	18
Y	800	20	880	20
Z	2000	40	2640	38
Total	4000		4400	

Ans. Sales value variance due to selling price = ₹2640 A
 { Due to volume = ₹22400 F
 due to sales mix = ₹11000 F
 due to quantity = ₹11400 F }

Q. 27 Calculate sales variances due to margin from the following information:

Standard				Actual	
Product Name	Units sold	Cost ₹	Sales Price ₹	Units sold	Selling price
X	1200	10	15	880	18
Y	800	15	20	880	20
Z	2000	35	40	2640	38
Total	4000			4400	

Ans. [Total margin variance = ₹640 A, Due to volume = ₹2000F, Due to selling price = ₹2640, Due to quantity = ₹2000 F]

Q. 28 Active and smart two products are manufactured and sold by a production unit. The following is the data given by the management of the unit regarding the standard and actually functioning of the unit.

Standard : 240 units of active manufactured at a total cost of ₹7200 and sold for ₹12000. 160 units of smart manufactured at a total cost of ₹2400 and sold for ₹4000.

Actual: 400 unit of active manufactured and sold for ₹18000.

200 units of smart manufactured and sold for ₹4000.

Calculate various sales margin variances.

Ans. [Total sales variance = 600F, Due to sales price = 3000F, Due to volume = 3600F, Due to sales mix = 400F, Due to quantity = 3200F]

Q. 29. You are appointed as cost accountant of a company. Given below is the company's operating report for March, 1986:

	Standard and variance ₹	Actual ₹
Sales-Budgeted	18000	
Variance due to Volume of orders Selling price	1000F 400F	19400
Profit budgeted	3800	
Variance due to Sales volume Sales price	240F 400F	4440
Production cost variance Labour – rate efficiency	(250)A (100)A	(350)A
Material -Price -usage	150F (60)A	90F
Overhead expenditure –Fixed -variable -efficiency -capacity	100F (250)A 200F 100F	150F
Operating- Profit		4330

Your assistant provide you the following information about sales and costs for April, 1986.

Sales	Budgeted units	Sales value ₹	Actual units	Sales value
Product A	250	10000	280	10800
Product B	200	6000	190	5500

Product C	150	3000	180	3500
		19000		19800
Product	Standard selling price per unit (₹)		Standard Product cost per unit (₹)	
A	40		31	
B	30		25	
C	20		15	

		₹
Labour: Standard labour cost per hour		0.90
Budgeted hours		4000
Actual clocked hours		4400
Standard hours produced		4500
Actual labour cost		4260
Material: Standard cost of material actually used		5230
Standard cost of material allowed		5330
Actual cost of material used		5430
Overheads: Budgeted rates of overhead recovery		
per labour hour -	Fixed	0.50
	variable	1.00
		1.50
Actual overhead costs:	Fixed	2000
	Variable	4300
		6300

Required- Prepare the operating statement for April, 1986 in the same form as for March, 1986.

(C. A. Final May, 1986)

Hint: Sales : Margin variance due to S.P. = $\sum_{i=j=1}^n [N_j(S_j - S_i)]$
 $= 280(\frac{10800}{280} - 40) + 190(\frac{5500}{190} - 30) + 180(\frac{3500}{180} - 20)$
 $= -400 - 200 - 100$
 $= 700(A)$
Due to volume = $\sum_{i=j=1}^n [(S_i - C_i)(N_j - N_i)]$
 $= 9(280 - 250) + 5(190 - 200) + 5(180 - 150)$
 $= 270 - 50 + 150 = 370(F)$

Labour:

$$\begin{aligned} \text{Rate variance} &= \sum_{i=j=1}^n [N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})] \\ &= 4400(0.9 - \frac{4260}{4400}) \\ &= 300 (A) \\ \text{Efficiency variance} &= \sum_{i=j=1}^n [R_{Si} (\frac{A_o}{S_o} \times N_{SL} \times T_{SL}) - (N_{Aj} \times T_{Aj})] \\ &= 0.9(4500 - 4400) \\ &= 90 (F) \end{aligned}$$

Material:

$$\begin{aligned} \text{Material price variance} &= \sum_{i=j=1}^n A_j (S_{Ri} - A_{Rj}) \\ &= 5230 - 5430 \\ &= 200 (A) \\ \text{Material usage variance} &= \sum_{i=j=1}^n S_{Ri} [S_i \times \frac{A_y}{S_y} - A_j] \\ &= 5330 - 5230 \\ &= 100 (F) \end{aligned}$$

Fixed overhead:

$$\begin{aligned} \text{Expenditure} &= SR \times BT - AR \times AT \\ &= 0.5 \times 4000 - 2000 \\ &= \text{Nil} \\ \text{Volume variance} &= SR(ST - BT) \\ &= 0.5(4500 - 4000) \\ &= 250 (F) \end{aligned}$$

Variable overhead:

$$\begin{aligned} \text{Efficiency} &= SR(ST - AT) \\ &= 1(4500 - 4400) \\ &= 100 (F) \\ \text{Exp.} &= AT(SR - AR) \end{aligned}$$

$$= 4400(1 - \frac{4300}{4400})$$

$$= 100 \text{ (F)}$$

Q. 30 Finding out the missing figures.

Compute the missing data indicated by the question marks from the following:

	Product R	Product S
Sales quantity		
Standard (units)	?	400
Actual (Units)	500	?
Price unit		
Standard (₹)	12	15
Actual (₹)	15	20
Sales price variance	?	
Sales volume variance	₹ 1200 F	
Sale Value variance	?	

Sales mix variance for both the products together was ₹450 F.

(C. A. Inter. Nov. 1988)

Hint: As sales volume variance for R = ₹1200 F
So $12(500 - y) = 1200$

$$\Rightarrow y = 400 \text{ units}$$

Sale price variance for R = $500(15 - 12) = 1500 \text{ F}$

Sales value variance for R = $1200 + 1500$
= 2700 F

we are given that sales mix variance for both = 450

So $\sum_{i=1}^n Si[Nj - (\frac{Ni \times \sum Nj}{\sum Ni})]$

$$= 12 [500 - \frac{400 \times (500 + x)}{800}] + 15 [x - \frac{400 \times (500 + x)}{800}] = 450$$

$$6000 - 6(500 + x) + 15x - \frac{15}{2}(500 + x) = 450$$

$$6000 - 3000 - 6x + 15x - 3750 - 7.5x = 450$$

$$1.5x = 450 + 750$$

$$1.5x = 1200$$

$$x = 800$$

So missing figures are as:

Standard unit of product R = y = 400 units

Actual unit of product S = x = 800 units

Selling price variance Product R = 1500 (F)

sales value variance of product R = 2700 (F)

Hence the result.

Q. 31 A factory is planning to produce and sell 8000 units of product P during operating period.

Its standard product unit and total costs are as follows:

Cost per unit (₹)

Direct material 1.111 units @ ₹5.40 per unit = 6.00

Direct labour 0.6 hours @ ₹5.00 per hour = 3.00

Variable overhead 0.6 hours @ ₹0.50 per hour = 0.30

Fixed overheads = 5.95

The product sells for ₹16.50/unit

The following data relate to the actual results for the 4-week period.

Actual orders received for the 4-week period = 8200 units

Actual sales = 7500 units

Actual production = 7500 units

Units of direct material purchased and issued to production = 7750 units

Direct material price per unit = ₹5.60

Direct labour hours = 4700

Direct labour rate (per hour) = 5.25

The total overhead expenditure amounted to ₹ 49,000 of which variable overhead was ₹ 2150.

You are required to:

- Produce an operating control statement which analyses the budget actual comparison for the four week period.
- Arrange the results you have produced in a way which will improve managements understanding the interpretation of their meaning, explaining the basis of the presentation you have adopted.

(C.I.M.A. London – Nov. 1989)

Sol. Hint:

Here BQ = 8000 units

B. hours = 8000×0.6
 BT = 4800 hours
 Standard hours ST = 7500×0.6
 = 4500 hours
 Actual hours AT = 4700 hours
 For fixed overheads
 Standard rate SR = $\frac{5.95}{0.6}/\text{hr.}$

$$= \frac{59.5}{6}/\text{hr.}$$

$$\text{Actual rate AR} = \frac{49000 - 2150}{4700} = \frac{4685}{470}/\text{hr.}$$

(i) Operation control statement as required.

	Original budget 8000 units	Flexible budget 7500 units	Actual 7500 units(₹)	Variance (₹)
Direct material	48000	45000	43400	1600 F
Direct labour	24000	22500	24675	2175 A
Variable overhead	2400	2250	2150	100 F
Fixed overhead	47600	47600	46850	750 F
Total costs	122000	117350	117075	275 F
Profit	10000	6400	6675	275 F
Sales	132000	123750	123750	-----

(ii) Analysis of variances in a systematic and understandable to the management for decision making.

Here actual quantity of raw material AQ = 7750 units

Actual rate AR = ₹5.60/unit

Standard quantity SQ = 7500×1.111
 = 8333.3 units

Standard rate SR = ₹5.40/unit

Material price variance = $AQ(SR - AR)$
 = $7750(5.40 - 5.60)$
 = 1550 A

Material usage variance = $SR(SQ - AQ)$
 = $5.40(8333.3 - 7750)$
 = ₹3150 F

So material cost variance = $3150 + (-1550) = ₹1600 F$

Labour rate variance = $AH(SR - AR)$
 = $4700(5 - 5.25)$
 = ₹1175 A

Labour efficiency variance = $SR(SH - AH)$
 = $5(4500 - 4700)$
 = ₹1000 A

Total labour cost variance = $1175 A + 1000 A$
 = ₹2175 A

Variable overhead expense variance = $AT(SR - AR)$
 = $4700(0.5 - \frac{2150}{4700})$
 = $2350 - 2150 = ₹200 F$

Variable overhead efficiency variance = $SR(ST - AT)$
 = $0.5(4500 - 4700)$
 = $0.5(-200) = ₹100 A$

Total variable overhead cost variance = $200F + 100A$
 = ₹100 F

Standard fixed overheads absorbed at standard rate = ₹44625

Fixed overhead expenditure variance = $SR \times BT - AR \times AT$
 = $\frac{59.5}{6} \times 4800 - \frac{4685}{470} \times 4700$
 = $47600 - 46850$
 = ₹750 F

Fixed overheads volume variance = $SR(ST - BT)$
 = $\frac{59.5}{6}(4500 - 4800)$
 = $\frac{59.5}{6} \times (-300)$

$$\begin{aligned}
&= \frac{12500 \times 20}{1250} \left[1250 - \frac{1250 \times 12600}{12500} \right] \\
&= 200 \left[1250 - 1260 \right] \\
&= ₹2000 \text{ A}
\end{aligned}$$

$$\begin{aligned}
\text{Material mix variance} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 20 \left[\frac{12500 \times 12600}{12500} - 12600 \right] \\
&= 20 \left[12600 - 12600 \right] \\
&= ₹0
\end{aligned}$$

Reconciliation:-

MCV = ₹4300 F

MPV+MUV = 6300F+2000A = ₹4300F

MMV+MYV = 0+2000A = ₹2000A

Prob. 2.

Standard quantity of material A	$S_i = 1350 \text{ kg}$
Standard quantity of material B	$S_2 = 650 \text{ kg}$
Standard cost rate of material A	$S_{R1} = ₹20 \text{ per kg}$
Standard cost rate of material B	$S_{R2} = ₹21 \text{ per kg}$
Standard yield $S_y = 1800 \text{ kg}$	
Actual quantity of material A	$A_1 = 1500 \text{ kg}$
Actual quantity of material B	$A_2 = 500 \text{ kg}$
Actual rate of material A	$AR_1 = ₹19.50 \text{ per kg}$
Actual rate of material B	$A_{R2} = ₹22 \text{ per kg}$
Actual output $A_y = 1850 \text{ kg}$	

$$\begin{aligned}
\text{Material cost variance} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times AR_j) \right] \\
&= \left[\left(\frac{1850}{1800} \times 1350 \times 20 \right) - (1500 \times 19.5) \right] + \left[\left(\frac{1850}{1800} \times 650 \times 21 \right) - (500 \times 22) \right] \\
&= (27750 - 29250) + (14029 - 11000) \\
&= -1500 + 3029 \\
&= ₹1529 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material price variance} &= \sum_{i=1}^n A_j (S_{Ri} - AR_j) \\
&= [1500(20 - 19.5) + 500(21 - 22)] \\
&= 750 - 500 \\
&= ₹250 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material usage variance} &= \sum_{i=1}^n S_{Ri} \left(\frac{S_i \times A_y}{S_y} - A_j \right) \\
&= 20 \left(1350 \times \frac{1850}{1800} - 1500 \right) + 21 \left(650 \times \frac{1850}{1800} - 500 \right) \\
&= 20(1387.5 - 1500) + 21(668.05 - 500) \\
&= -2250 + 352 \\
&= ₹1279 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material mix variance} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 20 \left[\frac{1350 \times (1500 + 500)}{1350 + 650} - 1500 \right] + 21 \left[650 \times \frac{(1500 + 500)}{1350 + 650} - 500 \right] \\
&= 20[1350 - 1500] + 21(650 - 500) \\
&= -3000 + 3150 \\
&= ₹150 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material yield variance} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{\sum S_i} \right) \right] \\
&= \frac{1350 \times 20}{1800} \left[1850 - \frac{1800 \times 2000}{2000} \right] + \frac{650 \times 21}{1800} \left[1850 - 1800 \times \frac{2000}{2000} \right] \\
&= 15(1850 - 1800) + 7.58(1850 - 1800) \\
&= 750 + 379 \\
&= ₹1129 \text{ F}
\end{aligned}$$

Q. 3:

Standard quantity of material A, $S_1 = 1400 \text{ unit}$
Standard quantity of material B, $S_2 = 400 \text{ unit}$
Standard quantity of material C, $S_3 = 200 \text{ unit}$
Standard rate of material A, $S_{R1} = ₹6$
Standard rate of material B, $S_{R2} = ₹5$
Standard rate of material C, $S_{R3} = ₹4$

Actual quantity of material A, $A_1 = 1500$ unit

Actual quantity of material B, $A_2 = 300$ unit

Actual quantity of material C, $A_3 = 350$ unit

Actual rate of material A, $AR_1 = ₹5$

Actual rate of material B, $AR_2 = ₹5$

Actual rate of material C, $AR_3 = ₹3.8$

Standard yield $S_y = 1750$ unit

Actual yield $A_y = 1800$ unit

$$\text{Material cost variance (MCV)} = \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right]$$

$$\begin{aligned} &= \left[\left(\frac{1800}{1750} \times 1400 \times 6 \right) - (1500 \times 5) \right] + \left[\left(\frac{1800}{1750} \times 400 \times 5 \right) - (300 \times 5) \right] + \left[\left(\frac{1800}{1750} \times 200 \times 4 \right) - (350 \times 3.8) \right] \\ &= [8640 - 7500] + [2057 - 1500] + [823 - 1330] \\ &= 1140 + 557 - 507 \\ &= 1190 \text{ F} \end{aligned}$$

$$\begin{aligned} \text{Material Price Variance (MPV)} &= \sum_{i=1}^n A_j (SR_i - AR_j) \\ &= 1500(6-5) + 300(5-5) + 350(4-3.8) \\ &= 1500 + 0 + 70 \\ &= 1570 \text{ F} \end{aligned}$$

$$\begin{aligned} \text{Material Usage variance (MUV)} &= \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} \right) - A_j \\ &= 6 \left[1400 \times \frac{1800}{1750} - 1500 \right] + 5 \left[\frac{400 \times 1800}{1750} - 300 \right] + 4 \left[\frac{200 \times 1800}{1750} - 350 \right] \\ &= 6[1440 - 1500] + 5[411.4 - 300] + 4[2057 - 350] \\ &= -360 + 557 - 577 \\ &= 380 \text{ A} \end{aligned}$$

$$\begin{aligned} \text{Material Mix Variance (MMV)} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\ &= 6 \left[\frac{1400 \times 2150}{2000} - 1500 \right] + \left[\frac{400 \times 2150}{2000} - 300 \right] + 4 \left[\frac{200 \times 2150}{2000} - 350 \right] \\ &= 6[1505 - 1500] + 5[430 - 300] + 4[215 - 350] \\ &= 30 + 650 - 540 \\ &= 140 \text{ F} \end{aligned}$$

$$\begin{aligned} \text{Material yield Variance (MYV)} &= \frac{\sum_{i=1}^n (S_i \times SR_i)}{S_y} \left[A_y - \left(\frac{S_y \times (\sum A_j)}{\sum S_i} \right) \right] \\ &= \frac{(1400 \times 6 + 400 \times 5 + 200 \times 4)}{1750} \left[1800 - \frac{1750 \times 2150}{2000} \right] \\ &= \frac{11200}{1750} (-81.25) \\ &= 520 \text{ A} \end{aligned}$$

Q. 4.

Standard quantity of material C, $S_1 = 0.4$

Standard quantity of material D, $S_2 = 0.6$

Standard yield $S_y = 0.9$ (Loss@ 10%)

Actual yield $A_y = 182$ kg

Standard rate of material C, $S_{R1} = ₹20$

Standard rate of material D, $S_{R2} = ₹30$

Actual quantity of material C, $A_1 = 90$ kg

Actual quantity of material D, $A_2 = 110$ kg

Actual rate of material C, $AR_1 = ₹18$

Actual rate of material D, $AR_2 = ₹34$

$$\begin{aligned} \text{Material cost variance} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right] \\ &= \left[\left(\frac{182 \times 0.4}{0.9} \times 20 \right) - (90 \times 18) \right] + \left[\left(\frac{182 \times 0.6}{0.9} \times 30 \right) - (110 \times 34) \right] \\ &= (1617.78 - 1620) + (3640 - 3740) \\ &= -2.22 - 100 \\ &= 102.22 \text{ A} \end{aligned}$$

$$\begin{aligned} \text{Material price variance (MPV)} &= \sum_{i=1}^n A_j (SR_i - AR_j) \\ &= 90(20-18) + 110(30-34) \\ &= 180 - 440 \\ &= 260 \text{ A} \end{aligned}$$

$$\begin{aligned} \text{Material usage variance} &= \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} \right) - A_j \\ &= 20 \left[\frac{0.4 \times 182}{0.9} - 90 \right] + 30 \left[\frac{0.6 \times 182}{0.9} - 110 \right] \end{aligned}$$

$$\begin{aligned}
&= 20(80.89-90)+30(121.33-110) \\
&= -182.22+340 \\
&= 157.78
\end{aligned}$$

$$\begin{aligned}
\text{Material Mix Variance (MMV)} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 20 \left(\frac{0.4 \times 200}{1} - 90 \right) + 30 \left(\frac{0.6 \times 200}{1} - 110 \right) \\
&= 20(80-90)+30(120-110) \\
&= -200+300 \\
&= 100 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material yield Variance (MYV)} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right) \right] \\
&= \frac{(0.4 \times 20 + 0.6 \times 30)}{0.9} \left[182 - \frac{0.9 \times 200}{1} \right] \\
&= \frac{8+18}{0.9} (182 - 180) \\
&= \frac{26}{0.9} \times 2 \\
&= 57.78 \text{ F}
\end{aligned}$$

Q. 5 Standard quantity of material X, $S_1 = 800$ kg
Standard quantity of material Y, $S_2 = 200$ kg
Standard quantity of material Z, $S_3 = 200$ kg
Standard output $S_y = 1000$ kg
Standard rate of material X, $S_{R1} = ₹2.50$
Standard rate of material Y, $S_{R2} = ₹4.00$
Standard rate of material Z, $S_{R3} = ₹1.00$
Actual quantity of material X, $A_1 = 157000$ kg
Actual quantity of material Y, $A_2 = 38000$ kg
Actual quantity of material Z, $A_3 = 36000$ kg
Actual out put $A_y = 200000$ kg
Actual rate of material X, $S_{R1} = ₹2.40$
Actual rate of material Y, $S_{R2} = ₹4.20$
Actual rate of material Z, $S_{R3} = ₹1.10$

$$\begin{aligned}
\text{Material cost variance} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times S_{Ri} \right) - (A_j \times AR_j) \right] \\
&= \left[\frac{200000}{1000} \times 800 \times 2.50 - 157000 \times 2.40 \right] + \left[\frac{200000}{1000} \times 200 \times 4 - 38000 \times 4.20 \right] + \left[\frac{200000}{1000} \times 200 \times 1 - 36000 \times 1.1 \right] \\
&= (400000-376800)+(160000-159600)+(40000-39600) \\
&= 23200+400+400 \\
&= 24000 \text{ F} \\
\text{Material price variance (MPV)} &= \sum_{i=1}^n A_j (S_{Ri} - AR_j) \\
&= 157000(2.50-2.40)+38000(4-4.20)+36000(1-1.1) \\
&= 15700-7600-3600 \\
&= 4500 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material usage variance} &= \sum_{i=1}^n S_{Ri} \left(\frac{S_i \times (A_y)}{S_y} - A_j \right) \\
&= 2.50 \left[\frac{800 \times 200000}{1000} - 157000 \right] + 4 \left[\frac{200 \times 200000}{1000} - 38000 \right] + 1 \left[\frac{200 \times 200000}{1000} - 36000 \right] \\
&= 2.50(160000-157000)+4(40000-38000)+1(40000-36000) \\
&= 7500+8000+4000 \\
&= 19500 \text{ F}
\end{aligned}$$

$$\begin{aligned}
\text{Material Mix Variance (MMV)} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 2.50 \left[\frac{800 \times 231000}{1200} - 157000 \right] + 4 \left[\frac{200 \times 231000}{1200} - 38000 \right] + 1 \left[\frac{200 \times 231000}{1200} - 36000 \right] \\
&= 2.50[154000-157000]+4[38500-38000]+1[38500-36000] \\
&= -7500+2000+2500 \\
&= 3000 \text{ A}
\end{aligned}$$

$$\begin{aligned}
\text{Material yield Variance (MYV)} &= \frac{\sum_{i=1}^n (S_i \times S_{Ri})}{S_y} \left[A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right) \right] \\
&= \frac{(800 \times 2.50 + 200 \times 4 + 200 \times 1)}{1000} \left[200000 - \frac{1000 \times 231000}{1200} \right] \\
&= \frac{(2000+800+200)}{1000} [200000 - 192500] \\
&= \frac{300}{1000} \times 7500 \\
&= 22500 \text{ F}
\end{aligned}$$

Q.6.

Standard quantity of material Tender, $S_1 = 1300$ ltr
 Standard quantity of material Soft, $S_2 = 500$ ltr
 Standard quantity of material Polite, $S_3 = 200$ ltr
 Standard yield, $S_y = 1750$ ltr
 Standard rate of material Tender, $S_{R1} = ₹12$
 Standard rate of material Soft, $S_{R2} = ₹11$
 Standard rate of material Polite, $S_{R3} = ₹10$
 Actual quantity of material Tender, $A_1 = 1400$ ltr
 Actual quantity of material Soft, $A_2 = 400$ ltr
 Actual quantity of material Polite, $A_3 = 200$ ltr
 Actual rate of material Tender, $A_{R1} = ₹11.50$
 Actual rate of material Soft, $A_{R2} = ₹10$
 Actual rate of material Polite, $A_{R3} = ₹11$
 Actual yield $A_y = 1800$ ltr

$$\begin{aligned}\text{Material cost variance} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right] \\ &= \frac{1800}{1750} \times 1300 \times 12 - 1400 \times 11.50 + \left[\frac{1800}{1750} \times 500 \times 11 - 400 \times 10 \right] + \left[\frac{1800}{1750} \times 200 \times 10 - 200 \times 11 \right] \\ &= (16046-16100) + (5657-4000) + (2057-2200) \\ &= -54 + 1657 - 143 \\ &= 1460 \text{ F}\end{aligned}$$

$$\begin{aligned}\text{Material price variance (MPV)} &= \sum_{i=1}^n A_j (SR_i - AR_j) \\ &= 1400(12-11.50) + 400(11-10) + 200(10-11) \\ &= 700 + 400 - 200 \\ &= 900 \text{ F}\end{aligned}$$

$$\begin{aligned}\text{Material usage variance} &= \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} - A_j \right) \\ &= 12 \left[\frac{1300 \times 1800}{1750} - 1400 \right] + 11 \left[\frac{500 \times 1800}{1750} - 400 \right] + 10 \left[\frac{200 \times 1800}{1750} - 200 \right] \\ &= -754 + 1257 + 57 \\ &= 1314 - 754 \\ &= 560 \text{ F}\end{aligned}$$

$$\begin{aligned}\text{Material Mix Variance (MMV)} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\ &= 12 \left[\frac{1300 \times 2000}{2000} - 1400 \right] + 11 \left[\frac{500 \times 2000}{2000} - 400 \right] + 10 \left[\frac{200 \times 2000}{2000} - 200 \right] \\ &= -1200 + 1100 + 0 \\ &= 100 \text{ A}\end{aligned}$$

$$\begin{aligned}\text{Material yield Variance (MYV)} &= \frac{\sum_{i=1}^n (S_i \times SR_i)}{S_y} \left[A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right) \right] \\ &= \frac{(1300 \times 12 + 500 \times 11 + 200 \times 10)}{1750} \left[1800 - \frac{1750 \times 2000}{2000} \right] \\ &= \frac{(15600 + 5500 + 2000)}{1750} \times (1800 - 1750) \\ &= \frac{23100}{1750} \times 50 \\ &= 660 \text{ F}\end{aligned}$$

Q 7. Here

$$\begin{aligned}S_1 &= 10m^3 & S_{R1} &= ₹8 \\ S_2 &= 8m^3 & S_{R2} &= ₹6 \\ S_3 &= 4m^3 & S_{R3} &= ₹12 \\ S_y &= 22m^3\end{aligned}$$

and

$$\begin{aligned}A_1 &= 10m^3 & A_{R1} &= ₹7 \\ A_2 &= 9m^3 & A_{R2} &= ₹7 \\ A_3 &= 5m^3 & A_{R3} &= ₹11 \\ A_y &= 22m^3\end{aligned}$$

$$\begin{aligned}\text{Material cost variance (MCV)} &= \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right] \\ &= \frac{22}{22} \times 10 \times 8 - 10 \times 7 + \left[\frac{22}{22} \times 8 \times 6 - 9 \times 7 \right] + \left[\frac{22}{22} \times 4 \times 12 - 5 \times 11 \right] \\ &= (80-70) + (48-63) + (48-55) \\ &= 10 - 15 - 7 \\ &= 12 \text{ A}\end{aligned}$$

$$\text{Material price variance (MPV)} = \sum_{i=1}^n A_j (SR_i - AR_j)$$

$$\begin{aligned}
&= 10(8-7)+9(6-7)+5(12-11) \\
&= 10-9+5 \\
&= 6F
\end{aligned}$$

$$\begin{aligned}
\text{Material usage variance} &= \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} \right) - A_j \\
&= 8 \left[\frac{10 \times 22}{22} - 10 \right] + 6 \left[\frac{8 \times 22}{22} - 9 \right] + 12 \left[\frac{4 \times 22}{22} - 5 \right] \\
&= 8(10-10)+6(8-9)+12(4-5) \\
&= -6-12 \\
&= 18A
\end{aligned}$$

$$\begin{aligned}
\text{Material Mix Variance (MMV)} &= \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] \\
&= 8 \left[\frac{10 \times 24}{22} - 10 \right] + 6 \left[\frac{8 \times 24}{22} - 9 \right] + 12 \left[\frac{4 \times 24}{22} - 5 \right] \\
&= 8(10.91-10)+1.64-7.64 \\
&= 7.28-9.28 \\
&= 2 A
\end{aligned}$$

$$\begin{aligned}
\text{Material yield Variance (MYV)} &= \frac{\sum_{i=1}^n (S_i \times SR_i)}{S_y} [A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right)] \\
&= \frac{(10 \times 8 + 8 \times 6 + 4 \times 12)}{22} \left[22 - \frac{22 \times 24}{22} \right] \\
&= \frac{(80+48+48)}{22} \times (22 - 24) \\
&= \frac{176}{22} (-2) \\
&= 16 A
\end{aligned}$$

Q. 8. Given:

$$\begin{aligned}
S_{R1} &= 12 & S_{R2} &= 15 \\
A_{R1} &= 15 & S_{R2} &= 20 \\
S_1 &= 50 & A_2 &= 70 \\
MUV_B &= 300 A
\end{aligned}$$

We know: in case of B

$$\begin{aligned}
MUV_B &= S_{R2}(S_2 - A_2) \\
\Rightarrow 15(S_2 - 70) &= -300 \\
S_2 - 70 &= -20 \\
S_2 &= 50
\end{aligned}$$

Standard input of material B = 50 units

$$\begin{aligned}
\text{Material price variance in case of B} &= A_2(S_{R2} - A_{R2}) \\
&= 70(15-20) \\
&= 350 A
\end{aligned}$$

$$\begin{aligned}
\text{Material cost variance for B} &= MPV + MUV \\
&= 350A + 300A \\
&= 650A
\end{aligned}$$

Material mix variance (MMV) = 45A (Given)

We know:

$$\begin{aligned}
\sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right] &= 12 \left(\frac{50 \times (x+70)}{100} - x \right) + 15 \left(\frac{50 \times (x+70)}{100} - 70 \right) = -45 \\
&[600(x+70)-1200]+[750(x+70)-105000] = -4500 \\
600X + 42000 - 1200X + 750X + 52500 - 105000 &= -4500 \\
150X &= 6000 \\
X &= 40
\end{aligned}$$

i.e. actual input of material A = 40 units

$$\begin{aligned}
\text{Material price variance in case of A} &= A_1(S_{R1} - A_{R1}) \\
&= 40(12-15) \\
&= 120A
\end{aligned}$$

$$\begin{aligned}
\text{Material usage variance in case of A} &= S_{R1}(S_1 - A_1) \\
&= 12(50-40) \\
&= 120F
\end{aligned}$$

$$\begin{aligned}
\text{Material cost variance in case of A} &= MPV + MUV \\
&= 120A + 120F \\
&= 0
\end{aligned}$$

Q. 9. Given:

$$\begin{aligned}
S_1 &= 8T & S_2 &= 12T \\
S_{R1} &= ₹40 & S_{R2} &= ₹60 \\
S_y &= 18T \\
A_1 &= 10T & A_2 &= 20T
\end{aligned}$$

$$A_{R1} = ₹30 \quad AR_2 = ₹68$$

$$A_y = 26.5T$$

$$\text{Material cost variance (MCV)} = \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right]$$

$$= \left[\left(\frac{26.5 \times 8}{18} \times 40 \right) - (10 \times 30) \right] + \left[\left(\frac{26.5 \times 12}{18} \times 60 \right) - (20 \times 68) \right]$$

$$= (471-300) + (1060-1360)$$

$$= 171-300$$

$$= 129A$$

$$\text{Material price variance (MPV)} = \sum_{i=1}^n A_j (SR_i - AR_j)$$

$$= 10(40-30) + 20(60-68)$$

$$= 100-160$$

$$= 60A$$

$$\text{Material usage variance} = \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} - A_j \right)$$

$$= 40 \left[\frac{8 \times 26.5}{18} - 10 \right] + 60 \left[\frac{12 \times 26.5}{18} - 20 \right]$$

$$= 71-140 = 69A$$

$$\text{Material Mix Variance (MMV)} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$= 40 \left[\frac{8 \times 30}{20} - 10 \right] + 60 \left[\frac{12 \times 30}{20} - 20 \right]$$

$$= (40 \times 2) + (60 \times (-2))$$

$$= 80-120 = 40A$$

$$\text{Material yield Variance (MYV)} = \frac{\sum_{i=1}^n (S_i \times SR_i)}{S_y} \left[A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right) \right]$$

$$= \frac{(8 \times 40 + 12 \times 60)}{18} \left[26.5 - \frac{18 \times 30}{20} \right]$$

$$= \frac{320+720}{18} [26.5 - 27]$$

$$= \frac{1040}{18} \times (0.5)$$

$$= 29A$$

Q. 10

$$S_1 = 15kg \quad S_2 = 20kg$$

$$S_{R1} = ₹5 \quad S_{R2} = ₹6$$

$$S_y = 25kg$$

$$A_1 = 22kg \quad A_2 = 20kg$$

$$A_{R1} = ₹5 \quad A_{R2} = ₹6.5$$

$$A_y = 28kg$$

$$\text{Material cost variance (MCV)} = \sum_{i=1}^n \left[\left(\frac{A_y \times S_i}{S_y} \times SR_i \right) - (A_j \times AR_j) \right]$$

$$= \left[\left(\frac{28 \times 15}{25} \times 5 \right) - (22 \times 5) \right] + \left[\left(\frac{28 \times 20}{25} \times 6 \right) - (20 \times 6.5) \right]$$

$$= (84-110) + (134.4-130)$$

$$= -26+4.4 = ₹21.6 A$$

$$\text{Material price variance (MPV)} = \sum_{i=1}^n A_j (SR_i - AR_j)$$

$$= 22(5-5) + 20(6-6.5)$$

$$= 0-10 = ₹10 A$$

$$\text{Material usage variance} = \sum_{i=1}^n SR_i \left(\frac{S_i \times (A_y)}{S_y} - A_j \right)$$

$$= 5 \left[\frac{15 \times 28}{25} - 22 \right] + 6 \left[\frac{20 \times 28}{25} - 20 \right]$$

$$= 5(16.8-22) + 6(22.4-20)$$

$$= -26+14.4 = 11.6 A$$

$$\text{Material Mix Variance (MMV)} = \sum_{i=1}^n S_{Ri} \left[\frac{S_i \times (\sum A_j)}{\sum S_i} - A_j \right]$$

$$= 5 \left[\frac{15 \times 42}{35} - 22 \right] + 6 \left[\frac{20 \times 42}{35} - 20 \right]$$

$$= 5[18-22] + 6[24-20]$$

$$= -20+24$$

$$= ₹4 F$$

$$\text{Material yield Variance (MYV)} = \frac{\sum_{i=1}^n (S_i \times SR_i)}{S_y} \left[A_y - \left(\frac{S_y \times \sum A_j}{\sum S_i} \right) \right]$$

$$= \frac{(15 \times 5 + 20 \times 6)}{25} \left[28 - \frac{25 \times 42}{35} \right]$$

$$= \frac{75+120}{25} [28 - 30]$$

$$= \frac{195}{25} \times (-2)$$

$$= ₹15.6 \text{ A}$$

Q 11 . Here $N_{Si} = 1,$ $T_{Si} = 500 \text{ hours},$ $R_{Si} = ₹ 10$

and $N_{Aj} = 1$ $T_{Aj} = 300 \text{ hours}$ $R_{Aj} = ₹ 12$ $A_O = S_O$

$$\begin{aligned} \text{Labour Cost variance} &= \sum_{i=j=1}^n \left[\frac{A_O}{S_O} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\ &= (1 \times 500 \times 10) - (1 \times 300 \times 12) \\ &= 5000 - 3600 \\ &= ₹ 1400 \text{ (F)} \end{aligned}$$

$$\begin{aligned} \text{Labour rate variance} &= \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\ &= 1 \times 300 (10 - 12) \\ &= -600 = ₹ 600 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{Labour efficiency variance} &= \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_O}{S_O} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right] \\ &= 10 [(1 \times 500) - (1 \times 300)] \\ &= 10 (500 - 300) \\ &= 2000 = ₹ 2000 \text{ (F)} \end{aligned}$$

Q 12.

Here $N_{Si} = 500$ $T_{Si} = 25 \text{ days}$ $R_{Si} = ₹ 10$

and $N_{Aj} = 600$ $T_{Aj} = 24 \text{ days}$ $R_{Aj} = ₹ 11$

$S_O = 32,000 \text{ units},$ $A_O = 40,000 \text{ units}$

$$\begin{aligned} \text{Labour cost variance} &= \sum_{i=j=1}^n \left[\frac{A_O}{S_O} (N_{Si} \times T_{Si} \times R_{Si}) - (N_{Aj} \times T_{Aj} \times R_{Aj}) \right] \\ &= \frac{40000}{32000} (500 \times 25 \times 10) - (600 \times 24 \times 11) \\ &= 156250 - 158400 \\ &= -2150 = ₹ 2150 \text{ (A)} \end{aligned}$$

$$\begin{aligned} \text{Labour rate variance} &= \sum_{i=j=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\ &= 600 \times 24 (10 - 11) \\ &= -14400 = ₹ 14400 \text{ (A)} \end{aligned}$$

$$\text{Labour efficiency variance} = \sum_{i=j=1}^n \left[R_{Si} \left\{ \left(\frac{A_O}{S_O} \times N_{Si} \times T_{Si} \right) - (N_{Aj} \times T_{Aj}) \right\} \right]$$

$$\begin{aligned}
&= 10 \left[\left(\frac{40000}{32000} \times 500 \times 25 \right) - (600 \times 24) \right] \\
&= 10 (15625 - 14400) \\
&= 12250 = 12250 \text{ (F)}
\end{aligned}$$

Q 13.

Standards of the company

$$N_{Si} = 80 \qquad T_{Si} = 45 \qquad R_{Si} = ₹ 0.50$$

Actuals of company

$$N_{A1} = 40 \qquad R_{A1} = ₹ 0.50$$

$$N_{A2} = 15 \qquad R_{A2} = ₹ 0.60$$

$$N_{A3} = 25 \qquad R_{A3} = ₹ 0.40$$

$$\begin{aligned}
\text{Labour rate variance} &= \sum_{i=1}^n (N_{Aj} \times T_{Aj} (R_{Si} - R_{Aj})) \\
&= 4 [40 \times 45 (0.50 - 0.50) + 15 \times 45 (0.50 - 0.60) + 25 \times 45 (0.50 - 0.40)] \\
&= 4 (0 - 67.5 + 112.5) \\
&= 180 = 180 \text{ (F)}
\end{aligned}$$

Q 14.

Actual hours worked = 4,50,500 hours

$$\begin{aligned}
\text{Standard hours worked} &= (10000 \times 15 + 15000 \times 20) \\
&= 150000 + 300000 = 4,50,000 \text{ hours.}
\end{aligned}$$

Standard rate = ₹ 5.00 per hour

Actual rate = ₹ 7.00 per hour for 12000 hours

₹ 7.50 per hour for 9400 hours

₹ 5.00 for rest i.e. 429100 hours (450500 – 12000 – 9400)

- (i) Labour Cost variance = Standard labour cost – Actual labour cost
 $= (450000 \times 5) - 2300000$
 $= 2250000 - 2300000$
 $= -50000 = ₹ 50,000 \text{ (A)}$
- (ii) Labour rate variance = $12000 (5 - 7) + 9400 (5 - 7.5) + 429000 (5 - 5)$
 $= -24000 - 23500$
 $= -47500 = ₹ 47500 \text{ (A)}$
- (iii) Labour efficiency variance = $5 (450000 - 450500)$
 $= 5 (-500)$
 $= -2500 = ₹ 2500 \text{ (A)}$



8. Cost Volume – Profit Analysis

Cost volume profit analysis means the analysis of cost of production, volume of sales and the profit earned after selling the manufactured products. Cost and the volume of production are directly related to each other as the production increases, there is an increase in the cost because more and more direct material, the direct labour cost and other directly related costs increases. In other words in the production process there is always requirement of the factors related to the production. As more and more units of the product are manufactured more and more units of input factors are needed. More and more input factors leads to the total increase in the cost. So we can say the cost of production is directly proportional to the volume of production profit factor which is the difference in the total sales and total cost is also directly related to the volume of sales. When more and more units of a product are sold if the contribution per unit is positive which lead to either minimizing the loss or maximizing the total profit. So, we can say profit is also positively related or directly related to the volume of sales.

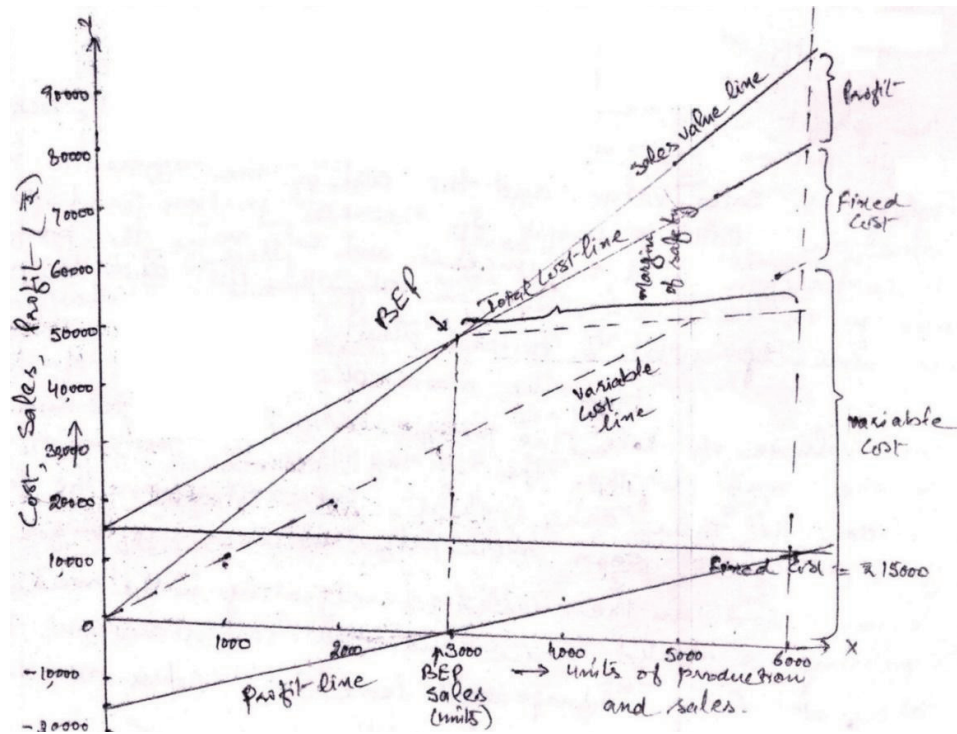
If we see the relation of cost and the profit, it is inverse. As the cost increase the profit portion decreases. Profit is nothing but the residual value of sales value and the cost i.e. the difference in sales value and cost is profit. If the cost portions tend to increase in comparison with the increase in sales value the profit portion will go on decreasing. We can say the cost and the profit are inversely related to each other.

From the above discussion cost of production, the volume of sales, the profit are related to one another in one way or the other. May there be position or negative relation all three are linked. So, to achieve the long term goal either to earn more profits or earn profit for a long term period in the market, penetrating in the market, capturing a market share and other various decisions to be taken at higher management level it becomes necessary to analyze all the three in depth.

Let us try to understand the subject in the detail graphically as below.

Table showing, cost, sales and profit regarding a particular product in a production unit

Units of Production and Sales	Fixed Cost ₹	Variable Cost per unit ₹	Selling price per unit ₹	Total Cost Value ₹	Total Sales Value ₹	Profit ₹
0	15000	10	15	15000	0	–15000
1000	15000	10	15	25000	15000	–10000
2000	15000	10	15	35000	30000	–5000
3000	15000	10	15	45000	45000	0
4000	15000	10	15	55000	60000	+5000
5000	15000	10	15	65000	75000	+10000
6000	15000	10	15	75000	90000	+15000



Graph showing cost, profit and volume of sales relating to the above table.

On the analysis of the above table and the graph we see when the production and sale of the product is zero the unit has to bear fixed expenses to the tune of ₹ 15000 because the fixed costs are independent of the volume of sales. When the production and sale of the product increases to 1000 units, the total cost of production is ₹ 25000 and total sales value is ₹ 10000. The loss which were first ₹ 15000 decrease to ₹ 10000. Again when the production and sale increases to 2000 units the total cost becomes ₹ 35000 and total sales value becomes ₹ 30000 i.e. the loss decreases to ₹ 5000. At 4000 units level of output and sales the total cost ₹ 45000 becomes equal to total sales value ₹ 45000. It is the points of no profit no loss because here both the types of costs the fixed as well as variable are covered. At 4000 units of sales the total cost is ₹ 55000 and sales are ₹ 60000 i.e. ₹ 5000 is the profit at this level. As the sales in units further rises to 5000 units and 6000 units, the profit rises to ₹ 10000 and ₹ 15000 respectively.

If the sales of the unit are 6000 units as above then 3000 units (6000–BEP sales 3000) will be the margin of safety of the production unit. The management can plan its strategy depending upon the BEP and MOS to meet the various long term objectives.

Objectives of the Cost–Volume Profit analysis:

The objectives of the cost volume profit analysis can be summarized as below:

1. Price of the products can be fixed through CVP analysis because whenever a product is launched or the product is to be sold to capture a share of the market in the competitive situations or otherwise, the management takes the help of EVP analysis.
2. The analysis will be helpful to the management in setting the volume of sales of the product in the market. It will help the management to know the adverse and favorable effects the various levels of sales whether to stick at a particular level of sales or to increase or decrease taking into consideration the long term profit earning policies of the production unit.

3. It also helps the management of the unit to take various decisions such as make or buy decision, various sales mix decisions, dropping of a product, shut down the unit etc.
4. This analysis helps to know the amount of overhead costs to be charged to the products at various levels of operations.
5. The analysis helps in the preparation of flexible budgets as the cost of production, fixed costs and selling prices are predetermined. The variable cost and sales value are directly linked to the volume of production and the fixed cost remain fixed up to certain level of production.
6. The analysis is also helpful in the performance evaluation prices of the unit for control purposes.

Before we proceed further for the analysis of cost–volume profit certain assumptions are to be taken into consideration. The main assumptions are given as below:

1. The selling price of the product at various levels of sales are assumed to be the same. No price reduction is needed to sell more and more units in the market.
2. The costs can be separated clearly into the fixed and variable costs.
3. Fixed costs remain unchanged at all the levels of the output.
4. What is produced is sold; the production is always equal to sales.
5. The production efficiency factor is taken to be nil at the various level of production.
6. Variable costs are directly proportional to the level of sales at all the volume of production.
7. Factor prices such as raw material and labour wages remain the same in the market,

As we know

Total cost = Fixed cost + variable cost

Profit / Loss = Total sales – total cost

= Total sales – fixed cost – variable cost

=(Total sales – variable cost) – fixed cost

Total sales – variable cost – fixed cost = profit / loss

= > $S - V = F \pm P$

Marginal Cost Equation

As shown in the above the marginal cost equation shows the relation between sales, cost and profit.

We know that

Profit / Loss = Total sales – Total cost

If Total sales > Total Cost, then the difference is Profit or otherwise loss.

Now Total cost = Total variable cost + Total fixed cost

So, Profit/Loss = Total sales – Total variable cost – Total fixed cost

Or Total sales – Total variable cost = Total fixed cost $\pm$ Profit/Loss

If selling price per unit = s

and variable cost per unit = v

number of units of output = x

Then $s \times x - v \times x = \text{Fixed cost} \pm \text{Profit/Loss}$

$$x(s-v) = \text{Fixed cost} \pm \text{Profit/Loss}$$

if $s-v = c$ i.e. the contribution per unit

$$\text{then } x \times c = F \pm P$$

where c is the contribution per unit

$$\text{So Total contribution} = F \pm P$$

Contribution:- Contribution is the difference between the sales value and the variable cost, contribution per unit is the difference in the selling price per unit and the variable cost per unit. The more the difference means more contribution per unit. In a production unit as the production starts or even at zero level production the production unit has to bear the burden of fixed costs. As the production starts each unit of product will enable the production unit to encash or cover the fixed costs. Whenever the fixed costs are covered through contribution, the immediate next unit (product unit) will begin to contribute the profit. So contribution plays an important role in the cost volume profit analysis.

$$\text{Total Sales} = \text{Total Cost} \pm \text{Profit/Loss}$$

$$\text{Total Sales} = \text{Fixed} + \text{Variable cost} \pm \text{Profit/Loss}$$

$$S = F + V \pm P$$

$$S - V = F \pm P$$

$$\text{Contribution} = F \pm P$$

Where S = Total sales, V = Total variable cost

F = Total fixed cost, P = Profit/Loss

Let us take an example where selling price is ₹ 15 per unit, variable cost ₹ 10 per unit, fixed cost ₹ 15000 then $(s-v) = ₹ 15 - ₹ 10 = ₹ 5$ is the contribution per unit i.e. each unit of production contribution ₹ 5 and in initial stages try to cover the fixed cost at 3000 units of output the total contribution will be ₹ $3000 \times 5 = ₹ 15000$ i.e. total fixed costs are fully recovered at this level after which each unit of the product produced and sold will contribute to the profit in other words each unit will earn a profit of ₹ 5. 3000 units of production as fully recovers the fixed as well as the variable cost increased is a level of no profit or no loss which is called Break-even point. If 6000 units of the product are produced and sold then profit will be $= 6000(15-10) - 1500 = 3000 - 1500 = ₹ 1500$.

$$\text{Or Profit} = \text{Total contribution} - \text{Fixed cost}$$

$$= \text{Production units} \times \text{Contribution} - \text{Fixed cost}$$

Prob.1. If the variable cost as estimated by a concern is ₹ 28 per unit of the product and the selling price is ₹ 32 per unit. Find out the profit or loss if the concern forecast to sell 10000 units and the fixed cost at ₹ 30000.

Sol. Contribution per unit Selling price per unit – Marginal cost per unit

$$= 32 - 28$$

$$= ₹ 4$$

Total Contribution = No. of units x Cost per unit

$$= 10000 \times 4$$

$$= ₹ 40000$$

Profit = Total contribution – Fixed cost

$$= 40000 - 30000$$

$$= ₹ 10000$$

Prob.2 Find out the marginal cost per unit from the following given information.

No. of units manufactured	Total Cost (₹)
10,000	150,000
12,000	1,60,000

Sol. In the problem given above we are not given the fixed cost and the marginal cost at any volume of production. Let us assume that

$$\text{Fixed cost} = ₹ x$$

$$\text{and variable cost per unit} = ₹ y$$

Then at 10000 units volume of production

$$\text{Total cost} = \text{Fixed cost} + \text{Total variable cost}$$

$$150,000 = x + 10000y \quad \text{I}$$

and at 12000 units of production.

$$160,000 = x + 12000y \quad \text{II}$$

From I and II we get

$$1,60,000 - 150,000 = (x - x) + 12000y - 10000y$$

$$10000 = 2000y$$

$$\Rightarrow y = ₹ 5$$

so the marginal cost = ₹ 5 per unit

P/v ratio or c/s ratio :-

P/v ratio or c/s ratio plays an important role in the decision making process of the management in various situations. It is the ratio of difference in sales and variable cost, and the sales of a concern.

If s is the sales and v is the variable cost then $\frac{s-v}{s} \times 100$ is the P/v ratio. High P/V ratio is always desired because high P/V ratio will enable an organization to cover the fixed cost with small increase in the volume of sales and after recovery of fixed cost will enable to earn high profits. But the adverse effect of high P/v ratio is also possible in recession or the situations where the demand tends to decrease.

Let a concern is having selling price per unit = ₹ s

and the marginal cost = ₹ v

Then contribution = ₹ (s-v)

$$P/v \text{ ratio} = \frac{s-v}{s} \times 100$$

If selling price = ₹ 20

variable cost = ₹ 10

$$\text{Then } P/v \text{ ratio} = \frac{s-v}{s} \times 100$$

$$= \frac{20-10}{20} \times 100$$

$$= \frac{10}{20} \times 100 = 50\%$$

It means after reaching the BEP sales, for every ₹ 100 increase in sales the profit to the tune of ₹ 50 will increase. Before the BEP 50% P/v ratio means for every ₹ 100 increase in sales value the contribution towards fixed cost will be ₹ 50.

So we can say

$$\text{B.E.P. (value)} = \frac{\text{Fixed Cost}}{\frac{P}{v} \text{ Ratio}}$$



More the P/v ratio, more easy to recover fixed cost and to approach the no profit no loss point i.e. the BEP.

Illustration 3.

Calculate the P/v ratio in the two situations given below :-

(i) Selling price per unit s = ₹ 10, and variable cost v = ₹ 6 per unit

(ii) Profit and sales of the concern for the two periods is as under:

Year	Sales	Profit
	₹	₹
2010	150,000	50,000
2011	170,000	55,000

Sol:- (i) Selling price per unit s = ₹ 10

variable cost per unit v = ₹ 6

contribution per unit s-v = ₹ (10-6)

= ₹ 4.

$$P/v \text{ ratio} = \frac{s-v}{s} \times 100$$

$$= \frac{4}{10} \times 100 = 40\%$$

(ii) Change in sales = 170000-150000 = ₹ 2000

Change in Profit = 55000-50000 = ₹ 5000

$$P/v \text{ ratio} = \frac{\text{Change in profit}}{\text{Change in sales}} \times 100$$

$$= \frac{5000}{20000} \times 100$$

$$= 25\%$$

We know that

Contribution in one period

$$C_1 = F + 50000 \quad [\text{In value}]$$

Contribution in second period

$$C_2 = F + 55000 \quad [\text{In value}]$$

Change in contribution

$$C_2 - C_1 = (F + 55000) - (F + 50000)$$

$$= ₹ 5000 \quad [\text{In Value}]$$

Change in sales = $S_2 - S_1 = 170000 - 150000$

$$= ₹ 20000$$

$$\text{P/V ratio} = \frac{\text{Change in contribution (value)}}{\text{Change in sales (value)}} \times 100$$

$$= \frac{5000}{20000} \times 100$$

$$= 25 \%$$

or we can deduce from above

$$\text{P/V ratio} = \frac{\text{Change in profit (when fixed cost remains the same)}}{\text{Change in sales value}} \times 100$$

BEP (Break-even point):— It is a point where total cost is recovered after selling a particular level of output. It is a point of no profits no loss. Before BEP the fixed costs are not fully recovered through contribution. After the BEP the sale of product begin to contribute towards profit. At the BEP the total contribution is equal to fixed cost.

We know

$$\text{Total sales} = F.C + V.C \pm \text{Profit}$$

$$\text{Sales} - V.C = F.C \pm \text{Profit}$$

$$\text{When Profit} = 0 \quad (\text{at Breakeven point})$$

$$\text{Sales} - V.C = F.C$$

$$S - V = F.C.$$

$$\frac{S - V}{S} = \frac{F.C.}{S}$$

$$S = \frac{F.C.}{\frac{S - V}{S}} = \frac{F.C.}{\frac{P}{V} \text{ ratio}}$$

$$\text{so Sales at B.E. Point} = \frac{F.C}{\frac{P}{v} \text{ ratio}}$$

$$\text{As BEP (Sales)} = \frac{F.C}{\frac{P}{v} \text{ ratio}}$$

The higher the P/v ratio means the lower the B.E.P i.e. when P/v ratio is much high the BEP can be easily and quickly approached. B.E.P is inversely related to the P/v ratio.

Higher P/v ratio is favorable as well as unfavorable to the production unit or the organization depending upon the situations. Whenever there is a situation of excess demand or in the situation of increasing demand and so increasing sales of the product the profit will shoot up but in the adverse situation i.e. the situation of decreasing demand and decreasing sales of the product decrease in profit will be at the same rate as it was in the increasing demand case. So, there are other factors to be considered in various types of managerial decisions along with the P/v ratio factor.

Illustration 4.

From the information given below calculate the

- (i) Contribution per unit
- (ii) Total contribution at 12000 units
- (iii) The P/v ratio

B.E.P sales and BEP units given fixed cost ₹ 2,50,000, Selling price = ₹ 45

variable cost per unit = ₹ 20

Solution:—

	Selling price per unit=	₹ 45
	variable cost per unit=	₹ 20
	Fixed cost =	₹ 250,000
(i)	Contribution per unit=	45–20= ₹ 25
(ii)	Total contribution at 12000 units of output	
	=	12000x25= ₹ 3,00,000
(iii)	P/v ratio	=
		$\frac{\text{Contribution per unit}}{\text{Selling price per unit}} \times 100$
		= $\frac{25}{45} \times 100 = 55.55\%$
(iv)	(a)	B.E.P (units)
		= $\frac{\text{Fixed cost}}{\text{Contribution per unit}}$
		= $\frac{250000}{25} = 10000 \text{ units}$
	(b)	B.E.P Sales = 10000x45 = ₹ 450000
	or	$\frac{250000}{55.55\%} = ₹ 450000$

Sales required to earn a desired level of profit

As we know

$$\begin{aligned}
 & \text{Total sales} - \text{variable cost} = \text{Fixed Cost} \pm \text{Profit} \\
 & (\text{units sold} \times \text{selling price}) - (\text{units sold} \times \text{variable cost per unit}) \\
 & = \text{Fixed Cost} \pm \text{Profit} \\
 & \text{units sold} (\text{Selling price} - \text{variable cost per unit}) = \text{Fixed Cost} \pm \text{Profit} \\
 & \text{Units sold} (\text{Contribution per unit}) = \text{Fixed Cost} \pm \text{Profit} \\
 \Rightarrow & \text{Units sold} = \frac{F.\text{cost}}{\text{Cont. per unit}} + \frac{\text{Profit}}{\text{Cont. per unit}} = \frac{F.\text{cost} + \text{Profit}}{\text{Cont. per unit}} \\
 \Rightarrow & \text{unit sold} \times \text{selling price} = \frac{F.\text{cost} + \text{Profit}}{\text{Cont. per unit}} \times \text{selling price} \\
 & \text{Sales (value)} = \frac{F.\text{cost} + \text{Profit}}{\frac{\text{Cont. per unit}}{\text{Selling price}}} \\
 & \text{Sales (value)} = \frac{F.\text{cost} + \text{Profit}}{\frac{P}{V} \text{ ratio}}
 \end{aligned}$$

$$\text{so sales required to earn a desired level of profit} = \frac{F.\text{Cost} + \text{Profit desired}}{\frac{P}{V} \text{ ratio}}$$

In unit of sales term

$$\text{The number of units required to earn a desired profit} = \frac{F.\text{cost} + \text{Profit}}{\text{Cont. per unit}}$$

Illustration 5 .

A production unit gives you the following information and desire you to calculate quantitatively

- (i) The number of units required to Break-even
 - (ii) The number of units required to earn ₹ 5000 as profit
 - (iii) The total sales value to earn a profit of ₹ 8000
- Fixed cost = ₹ 50,000, Selling price per unit = ₹ 15
variable cost per unit = ₹ 10.

Solution:—

$$\begin{aligned}
 \text{Selling price per unit} &= ₹ 15 \\
 \text{Variable cost per unit} &= ₹ 10 \\
 \text{Contribution per unit} &= 15 - 10 = ₹ 5. \\
 \text{Fixed cost} &= ₹ 50000 \\
 \text{P/v ratio} &= \frac{5}{15} \times 100 = 33.33\%
 \end{aligned}$$

$$\begin{aligned}
 \text{(i) The number of units required to Break-even} &= \frac{F.\text{cost} + \text{Profit}}{\text{Cont. per unit}} \\
 &= \frac{50000}{5} \\
 &= 10,000 \text{ units}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) The number of units required to earn a profit of ₹ 5000} &= \frac{F.cost + Profit}{Cont.per unit} \\
 &= \frac{50000 + 5000}{5} \\
 &= \frac{55000}{5} = 11000 \text{ units} \\
 \text{(iii) Total sales value to earn a profit equal to ₹ 8000} &= \frac{F.cost + Profit}{Cont.per unit} \times \text{selling price} \\
 &= \frac{50000 + 8000}{5} \times 15 \\
 &= 58000 \times 3 = ₹ 17,4,000 \\
 \text{or} &= \frac{F.cost + Profit}{\frac{P}{v} ratio} \\
 &= \frac{50000 + 8000}{33.33\%} = ₹ 17,4,000
 \end{aligned}$$

Combined Break-even point:–

A company may be having different production units under the same management at different location. All may have different variable costs and different fixed costs. In such situations combined breakeven point is desired i.e. the point where the total fixed costs are met with through selling of different quantities of the product of the production units. Two methods can be applied here to arrive at the combined break-even point.

- (i) Constant product mix method.
- (ii) Variable product mix method.

In constant product mix method the product mix remains unchanged i.e. the total sales values and unit remains in the same ratio as the original ratio.

Suppose the company is having two production units A and B producing the same product and having the following cost and sale information regarding the same product:–

Factory A:	Selling price =	₹ 5 per unit
	Variable cost =	₹ 3 per unit
	Fixed cost =	₹ 12000
	Units produced =	10000 (Capacity production)
Factory B:	Selling price =	₹ 5 per unit
	Variable cost =	₹ 4 per unit
	Fixed cost =	₹ 10000
	Units produced =	15000 (Capacity production)

Combined BEP can be found out as

$$\begin{aligned}
 \text{Contribution per unit in A} &= 5 - 3 \\
 &= ₹ 2 \\
 \text{Contribution per unit in B} &= 5 - 4 \\
 &= ₹ 1
 \end{aligned}$$

$$\begin{aligned}
 \text{Combined contribution} &= 2 \times \frac{2}{5} + 1 \times \frac{3}{5} \\
 &= \frac{4}{5} + \frac{3}{5} \\
 &= \frac{7}{5}
 \end{aligned}$$

$$\text{Combined P/v ratio} = \frac{7}{5} \times \frac{1}{5} \times 100 = 28\%$$

$$\begin{aligned}
 \text{So combined BEP} &= \frac{F. cost}{\text{Combined } \frac{P}{v} \text{ ratio}} \\
 &= \frac{10000 + 12000}{0.28} \\
 &= \frac{22000}{0.28} \\
 &= ₹ 78571
 \end{aligned}$$

$$\begin{aligned}
 \text{units to be produced by A unit} &= 78571 \times \frac{2}{5} \times \frac{1}{5} \\
 &= 6286
 \end{aligned}$$

$$\begin{aligned}
 \text{units to be produced by B unit} &= 78571 \times \frac{3}{5} \times \frac{1}{5} \\
 &= 9428
 \end{aligned}$$

Reconciliation :-

$$\begin{aligned}
 \text{Total contribution in A at BEP} &= 6286 \times 2 \\
 &= ₹ 12572
 \end{aligned}$$

$$\begin{aligned}
 \text{Total contribution in B at BEP} &= 9428 \times 1 \\
 &= ₹ 9428
 \end{aligned}$$

$$\begin{aligned}
 \text{Total contribution} &= 9428 + 12572 \\
 &= 22000 \\
 &= \text{Fixed Cost}
 \end{aligned}$$

(iii) Variable product mix method:-

In variable product mix method of finding out the combined Break-even point, the unit which is having higher P/v ratio is selected and its capacity is fully utilized and balance fixed cost portion if left is covered through production from the second and following the same procedure from the rest of units.

Let us again take the example as in the constant product mix method.

$$\begin{aligned}
 \text{P/v ratio of Factory A} &= \frac{2}{5} \times 100 \\
 &= 40\%
 \end{aligned}$$

$$\begin{aligned}
 \text{P/v ratio of Factory B} &= \frac{1}{5} \times 100 \\
 &= 20\%
 \end{aligned}$$

Factory A's P/v ratio is more than that of B so its capacity will be fully utilized.

$$\begin{aligned}
 \text{Capacity of Factory A} &= 10000 \text{ units} \\
 \text{Contribution given by factory A} &= 10000 \times 2 \\
 &= ₹ 20000
 \end{aligned}$$

$$\begin{aligned}
 \text{Total fixed cost of both factories} &= 12000 + 10000 \\
 &= ₹ 22000 \\
 \text{Balance fixed cost to be covered for B.E.P} &= 22000 - 20000 \\
 &= ₹ 2000 \\
 \text{Contribution per unit in factory B} &= 5 - 4 \\
 &= ₹ 1
 \end{aligned}$$

$$\text{So, the production required} = \frac{2000}{1} = 2000 \text{ units}$$

So at B.E.P (combined) Production units required are 10,000 and 2000 units in factory A and B respectively

Reconciliation :-

$$\begin{aligned}
 \text{Total contribution from both the factories} &= 2 \times 10000 + 1 \times 2000 \\
 &= 20000 + 2000 \\
 &= ₹ 22000 \\
 \text{Total fixed cost} &= 12000 + 10000 \\
 &= ₹ 22000
 \end{aligned}$$

Illustration:6.

A company is producing on identical product in two factories. Following are the details in respect of both the factories:

	Factory X	Factory Y
	₹	₹
Selling price per unit	50	50
Variable cost per unit	40	35
Fixed Cost	2,00,000	3,00,000
Depreciation included in above	40,000	30,000
Sales (units)	30,000	20,000
Production Capacity	40,000	30,000

You are required to determine:

- Break-even point (BEP) for each factory individually.
- Which factory is more profitable?
- Cash (BEP) for each factory individually.
- BEP for the company as a whole assuming the present product mix is 3:2.

Solution :

$$\text{Contribution per unit in factory X} = 50 - 40 = ₹ 10$$

$$\text{Contribution per unit in factory Y} = 50 - 30 = ₹ 15$$

$$\text{P/V ratio for factory X} = \frac{10}{50} \times 100 = 20 \%$$

$$\text{P/V ratio for factory Y} = \frac{15}{50} \times 100 = 30 \%$$

$$\begin{aligned} \text{(a) Break even point (BEP) for factory X} &= \frac{F \text{ Cost}}{\text{Cont. per unit}} = \frac{200000}{10} \\ &= 20000 \text{ units} \end{aligned}$$

$$\begin{aligned} \text{Break even point (BEP) for factory Y} &= \frac{F \text{ Cost}}{\text{Cont. per unit}} = \frac{300000}{15} \\ &= 20000 \text{ units} \end{aligned}$$

(b) We see from the above analysis BEP in both the factories is 20000 units. Factory Y at 20000 units covers a fixed cost of ₹ 30000. When the sale tends to decrease below 20000 units the company with lower P/v ratio will be beneficial because the loss incurred for every unit decrease in output will be lower than that of the other. So, if the sale decreases below 20000 units of the product then factory X is preferred. When the sale tend to increase i.e. more than 20000 factory Y will be more profitable in covering the fixed cost in the second phase for every unit increase in sale.

$$\begin{aligned} \text{(c) Cash fixed cost in Factory X} &= 200000 - 40000 \\ &= ₹ 160000 \end{aligned}$$

$$\begin{aligned} \text{Cash fixed cost in Factory Y} &= 300000 - 30000 \\ &= ₹ 270000 \end{aligned}$$

$$\text{Cash BEP in Factory X} = \frac{160000}{10} = 16000 \text{ units}$$

$$\text{Cash BEP in Factory Y} = \frac{270000}{15} = 18000 \text{ units}$$

(d) For combined BEP let us first of all compute the combined contribution taking into consideration present product mix of 3:2

$$\begin{aligned} \text{Combined contribution} &= 10 \times \frac{3}{5} + 15 \times \frac{2}{5} \\ &= 6 + 6 = ₹ 12 \end{aligned}$$

$$\begin{aligned} \text{Total fixed cost} &= 200000 + 300000 \\ &= ₹ 500000 \end{aligned}$$

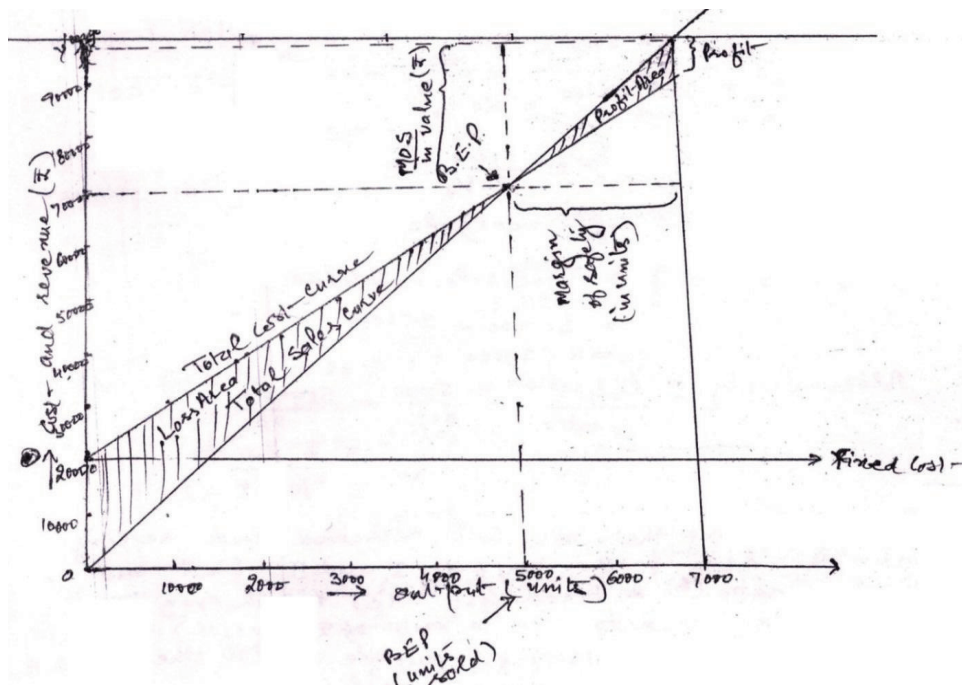
$$\begin{aligned} \text{Combined B.E.P in (units)} &= \frac{500000}{12} \\ &= 41,667 \text{ units} \end{aligned}$$

Margin of Safety: – One of the most important factors to be considered in the decision making process at the management level is the margin of safety. It is the difference between the volume of sales of the production unit and the break-even point sales. It tells us about how far away production entity is from the break-even point. The more difference is always desired. So excess of sales over break-even point sales is margin of safety. It can be expressed in units of the product sold, excess value of sales over break-even point sales, as percentage of total sales.

Let us take an example to clear the point

Let factory A is having the following information:–

$$\text{Selling price per unit} = ₹ 14$$



From the above graph it is very clear that at 5000 units of production there is neither profit nor any loss sale curve and total cost curve meet each other or we can say what is spent in production is recovered from the sale of the product. The company or the production entity is producing and selling 7000 units in the market so it is at 2000 units excess above the BEP sale. We can say in other words the companies margin of safety is 2000 units and in sales vale it is $2000 \times 14 = ₹ 28000$ above the B.E.P.

Illustration 7. A company Hero Ltd gives you the information about its sales and profits as follows:–

Sales =	₹ 500000
Less: variable cost=	₹ 400000
Fixed cost=	₹ 50000

	= 450000
Profit before tax=	50000

You are required to find out

- (i) P/v ratio (ii) The BEP sales (ii) Margin of Safety

Sol:–

$$\begin{aligned}
 \text{Contribution} &= 500000 - 400000 = ₹ 100000 \\
 \text{Sales} &= ₹ 500000 \\
 \text{(i) P/v ratio} &= \frac{100000}{500000} \times 100 = 20\% \\
 \text{(ii) B.E.P sales} &= \frac{\frac{F.cost}{P}}{\frac{P}{v} ratio} = \frac{500000}{20\%} \\
 &= 50000 \times \frac{100}{20} = ₹ 250000 \\
 \text{(iii) Margin of safety} &= \text{Total sales} - \text{BEP sales} \\
 &= 500000 - 250000 = ₹ 250000 \\
 \text{Alternatively} &= \frac{\text{Profit}}{\frac{P}{v} ratio} = \frac{50000}{20\%} \\
 &= 50000 \times \frac{100}{20} = ₹ 250000
 \end{aligned}$$

Illustration:–8

Assuming that the cost structure and selling prices remain the same in the period I and II Find out (a) Profit volume ratio (b) Fixed cost (c) Break–even point sales (d) Sales required to earn a profit of ₹ 20000 (e) Sales required to earn a profit of ₹ 15000 (f) variable cost in the period II (g) sales to earn a profit of 10% on sales.

Period	Sales ₹	Profit ₹
I	1,20,000	9,000
II	1,40,000	13,000

Solution:–

$$\begin{aligned}
 \text{Change in profit} &= 13000 - 9000 = ₹ 4000 \\
 \text{Change in sales} &= 14000 - 12000 = ₹ 2000 \\
 \text{(i) P/v ratio} &= \frac{\text{Change in Profit}}{\text{Change in sales}} \times 100 = \frac{4000}{20000} \times 100 = 20\%
 \end{aligned}$$

(ii) To find out the Fixed cost take either of the periods say period I

$$\text{Sales} = 120,000$$

$$\text{P/v ratio} = 20\%$$

$$\begin{aligned}\text{So contribution} &= \text{S} \times \text{P/v ratio} = 120000 \times 20\% \\ &= ₹ 24000\end{aligned}$$

$$\begin{aligned}\text{So fixed cost} &= 24000 - 9000 \quad \text{or} \quad (\text{S} - \text{V} - \text{P}) \text{ as } \boxed{\text{P} = \text{S} - \text{F} - \text{V}} \\ &= ₹ 15000\end{aligned}$$

$$\begin{aligned}\text{(c) Break-even points sales} &= \frac{\text{F.cost}}{\text{P/v ratio}} = \frac{15000}{20\%} \\ &= ₹ 75000\end{aligned}$$

(d) Sales required to earn a profit of ₹ 20000

$$\begin{aligned}&= \frac{\text{F Cost} + \text{desired profit}}{\text{P/v ratio}} \\ &= \frac{15000 + 2000}{20\%} \\ &= \frac{35000}{20\%} = ₹ 175000\end{aligned}$$

(e) Margin of safety at a profit ₹ 15000

$$\begin{aligned}\text{MOS} &= \frac{\text{Profit}}{\text{P/v ratio}} = \frac{15000}{20\%} \\ &= ₹ 75000\end{aligned}$$

$$\begin{aligned}\text{(e) Variable cost in Period II} &= (1 - \text{P/v ratio}) \times \text{Sales} \\ &= (1 - 20\%) \times 140000 \\ &= 140000 \times 80\% \\ &= ₹ 112000\end{aligned}$$

$$\text{As P/v ratio} = 20\%$$

$$\text{or Contribution} = 20\% \text{ of sales}$$

$$\text{S} - \text{V} = 20\% \text{ of S}$$

$$\text{S} - 20\% \text{ of S} = \text{V}$$

$$\text{V} = 80\% \text{ of S}$$

(g) Sales required to earn a profit of 10% on Sales

$$\begin{aligned}\text{Let sales} &= x \\ x &= \frac{\text{F.C.} + 10\% \text{ of } x}{\text{P/v ratio}} \\ x &= \frac{15000 + 0.1 x}{0.2} \\ 0.2 x &= 15000 + 0.1 x \\ \text{or } 0.1 x &= 15000 \\ x &= \frac{15000}{0.1} \\ x &= ₹ 150,000\end{aligned}$$

So sales required to earn a profit equal to 10% on sales = ₹ 150,000

Illustration 9. The ratio of variable cost to sales is 60%. The break-even point occurs at 80% of sales. Fixed cost is ₹ 200000. Find the sales capacity and the sales at break-even point. Also determine the profit at 90% and 100% sales capacity (CS – Inter Dec., 2009).

Sol:–

We are given variable cost = 60% of sales

So contribution = 40% of sales

or P/v ratio = 40%

$$\text{B.E.P (sales)} = \frac{F. Cost}{\frac{P}{v} ratio}$$

$$= \frac{200000}{40\%}$$

$$= ₹ 500000$$

B.E.P (sales) = 80% of sales

$$\text{so } x \times 80\% = 500000$$

$$x = \frac{500000}{80\%}$$

$$= ₹ 625000$$

So total sales or sales capacity = ₹ 625000

Determination of profit at 90% and 100% of capacity

	90% capacity ₹	100% capacity ₹
Sales	5,62,500	6,25,000
Variable Cost	3,37,500	3,75,000
Contribution	2,25,000	2,50,000
Fixed Cost	2,00,000	2,00,000
Profit	25,000	50,000

Illustration: 10 A company has a fixed cost of ₹ 200000. It sells two products X and Y in the ratio of 2:1. If contribution of X is ₹ 10 per unit and of Y is ₹ 20 per unit, how many units of X and Y should be sold at break-even point? (B.com Hons. Delhi 2010).

Sol:–

Contribution of X = ₹ 10 per unit

Contribution of Y = ₹ 20 per unit

Sales ratio = 2:1

$$\begin{aligned} \text{Combined contribution of X and Y} &= 10x \frac{2}{3} + 20x \frac{1}{3} \\ &= \frac{20}{3} + \frac{20}{3} = \frac{40}{3} \end{aligned}$$

$$\begin{aligned} \text{B.E.P (in units)} &= \frac{F. cost}{\text{Cont. per unit}} \\ &= \frac{200000}{40/3} = \frac{200000 \times 3}{40} \end{aligned}$$

$$= 15000 \text{ units}$$

$$\left. \begin{aligned} \text{units of X} &= 15000 \times \frac{2}{3} = 10000 \text{ units} \\ \text{units of Y} &= 15000 \times \frac{1}{3} = 5000 \text{ units} \end{aligned} \right\} \text{Answer}$$

Illustration 11. A Ltd Manufactures and sells four types of products under the brand names P,Q,R and S. The sales mix in value comprise $33\frac{1}{3}\%$, $41\frac{2}{3}\%$, $16\frac{2}{3}\%$, $8\frac{1}{3}\%$ of P,Q,R and S respectively. The total budgeted sales (100%) are ₹ 60000 per month.

Operating costs are:

Variable costs:

Product P ----- 60 % of selling Price

Product Q ----- 68 % “ “ “

Product R ----- 80 % “ “ “

Product S ----- 40 % “ “ “

Fixed Cost : ₹ 14700 per month

Calculate the break even point for the products on an overall basis.

(CS. Final, June, 1987)

Solution:

	Products				
	P	Q	R	S	Total
Sales Value (₹)	20000	25000	10000	5000	60000
Variable (₹)	12000	17000	8000	2000	39000
Contribution (₹)	8000	8000	2000	3000	21000
Fixed cost (₹)					14700
					Profit (₹)
					6300

$$\begin{aligned} \text{Overall P/v ratio} &= \frac{\text{Contribution}}{\text{sales}} \times 100 \\ &= \frac{21000}{60000} \times 100 \\ &= 35\% \end{aligned}$$

$$\begin{aligned} \text{Break even point sales} &= \frac{\text{Fixed cost}}{\frac{\text{P}}{\text{v}} \text{ ratio}} \\ &= \frac{14700}{35\%} = ₹ 42000 \end{aligned}$$

Illustration 12. Fill in the blanks for each of the independent situations:

	A	B	C	D	E
Selling price per unit (₹)		₹ 50	₹ 20	....	₹ 30

Variable cost as % of selling price	60	...	75	75	....
No. of units sold	10,000	4,000	....	6,000	5,000
Marginal contribution	₹20,000	₹80,000	.....	₹25,000	₹50,000
Fixed costs	₹12,000	.....	₹120,000	₹10,000	.....
Profit/Loss	.....	₹20,000	₹30,000	.....	₹15,000

Sol: For product A

Let selling price = ₹ x

then $10000(x - 0.6x) = 20000$

$$0.4x = 2$$

$$x = \frac{2}{0.4} = ₹ 5$$

Profit = Contribution – fixed cost

$$= 20000 - 12000$$

$$= ₹ 8000$$

(b) For product – B

Let variable cost as percentage of sales = x

$$4000 \left(50 - 50 \times \frac{x}{100} \right) = 80,000$$

$$50 - 0.5x = 20$$

$$0.5x = 30$$

$$x = \frac{30}{0.5} = 60$$

Let fixed cost = y

then $80,000 - \text{F.C.} = 20000$

$$80,000 - y = 20000$$

$$y = 80000 - 20000 = ₹ 60000$$

(c) Let the number of units sold = x

Marginal contribution = 75%

F contribution/sales ratio = $1 - 0.75$

$$= 0.25 = 25\%$$

But marginal contribution = F.C. + profit

$$= 120000 + 30000$$

$$= ₹ 150000$$

$$x \times 20 \times 25\% = 150000$$

$$x \times 20 \times \frac{25}{100} = 150000$$

$$\Rightarrow x = 150000 \times \frac{100}{20 \times 25}$$

$$=30000 \text{ units}$$

$$\text{Marginal contribution} = ₹ 150000$$

(D) Let selling price of products D = x

$$\text{Then } 6000(x - 0.75x) = 25000$$

$$0.25x = \frac{25000}{6000}$$

$$x = \frac{25000}{6000} \times \frac{1}{0.25}$$

$$x = ₹ 16.67$$

(E) Let the variable cost as percentage of selling price = x

$$\text{then } 5000 \left(30 - \frac{30 \times x}{100} \right) = 50,000$$

$$30 - \frac{30x}{100} = 10$$

$$\Rightarrow \frac{30x}{100} = 20$$

$$x = \frac{20 \times 100}{30} = 66.67\%$$

$$\text{Contribution} - \text{F cost} = \text{profit}$$

$$50,000 - \text{F cost} = 15000$$

$$\text{so fixed cost} = 50000 - 15000 = ₹ 35000$$

Illustration 13. The sales turnover and profit during two years are as follows:

Year	Sales ₹	Profit ₹
2009	180,000	20,000
2010	200000	25000

Calculate (i) P/v ratio and fixed cost (ii) Break even point.

(iii) The sales required to earn a profit of ₹ 40000

(iv) Profit when sales are ₹ 230000 (v) Margin of safety at profit of ₹ 50000 (vi) variable cost of the two periods.

Solution:

$$\begin{aligned} \text{Change in profit} &= 25000 - 20000 \\ &= ₹ 5000 \end{aligned}$$

$$\begin{aligned} \text{Change in sales} &= 200000 - 180000 \\ &= ₹ 20000 \end{aligned}$$

$$\begin{aligned} \text{(i) P/v ratio} &= \frac{5000}{20000} \times 100 \\ &= 25\% \end{aligned}$$

$$\text{Contribution} - \text{Fixed cost} = \text{Profit}$$

$$180000 \times 25\% - \text{Fixed cost} = 20000$$

$$45000 - \text{fixed cost} = 20000$$

$$\text{Fixed cost} = 45000 - 20000$$

$$= ₹ 25000$$

$$(ii) \quad \text{Break-even point} = \frac{F.cost}{\frac{P}{v}ratio}$$

$$= \frac{25000}{25\%}$$

$$= ₹ 100000$$

$$(iii) \quad \text{Sales required to earn a profit of ₹ 40000}$$

$$= \frac{\text{Fixed cost} + \text{Profit}}{\frac{P}{v}ratio}$$

$$= \frac{25000 + 40000}{25\%} = \frac{65000}{25\%} = ₹ 260,000$$

$$(iv) \quad \text{Profit when sales are ₹ 2,30,000}$$

$$\text{Profit} = \text{contribution} - \text{fixed cost}$$

$$= 230000 \times 25\% - 25000$$

$$= ₹ 32,500$$

$$(v) \quad \text{Margin of safety at profit of ₹ 50000}$$

Let x be the sales required to earn a profit of ₹ 50000

$$x \times 25\% - 25000 = 50000$$

$$\frac{x}{4} = 75000$$

$$x = 3,00,000$$

$$\text{Margin of safety} = 300000 - \text{BEP sales}$$

$$= 300000 - 100000 = ₹ 200000$$

$$(vi) \quad \text{Variable cost for 2009 and 2010}$$

$$P/v \text{ ratio} = 25\%$$

$$\text{so variable cost or marginal cost} = (1 - 25\%) = 75\% \text{ of sales}$$

$$v. \text{ cost for 2009} = 180000 \times 75\% = ₹ 135000$$

$$v. \text{ cost for 2010} = 200000 \times 75\% = ₹ 150000$$

When sales of two periods and profits of the two period for the same unit and the company is given we can find out the P/v ratio the following formula.

$$P/v \text{ ratio} = \frac{\text{Change in profit of two periods}}{\text{change in sales of the relating two periods.}}$$

$$= \frac{\Delta P}{\Delta S}$$

We can prove it as follows:

$$\text{we know that } S = F + V + P$$

Let for period I

$$S_1 = F + V_1 + P_1 \quad [\text{as } F \text{ is constant}]$$

and for period II

$$S_2 = F + V_2 + P_2$$

$$\text{Now } S_2 - S_1 = (V_2 - V_1) + (P_2 - P_1)$$

dividing by $S_2 - S_1$ we get

$$\{(S_2 - S_1)/(S_2 - S_1)\} = \{(V_2 - V_1)/(S_2 - S_1)\} + \{(P_2 - P_1)/(S_2 - S_1)\}$$

$$1 = \frac{\text{Marginal Cost}}{\text{Sales}} + \frac{\text{Change in profit}}{\text{Change in sales}}$$

$$1 - \text{Marginal cost/sales ratio} = \frac{\text{Change in profit}}{\text{Change in sales}}$$

$$\text{P/V ratio} = \frac{\text{Change in profit}}{\text{Change in sales}}$$

Illustration 14. XYZ Ltd. furnishes you the following income information:

Period	Year 2010	
	I	II
Sales (₹)	4,05,000	5,13,000
Profit earned (₹)	10,800	32,400

From the above, you are required to compute the following assuming that fixed cost remains the same in both the periods.

- (i) P/v ratio (ii) Fixed costs (iii) The amount of profit or loss when sales are ₹ 3,24,000 (iv) Amount of sales required to earn a profit of ₹ 54,000

Sol:-

$$\begin{aligned} \text{Change in sales} &= 513000 - 405000 \\ &= ₹ 108000 \\ \text{Change in profit} &= 32400 - 10800 \\ &= ₹ 21600 \end{aligned}$$

(i)
$$\text{P/v ratio} = \frac{\text{change in profit}}{\text{change in sales}} \times 100$$

$$= \frac{21600}{108000} \times 100 = 20\%$$

- (ii) Fixed cost
we know

$$\begin{aligned} \text{Contribution} - \text{profit} &= \text{Fixed cost} && \text{as } [\text{Cont.} = \text{F} + \text{P}] \\ \text{S} \times \text{p/v ratio} - \text{profit} &= \text{fixed cost} \\ 405000 \times 20\% - 10800 &= 81000 - 10800 \\ &= ₹ 70200 \end{aligned}$$

- (iii) Sales when profit is ₹ 54000
again

$$\begin{aligned} \text{S} \times \text{P/v ratio} &= \text{Fixed cost} + \text{profit} \\ \text{S} \times 20\% &= 70200 + 54000 \\ \text{S} &= \frac{70200 + 54000}{20\%} \\ &= ₹ 6,21,000 \end{aligned}$$

- (iv) Profit when sales are ₹ 3,24,000
- $$\begin{aligned} \text{S} \times \text{P/v ratio} &= \text{F.C.} + \text{profit} \\ \text{so profit} &= \text{S} \times \text{P/v ratio} - \text{F.C} \end{aligned}$$

$$\begin{aligned}
&= 324000 \times 20\% - 70200 \\
&= 64800 - 70200 \\
&= ₹ 5400 \text{ loss.}
\end{aligned}$$

In percentage terms the sum of contribution to sales ratio and variable cost to sales ratio is always equal to 100. In decimal terms the sum of c/s or P/v ratio to marginal cost to sales or variable cost to sales ratio is one.

We can say

$$\begin{aligned}
&\text{P/V ratio} + \text{marginal cost ratio} = 100 \\
&\text{or P/v ratio} + \text{marginal cost ratio} = 1
\end{aligned}$$

$$\text{We know} \quad S = V + F + P \quad [\text{Contribution} = F + P]$$

dividing both sides by S we get

$$\frac{S}{S} = \frac{V}{S} + \frac{F+P}{S}$$

$$1 = \text{marginal cost to sales ratio} + \text{contribution to sales ratio}$$

$$1 = \text{marginal cost to sales ratio} + \text{P/v ratio}$$

Illustration 15. S. Ltd furnishes you the following information relating to the half year ending 30th June, 1980.

	₹
Fixed Expenses	50,000
Sales value	2,00,000
Profit	50,000

During the second half of the same year the company has projected a loss of ₹ 10,000.

You are required to calculate.

- The P/v ratio, break-even point and margin of safety for six months ending 30th June, 1980.
- Expected sales volume for second half of the year assuming that selling price and fixed expenses remains unchanged in the second half of the year also.
- The break-even point and margin of safety for the whole year 1980.

[ICWA inter Dec, 1986]

Solution:

$$\begin{aligned}
\text{(i)} \quad \text{Contribution} &= \text{Fixed expenses} + \text{Profit} \\
&= 50000 + 50000 = ₹ 100000
\end{aligned}$$

$$\text{P/v ratio} = \frac{F+P}{\text{sales}} = \frac{100000}{200000} \times 100 = 50\%$$

$$\text{Break-even point} = \frac{F}{\frac{P}{v} \text{ ratio}} = \frac{50000}{50\%} = ₹ 1,00,000$$

$$\text{Margin of safety} = 200000 - 100000 = ₹ 1,00,000$$

$$\begin{aligned}
\text{(ii)} \quad \text{Contribution in the second half of the year} &= F + \text{Profit} \\
&= 50000 - 10000 = ₹ 40,000
\end{aligned}$$

Expected sales volume (Value) =

$$S \times \text{P/V ratio} = \text{Contribution}$$

$$S \times 50\% = 40000$$

$$S = \frac{40000}{50\%} = ₹ 80,000$$

$$\text{(iii) Break-even point for the whole year} = \frac{\text{Total Fixed costs}}{\frac{P}{v} \text{ ratio}}$$

$$= \frac{100\,000}{50\%} = ₹ 200\,000 \quad [\text{As F.C} = 50000 + 50000 = ₹ 100000]$$

$$\begin{aligned} \text{Margin of safety} &= \text{Total sales} - \text{BEP sales} \\ &= (200000 + 80000) - (200000) \\ &= ₹ 80,000 \end{aligned}$$

$$\begin{aligned} \text{or } &= \frac{\text{Total Profit}}{\frac{P}{v} \text{ ratio}} = \frac{50000 - 10000}{\frac{P}{v} \text{ ratio}} \\ &= \frac{40000}{50\%} = ₹ 80000 \end{aligned}$$

Various effects of certain changes on P/v ratio, BEP of sales and margin of safety.

The various factors effecting the cost of production are (1) Fixed cost (2) Variable cost (3) volume of sales (units of product sold). Total cost is directly related to these factors in the sense that whenever the fixed cost though constant for a certain level of production increases, there is an increase in the cost of production or the total cost. Variable cost is directly related to the total cost of production. Similarly whenever the units of production increases the total cost also increases. Let us see the effect of changes in these on the level of P/v ratio, the breakeven point and the margin of safety.

Take the case of fixed cost: The change in the fixed cost will not effect the P/v ratio, because the P/v ratio is based on the contribution and sales. Fixed cost is excluded from the evaluation of P/v ratio. Fixed cost fluctuation will effect the Breakeven point, because higher the fixed cost, the higher the break-even point will be. As $\text{BEP} = \frac{F.\text{cost}}{\frac{P}{v} \text{ ratio}}$.

Taking P/v ratio constant, BEP is directly related to the fixed cost. Higher the fixed cost means higher the BEP implies decrease in the margin of safety.

Effect of variable cost: Variable cost is inversely related to the contribution. Increase in variable cost leads to decrease in contribution and so decrease in the P/v ratio. Decrease in P/v ratio leads to increase in the break even point sales. Increase in BEP sales leads to decrease in margin of safety. So we can say variable cost has adverse or a negative effect on P/v ratio and so margin of safety.



and vice-versa

Effect of volume of sales (units sold):

As we know P/v ratio is the contribution to sales ratio. When we calculate P/v ratio, the number of units are not taken into consideration, Though taken into consideration its effect will be nulled while calculating the P/v ratio. As volume of units sold have no effect on P/v ratio so it will have no effect on BEP sales. margin of safety will be effected with the volume of units sold. As margin of safety is the difference in the actual sales and BEP sales. Higher the volume of sales the higher the margin of safety. So we can say from above the volume of sales has no relation with P/v ratio, BEP sales, but a direct relation with the margin of safety.

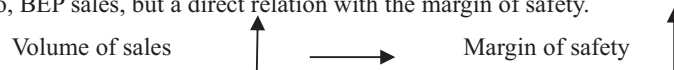


Illustration 16. The variable cost structure of a product manufactured by a company during the current year is as under:

Material ₹ 120 per unit: labour ₹ 30 per unit : overheads ₹ 12 per unit.

The selling price per unit is ₹ 270 and the fixed cost and sales during the current year are ₹ 14,00,000 and ₹ 40,50,000 respectively.

During the forthcoming year the direct workers will be entitled to a wage increase of 10% from the beginning of the year and the material cost, variable overhead and fixed overhead are expected to increase by 7.5%, 5% and 3% respectively.

Following are required to be computed:

- (a) New sales price in the forthcoming year if the current P/v ratio is to be maintained.
- (b) Number of units that would be required to be sold during the forthcoming year so as to yield the same amount of profit as in the current year, assuming the selling price per unit will not be increased.

Solution:

Let us first of all calculate the current P/v ratio.

$$S = ₹ 270 \text{ per unit}$$

$$v = 120 + 30 + 12 = ₹ 162 \text{ per unit}$$

$$\text{Contribution} = 270 - 162 = ₹ 108 \text{ per unit}$$

$$\text{P/v ratio} = \frac{C}{S} \times 100 = \frac{108}{270} \times 100 = 40\%$$

- (a) New variable cost

$$\text{Material cost} = 120 \times (1 + 0.075) = ₹ 129$$

$$\text{Labour cost} = 30 \times (1 + 0.1) = ₹ 33$$

$$\text{Variable overhead} = 12 \times (1 + 0.05) = ₹ 12.6$$

$$\text{Variable cost} = 129 + 33 + 12.6 = ₹ 174.6$$

As per the condition of the question

$$\frac{S - V}{S} = 40\%$$

$$\frac{S - 174.6}{S} = 0.4$$

$$S - 174.6 = 0.4S$$

$$S - 0.4S = 174.6$$

$$0.6S = 174.6$$

$$S = \frac{174.6}{0.6} = ₹ 291 \text{ per unit}$$

- (b) Last year profit = $4050000 \times 0.4 - 1400000$
= ₹ 220000

$$\begin{aligned} \text{New Fixed cost} &= 1400000 \times (1 + 0.03) \\ &= ₹ 1442000 \end{aligned}$$

$$\begin{aligned} \text{New contribution} &= 270 - 174.6 \\ &= ₹ 95.4 \text{ per unit} \end{aligned}$$

$$\begin{aligned} \text{New sales (units) to earn the desired profit} &= \frac{F + P}{\text{Cont. per unit}} \\ &= \frac{1442000 + 220000}{95.4} \\ &= \frac{1662000}{95.4} \\ &= 17422 \text{ units approx.} \end{aligned}$$

Situations where marginal costing and cost volume profit analysis can be applied.

Marginal cost is the cost required to produce and sell an extra unit and cost-volume profit analysis tells us the effect of cost and volume on the overall profit. Both are helpful to the management in taking appropriate decisions in various situations such as launching a new product in the market, fixing the selling price, make or buy a product and so on. The following are the listed situations where the marginal costing and the cost volume profit analysis can applied.

1. Cost control
2. Profit planning
3. Evaluation of performance
4. Decision making

Let us take one by one.

- 1) **Cost Control** : Marginal costing system is helpful to control the cost as far as possible. Cost is divided into two major parts fixed and the variable cost. Fixed costs are the cost which are independent of the volume of production up to a certain level of production. Variable cost vary with the units of production and is made up of material, overhead and labour cost. The lower level of the management through various tools can have a check over these costs. Checking the in efficiencies in material, labour and overheads can lower the marginal cost. Bulk purchase of raw material, less wastage are the exemplary tools to minimize the material cost. Lowering the managing cost means lowering the total cost and hence increase in the total profit.

- 2) **Profit Planning**:

Marginal costing is helpful in the planning of the profit in future i.e. maximizing the profit in the near future or maintain a certain level of profit. As we know profits are increased or decreased with the fluctuations in the selling prices, variable costs and the units of product sold. Absorption costing can not chalk out the correct effects of change in sale price, variable cost or the product mix on the profit of the concern.

Illustration 17. Reprographics Ltd. manufactures a document reproducing machines which has a variable cost structure as follows:

	₹
Material	40
Labour	10
Overhead	4
Selling price	90

Sales during the current year are expected to be ₹ 13,50,000 and fixed overheads 1,40,000

Under wage agreement, an increase of 10 percent is payable to all direct workers from the beginning of the forthcoming year, while material costs are expected to increase by $7\frac{1}{2}$ percent, variable cost by 5% and fixed over head costs 3 percent.

You are required to calculate:

- (a) The new selling price if the current P/v ratio is to be maintained and
- (b) The quantity to be sold during the forthcoming year to yield the same amount of profit as the current year assuming the selling price to remain at ₹ 90.

(CA inter

May 1985)

Solution:

$$\begin{aligned}
 \text{Marginal cost} &= 40+10+4 \\
 &= 54 \\
 \text{Contribution} &= 90-54 \\
 &= 36
 \end{aligned}$$

$$P/v \text{ ratio} = \frac{36}{90} \times 100 = 40\%$$

$$\begin{aligned} \text{(a) New labour cost} &= 10 \times (1 + 10\%) = ₹ 11 \\ \text{Material cost} &= 40 \times (1 + 7.5\%) = ₹ 43 \\ \text{Variable cost} &= 4 \times (1 + 5\%) = ₹ 4.20 \\ \text{New marginal cost} &= ₹ 58.20 \end{aligned}$$

$$\begin{aligned} \text{New fixed cost} &= 140000 \times (1 + 3\%) \\ &= ₹ 144200 \end{aligned}$$

$$P/v \text{ ratio} = 40\%$$

$$\text{So marginal cost ratio} = 60\% = (100 - 40\%)$$

$$\begin{aligned} \text{New selling price} &= \frac{58.20}{60\%} \\ &= ₹ 97 \end{aligned}$$

(b) Let x be the units sold

$$[x \times \text{expected contribution per unit}] - \text{New fixed cost} = \text{current year profit}$$

$$x \times (90 - 58.20) - 144200 = (1350000 \times 40\% - 140000)$$

$$x \times 31.80 = 400000 + 144200$$

$$x = \frac{544200}{31.80}$$

$$x = 17114 \text{ approx}$$

Illustration 18. Zed Ltd reported the following figures for 1983 and 1984.

	1983	1984
Sales (₹)	50,00,000	60,00,000
Total Cost (₹)	45,00,000	52,00,000

The company anticipated that in 1985

- (i) Variable cost rates on average, would record an increase of 10% over the year 1984.
- (ii) Sales would record an increase of 20% over the 1984 level in volume.
- (iii) Selling price on average would increase by 5%.
- (iv) In addition another 10,00,000 of sales (1984 level) would be made to Government at a special discount of 10% thereof and
- (v) Fixed cost would increase by ₹ 300000
 - (a) Ascertain the expected profit/loss in 1985.
 - (b) If increase in fixed costs mentioned above arises only if the sales to government is made, would you recommend the sale to be made?
 - (c) What is the P/v ratio in 1985, normal sales?

(C.S. final June 1983)

Solution:

Let us calculate first of all the P/v ratio

$$\begin{aligned} P/v \text{ ratio} &= \frac{\text{Change in profit}}{\text{Change in sales}} \times 100 \\ &= \frac{(6000000 - 5200000) - (5000000 - 4500000)}{(6000000 - 5000000)} \times 100 \\ &= \frac{800000 - 500000}{1000000} \times 100 = \frac{300000}{1000000} \times 100 = 30\% \end{aligned}$$

$$\begin{aligned}\text{So marginal cost ratio} &= 100 - 30 \\ &= 70\%\end{aligned}$$

Take the year 1984

Total sales	= 60,00,000
Marginal cost	= 70% of 6000000
	= 4200 000
Total cost	= 5200 000
So fixed cost	= 1000000

$$\begin{aligned}\text{(a) Sales in 1984} &= ₹ 60 00 000 \\ \text{Sales increase due to volume} &= 20\% \\ &= 6000000 \times 20\% \\ &= ₹ 1200000\end{aligned}$$

$$\begin{aligned}\text{Sales in 1985 as an increase of volume} &= 6000000 + 1200000 \\ &= ₹ 7200000\end{aligned}$$

$$\begin{aligned}\text{Increase in sales due to selling price} &= 7200000 \times (1 + 5\%) \\ &= 7200000 + 360000 \\ &= ₹ 75,60,000\end{aligned}$$

Sales to Government

$$\begin{aligned}(\text{₹ } 10,00,000 - 10\% \text{ discount}) &= 900000 \\ \text{Total sales} &= ₹ \quad \underline{8460000}\end{aligned}$$

sales without any increase in price

$$\begin{aligned}\text{i.e. sales without any price effect} &= 6000000 \\ 20\% \text{ increase in volume} &= \quad \underline{1200000} \\ &= 7200000\end{aligned}$$

$$\begin{aligned}+ \text{ special sales to government} &= \quad \underline{1000000} \\ \text{Total} &= ₹ 8200000\end{aligned}$$

$$\begin{aligned}\text{New. Marginal cost} &= 8200000 \times (70\% + 10\% \text{ increase in M.C}) \\ &= 820000 \times 77\% \\ &= ₹ 63,14000\end{aligned}$$

$$\begin{aligned}\text{New fixed cost} &= ₹ 1000000 + ₹ 300000 \\ &= ₹ 1300000\end{aligned}$$

$$\text{Total cost} = ₹ 76,14,000$$

$$\begin{aligned}\text{Profit} &= \text{Total sales} - \text{Total cost} \\ &= 8460000 - 7614000 = ₹ 8,46000\end{aligned}$$

(b) Decision regarding recommending the acceptance or not of the government order.

$$\begin{aligned}\text{Total sales to govt.} &= ₹ 10,00,000 \\ \text{Less special discount} &= ₹ 1,00,000\end{aligned}$$

Incremental revenue from Govt order = ₹ 9,00,000
 Less variable cost 77 % of 10,00,000 = ₹ 7,70,000
 Increase in F.C. specially linked order=₹ 3,00,000 } =₹ 10,70,000
 Net loss on accepting of the order = ₹ 1,70,000

So acceptance of order is not recommendable.

(c) New variable cost or marginal cost ratio = 77%

Normal sales due to increase in volume = 72,00,000

(Excluding govt. sales)

So variable cost = 7200000 × 77%
 = 5544000

Sale receipts taking the price rise effect
 = 7200000 × (1.05)
 = 7560000

So new P/v ratio = $\frac{5544000}{7560000} \times 100$
 = 26.67%

[As increase in selling price will not effect the variable cost (only sales due to increase in volume will be taken for the calculation of variable cost)]

(3) Performance evaluation:

Marginal costing is an important tool in the evaluation of the performance of each sector of the concern, the performance of the different products, markets etc. As the fixed cost for the whole organization remains the constant, the marginal cost becomes an important tool in the evaluation of the performance. If special fixed cost is attached to the particular activity then for the evaluation of the performance it shall also be taken into account along with the marginal cost.

Illustration 19. A company engaged in plantation activities has 200 hectares of virgin land which can be used for growing jointly or individually tea, coffee and cardamom. The yield per hectare of the different crops and their selling prices per kg are as under:

	Yield (kgs)	Selling price ₹ per kg
Tea	2000	20
Coffee	500	40
Cardamon	100	250

The relevant cost data are given below

(a) Variable cost per kg

	Tea ₹	Coffee ₹	Cardamom ₹
Labour charges	8	10	120
Packing material	2	2	10

other costs	4	1	20
Total cost	<u>14</u>	<u>13</u>	<u>150</u>

(b) Fixed cost per annum:

	₹
Cultivation and growing cost	10,00,000
Administrative cost	2,00,000
Land revenue	50,000
Repair and maintenance	2,50,000
other costs	3,00,000
Total costs	<u>18,00,000</u>

Calculate the priority of production if there is no limiting factor.

Solution:

	Tea	Coffee	Cardamon
Selling price (₹)/kg	20	40	250
Less variable cost per kg			
(₹)			
Labour	8	10	120
Packing charges	2	2	10
other cost	4	1	20
Total cost	<u>14</u>	<u>13</u>	<u>150</u>
Contribution per kg	16	27	100
Total contribution per hectare	16×2000=32000	500×27=13500	100×100=10000
Priority of production (rank)	I	II	III

Illustration 20. The skyrock Ltd. produces and sells three types of products P,Q and R. The management committee has decided to discontinue the production of 'Q' since there is not much profit in it. From the following set of information find out the profitability of the products and give your short comments on the decision of the management.

Products	Selling price per unit (₹)	Direct material per unit (₹)	Direct wages per unit		
			Dep. A	Dep. B	Dep. C
			(₹)	(₹)	(₹)
P	300	60	20	15	10
Q	275	30	20	20	10
R	305	70	12	10	20

absorption rates of overhead on the direct wages are

	Dep A	Dep B	Dep C
variable overheads	150%	120%	200%
Fixed overhead	200%	240%	150%

Solution:

		Products		
		P	Q	R
Selling price per unit (₹)		300	275	305
Variable cost:				
(i) Direct material (₹)	60	30	70	
(ii) Direct wages per unit (₹)				
Dep A	20	20	12	
Dep B	15	20	10	
Dep C	10	10	20	
(iii) Variable overheads per unit (₹)				
Dep A	30	30	18	
Dep B	18	24	12	
Dep C	20	20	40	
Total variable cost (₹)	173	154	182	
Contribution per unit (₹)	127	121	123	
P/v ratio	42.33%	44%	40.33%	

Though contribution per unit of Q is ₹ 121 and is the lowest but its P/v ratio is higher than other two which is 44%. So stress should be on increasing the sale of this product because of its higher P/v ratio. Also the product has a +ve contribution, each unit contribute ₹ 121. So it is not advisable to discontinue the product.

(4) Decision Making:

Marginal costing system is very much helpful to the management to take various types of decisions such as postponement of production, make a product or buy the product from the market, exporting the product or not accepting an order or rejecting etc. The decisions where the fixed costs which remains constant or stationary even when the volume of output is zero and the fixed cost is not considered in the evaluation and stability of the concern to stay and earn a long term profits in the market.

The various areas of decision making where marginal costing is helpful to the management are

- (i) Fixation of selling price
- (ii) Key or limiting factors.
- (iii) Make a buy decisions.
- (iv) Maintaining a desired level of profit.
- (v) Effects of changes in price.
- (vi) Selection of suitable product mix
- (vii) Closing down or suspending production.
- (viii) Alternative method of production.
- (ix) Alternative course of action.

- (x) Cost indifferent point.
- (xi) Diversification of products.

To understand the decision making process through marginal costing let us take each area one by one.

(i) Fixation of selling price:

Marginal costing is very much helpful in fixing the selling price. Though marginal costing i.e. variable cost and contribution are the main yard stick to fix the price but other situations are also to be kept in mind while fixing the selling price. In the normal situation first target is to cover as far as possible the fixed costs and afterward the desired profit. Other situations are whether the company has to fix price of the product as a new launch, whether to fix price for export, eradication of weak competitors from the market and so on.

The main aim of each organization is to earn profits in the long term. If the situations are normal the organization will fix price to cover total costs incurred and a desired level of profit. But situations may arise where the organization has to lower the prices. While having a proper watch on the situation which arises before the management, the management first of all fix the price in such a way to earn as far as possible certain profit level, secondly to cover the possible fixed costs which will be overall beneficial to the organization, thirdly to fix prices in such a way to cover the variable cost in the short run in the special situations.

Fixing the prices below the marginal cost is not advisable because at this stage the organization is not covering the incurred variable costs and so the fixed cost. Say ₹ 5 is the variable cost and ₹ 20000 is the fixed cost. If the company or the particular concern fix price above ₹ 5 let it be ₹ 7 then for every unit of production and sale it will contribute ₹ 2 and every unit of sale will lower the fixed cost to be covered. If the price is fixed below ₹ 5 say ₹ 4 then there will be a negative contribution of ₹ 1.00 for every unit of production and sale and loss will begin to increase the fixed cost ₹ 20000 and ₹ 1 for every next unit of sale. So loss will go on increasing.

But still the management of the concern may fix the price below the variable cost considering a short term loss and hoping to earn and cover the same in the long term. The situations where the price can be fixed below the marginal or variable cost are as under:

1) When new product is introduced in the market

The management may fix the price of the product below the marginal cost in the situation in which it has to introduce a new product in the market. Making the product popular and making the buyers to familiarize with the product, price is kept below the marginal cost. Hope of the management is kept that the situation will be for a short term and it can cover the incurred losses and the total costs in the coming future.

2) To enter into the foreign markets: when the aim of the concern is to enter into the foreign market it can fix prices below the marginal costs.

3) When the labour force cannot be retrenched:

If the labour unions are very strong and law of the land do not allow to retrench the labour force, the management on complete scrutiny of the situation hoping to get positive results in future can fix the price below marginal cost.

4) When goods are perishable in nature.

If the situation is such that the goods are perishable then it is recommended to sell these below the marginal cost otherwise the cost may increase and hence the loss, than to sell below marginal cost level.

5) When weak competitors are to be eliminated

When it seems that the competitors in the market are very weak and cannot compete in the long run at lower price. The management can fix price below marginal cost to eliminate the competitors and capturing a major share of market in the long term.

- 6) When goods are sent to the market for advertisement and publicity the price can be below the marginal cost.
- 7) The situation may arise where the closure of business means breaking connections of business and for re-establishing the business connections has to increase a heavy costs. In these types of situations to lower the total loss the concern can fix prices below the marginal cost.
- 8) When the sale of one of the products is linked to the sale of the other then management may fix the price of the product at less than marginal cost. It will be in overall benefit to the concern to sell it below the marginal cost because if its production and sale is closed the sale of the product linked will fall and overall loss will be more than the loss incurred in its sale.

Illustration 21. A company furnished you the following information and require you to fix the price of the product it want to sell.

	₹
Fixed cost	300 000
Variable cost per unit	
(i) Direct material (₹)	40
(ii) Direct labour (₹)	20
(iii) Direct overheads (₹)	15
(iv) other directly linked expenses up to sales (₹)	5

The company expects to sell 25000 units in the market and desire to earn a profit of ₹ 50000.

Solution:

$$\text{Total variable cost per unit} = (40 + 20 + 15 + 5) = ₹ 80$$

$$\text{Total contribution required} = F + P$$

$$= 300000 + 50000$$

$$= ₹ 350000$$

$$\text{Let the selling price of the product} = ₹ x$$

Then

$$25000(x - 80) = 350000$$

$$x - 80 = \frac{350000}{25000}$$

$$x - 80 = 14$$

$$x = 80 + 14 = 94$$

so selling price = ₹ 94 per unit

Illustration 22.

A manufacturer of a certain product has been exclusively in Indian market up to now. He has just received his first export enquiry and wants to quote as competitively as the circumstances will allow. His latest Indian cost sheet is:

Raw material = ₹ 34 per unit

Direct labour =	₹ 13 per unit
Services =	₹ 10 per unit
Works overhead =	₹ 10 per unit
Office overhead =	₹ 2 per unit
Total cost =	₹ 69 per unit
Profit earned in India =	₹ 6 per unit
Indian selling price =	₹ 75 per unit

Management is thinking of quoting a selling price some where between ₹ 69 and ₹ 75 per unit for this export order. One of the directors suggested quoting an even down price based on the principles of marginal costing. As a firms management accountant, you are requested to compute the lowest price the management could quote on these principles. State clearly any assumptions that you may make on the above facts and also any other costs of facts.

Solution:

The variable cost per unit	₹
Raw material	34
Direct labour	13
Services	5
Works overheads	5
Total (₹)	57

The minimum price that can be quoted for the export order is ₹ 57.

Assumptions:

- 1) With the acceptance of order and for manufacture of the product for export market the fixed cost remains unchanged or constant.
- 2) 50% of the services costs per unit is assumed to be fixed.
- 3) 50% of the works overheads are also taken to be fixed while reaching at decision of price fixation for export order.
- 4) Office overheads are also taken to be fixed.

So depending upon the above assumptions the lowest price that can be quoted is ₹ 57.

Illustration 23. A company desire to fix price is two types of markets i.e. in a monopoly and in competitive market. The number of units sold in the above markets are 2000 and 10000 respectively the fixed cost is ₹ 200000 and the total variable cost is ₹ 50 per unit. Work out price that can be fixed in the two markets under the normal working conditions, to earn a profit of ₹ 150,000.

Solutions–

As the conditions are normal in both the situations, the total costs incurred will be covered under monopoly

No. of units sold	= 2000
Total variable cost	= 2000 × 50
	= ₹ 100000
Total fixed cost	= ₹ 200000

Total cost	= ₹ 300000
Desired profit	= 150000
So the selling price to be fixed	= $\frac{300000+150000}{2000}$
	= $\frac{450000}{2000}$
	= ₹ 225 per unit

Under competition:

No. of units sold	= 10,000
Total variable cost	= 10000 × 50
	= ₹ 500000
Total fixed cost	= ₹ 200000
Total Cost	= ₹ 700000
Desired profit	= ₹ 150000
So the selling price to be fixed	= $\frac{700000+150000}{10000}$
	= $\frac{850000}{10000}$
	= ₹ 85 per unit

So price under monopoly = ₹ 225

price under competitive market = ₹ 85

(ii) The key or limiting factors.

Situations may arise where the factors of production are in limited supply such as material, labour, machine capacity, sales etc. In these situations marginal cost plays an important role in managerial decisions. Priorities in production is made in such a manner that the limited supply factor on its utilization in the process can give maximum contribution and so maximum profit.

Illustration 24. A company is producing and selling three products the lovely, the beautiful and charming. The cost data relating to these is as under

	The Lovely	The beautiful	The charming
	per unit	per unit	per unit
Raw material (Kg) (required)	5 Kg	3 Kg	2 Kg
Raw material (₹)	40	30	20
1. Direct Labour (₹)	25	20	18
2. Variable overheads (₹)	15	10	12
Total (₹)	80	60	50
Selling price per unit (₹)	100	70	65

Fixed Cost is ₹ 2000

The input material is in limited supply and its supply is 820 kg.

You are required to advise the management as a cost accountant.

- (i) The priority of production of the three products.
- (ii) The overall maximum profit that can be attained through sale of the products if sale of each product cannot go beyond 100 units.

Solution:—

(a)	Products		
	The Lovely (₹)	The beautiful (₹)	The charming (₹)
Selling price per unit	100	70	65
variable cost L			
(i) Raw material (₹)	40	30	20
(ii) Direct material (₹)	25	20	18
(iii) Variable overhead (₹) :	15	10	12
Contribution per unit (₹)	$\frac{80}{20}$	$\frac{60}{10}$	$\frac{50}{15}$
Raw material required	5 kg	3 kg	2 kg
Contribution /kg of raw material	4	3.33	7.5
Priority in production	II	III	I

(b) Total contribution		
Production of charming	100 units	$100 \times 15 = ₹ 1500$
Production of Lovely	100 units	$100 \times 20 = ₹ 2000$
Balance raw material=(820–200–500)=	120 kg	
Production of beautiful		
$\frac{120}{3} = 40 \text{ units}$	40 units	$40 \times 10 = ₹ 400$
Total contribution	= ₹ 3900	
Fixed cost	= ₹ 2000	
Maximum attainable profit	= ₹ 1900	

Illustration 25. In a factory producing two different kinds of articles, the limiting factor is the availability of labour from the following information from the factory for the year 2010 show which product is more profitable.

	Product A	Product B
	Cost per unit	Cost per unit
	₹	₹
Material	5.00	5.00
Labour		
6 hours @ ₹ 0.50	3.00	
3 hours @ ₹ 0.50		1.50
Overheads:		
Fixed 50 % of labour	1.50	0.75
Variable	1.50	1.50
Total Cost	11.00	8.75
Selling price	14.00	11.00
Profit	3.00	2.25
Total production for the month (units)	500	600

Maximum capacity per month = 4800 hours

Suppose (i) 1000 units of B are manufactured instead of 600 units or (ii) 700 units of A are manufactured instead of 500 units. Give proof in support of your answer by assuming the above output.

Sol:—

	Product A	Product B
	₹	₹
Selling price per unit	14.00	11.00
Variable cost :		
Material	5.00	5.00
Labour	3.00	1.50
Overheads	1.50	1.50
Contribution per unit	<u>9.50</u> 4.50	<u>8.00</u> 3.00
Contribution per hour	0.75	1.00
Priority of production	II	I

Product B is more profitable to be produced

(i) 1000 units of B are produced

Contribution on producing 1000 units of B = ₹ 3000

Balance labour hours (4800–3000) = 1800 hours

Production of A = $\frac{1800}{6} = 300$ units

Contribution on producing 300 units of A = ₹ 1350

Total contribution = ₹ 4350

(ii) When 700 units of A are manufactured instead of 500 units.

Contribution on production of 700 units of A = ₹ 3150

Hours utilized on production of 700 units of A

$$= 700 \times 6 = 4200$$

$$\text{Balance hours} = 4800 - 4200 = 600 \text{ hours}$$

$$\text{Production of B} = \frac{600}{3} = 200 \text{ units}$$

$$\text{Contribution given by 200 units of B} = ₹ 600$$

$$\text{Total contribution} = ₹ 3750$$

Fixed cost is not taken into account as it is constant in both situations so the first situation where total contribution is higher is recommended so 1000 units of B and rest 300 units of A should be produced to maximize profit.

Illustration 26. A Ltd manufactures three products and the cost particulars for a year are as follows:

	Product		
	X (₹)	Y (₹)	Z (₹)
Sales	200,000	400,000	250,000
Material cost	100,000	150,000	125,000
Labour cost	30,000	50,000	40,000
Variable overhead	10,000	20,000	25,000
Fixed overhead	35,000	50,000	25,000

The company imports one of the raw material which is used in manufacture of all products. The consumption of material is as follows:

X – 2000 kgs

Y – 5000 kgs

Z – 3000 kgs

There is restriction in import of the material. The management is planning to close down one of the lines of product and utilize the material for other two to improve the profitability. As the secretary of the company prepare a report for the closure of one line for improving the profitability.

(ACS–Inter Dec, 86)

Solution:–

Statement of profitability

	Product			Total
	X ₹	Y ₹	Z ₹	
Sales variable cost	20000	400000	250000	8,50,000
Variable Cost	140000	220000	190000	550000
Contribution	60000	180000	60000	3,00,000
Raw material utilized (Kgs)	2000	5000	3000	10,000
Contribution per kg of raw material	₹ 30	₹ 36	₹ 20	
Priority in production	II	I	III	

As the management is planning to close the production one of the product as raw material is in limited supply.

So the product Z with lowest contribution should not be produced and the raw material so spared should be used to produce the product having the highest contribution of the three i.e. product Y.

Total contribution will be

Contribution production of product X = ₹ 60,000

Balance Raw material = 10000–2000 = 8000 kg

Contribution on production of y = $\frac{180000}{5000} \times 8000$ = ₹ 288,000

Total contribution = ₹ 348000

Fixed Cost = ₹ 110000

Balance profit = ₹ 238000

Increase in the total profit is equal to the increase in contribution i.e. = ₹ 48000

(108000–60000)

Increase in contribution on producing extra units of Y = 1,08000

Contribution foregone on discontinuing the production of Z = 60000

Balance increase in contribution = ₹ 48000

(iii) Make or Buy decision:

Situations may arise where the management of the concern has to decide whether a particular input for the final product should be purchased from the market or whether it is beneficial to make within the concern itself. Here while deciding, management has to keep in mind the cost related to the particular product. As we know fixed cost remains the same, marginal cost becomes the main deciding factor. If the product is available in the market at lower than the related marginal cost then it should be purchased otherwise made. But sometimes situations may arise where the production of the product is not possible within the available capacity and so certain extra fixed costs has to be incurred along with the marginal costs, then in those the marginal costing will not be the only deciding factor.

Factor influencing make or buy decision:

While giving any decision on the issue of make or buy the component or the input, the following factors should be considered.

Cost factors:

- 1) Any special machinery or equipment required for its production.
- 2) Availability of labour required for its production.
- 3) Any transportation involved due to the location of production.
- 4) Cost of acquiring special know how required for production.
- 5) Quality of the product which effects the production.
- 6) Availability of plant facility.
- 7) Market trends i.e. market price, its availability in future.
- 8) Space required for the production of the item.
- 9) Whether the released capacity can be utilized for any other profitable activity.

So while deciding management should keep in mind and ensure its quality, availability in future, future market trends, the management should be vigilant not only the present costs but costs related to the product in future also.

Non-cost factors: There are other non-cost factors which have to be kept in mind while deciding about the make or buy the product. These can be summarized as.

- 1) Quality of the item effects the overall production of quality product. If the item is available in the market of desired and standard quality then decision should be in favour of buying otherwise in favour of making ignoring the cost related in making.
- 2) Must ensure the supply of the item in future. If the supplier do not ensure its proper supply then the company should make the product.
- 3) Sometime it is beneficial for the concern to make the product in its own because of some secrecy measures. Suitable examples can be in case of chemical factories, if a particular input is purchased from the market keeping cost factor into consideration of decision may sometime lead to disclose the formula and can adversely effect the concern in the long term.
- 4) If the demand of the product is fluctuating i.e. sometimes it goes up and a sometime go down then it should be purchased from the market but if the demand is regularly increasing then it should be made within the concern.
- 5) It should also be kept in mind that the supplier who supply the product is not a competitor of the final product. If it is so then in future it can effect the production of the product.

Illustration 27. A supplier has offered the company to supply the component port at ₹ 15 per unit. The management is considering whether to accept the offer or not and seeks your advice as a cost accountant. Other data relating to the component is as follows:

- (i) Direct material required for manufacture of one unit of the component is ₹ 6.00
- (ii) Direct Labour required is ₹ 3.00 per unit.
- (iii) Direct overheads ₹ 3.00 per unit.
- (iv) Fixed cost absorbed ₹ 5.00 per unit.

What should be your advice if the supplier giving the assurance of regular supply at standard quality at ₹ 11.50

Sol:—

The cost related to the component:

i. Direct material	= ₹ 6.00
ii. Direct labour	= ₹ 3.00
iii. Direct overhead	= ₹ 3.00
iv. Fixed allocated cost	= ₹ 5.00
Total cost	<u>= ₹ 17.00</u>

Fixed cost are allocated to the component will not be taken into account while decision making.

The marginal cost :

1. Direct material	= ₹ 6.00
2. Direct labour	= ₹ 3.00
3. Direct overheads	= ₹ 3.00
Total	<u>= ₹ 12.00</u>

The marginal cost of making is ₹ 12.00 while the supplier supply at ₹ 15.00 per unit. The advice is to manufacture the component as there is available capacity.

If the supplier reduces the price of the component at ₹ 11.50 the offer should be accepted.

Illustration 28. A company is considering the proposal of an outside supplier to supply a components used in the production at ₹ 5 per components. The company is in need of 25000 components annually.

If these components are to be manufactured within the company it has to purchase an extra machine for ₹ 50000 with annually capacity of 30000 components and a life of 5 years. The other costs which the company will have to incur are

- (i) Direct material per component = ₹ 2.00
- (ii) Direct labour cost per component = ₹ 1.00
- (iii) Variable overheads are 100% of the labour cost

Decide whether to purchase the component from the supplier or manufacture it within the company.

Further if the supplier offer an extra 5000 components at ₹ 4.50 what should be your decision.

Solution:

The variable cost related to the component.

1.	Direct material	= ₹ 2.00
		= ₹ 1.00
2.	Direct labour cost	= ₹ 1.00
3.	Variable overheads	
		= ₹ 4.00
	Total variable cost	

Fixed cost related to the component

Depreciation	= ₹ 0.40
$\frac{50000}{5} = ₹ 10000 \text{ p.a.} = \frac{10000}{25000}$	
Total related cost exclusively with the product	= ₹ 4.40
	= ₹ 5.00

The supplies price

The proposal should not be accepted because in both the offers the related manufacturing cost is less than the price offered.

(IV) Maintaining a desired level of profit:

Marginal costing system for taking various type of decision is also helpful in taking the decision regarding earning of desired level of profit. As we know contribution per unit is the difference between the selling price and variable cost. It in the initial stages helps to recover the fixed cost and as the fixed costs are fully recovered and we reach at BEP, every further production and sale will contribute towards profit. So through the process we can maintain a desired level of profit.

Illustration 29. The selling price of a product in a company is ₹ 100. The company desires to earn profit to the tune of ₹ 60000. The other information given by the company regarding the cost of its production is given as under.

Fixed cost = ₹ 100000

variable cost per unit of the product:

Raw material required 5 kg @ ₹ 4 per kg	= ₹ 20
Labour cost 2 hours @ ₹ 5 per hour	= ₹ 10
Overhead cost directly linked @ 100% on labour	= ₹ 10
variable selling and distribution cost	= ₹ 10
Total	= ₹ 50

Please tell the company about the number of units of the product it should produce to reach at the desired level of profit.

Solution :

Selling price per unit	= ₹ 100
Variable cost per unit	= ₹ 50
Contribution per unit	= ₹ 50

$$\text{B.E.P. sales} = \frac{F}{\text{Contribution per unit}}$$

$$= \frac{100000}{50} = 2000 \text{ units}$$

units of the product required to earn profit of ₹ 60000

$$= \frac{F+P}{\text{cost per unit}} = \frac{100000+60000}{50}$$

$$= \frac{160000}{50} = 3200 \text{ units}$$

Illustration 30. 50000 units of an item are produced and sold in the home market at ₹ 50 per unit. The home market cannot absorb more than 50000 units in a year but there is an export market for the item @ ₹ 30 per. It is proposed to increase the production and sell the additional quantities in the foreign market. The variable cost works out to ₹ 25 per unit and the fixed charges amount to ₹ 800000 in a year. Calculate the number of additional units to be made and sold abroad to achieve total profit of ₹ 600000 in a year both on domestic and foreign sales together.

Solution:

The selling price of the product in domestic market	= ₹ 50 per unit
Selling price of the product in the foreign market	= ₹ 30 per unit
Variable or marginal cost linked to the product	= ₹ 25 per unit
contribution per unit in domestic market	= 50-25 = ₹ 25
Contribution per unit in the foreign market	= 30-25 = ₹ 5

As the contribution per unit is positive and there is a production capacity available. So the unit can be sold in the foreign market.

Contribution earned through sale of 50000 units in the domestic market	= 50000 × 25
	= ₹ 12,50,000
Fixed cost	= ₹ 8,00,000
Profit earned in domestic market	= 1250000 – 800000
	= ₹ 4,50,000
Balance profit required from foreign market	= 600000 – 450000
	= ₹ 150000
Contribution per unit in the foreign market	= 5

required additional sale

$$\begin{aligned} &= \frac{150000}{5} \\ &= 30000 \text{ units} \end{aligned}$$

This can also be solved as below

Let x be the number of units sold in the foreign market

$$\text{so } \left[50000 \times \frac{\text{cont per unit}}{(\text{domestic})} \right] + \left[x \times \frac{\text{cont. per unit}}{(\text{Foreign})} \right] - 800000 = 6,00,000$$

$$50000 \times 25 + x \times 5 = 800000 + 600000$$

$$x \times 5 = 14,00,000 - 12,50,000$$

$$x = \frac{150000}{5}$$

$$= 30000 \text{ units}$$

(V) Effect of changes in price:–

Change in price of the product means change in the contribution. As we know change in price is inversely related to change in the contribution and so change in overall profit. Certain government regulations may compel the organization to cut the price in so many situations. Sometimes penetrating into the new market and acquiring a particular share of the market, competitive conditions compels the organization to cut the price to achieve a long term motives. When price is reduced under any of the above condition the contribution will reduce and which will lead to reduction in the overall profit.

Illustration 31.

A company producing a product X and is selling in the market at ₹ 50 per unit the fixed cost per year which remains constant irrespective of units of production is ₹ 200000. In the market the company is selling 15000 units. The other costs directly related to the production is given as under.

1) Raw material required per unit	= ₹ 10
2) labour cost required per unit	= ₹ 5
3) Other directly related per unit cost	= ₹ 5

The government has urged the management of the company to supply 1000 units at ₹ 35 per unit to be supplied by the Government to military personnel.

Please comment on the profit if the same supply were in the market rather to government.

Solution:

Selling price per unit	=	₹ 50
Less variable cost:		
(i) Raw material cost per unit	= ₹ 10	
(ii) Labour cost per unit	= ₹ 5	
(iii) Other directly related cost (per unit)	= ₹ 5	
		₹ 20
Contribution per unit	=	₹ 30
Fixed cost	=	₹ 200000

$$\begin{aligned}
 \text{Profit} &= (30 \times 15000) - (200000) &= ₹ 2,50,000 \\
 \text{Government supply selling price} &&= ₹ 35 \\
 \text{Contribution per unit in govt. sales} &&= 35 - 20 = ₹ 15 \\
 \text{Total contribution on Govt. sales} &&= 15 \times 5000 = ₹ 75000 \\
 \text{Total profit} &= 250000 + 75000 \\
 &= ₹ 325000 \\
 \text{In whole supply was at market price then} && \\
 \text{Total profit should be} &= (20000 \times 30) - (200000) \\
 &= 600000 - 200000 \\
 &= ₹ 400000
 \end{aligned}$$

Reduction in profit on Government intervention

$$\begin{aligned}
 &= 400000 - 325000 \\
 &= ₹ 75000
 \end{aligned}$$

Illustration 32. The revenue account of Goodwill Co. Ltd. has been summarized as shown below.

Sales	₹	₹
		60,00,000
Direct material	1800000	
Direct wages	1200000	
variable overheads	480000	
Fixed overheads	1720000	
		52,00,000
Profit		8,00,000

The licensed capacity of the company is ₹ 80,00,000 but the key factor is sales demand. It is proposed by the management that in order to utilize the existing capacity, the selling price of the product should be reduced by 5%.

You are required to prepare a forecast statement showing the effect of the proposed reduction in selling price after taking into account the following changes in costs.

- Sales forecast ₹ 7600000 (at reduced prices)
- Direct wages rates and variable overheads are expected to increase by 5%.
- Direct material prices are expected to increase by 2%.
- Fixed overheads will increase by ₹ 80000.

Sol:— Forecast statement under the said conditions

	₹
Sales at full capacity	= 8000000
Less reduction in sales value due to new selling price	= 400000
5% of 80,00,000= ₹ 4,00,000	
New sales value	= 76,00,000

Less variable cost related to sales

(i) Direct material cost =	24,48,000
$\left[8000000 \times \frac{800000}{6000000} \right]$	
$\times (1.02)$ i. e. due to 2% increase in material price	
(ii) $\left[\frac{1200000}{6000000} \times 8000000 \times 1.05 \right]$	16,80,000
(iii) variable overheads	<u>6,72,000</u>
$\left[\frac{480000}{6000000} \times 8000000 \times 1.05 \right]$	48,00,000
Marginal cost	28,00,000
Less fixed cost	18,00,000
[₹ 1720000+80000]	
Profit	10,00,000

Working :

1. Valuation of Direct material

direct material required for new sales at the initial normal prices = $\frac{1800000}{6000000} \times 8000000$ ₹ 24,00,000

=

Direct material cost at increased prices @2% = $2400000 \times (1 + 0.02)$ ₹ 24,48,000

2. Valuation of Direct wages

Direct wages at new sales at normal prices = $\frac{1200000}{6000000} \times 8000000$ ₹ 16,00,000

Direct wages at increased wage rates =

= $1600000 \times (1 + 0.05)$ = ₹ 1680000

3. Valuation of variable overheads.

Variable overheads required for new sales at normal prices = $\frac{480000}{6000000} \times 8000000$ = ₹ 6,40,000

variable overheads at increases rates =

= $640000 \times (1 + 0.05)$ = ₹ 6,72,000

4. Fixed overhead increase = 80000

Total new fixed overheads = 17,20,000 + 80000 = ₹ 18,00,000

vi) Selection of suitable product mix

As we know production capacity is limited to the supply of various factors of production and sales. For maximizing the profit we have to choose a best combinations of the products. Marginal costing system plays a key role to decide such situations. For example let a company is producing three products X, Y and Y with selling prices ₹ 10, ₹ 15 and ₹ 20 per unit respectively. For each unit of production 2 kg, 3kg and 4kg of a common raw material is required and market can absorb 300, 250 and 200 units of X,Y,Z respectively. Variable costs linked to the production

of one unit of the product is say ₹ 5, ₹12 and ₹ 15 respectively. The raw material is in limited supply of 1520 kg. Then the suitable product mix which will maximize the overall profit can be calculate as:

$$\text{Contribution per unit of 'X'} = 10 - 5 = ₹ 5$$

$$\text{Contribution per unit of 'Y'} = 15 - 12 = ₹ 3$$

$$\text{Contribution per unit of 'Z'} = 20 - 15 = ₹ 5$$

As the availability of raw material is limited so we should have to calculate contribution per unit of each product with respect to per kg of the raw material utilized.

So

Contribution per kg of raw material used

$$\text{For product X} = \frac{5}{2} = ₹ 2.5 \text{ per kg}$$

$$\text{For product Y} = \frac{3}{3} = ₹ 1.00 \text{ per kg}$$

$$\text{For product Z} = \frac{5}{4} = ₹ 1.25 \text{ per kg}$$

So priority of production of the products will be X,Z,Y.

For production X the raw material

$$\text{required} = 300 \times 2 = 600 \text{ kg}$$

For production of Z the raw material

$$\text{required} = 200 \times 4 = 800 \text{ kg}$$

$$\begin{aligned} \text{Balance raw material available} &= 1520 - 600 - 800 \\ &= 120 \text{ kg} \end{aligned}$$

$$\text{The units of Y that can be produced} = \frac{120}{3} = 40$$

So total contribution will be

$$\begin{aligned} &= (300 \times 5) + (200 \times 5) + (40 \times 3) \\ &= 1500 + 1000 + 120 \\ &= ₹ 2620 \end{aligned}$$

So from the above discussion and example we can say the marginal costing is very much helpful in deciding the suitable product mix whenever there is limitation in the availability of the factor of production or limitation of market absorption for the product.

Illustration 33. From the following particulars, find the most profitable product mix and prepare a statement of profitability of that product mix:

	Product A	Product B	Product C
Units budgeted to be produced and sold	1,800	3,000	1,200
Selling price per unit (₹)	60	55	50
Direct material	5 kg	3 kg	4 kg
Direct labour	4hrs	3 hrs	2 hrs
Variable overheads	₹ 7	₹ 13	₹ 8
Fixed overheads	₹ 10	₹ 10	₹ 10
Cost of Direct material per kg	₹ 4	₹ 4	₹ 4
Direct Labour hour rate	₹ 2	₹ 2	₹ 2
Maximum possible units of sales	4,000	5,000	1,500

All the three products are produced from the same direct material using the same types of machines and labour. Direct labour, which is the key factor, is limited to 18,600 hours [CA Inter, May, 1990]

Solution:

Statement showing contribution per direct labour hour

Product	A(₹)	B(₹)	C(₹)
Direct material : 5×4	20	12	16
Direct wages : 4×2	8	6	4
Variable overheads	7	13	8
Marginal cost	35	31	28
Selling price	60	55	50
Contribution per unit	25	24	22
Contribution per direct labour hour	$\frac{25}{4}$	$\frac{24}{3}$	$\frac{22}{2}$
	= 6.25	8	11
Priority	III	II	I

Statement of profitability on basis of original Budget.

Product	No. of units	DLHrs	Contribution per unit (₹)	Total contribution (₹)
A	1800	7200	25	45000
B	3000	9000	24	72000
C	1200	2400	22	26400
Total		18600		1,43,400
Less Fixed overheads.				
A $1800 \times 10 = ₹ 18000$				
B $3000 \times 10 = ₹ 30000$				
C $1200 \times 10 = ₹ \underline{12000}$				
				60000
Profit				83,400

Statement of Product mix

Product	Priority	No. of Units	D.L. Hrs	Balance D.L. Hrs
C	I	1500 (max)	3000	15600
B	II	5000 (Max.)	15000	600
A	III	150 (600÷4)	600	—
			18600	

Statement of Profitability under the suitable Product mix

Product	No. of units	Contribution Per unit (₹)	Total contribution (₹)
A	150	25	3,750
B	5000	24	120,000
C	1500	22	33000
Total contribution			156750
Fixed overheads			60000
Maximum attainable profit			96750

Illustration 34. Small tools factory has a plant capacity adequate to provide 19800 hours of machine use. The plant can produce all A type tools or all B type tools or mixture of two type of tools. Following information is relevant.

Per type	A	B
Selling price (₹)	10	15
Variable cost (₹)	8	12
Hours required to produce	3	4

Market conditions are such that no more than 4000 A type tools and 3000 B type tools can be sold in a year. Annual fixed costs are 9900.

Compute a suitable product mix that will maximize the net income to the company and find that maximum net income.

Solution:

Statement of contribution per unit consumption of the limiting factor.

Per type	Tools	
	Type A	Type B
Selling price (₹)	10	15
Variable cost (₹)	8	12
Contribution per type (₹)	2	3
Machine Hours required	3	4
Contribution per machine hour	0.66	0.75
Priority of Production	II	I

Statement showing the product mix

Product type	No. of unit	Hours required	Balance Hours
B	3000 (max)	12000	19800–12000 = 7800
A	7800÷3=2600	7800	-----

Statement of Profitability

Product type	No. of units	Contribution per unit ₹	Total contribution ₹
A	2600	2	5200
B	3000	3	9000
Total contribution			14200
Less Fixed cost:			9900
Profit:			4300

(VII) Closing down or suspending activity:

It is very important decision making, whenever a concern incur losses. Whenever the concern faces such a situation of facing losses when the activity is carried on, the management should be very careful in taking decision under these situations because whenever an activity is closed down or is suspended for a period time, may lead to loose the business relations and it may be a problem to re-establish the same business activity in future. The management should see whether the product is contributing towards fixed cost. If it is contributing towards the fixed cost then decision should not be to close down the production of the product and the management while deciding should take into consideration the other aspects also. The cost incurred on closing down as the fixed expenses burden may increase because closure lead to nil contribution towards fixed costs and hence increase in total loss. Certain fixed costs may be there which could be avoided in the closure but there may be certain fixed costs which will have to be incurred at the time of closing the operation like redundancy payments, necessary maintenance of plant or overhauling the plant, training of the personnel etc. So we can say closing down activity decision should not be taken in hasty by the management, the other costs associated with the closure should also be kept in mind while taking the decision.

There may be certain non cost considerations while taking the decisions of close down, suspend the activity or not. These non costs considerations as summarized below should also be kept in mind and given due importance in decision making.

- (i) Whenever the activity is suspended or closed down the business relations may effect adversely and the competitors may establish there business in the said period and re establishing the business may become difficult. So, it should also be kept in mind before taking the decision.
- (ii) Closing down or suspending the activity means retrenchment of workers. The company first of all will have to pay a huge amount to the workers and secondly for restarting the business after the recession or other reason is over, the company will have to incur heavy amount on recruitment and also face a difficulty in recruiting the skilled and efficient workers.
- (iii) The recovery from debtors will also be another problem, because some of the debtors who are not supplied the product regularly or properly or to whom supply is suspended will not return the debt easily.
- (iv) Reputation of the company will be effected adversely in the market, the company may loose its image.
- (v) Plant may become obsolete during the period of suspension or closure and a huge amount will be needed on restart.

Illustration 35.

The following is a statement of a company facing recession in demand for its product in the market and during the period it works only at 50% of the total capacity and incur a total loss if continuing production.

	<u>Capacity</u>		
	<u>100%</u>	<u>90%</u>	<u>60%</u>
Direct material (₹)	200000	180000	120000
Direct labour (₹)	75000	67500	45000
Variable overheads (₹)	50000	45000	30000
Total variable cost (₹)	325000	292500	195000
Fixed costs (₹)	80000	80000	80000
Total costs (₹)	405000	372500	275000
Sales (₹)	475000	427500	285000
	70000	50000	10000

As continuing production at 50% is not beneficial and management is considering its closure and for proper decision, approaches an expert on the issue.

After a careful investigation of the situation, the expert is of the view that closure is not advisable because after the recession period the company is likely to function at 75% of the capacity and the recession period will be over within one cycle of operation at 50% the other considerations are as under:

The fixed cost on closure will lower the fixed cost to ₹ 40000, the overhauling the plant and training of personal on re-opening will cost ₹ 7500, retrenchment and other such payment will be ₹ 11000, necessary maintenance will amount to ₹ 3750 justify the decision of the expert.

Solution :

Statement of profitability at different levels.

Particulars	Capacity			
	100%	90%	60%	50%
(i) Raw material cost (₹)	200000	180000	120000	100000
(ii) Direct labour cost (₹)	75000	67500	45000	37500
(iii) Variable overhead cost (₹)	50000	45000	30000	25000
Total variable cost (₹)	3,25,000	292,500	195000	1,62,500
Fixed cost (₹)	80,000	80000	80000	80000
Total cost (₹)	405000	372500	275000	242500
Profit or loss (₹)	70000	55000	10000	(5000)
Sales (₹)	475000	427500	285000	237500

Statement of profitability on closure and after

Particulars	Capacity		
	0%	50%	75%
Total variable cost (₹)	0	162500	2,42,750
Fixed cost (₹)	40000	80000	80000
Costs on closure (₹) (11000 + 7500 + 3750)	22250	—	—
Total cost (₹)	62250	242500	323750
Profit/loss (₹)	(62250)	(5000)	32,500
Sales	0	237500	356250

From above it is clear that on closure the total loss is ₹ 62250 and operating at 50% total loss reduces to ₹ 5000 and it is said that within one business cycle the recession will be over and the company will function at 75% of capacity so the profit will rise to ₹ 32500 so closure is not recommended.

(VIII) Alternative course of Action:

Whenever management of a concern has to choose the action between the various possibilities then the management should choose one which gives the highest profit. As we know the fixed cost does not change so the only deciding factor before management is the contribution. So the management should choose that action which give the total highest contribution. If there is any change in the fixed cost then that change along with the change in contribution should be kept in mind to reach at the right decision.

Illustration 36. The cost per unit of the three products A, B and C of a concern is as follows:

	A	B	C
	₹	₹	₹
Direct material	10	8	9
Direct Labour	6	7	6
Variable expenses	4	5	3
Fixed Expenses	3	3	2
Total cost	23	23	20
Profit	9	7	6
Selling price	32	30	26
Number of units produced	10,000	5,000	8,000

Production arrangements are such that if one product is given up, the production of the other can be raised by 50%. The directors propose that C should be given up because the contribution in that case is the lowest. Do you agree?

(B.Com. Hons.)

Solution:

Table showing the contribution of the three products

Particulars	Product		
	A ₹	B ₹	C ₹
Direct material	10	8	9
Direct labour	6	7	6
Variable expenses	4	5	3
Total variable cost	20	20	18
Selling price	32	30	26
Contribution per unit	12	10	8

Profitability table if production of one of the product is given up.

Action	units of production hour	Contribution per unit ₹	Total contribution ₹
I. If production of A is given up. Production of B Production of C	$5000 \times (1.5) = 7500$ $8000 \times (1.5) = 12000$	10 8	75000 96000 171000
II. If production of B is given up Production of A Production of C	$10000 \times (1.5) = 15000$ $8000 \times (1.5) = 12000$	12 8	180000 96000 276000
III. If production of C is given up Production of A Production of B	$10000 \times (1.5) = 15000$ $5000 \times (1.5) = 7500$	12 10	180000 75000 255000

If we compare the contribution in the above three possible actions then in II action contribution is ₹ 276000 which is maximum. In the question nothing has been said about the change in fixed cost, so is taken as same and is not considered for decision. So decision of the management is not right and to get the highest profit the production of B should be given up and get the total profit of 215000 [$276000 - (10000 \times 3 + 5000 \times 3 + 8000 \times 2)$] i.e. $276000 - 61000 = ₹ 215000$

(IX) Alternative method of production

Situations may arise in which decision is to be taken between the various method of production. In such situations the method which is most profitable to the concern should be choose. If wage rates are so low that it is beneficial to the concern to produce at total low cost, then labour intensive production method should be selected or vice versa. Here marginal cost should be the basis of comparison. Contribution given by the different methods should be the basis of comparison while arriving at an appropriate right decision.

Illustration 37. Two methods of production are there for production of the product 'X'.

The company provide you the data and seeks you advice on the method of production it should adopt. The fixed cost in both the methods is ₹ 50000. The factors of production are no constraint and are easily available.

	Method of Production	
	A (₹)	B (₹)
For every unit of production 'X'		
Raw material required	10	10
Labour hours required	1	4
Machine hours required	3.5	1
wage rate is ₹ 4 per hour		
Machine rate is ₹ 3 per hour		
Other variable overhead rate @ ₹ 2 per machine hour		

Selling price of the product 'X' is ₹ 50 per unit. Scrutinize the situation and give your advice.

Solution:

Comparative statement of Profitability

For every unit of product 'X'	Method of Production	
	A ₹	B ₹
1. Raw material required	10	10
2. Direct labour cost	4	16
3. variable machine cost	10.5	3
4. other variable overhead cost	7.0	2
Total marginal cost	31.5	31
Selling price per unit	50	50
Contribution per unit	18.5	19

Contribution in the second i.e. method B is more than that of A and fixed cost if any of the method is adopted is ₹ 50000 and so is irrelevant in the decision making. So the method which gives the more contribution will be adopted i.e. Method B.

(X) The cost indifferent point.

It is the point where the cost incurred on production of a product through two or more methods is same. e.g. let in a production method say A fixed cost is 50000 and variable cost is 4 per unit and in the second say B production method fixed cost is 40,000 and variable cost is 5. Then at the production level of 10000 units the total cost incurred through A and B will be the same and will be cost in -different point. Sometime we have to decide the method or the machine preferred for production then cost indifferent point will also play a key role in the selection.

Cost indifferent point is not break even point because later is the point relating to the particular method where profit is zero and all costs are equal to the revenue earned and may be different under different methods.

Illustration 38.

A company desire to take your advice in selection between the two machines capable of producing the same product and giving you the following data regarding the two.

	Machine A	Machine B
Total variable Cost(₹)	10	9
Total fixed cost (₹)	100000	1,53,000
Selling price of the product	12	12

You are required to completely analyze the situation and advise the company to select the machine with proper reasons for your decision.

Solution:

Working:

(i)	Machine A	Machine B
Selling price per unit (₹)	12	12
Variable cost per unit (₹)	10	9
Contribution per unit (₹)	<u>2</u>	<u>3</u>
(ii) P/V ratio c/s ratio	$\frac{2}{12} \times 100 = 16.67\%$	$\frac{3}{12} \times 100 = 25\%$
(iii) Cost indifferent point (units)		

Let x be the number of units produced where the total cost for the both the machine is same then
 $10x + 100000 = 9 \times x + 153000$

$$10x - 9x = 153000 - 100000$$

$$x = 53000$$

So cost indifferent point = 53000 units

(iv)	Break event point	$\text{Machine A} = \frac{100000}{2} = 50000 \text{ units}$ $\cdot \left(\frac{\text{Fixed cost}}{\text{cost/unit}} \right)$ $\text{Machine B} = \frac{153000}{3} = 51000 \text{ units}$

Answer:

- 1) BEP comparison shows that machine A is having the lower B.E.P. so it will be preferred as it will begin to earn profit early i.e. after 50,000 units sale whereas machine B will be in loss up to 51,000 units. So it the sale is expected to the within 50000 units and 51000 units, machine A is preferred to be used in production.

- 2) P/v ratio of machine B is 25% which is more than that of machine A. So machine B is going to give more contribution towards profit for any increase in sale. One unit extra of product sold will give a profit of ₹ 3 in case of machine B and ₹ 2 in case of machine A. So, in the event of expected increase in sales in future the machine B will be preferred to be used in production.
- 3) Cost indifferent Point

Cost indifferent point for the machines is 53000 units. At this point total cost will be ₹ 630000 for both the machines. When we cross this level of sales the profit of B will be more than that of A.

Recommendation: In case the demand is likely to be between 50000 units and 53000 units in future the company is advised to produce the product with machine A. But if the market is likely to absorb more than 53000 units then machine B is preferred to be used for production.

(XI) Diversification of productions: Situations may arise where the company is having the capacity available and is considering to produce an extra product with the main product. The product so produced do not hinder the production and the sale of the main product and give an extra contribution, then the company should produce the product. It should be kept in mind the incremental costs associated with its production are less than the revenue collectable, the fixed cost of the company should remain undisturbed.

Let us take a situation where the company produce 'X' product and is having fixed cost say ₹ 100000 and with its production a by-product Y is produced and small amount of variable cost say ₹ 2 can make the by-product salable in the market the by-product salable in the market at sale price ₹ 2.50. Then for every one unit of the product Y the company can earn ₹ 0.50, so company should start production and sale of the product.

If we go in absorption costing the decision may not be in favour of the production of Y because per unit absorption of fixed cost may be more than ₹ 0.50. So while deciding only marginal cost should be taken into consideration because fixed cost has already been incurred and will not change either y is produced or not.

Illustration 39. A company is producing a product X and is considering to use the available capacity in producing and selling another product Y in the market. The fixed cost of the company is ₹ 3,15000 p.a. and is producing 15000 units of 'X'.

The company is estimating a sale of 4000 units of Y in the market.

Particular	Product	
	X	Y
	₹	₹
Raw material consumed	15	3
Direct labour cost	11	2
Variable overhead cost	7	1.50
Total	33	6.50
selling price per unit	63	9.00

Should the company produce and sell the product Y in the market? Comment.

Solution:

Statement of contribution of the two products.

	Product	
	X	Y
	₹	₹
Raw material cost required	15	3
Direct Labour cost required	11	2
variable overhead cost	7	1.50
Marginal cost	33	6.50
Selling price per unit	63	9.00
Contribution per unit	30	2.50
Statement of profitability		
	Producing the Product 'X' only (₹)	Producing the Both products i.e. 'X' and 'Y' (₹)
Total contribution 'X'	$30 \times 15000 = 4,50,000$	$30 \times 15000 = 4,50,000$
'Y'		$2.5 \times 4000 = 10000$
	450,000	460000
Fixed cost	315000	315000
Profit	135000	145000

The company should produce the product Y as available capacity is there and the fixed cost is unaffected on its production and has a positive contribution.

More solved problems to give an in depth knowledge about the subject.

Illustration 40.

From the figures relating to one year's working at 100% capacity level in a manufacturing business, prepare a breakeven chart and determine from the chart the Break even point. Also verify your results by calculations.

The figures are

Fixed overheads	(₹) 1,20,000	Direct material	(₹) 4,10,00
Variable overheads	(₹) 2,00,000	Sales	(₹) 10,00,000

Direct wages

(₹) 1,50,000

Solution:

Working:

Sa les	Capacit y	Direct material ₹	Direct wages ₹	Variable overhead s ₹	Total variable cost ₹	Fixed cost ₹	Total cost ₹	Sale ₹	Profit ₹
1	10%	41,000	15,000	20,000	76,000	120,000	196,000	100,000	−96,000
2	20%	82,000	30,000	40,000	152,000	120,000	272,000	200000	−72,000
3	30%	123,000	45,000	60,000	228,000	120,000	348,000	300,000	−48,000
4	40%	164,000	60,000	80,000	304,000	120,000	424,000	400,000	−24,000
5	50%	2,05,000	75,000	100,000	380,000	120,000	500,000	500,000	BEP
6	60%	246,000	90,000	120,000	456,000	120,000	576,000	600,000	+24000
7	70%	287,000	105,000	140,000	532,000	120,000	652,000	700,000	+48000
8	80%	328,000	120,000	160,000	608,000	120,000	728,000	8,00,000	+72000
9	90%	36,9000	135,000	180,000	684,000	120,000	804,000	900,000	+96000
10	100%	410,000	150,000	200,000	760,000	120,000	880000	1000,000	+120,000

Graphical Presentation Break-Even Chart

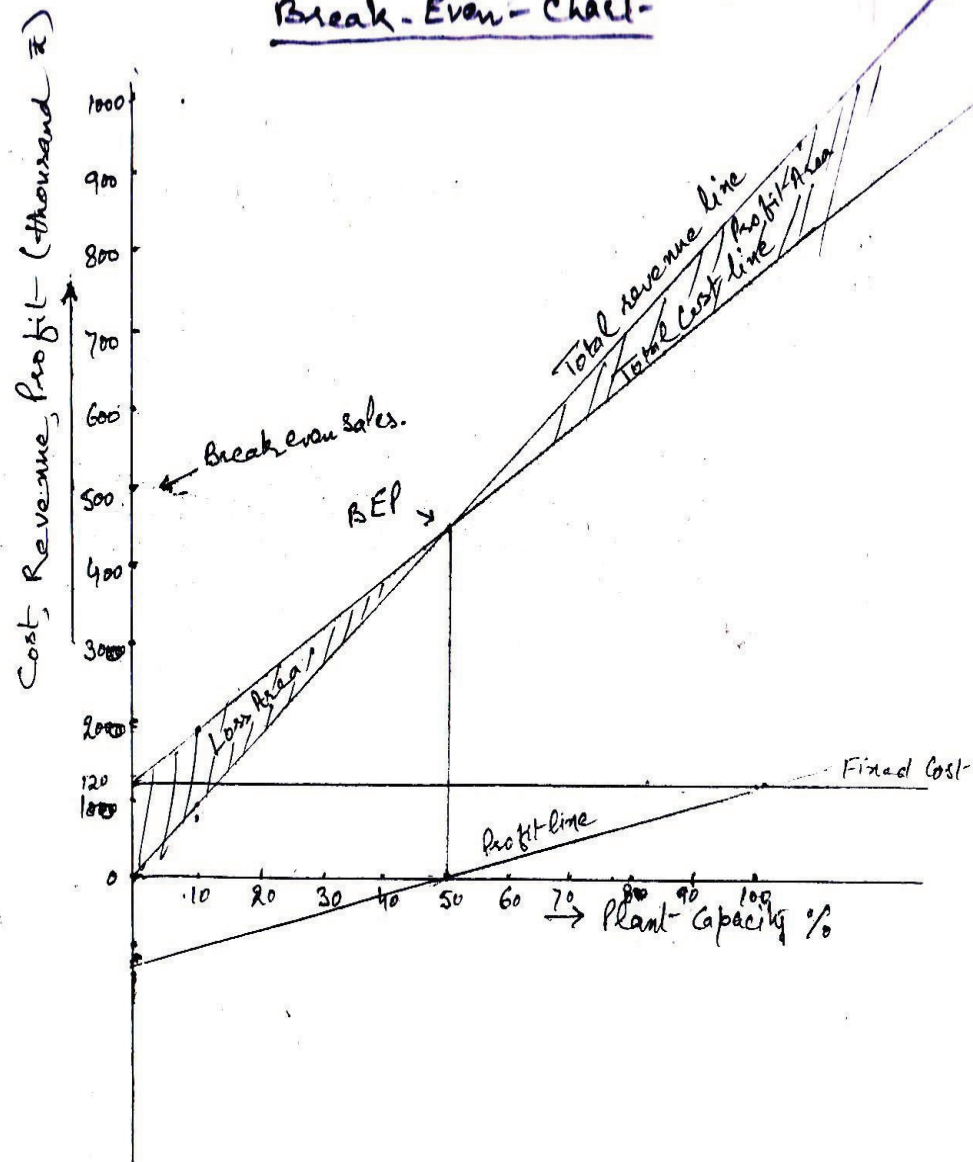


Illustration 41.

Two companies ABC Ltd and XYZ Ltd. sell the same type of the product. Their budgeted profit and loss account for the year shows the following.

Comparative statement				
	ABC Ltd.		XYZ Ltd.	
	('₹ '000)		('₹ '000)	
Sales	150		150	
Less variable cost	120		100	
Fixed cost	15	135	35	135
Budgeted Profit	15		15	

You are required to calculate the break even point of each company. Also state which company is likely to earn greater profit if there is (i) heavy demand and (ii) poor demand for its product.

(CS inter Dec, 1990)

Solution:

<u>Comparative statement</u>		
	ABC Ltd.	XYZ Ltd.
	(₹ 000)	(₹ 000)
Sales	150	150
Less variable cost	120	100
Contribution	30	50
P/v ratio	$\frac{30}{150} \times 100 = 20\%$	$\frac{50}{150} \times 100 = 33\frac{1}{3}\%$
Break even point (Sales)	$\frac{15000}{20\%} = ₹ 75000$	$\frac{35000}{33\frac{1}{3}\%} = ₹ 105000$
$\left[\frac{F.C}{\frac{P}{v} ratio} \right]$		
Margin of safety	150000–75000= ₹ 75000	150000–105000= ₹ 45000

- (i) In case of heavy demand of the product the company with higher P/v ratio will earn more profit than that which is having lower P/v ratio. As BEP sales are approached then for every other rupee increment in sale the profit of

that with higher P/v ratio will be more than the other so in the given question XYZ will earn more profit in case there is heavy demand for the product in the market.

- (ii) In case of poor demand of the product the company with lowest break even point will begin to earn profit for early approach of BEP. So in the question the company ABC Ltd is likely to earn more profit in the event there is poor demand for the product in the market.

Illustration 42.

XYZ Ltd is selling three brands of its product in the brand names X,Y and Z. The details regarding unit costs and selling prices are as follows:

	X	Y	Z
	₹	₹	₹
Direct material	6	12	16
Direct Labour	8	8	20
Variable overheads	6	20	14
Selling price	36	50	96

The monthly fixed expenditure is ₹ 540000. Sales volume for the month of July and August of 1989 are as follows:

	X	Y	Z
July	20,000	20,000	20,000
August	40,000	26,000	10,000

Find out the monthly profits and if your computation brings out higher profits was earned in the month having lower sales volume. Kindly justify the finding with reasons.

(ICWA Inter Dec, 1989)

Solution:

Statement of contribution and P/v ratio

Product	X	Y	Z
	₹	₹	₹
Direct material	6	12	16
Direct Labour	8	8	20
Variable overhead	6	20	14
Marginal cost	20	40	50
Selling price	36	50	96
Contribution per unit	16	10	46
P/v ratio = $\frac{c}{s} \times 100$	$\frac{16}{36} \times 100$ =44.44%	$\frac{10}{50} \times 100 = 20\%$	$\frac{46}{96} \times 100 = 47.92\%$

Statement of monthly profit

Month : July

Contribution from:

X	20000×16	= ₹ 320000
Y	20000×10	= ₹ 200000
Z	20000×46	= ₹ 920000
Total	60000 units	= ₹ 1440000
Less fixed cost		= ₹ 540000
Net profit		= ₹ 900000

Month August

Contribution from :

X	40000×16	= ₹ 640000
Y	26000×10	= ₹ 260000
Z	10000×46	= ₹ 460000
Total	76000 units	= ₹ 1360000
Less fixed cost		= ₹ 540000
Net profit		= ₹ 820000

Profit in the month of August is ₹ 820000 is less than that of July ₹ 900000 though total sale of the products taken together is more. This is because there is difference in contribution per unit for each product. Z product has maximum contribution and its 20,000 units are produced in July and 10,000 units are produced in August. So there is an increase in the total contribution in July so higher profits than August. For maximizing the profit more and more units of the product with higher contribution should be produced.

Illustration 43.

The Asian Industries specialize in the manufacture of small scale motors. The cost structure of a motor is as under:

Material	₹ 50
Labour	₹ 80
Variable overheads	@ 75% of the labour cost

Fixed overheads of the company amount to ₹ 2.40 lakhs per annum. The sale price of the motor is ₹ 230 each.

- (a) Determine the number of motors that have to be manufactured and sold in a year in order to break even.

- (b) How many motors have to be made and sold to make a profit of ₹ 100000 per year?
 (c) If the sales price is reduced by ₹ 15 each, how many motors have to be sold to break even?

Solution:–

Working:	₹
Selling price per motor	= 230
Less"	
1. Material	₹ 50
2. Labour	₹ 80
3. Variable overheads	₹ 60
(75% of 80)	= 190
Contribution per motor	= 40

Answer:

(a) Fixed cost = ₹ 2,40,000

No. of motors required to be sold to break even

$$= \frac{\text{Fixed cost}}{\text{cont. per unit}} = \frac{240000}{40}$$

= 6000 motors

(b) Required profit = ₹ 100 000 per year

Fixed cost = ₹ 240000 per year

No of motors required to be sold to earn the required profit

$$= \frac{F. cost + Profit}{Cont. per unit} = \frac{240000 + 100000}{40}$$

$$= \frac{340000}{40} = 8500 \text{ motors}$$

New selling price = 230–15 = ₹ 215

Marginal cost = ₹ 190

New contribution per unit = ₹ 25

New Break even point (units)

$$= \frac{\text{Fixed cost}}{\text{cont. per unit}}$$

$$= \frac{240000}{25} = 9600 \text{ motors}$$

Illustration 44.

Following are the present cost and output data of a manufacturer:

Product	Price	Variable cost per unit	% of sales
	₹	₹	₹
Tables	120	80	40
Chairs	60	40	35
Book cases	80	60	25

Total fixed cost ₹ 40,000

Last year sales was ₹ 2,00,000

The manufacturer is considering to drop the line of book cases and replace with cabinets. His estimates for the new scheme are as follows:

Product	Price ₹	Variable cost Per unit ₹	% of sales
Tables	120	80	40
Chairs	60	40	40
Cabinets	150	100	20

Total fixed cost per annum ₹ 40000

Sales ₹ 250000

Is the change worth undertaking

Solution:

Last year contribution

	Product	Sales value	Marginal cost	Contribution
1.	Tables	80000	53333	26667
2.	Chairs	70000	46667	23333
3.	Book cases	50000	37500	12500
			Total	62500

Contribution under new proposal

	Product	Sales value	Marginal cost	contribution
1.	Tables	100000	66667	33333
2.	Chairs	100000	66667	33333
3.	Cabinets	50000	33333	16667
			Total	83333

New contribution is ₹ 20,833 (83333–62500) more than that of last year and there is no change in the fixed cost so the consideration for change is worth undertaking.

Illustration 45. From the following figures find the break-even volume:

Selling price per ton	₹ 69.50
Variable cost per ton	₹ 35.50
Fixed expenses	₹ 18.02 lakhs

If this volume represents 40% capacity, what is the additional profit for an added production of 40% capacity, the selling price of which is 10% lower for 20% capacity production and 15% lower than the existing price, for the other 20% capacity.

Solution:

$$\text{Selling price per ton} = ₹ 69.50$$

$$\text{Variable cost per ton} = ₹ 35.50$$

$$\text{Contribution per ton} = ₹ 34$$

$$\text{Break even point volume} = \frac{\text{Fixed cost}}{\text{cost per unit}}$$

$$= \frac{18,02,000}{34}$$

$$= 53000 \text{ tonnes}$$

This production i.e. 53000 tons represents 40% of the capacity.

For next 20% of capacity the new price (10% lower)

$$= 69.50 \times (1 - 10\%)$$

$$= 69.50 \times 0.9 = 62.55$$

New contribution for next 20% of capacity = $62.55 - 35.5 = ₹ 27.05$

For next 20% of capacity the new price (15% lower)

$$= 69.50 \times (1 - 15\%)$$

$$= 69.50 \times 0.85$$

$$= 59.075$$

New contribution for next 20% of capacity = $59.075 - 35.5$

$$= 23.575$$

Total contribution:		₹
For 40% of the capacity	$= 53000 \times 34$	$= 18,02,000$
Next 20% of capacity	$= 26500 \times 27.05$	$= 7,16,825$
Next 20% of capacity	$= 26500 \times 23.575$	$= 6,24,737.50$
Total		$= 31,43,562.50$
Less Fixed cost		$= 18,02,000.00$

Profit (₹)

= 13,41,562.50

As 40% of capacity represents the B.E.P. so covers the fixed expenses. So this profit is the additional profit after the said rice reduction 10% and 15% at next 20% and another 20% increase in the production capacity.

Illustration 46.

Frazer Ltd manufactures and sells a product the selling price and raw material cost of which have remained unchanged during the past two years. The following are the relevant data:

Particulars	Year 1	Year 2
Quantity sold (kgs)	100	150
	₹	₹
Sales value	20,000	?
Raw material	10,000	?
Direct wages	3000	?
Factory overheads	5000	5700
Profit	2000	2550

During the year 2, direct wages rates increased by 50% but there was a saving in fixed factory overheads to the tune of ₹ 300.

Required: What quantity in (Kgs) the company should have produced and sold in year 2 in order to maintain the same amount of net profit per kg as it earned during the year?

Solution:–

Working :	₹
Year I	
Selling price per kg $\left(\frac{20000}{100}\right)$	= 200
Less Direct material $\frac{10000}{100} = ₹ 100$	}
Direct wages $= \frac{3000}{100} = ₹ 30$	
*Variable Factory overheads = ₹ 20	
Contribution per kg	150
Total contribution 50×100	50
Less Fixed factory overheads	= ₹ 5000
Net profit	= ₹ 3000
Profit per kg $\frac{2000}{100}$	= ₹ 20

* As given in the question there is saving of factory overheads in year

2. So factory overheads in year 2	= ₹ 5700 + 300
	= ₹ 6000
Factory overheads in year 1	= ₹ 5000
difference	= ₹ 1000
difference in Production	= 150 – 100
	= 50kg
The variable portion	= ₹ $\frac{1000}{50}$
	₹ 20 per kg
Fixed overhead cost = Total–variable = 5000 – 20 × 100	
	= 5000 – 2000 = ₹ 3000

Answer:

Computation of quantity (Kgs) required to be sold to get the same per kg profit as in year 1.

	₹
Selling price per kg	= 200
Raw material ₹ 100	
Direct wages ₹ 45	
(30 + 50%)	
Variable factory overheads ₹ 20	
Marginal cost	= 165
Contribution per kg	= 35

Let x be the number of kg of the product sold then

$$35x - 2700 = x \times 20 \quad \text{[required profit]}$$

$$35x - 20x = 2700$$

$$15x = 2700$$

$$x = \frac{2700}{15} = 180kg$$

or contribution–fixed cost= Profit

$$\text{fixed cost} = ₹ 3000 - 300 = ₹ 2700$$

Illustration 47.

XYZ Ltd. furnishes you the following income information.

	Year 2010	
	First half (₹)	Second half (₹)
Sales	8,10,000	10,26,000
Profit earned	21,600	64,800

From above, you are required to compute the following assuming that the fixed cost remains the same in both the periods:

(i) P/v ratio (ii) Fixed costs (iii) The amount of profit or loss when sales are ₹ 648000 (iv) The amount of sales required to earn a profit of ₹ 108000.

Solution:

$$\text{Change in profit} = 64800 - 21600$$

$$= ₹ 43200$$

$$\text{Change in sales} = 1026000 - 810000$$

$$= ₹ 216000$$

$$\begin{aligned} \text{(i) P/v ratio} &= \frac{\text{Change in profit}}{\text{change in sales}} \times 100 \\ &= \frac{43200}{216000} \times 100 = 20\% \end{aligned}$$

(ii) Calculation of fixed cost

$$\text{Sales in period I} = ₹ 810000$$

$$\text{P/v ratio} = 20\%$$

$$\text{so contribution} = 810000 \times 20\% = ₹ 162000$$

as we know contribution – Fixed cost = Profit

$$\text{or fixed cost} = \text{contribution} - \text{profit}$$

$$\text{So fixed cost} = 162000 - 21600$$

$$= ₹ 140400$$

(iii) Profit or loss when sales are ₹ 648000

$$\text{Sales} = ₹ 648000$$

$$\text{Contribution} = 648000 \times 20\% = ₹ 129600$$

$$\text{Profit/Loss} = \text{contribution} - \text{fixed cost}$$

$$= 129600 - 140400$$

$$= \text{Loss ₹ 10800}$$

(iv) Amount of sales required to earn profit of ₹ 108,000

$$\begin{aligned}
 &= \frac{\text{Fixed cost} + \text{required profit}}{\frac{P}{V} \text{ratio}} \\
 &= \frac{140400 + 108000}{20\%} \\
 &= \frac{248400}{0.2} = ₹ 12,42,000
 \end{aligned}$$

Illustration 48 (a) Calcutta company Ltd manufactures and sells four types of products under the brand names ACE, Utility, Luxury and Supreme. The sales mixture in value comprises of

	Brand Percentage
ACE	$33\frac{1}{3}\%$
Utility	$41\frac{2}{3}\%$
Luxury	$16\frac{2}{3}\%$
Supreme	$8\frac{1}{3}\%$
	100%

The total budgeted sales (100%) are ₹ 600000 per month.

The operating costs are:

ACE	60% of selling price
Utility	68% of selling price
Luxury	80% of selling price
Supreme	40% of selling price

The fixed costs are ₹ 159,000 per month. Calculate the break-even point for the product on an overall basis

(b) It has been proposed to change the sales mix as follows, the total sales per month remaining ₹ 600000.

Brand	Percentage
ACE	25%
Utility	40%
Luxury	30%
Supreme	5%
	100%

Assuming that this proposal is implemented, calculate the new breakeven point.

(CA Final Nov. 86)

Solution:

(a) statement showing contribution on overall basis.

	Brand				
	ACE ₹	Utility ₹	Luxury ₹	Supreme ₹	Total
Sales ₹ (600000)	200,000	250000	1,00,000	50,000	6,00,000
Operating cost (₹)	1,20,000	1,70,000	80000	20,000	390000
Contribution (₹)	80,000	80,000	20,000	30,000	210,000

Fixed cost = ₹ 1,59,000

P/v ratio = $\frac{210000}{600000} \times 100 = 35\%$

BEP (sales value) = $\frac{F.cost}{\frac{P}{v}ratio} = \frac{158000}{35\%} = ₹ 454,286$

(b) Statement of contribution under revised sales mix proposal

	Brand name				
	ACE ₹	Utility ₹	Luxury ₹	Supreme ₹	Total ₹
Sales (600,000) (25%)	150,000	2,40,000	1,80,000	30,000	6,00,000
Operating cost (₹) (60%)	90,000	163,200	144,000	12,000	4,09,200
Contribution (₹)	60,000	76,800	36,000	18000	1,90,800

New P/v ratio = $\frac{190800}{600000} \times 100 = 31.8\%$

(overall basis)

New BEP (sales value) = $\frac{159000}{31.8\%}$

= ₹ 500000

Illustration 49.

The Sky Rock Ltd. produces and sells three types of products P,Q and R. The management committee has decided to discontinue the production of 'Q' since there is not much profit in it. From the following set of information find out the profitability of the products and give your short comments on the decision of the management.

Product	Selling Price per unit (₹)	Direct material Per unit (₹)	Direct wages per unit		
			Dept. A (₹)	Dept. B (₹)	Dept. C (₹)
P	300	60	20	15	10
Q	275	30	20	20	10

R 305 70 12 10 20

The absorption rates of overheads on the Direct wages are:

	Dept. A	Dept. B	Dept. C
Variable overheads	150%	120%	200%
Fixed overheads	200%	240%	150%

Solution:

Statement of contribution per unit of the products

	Products		
	P	Q	R
	₹	₹	₹
Selling Price	300	275	305
Direct material per unit	60	30	70
Direct wages Dep A	20	20	12
Dep B	15	20	10
Dep C	10	10	20
Variable overheads			
Dep A	30	30	18
Dep B	18	24	12
Dep C	<u>20</u>	<u>20</u>	<u>40</u>
	173	154	182
Contribution per unit	127	121	123
P/v ratio	42.33%	44%	40.32

Management is not right in its decision of discontinuing the product 'Q' because of its lowest contribution per unit.

The c/s or P/v ratio of the product Q is more than the other two products P and R. So emphasis should be there to increase its sales because the profit will shout up for any rupee increase in sales of the product because of higher contribution to sales ratio.

Illustration 50.

The following figures relates to one year work in a manufacturing business

	₹
Fixed overhead	1,20,000
Variable overhead	2,00,000

$$P/v \text{ ratio} = \frac{250000}{1010000} = 24.75\%$$

$$\begin{aligned} \text{B.E.P. (Sales value)} &= \frac{\text{Fixed cost}}{\frac{P}{v} \text{ ratio}} \\ &= \frac{120000}{24.75\%} = ₹ 484848 \text{ (approx)} \end{aligned}$$

Illustration 51. Mr. X has 200000 investment in his business firm. He wants a 21 percent return on his money. From an analysis of recent cost figures, he finds that his variable cost of operation is 58% of sales, his fixed costs are ₹ 84000 per year. Show computations to answer the following questions.

- (i) What sales volume must be obtained to break even?
- (ii) What sales volume must be obtained to get 21% return on his investment?
- (iii) Mr. X estimates that even if he closed the doors of his business, he would incur ₹ 21000 as expenses per year. At what sales would he be better off by locking his business?

Solution :

Variable cost of operation = 58%

$$P/v \text{ ratio} = 100 - 58$$

$$= 42\%$$

fixed cost = ₹ 84000

$$\begin{aligned} \text{(i) Sales required to break even} &= \frac{\text{Fixed cost}}{\frac{P}{v} \text{ ratio}} \\ &= \frac{84000}{42\%} = ₹ 200000 \end{aligned}$$

$$\begin{aligned} \text{(ii) Return in investment required} &= 21\% \\ &= 200000 \times 21\% = ₹ 42000 \end{aligned}$$

Sales required to get profit on investment ₹ 42000

$$\begin{aligned} &= \frac{\text{Fixed cost} + \text{Profit}}{\frac{P}{v} \text{ ratio}} \\ &= \frac{84000 + 42000}{42\%} = \frac{126000}{42\%} = ₹ 300000 \end{aligned}$$

- (iii) Sales below which he should lock his business rather than running.

Fixed cost = 84000

Expenses even on locking = 21000

Sales below which Mr. X should lock the business

$$\begin{aligned} &= \frac{\text{Fixed cost} + \text{Profit}}{\frac{P}{v} \text{ ratio}} \\ &= \frac{84000 + 21000}{42\%} = \frac{63000}{0.42} = ₹ 150000 \end{aligned}$$

So if the sales decreases below ₹ 1,50,000 he should lock the business. He should start the business if the sales are more than ₹ 1,50,000.

Illustration 52. A Japanese soft drink company is planning to establish a subsidiary company in India to produce mineral water based on the estimated annual sales of 40,000 bottles of mineral water. Cost studies produced the following estimates for Indian subsidiary.

	Total Annual costs (₹)	Variable cost as % of total annual cost (%)
Material	210,000	100
Labour	150,000	80
Factory overheads	92000	60
Administration overheads	40000	35

The Indian production will be sold by manufactures representatives who will receive a commission of 8% of the sales price. No portion of the Japanese office expenses is to be allocated to the Indian subsidiary.

You are required to:

- Compute the sale price per bottle to enable to management to realize an estimated 10% profit on sale proceeds in India.
- Calculate the break even point in rupee sales on the assumption that the sales price per bottle is ₹ 14.

Solution:

Working (i) Segregating the fixed and variable costs

	Variable Portion (₹)	Fixed Portion (₹)	Total (₹)
1. Material	210,000	—	210,000
2. Labour	120,000	30,000	150,000
3. Factory overheads	55,200	36,800	92,000
4. Administrative overheads	14,000	26,000	40,000
	3,99,200	92,800	4,92,000

- Let the selling price per bottle = x
Profit required @10% = $0.1x$
Commission on sales @8% = $0.08x$
Total cost to be covered = 492000
so $40,000 [x - 0.1x - 0.08x] = 492000$
 $[40000 \times 0.82]x = 492000$

$$x = \frac{492000}{0.82 \times 40000} = \frac{492000}{32800}$$

$$= ₹ 15$$

So selling price per bottle = ₹ 15

- To calculate the break even point sales. We should first of all calculate all the variable costs. As commission on sales has to be given for every sale, it should be included in variable cost.

Variable cost as calculated in (i) working above

commission on sales	= ₹ 399200
$[40000 \times 14 \times 8\%]$	= ₹ 44800
Total variable cost	= <u>444000</u>
Total sales	
4000×14	= 560000

$$\begin{aligned}
 \text{Total contribution} &= 116000 \\
 \text{Break even point sales (value)} &= \frac{\text{Fixed cost}}{\text{contribution}} \times \text{Total sales} \\
 &= \frac{92800}{116000} \times 560000 \\
 &= ₹ 448000 \\
 \text{No. of bottle to be sold at break even point} &= \frac{448000}{14} \\
 &= 32000 \text{ bottles}
 \end{aligned}$$

Illustrations 53.

The following particulars are extracted from the records of a company.

	Product A	Product B
	Per unit	Per unit
Sales	₹ 100	₹ 120
Consumption of material	2 kg	3 kg
Material cost	₹ 10	₹ 15
Direct wages cost	₹ 15	₹ 10
Direct expenses	₹ 5	₹ 6
Machine hours used	3	2
Overhead expenses		
Fixed	₹ 5	₹ 10
variable	₹ 15	₹ 20

Direct wages per hour is ₹ 5. Comment on profitability of each product (both use the same raw material) when

- Total sales potential is limited
- Raw material is in short supply.
- Production capacity (in terms of machine hours) is the limiting factor
- (iv) Assuming Raw material as the key factor, availability of which is 10000 kg and maximum sales potential of each product being 3,500 units. Find out the product mix which will yield the maximum profit.

[ICWA inter. June, 1989)

Solution:-

Statement of contribution of the products.

	Products	
	Production A ₹	Production B ₹
Material cost	10	15

Direct wages cost	15	10
Direct expenses	5	6
Variable overheads	15	20
Marginal cost	45	51
Selling price	100	120
Contribution	55	69
Contribution per kg of raw material	$\frac{55}{2} = ₹ 27.5$	$\frac{69}{3} = ₹ 23$
Contribution per machine hour	$\frac{55}{3} = ₹ 18.33$	$\frac{69}{2} = ₹ 34.5$
P/v ratio:	$\frac{55}{100} \times 100 = 55\%$	$\frac{69}{120} \times 100 = 57.5\%$

(i) When total sales potential is limited then the product with highest contribution per unit will be selected. Here product B is having more contribution and P/v ratio, should be produced.

(ii) When raw material is the limiting factor and is in limited supply, the product with more of higher per kg of the raw material will be selected. So, as per kg of the raw material supply the company should give priority to product A for production as is having ₹ 27.5 contribution per unit of the raw material used.

(iii) When machine hours is the limiting factor then comparison is to be made between the products with the contribution per unit of the machine hours. the product with higher contribution per machine hour should be given priority in production. So product B should be produced in maximum amount to get maximum profit.

(iv) When the raw material supply is limited to 10000 kg and maximum sale potential of each product is limited to 3500 units then

The product with higher contribution per unit per kg of raw material used should be produced first and balance raw material should be used for the production of the other product.

Product	No. of units Produced	Raw material used (kg)	Balance raw material (kg)	Total contribution (₹)
A	3500	$3500 \times 2 = 7000$	$10000 - 7000 = 3000$	$3500 \times 55 = 192500$
B	$3000 \div 3 = 1000$	3000	—	$1000 \times 69 = 69000$
		Total contribution		261500

Number of units that will give maximum profit

is Product A = 3500 units

Product B = 1000 units

Illustration 54 A manufacturer has three products A, B and C. Currently sales, cost and selling price details and processing time requirements are as follows:

	Product A	Product B	Product C

Annual sales (units)	6000	6000	750
Selling Price (₹)	20	31	39
Unit cost (₹)	18	24	30
Processing time required per unit (hours)	1	1	2

The firm is working at full capacity (13,500 processing hours per year). Fixed manufacturing overheads are absorbed into unit costs by a charge of 200% of variable costs. This procedure fully absorbs the fixed manufacturing overhead. Assuming that:

- (i) Processing time can be switched from one product line to another.
- (ii) The demand at current selling price is
Product A = 11000 units
Product B = 8000 units
Product C = 2000 units
- (iii) The selling prices are not to be altered you are required to calculate the best production program for the next operation period and to indicate the increase in net profit that this should yield. In addition, identify the shadow price of a processing hour.

Solution:-

Working: As it is given unit cost includes variable and fixed cost. Fixed cost is absorbed at the rate of 200% of the variable cost included in the unit cost.

Let x be the variable cost

then 200% of x i.e. $2x$ will be the fixed cost

so $x + 2x = 18$ in case of product A

or $x = ₹ 6$ per unit of product A

i.e. variable cost included in unit cost

$$= \frac{1}{3}rd \text{ of the unit cost}$$

so variable cost in products is as under

$$\text{Product A} = \frac{1}{3} \times 18 = ₹ 6 \text{ per unit}$$

$$\text{Product B} = \frac{1}{3} \times 24 = ₹ 8 \text{ per unit}$$

$$\text{Product C} = \frac{1}{3} \times 30 = ₹ 10 \text{ per unit}$$

Statement of contribution per processing hour

	Product A	Product B	Product C
	₹	₹	₹
Variable cost	6	8	10
Selling price	20	31	39
Contribution per unit	14	23	29
Processing time (has)	1	1	2
Contribution per processing hour	14	23	14.5
Priority	III	I	II

Optimum Product mix statement (contribution)

Product	Output	Hours required	Balance hours	contribution per unit ₹	Total contribution ₹
B	8000	8000	13500 – 8000 = 5500	23	184000
C	2000	4000	5500 – 4000 = 1500	29	58000
A	1500 ÷ 1 = 1500	1500	–	14	21000
Total contribution					2,63,000

Existing Product mix statement (contribution)

Product	Output	Hours required	Balance hours	contribution per unit ₹	Total contribution ₹
A	6000	6000	13500 – 6000 = 7500	14	84000
B	6000	6000	7500 – 6000 = 1500	23	138000
C	750	1500	–	29	21750
Total contribution					2,43,750

$$\begin{aligned}\text{Increase in total profit} &= 263000 - 243750 \\ &= ₹ 19,250\end{aligned}$$

Shadow price:

As it is given in the question in (ii) the production of B and C have been maximized and at full demand in the market there is available demand for the product in the market so if there is any available capacity in terms of processing hours that can be utilized for the production of the product A. The contribution per machine hour in respect of the product A is ₹ 14. So, the shadow price of the processing hour is ₹ 14 in the present case.

Illustration 55.

XYZ Co. Ltd. manufactures Automobile accessories and parts. the following are the total costs as also the unit costs of processing a component: SSB1000

Cost Element	Total cost for 100000 units (₹)	Unit cost ₹
1. Direct Material	500,000	5
2. Direct labour	800,000	8
3. Variable Factory overhead	600,000	6
4. Fixed Factory overhead	500,000	5
	2400,000	24

Another manufacture has offered to sell the same part to XYZ Ltd. for ₹ 22 each.

The fixed overhead would continue to be incurred even when the component is bought out although there would be a reduction to the extent to ₹ 150,000 following the saving in salaries of supervisory, personnel that could be avoided if the company opts to 'buy' rather than make.

Required

- (a) Should the part be made or bought considering that the present facility when released following a buying decision would remain idle?
- (b) In case the released facility can be rented to another manufacturer, for ₹ 50000 as there is a good demand for spare facilities, what will be the position?

[ICWA final Dec 85]

Solution:

Let us compare the three situations together as it is given in the question that the fixed cost incurred by the company in production of the product is not fully saved and a huge amount of it has to bear by the company if the company decide to buy rather to make. So it will also form a part of the decision making process.

Comparative statement of cost incurred in the three situations.

	Situation		
	Make the product by the company (₹)	Buy and facility released remain idle (₹)	Buy and facility released is rented out (₹)
(i) Total variable cost incurred on making (500000+800000+6000000)	19,00,000	—	—
(ii) Buy the product from the market	—	22,00,000	22,00,000
(iii) fixed cost incurred in three situations	500000	350000(1)	300000(2)
Total cash outflow	2400,000	25,50,000	25,00,000

If we compare the three situation we see that the total cash outflow in the first case i.e. making the product in its own is ₹ 2400,000 is the minimum of the other two situations. So the decision should be in the favour of making the product by the company.

Note: (1) Total Fixed cost incurred in case 'making' ₹500,000
saving in the fixed cost if facility released remain idle ₹150,000

Fixed cost incurred in case facility released remain idle ₹350,000

(2) Total fixed cost incurred in case 'making' ₹500,000
saving in fixed cost if facility released is rented out @ ₹ 50000
[150,000 saving in out flow+ 50,000 inflow] ₹200,000

Fixed cost incurred in case facility released can be rented out

₹300 000

Illustration 56. A manufacturer produces two products X_1 and X_2 . Each of the two products passes through two processes Q_1 and Q_2 . Maximum available hours for Q_1 and Q_2 are 1200 hours and 7200 hours respectively.

Following details are available:

One unit of X_1 takes 12 hours in Q_1 and 6 hours in Q_2 and

One unit of X_2 takes 8 hours in Q_1 and 5 hours in Q_2

Product	Per unit	
	X_1	X_2
	₹	₹
variable cost	30	25
Sales value	50	39

Find out the optimum product mix and the maximum contribution.

[ICWA Final Dec 1984]

Solution:

Contribution per unit of product X_1 = selling price–variable cost

$$= 50 - 30 = ₹ 20$$

Contribution per unit of product X_2 = selling price–variable cost

$$= 39 - 25 = ₹ 14$$

Maximize $20X_1 + 14X_2$ (where X_1 = number of units of first product

X_2 = Number of units of second product)

subject to $12X_1 + 8X_2 \leq 12000$

$$6X_1 + 5X_2 \leq 7200$$

introducing the slack variable

$$12X_1 + 8X_2 + X_3 \leq 12000$$

$$6X_1 + 5X_2 + X_4 \leq 7200$$

Subject to $X_1, X_2, X_3, X_4 \geq 0$

By solving the above, we get an optimum product mix as

(simplex method)

$$X_1 = 200 \text{ units}$$

$$X_2 = 1200 \text{ units}$$

(b) Maximum contribution

₹

$$X_1 = 200 \times 20 = 4000$$

$$X_2 = 1200 \times 14 = 16800$$

$$\text{Total} = ₹ 20,800$$

Illustration 57.

Maria runs a wine club. She buys six different types of wine in cases of 12 each and sells the wine in cases of six, each case containing one bottle of each type.

Purchase cost per cost of 12	₹
Valpolicella	18.00
Bardolino	18.00
Liebfraumilch	18.60
Niersteiner	21.00
Bereich Bernkastel	20.40
Piesporter	24.00
Selling price per case of 6	12.00
variable distribution cost per case	0.50
Annual Fixed expenses	
Storage	2000
Wages	1000

Consider each question independently.

- What is the annual break even point in sales revenue and in unit sales?
- If 3800 cases were sold in the year, what would Maria's profit be?
- Maria thinks that by spending ₹ 200 per month on advertisement, she can achieve annual sales of ₹ 5000 cases what would her profit be under this scheme?
- The wages are paid to an assistant, Barbara, who sells the wine. Barbara offers to forgo her salary in exchange for ₹ 0.25 commission for every case sold. If Maria accepts Barbara's offer, what would be annual break even point in sales revenue and in unit sales?
- Maria's target profit is ₹ 6000. How many cases be sold to achieve this figure: (i) If Barbara receives her ₹ 1000 salary? (ii) If Barbara is paid by commission?
- What level of sales produces a profit figure which is the same whether Barbara is paid by salary or by commission?

[CIMA London–Adapted]

Solution:

Statement of contribution per case of 6 bottles.

	₹
Purchase cost: volpolicella $18 \div 12$	1.50
Bardolino $18 \div 12$	1.50
Liebfranmuch $18.60 \div 12$	1.55
Ncesstainer $21 \div 12$	1.75
Bereich Bernkastel $20.40 \div 12$	1.70
Piespotter $24.00 \div 12$	2.00
	10.00
Variable distribution cost per case	0.50

Marginal cost

10.50

Selling price per case of 6

12.00

Contribution per case

1.50

Fixed cost = ₹ 2000 + 1000 = ₹ 3000 per annum

$$\begin{aligned} \text{(a) Break even point (number of cases)} &= \frac{\text{Fixed cost}}{\text{cont. per case}} \\ &= \frac{3000}{1.5} = 2000 \text{ cases} \end{aligned}$$

$$\begin{aligned} \text{Break even point (sales value)} &= (2000) \times (\text{selling price per case}) \\ &= 2000 \times 12 \\ &= ₹ 24000 \end{aligned}$$

(b) Profit on sale of 3800 cases

$$\begin{aligned} \text{Total contribution of 3800 cases} &= 3800 \times 1.5 \\ &= ₹ 5700 \\ \text{Less fixed cost} &= ₹ 3000 \\ \text{Profit} &= ₹ 2700 \end{aligned}$$

$$\begin{aligned} \text{(c) Total contribution on sale of 5000 cases} &= 5000 \times 1.5 \\ &= ₹ 7500 \end{aligned}$$

Less fixed cost :

$$\begin{aligned} (3000 + (200 \times 12)) &= ₹ 5400 \\ \text{Profit} &= ₹ 2100 \end{aligned}$$

$$\begin{aligned} \text{(d) New marginal cost} &= ₹ 10.50 + 0.25 \\ \text{(per case)} &= ₹ 10.75 \end{aligned}$$

$$\text{New fixed cost} = 3000 - 1000 = ₹ 2000$$

$$\text{New contribution per case} = 12 - 10.75 = 1.25$$

Break even point (number of cases)

$$\begin{aligned} &= \frac{\text{Fixed cost}}{\text{contribution per case}} \\ &= \frac{2000}{1.25} = 1600 \text{ cases} \end{aligned}$$

$$\begin{aligned} \text{Break even point (sales value)} &= 1600 \times 12 \\ &= ₹ 19,200 \end{aligned}$$

(e) Target profit = ₹ 6000

cases to be sold to achieve the target profit

(i) When Barbara receives the salary of ₹ 1000 per annum

$$\begin{aligned} \text{number of cases to be sold} &= \frac{\text{fixed cost} + \text{desired profit}}{\text{cont. per unit}} \\ &= \frac{3000 + 6000}{1.5} \\ &= \frac{9000}{1.5} = 6000 \text{ cases} \end{aligned}$$

(ii) When Barbara receives commission @ ₹ 0.25 per case

$$\begin{aligned} &= \frac{\text{Fixed cost} + \text{desired profit}}{\text{Cont. per unit}} \\ &= \frac{2000 + 6000}{1.25} = \frac{8000}{1.25} = 6,400 \text{ cases} \end{aligned}$$

- (f) To solve the problem and to find out the number of cases to be sold under the given condition

let the number of cases sold = x

so

$$1.5x - 3000 = 1.25x - 2000$$

$$1.5x - 1.25x = 3000 - 2000$$

$$0.25x = 1000$$

$$x = \frac{1000}{0.25} = 4000$$

Hence 4000 cases should be sold to be indifferent or earn the same level of profit.

The profit at 4000 cases will be

$$1.5 \times 4000 - 3000 = 6000 - 3000 = ₹ 3000$$

$$\text{or } 1.25 \times 4000 - 2000 = 5000 - 2000 = ₹ 3000$$

Illustration 58.

The variable cost of power drill manufactured by Home tools Limited is 4 and the selling price ₹ 10. The company expects its net profit for the year just ending to be ₹ 275000 after charging fixed cost to ₹ 85000

The company's production capacity is not fully utilized and market research suggest three alternative strategies for the forth coming year, viz:

Strategy	Reduce selling price by	sales volume expected to increase by
1	5%	10%
2	7%	20%
3	10%	25%

- (a) Assuming the same cost structure as the current year, evaluate the alternate strategies available to the company and state which is the most profitable.
- (b) Suggest other considerations which management would probably have in mind in making the decision.

Solution:

Let us first of all calculate volume of production at present level.

$$\begin{aligned} \text{contribution per unit} &= \text{selling price} - \text{variable cost} \\ &= 10 - 4 = ₹ 6 \end{aligned}$$

$$\begin{aligned} \text{Total contribution at present} &= \text{fixed cost} + \text{profit} \\ &= 275000 + 85000 \\ &= ₹ 3,60,000 \end{aligned}$$

let x be the units produced then

$$\begin{aligned} 6x &= 360000 \\ x &= \frac{360000}{6} = 60000 \text{ units (drills)} \end{aligned}$$

Case strategy 1.

$$\begin{aligned} \text{New selling price} &= 10 \times (1 - 5\%) \\ \text{(per drill)} &= 10 \times 0.95 = ₹ 9.5 \\ \text{variable cost per drill} &= ₹ 4.0 \\ \text{New contribution} &= 9.5 - 4 \\ &= ₹ 5.5 \end{aligned}$$

$$\begin{aligned}\text{New volume of sales} &= 60000 \times (1 + 10\%) \\ &= 60000 \times (1.1) = 66000 \text{ drills}\end{aligned}$$

$$\text{New contribution} = 66000 \times 5.5 = ₹ 3,63,000$$

Strategy 2

$$\begin{aligned}\text{New selling price} &= 10 \times (1 - 7\%) \\ \text{(Per drill)} &= 10 \times 0.93 \\ &= ₹ 9.30\end{aligned}$$

$$\text{New contribution per drill} = 9.30 - 4 = ₹ 5.30$$

$$\begin{aligned}\text{New volume of sales} &= 60000 \times (1 + 20\%) = 60000 \times (1.2) \\ &= 72000 \text{ drills}\end{aligned}$$

$$\text{New total contribution} = 72000 \times 5.3 = ₹ 3,81,600$$

Strategy 3:

$$\begin{aligned}\text{New selling price} &= 10 \times (1 - 10\%) \\ \text{(per drill)} &= 10 \times 0.9 \\ &= ₹ 9\end{aligned}$$

$$\begin{aligned}\text{New contribution drill} &= 9 - 4 \\ &= ₹ 5\end{aligned}$$

$$\begin{aligned}\text{New volume of sales} &= 60000 \times (1 + 25\%) \\ &= 75000 \text{ drills}\end{aligned}$$

$$\text{New total contribution} = 75000 \times 5 = ₹ 3,75,000$$

As the fixed cost does not change with change in the volume of production so the comparison and decision making tool is the contribution. The total contribution in strategy-2 is the highest, so should be adopted. It is the most profitable than the other two.

$$\begin{aligned}\text{Total highest profit} &= \text{Total contribution} - \text{fixed expenses} \\ &= 381600 - 85000 \\ &= ₹ 2,96,600\end{aligned}$$

(b) The other considerations which the management would probably have in mind.

- (i) The fixed cost which have been assumed to be fixed with the increase in the volume of production.
- (ii) The absorption of the increased production in the market i.e. whether the sale will increase in line with the increase in production.
- (iii) The reaction of competitors in the market. They can react at the same time and can adopt the same strategy of lowering the price to increase their sales.

Practical problems

1. If sales are ₹ 500,000, variable cost ₹ 300,000 then find out (i) contribution, (ii) The P/v ratio.

$$\text{Ans. [₹ 200,000, 40 \%]}$$

2. When fixed costs are ₹ 1,50,000 and selling price of the product is ₹ 25 per unit and the variable cost is ₹ 10 per unit then.

- (i) Find out the contribution per unit.
- (ii) The P/v ratio.
- (iii) B.E. point in the number of units.

$$\text{Ans. [(i) ₹ 15, (ii) 60 \%, (iii) 10,000]}$$

3. A company is selling its product at ₹ 19 per unit and the cost data relating to the production of the product is given as under.

- (i) Raw material required ₹ 7 per unit.
- (ii) Direct labour required per unit ₹ 3
- (iii) Variable overhead cost relating to the product ₹ 3
- (iv) Total fixed cost of the company ₹ 180,000

Find out :
 (i) Marginal cost per unit.
 (ii) Marginal cost to sales ratio.
 (iii) Contribution to sales ratio.
 (iv) Break even point sales both in terms of number of units and the sales value.

Ans. [(i) ₹ 13 (ii) 68.42% (iii) 31.58% (iv) 30,000, ₹ 570,000]

4. You are required to calculate (i) Margin of safety (ii) Sales (iii) variable cost from the following figures. Fixed cost ₹ 12000, profit ₹ 1000 Break even point sales 60,000

Ans. [(i) ₹ 5000, (ii) ₹ 65000, (iii) ₹ 52000]

5. If company's variable cost is @ 55% of the selling price and fixed cost is ₹ 450000. Find out its P/v ratio and the margin of safety if the total sales are ₹ 1250,000.

Ans. [P/v ratio = 45%, MOS = ₹ 250,000]

6. If margin of safety of a concern is ₹ 20,000 and it represents 40% of the capacity, P/v ratio is 30% then find out

- (i) Break even point sales.
- (ii) Fixed cost.
- (iii) Total profits.

Ans. [(i) ₹ 30,000 (ii) ₹ 9000 (iii) ₹ 6000]

Q.7 From the data given below regarding the sales and profit of two different periods when sales price, the variable cost per unit and the fixed cost remains the same, Find out

- (i) P/v ratio (ii) Fixed Cost (iii) Variable cost to selling price ratio.

Data:

	Period I	Period II
	₹	₹
Sales	100,000	1,20,000
Profit	15,000	27,000

Ans: [(i) 60% (ii) ₹ 45000 (iii) 40%]

- Q.8 (i) Ascertain Profit when sales are ₹ 200000; Fixed cost ₹ 40000, BEP ₹ 160000.

- (ii) Ascertain sales, when Fixed Cost ₹ 20000; Profit ₹ 10000, BEP ₹ 40000.

(iii) The ratio of variable cost to sales is 70%. The break-even point occurs at 60% of the capacity. Find out the capacity sales when fixed costs are ₹ 90000. Also compute profit at 75% of the capacity sales.

(iv) The profit volume ratio of X Ltd is 50% and the margin of safety is 40%. You are required to calculate the net profit if the sales volume is ₹ 100,000.

Ans: [(i) ₹ 10000 (ii) ₹ 60000 (iii) ₹ 500000; Profit

₹ 22500 (iv) ₹ 20000].

$$\text{Hint: (i) } \frac{F}{P/v \text{ ratio}} = \text{BEP} \quad \Rightarrow \quad P/v \text{ ratio} = \frac{F}{\frac{40000}{BEP}} = \frac{40000}{16000} = 25\%$$

$$P = 200000 \times 0.25 - 40000 = 10000$$

(ii) P/v ratio =

$$\frac{F.C}{BEP} = \frac{20000}{40000} = 50\%$$



$$0.5x = 20000 + 10000$$

$$x = \frac{30000}{0.5} = ₹ 60000$$

(iii) Marginal cost ratio = 70%. So p/v ratio = 30%

$$\frac{90000}{0.3} = 0.6s \quad \Rightarrow \quad S = 500,000 \text{ and } P = (500000 \times 0.75 \times 0.3) - (90000)$$

$$= ₹ 22500$$

$$(iv) \quad x - \frac{F.C}{0.5} = 0.4x$$

$$0.6x = \frac{F.C}{0.5} \quad \Rightarrow \quad F.C = 0.3x$$

$$\text{i.e. } F.C = 0.3 \times 100000$$

$$= ₹ 30000$$

$$\text{Contribution} =$$

$$100000 \times 50\% = ₹ 50000$$

$$\text{Profit} = \text{Contribution} - \text{Fixed cost} =$$

$$50000 - 30000 = ₹ 20000$$

Q.9 From the data given as under find out the

(i) P/v ratio (ii) Break-even point sales (iii) Margin of safety sales.

	₹	₹
Sales		500000
Variable cost of sales	400000	
Fixed cost	50000	
		450000
Profit		50000

Ans: [(i) 20%

(ii) ₹ 250000

(iii) ₹ 250000]

Q.10 By noting "P/v will increase or P/v will decrease or P/v will not change" as the case may be, state how the independent situation will affect the P/v ratio:

- (i) An increase in physical sales volumes;
- (ii) An increase in Fixed cost;
- (iii) A decrease in the variable cost per unit;
- (iv) A decrease in the contribution margin;
- (v) An increase in the selling price per unit;
- (vi) A decrease in the fixed cost;

(vii) A 10% increase in both selling price and variable cost per unit;

(viii) A 10% increase in the selling price per unit and 10% decrease in the physical sales volume.

(ix) A 50% increase in the variable cost per unit and 50% decrease in the angle of incidence

[ICWA Dec, 1990]

Ans: [{(iii), (v), (iii), (viii)}, Increase in P/v ratio]

[(iv), (ix) decrease in P/v ratio]

[(i), (ii), (vi), (vii), No change in P/v ratio]

Q.11 (i) When volume is 3000 units, average cost is ₹ 4. When volume is 4000, average cost is ₹ 3.50. The break-even point is 5000 units. Find the profit volume ratio.

(ii) ABC Ltd has fixed costs ₹ 20000. It has two products that it can sell, A and B. The company sells these products at a rate of 2 units of A to 1 unit of B. How many units of A and B would be sold at the break-even point?

(iii) If margin of safety is 40% of sales, find fixed costs when profit is ₹ 20000.

Ans: [(i) 37.5% (ii) A-10000 units, B-5000 units (iii) ₹ 30000]

Hint: (i)

$$\begin{aligned} \text{Total cost at 4000 units} &= 4000 \times 3.5 = ₹ 14000 \\ \text{Total cost at 3000 units} &= 3000 \times 4 = ₹ 12000 \\ \therefore 1000 \times &= 2000 \\ x &= ₹ 2 \quad \text{i.e. variable cost} \\ \text{F. cost} &= 14000 - (4000 \times 2) = ₹ 6000 \\ \frac{\text{F. Cost}}{\text{Cont. per unit}} &= 5000 \text{ (B.E.P)} \\ \frac{6000}{5000} &= S-2 \\ S &= 3.2 \\ C &= 1.2 \\ \text{C/S or P/v ratio} &= \frac{1.2}{3.2} \times 100 = 37.5\% \end{aligned}$$

(ii)

$$\begin{aligned} \text{F. Cost} &= ₹ 20000 \\ &= A + B \\ \text{Total contribution per lot} &= 2 \times 1 + 1 \times 2 = ₹ 4 \\ \text{B.E.P in lots} &= \frac{2000}{4} = 5000 \text{ lots} \\ \text{So For A} &= 5000 \times 2 = 10000 \text{ units} \\ \text{For B} &= 5000 \times 1 = 5000 \text{ units} \end{aligned}$$

(iii)

$$\begin{aligned} \text{S-B.E.P} &= 40\% \text{ of S} \\ \text{So } S - \text{BEP} &= 0.4 S \\ 0.6 S &= \text{BEP} \\ 0.6 S &= \frac{\text{F. Cost}}{\text{Cont.}} \times \text{sale} \\ \text{Cont.} &= \frac{\text{F. Cost}}{0.6} \\ \text{as } \text{Cont.} - \text{F.C} &= \text{Profit} \\ \left(\frac{\text{F. Cost}}{0.6} \right) - \text{F.C.} &= 20000 \end{aligned}$$

$$\frac{0.4}{0.6} F.C = 20000$$

$$F. Cost = \frac{20000}{0.4} \times 0.6 = ₹ 30000$$

Q.12 From the data given below find out:–

- (a) P/v ratio
- (b) Sales and
- (c) Margin of safety

Fixed Cost	₹ 20000
Profit	₹ 10000
B.E.Point	₹ 40000

Ans:– [(a) 50% (b) ₹ 60000 (c) ₹ 20000]

Q.13 Calculate the break–even point from the following figure:–

	₹
Sales	3,00,000
Fixed expenses	75,000
Direct material	1,00,000
Direct Labour	60,000
Direct expenses	40,000
[Ans. = ₹ 2,25,000]	

Q.14 Find out the following from the data given below:–

- (i) The P/v ratio
- (ii) B.E.P Sales
- (iii) Margin of safety

	₹
Selling price per unit	30
Material cost per unit	10
Labour cost per unit	5
Variable overheads per unit	5
Fixed cost	₹ 100000

Further it is also given that B.E.P occurs at 50% of the overall capacity, and the company is currently working at 75% of the capacity.

Ans: [(i) $33\frac{1}{3}$ (ii) ₹ 300000 (iii) 5000 units, ₹ 1,50,000]

Q.15 Following costs and sales of a manufacturing company for the first half and second half of 2009–10 are given:–

	First half	Second half
Sales (₹)	2400000	3000000
Total cost	2180000	2600000

You are asked to determine.

- (i) Contribution to sales ratio of the firm (ii) Annual fixed costs
(iii) Break-even point (iv) Margin of safety as percentage of sales.

Ans: [(i) 30% (ii) ₹ 10,00,000 (iii) ₹ 33,33,333 (iv) 38.3%]

Q.16 From the following data calculate

- (i) The break-even point expressed in amount of sales in rupees.
(ii) The number of units that must be sold to earn a profit of ₹ 60000 per year.

	₹
Sales Price	20 per unit, variable manufacturing cost ₹ 11 per unit
Variable selling cost	3 per unit
Fixed factory overheads	5,40,000 per year
Fixed selling cost	2,52,000 per year

Ans: [(i) ₹ 26,40,000 (ii) ₹ 1,42,000]

Q.17. S Ltd. furnishes you the following information relating to the half year ending 30th June, 1980.

	₹
Fixed Expenses	25000
Sales value	100000
Profit	25000

During the second half of the same year the company has projected a loss of ₹ 5000. Find out

- (i) The P/v ratio, break-even point and margin of safety for six months ending 30th June, 1980.
(ii) Expected sales volume for second half of the year assuming that selling price and fixed expenses remain unchanged in the second half year also.
(iii) The break-even point and margin of safety for the whole year 1980.

Ans: [(i) 50% , ₹ 50,000, ₹ 50000 (ii) ₹ 40000 (iii) ₹ 100000, ₹ 40000]

Q.18. From the following data, you are required to calculate the break-even point and net sales value at this point.

	₹
Direct material cost per unit	8
Direct labour cost per unit	5

Fixed overheads ₹ 24000
Variable overheads @ 60% on direct labour
Selling price per unit ₹ 25
Trade discount @ 4%
If sales are 15% and 20% above the break-even point volume, determine the net profits.
Ans: [3000 units, ₹ 72000, ₹ 3600, ₹ 4800]

Q.19. The budgeted sales of the products of a company are as follows.

	Products		
	X	Y	Z
Budgeted sales in units	15000	10000	20000
Budgeted selling price per unit (₹)	9	8	10
Budgeted variable cost per unit ₹	3	5	6
Budgeted fixed expenses (Total) ₹	59000	16000	52000

From the above information you are required to compute the following for each product

- (a) The budgeted profit (b) The budgeted break-even-point
(c) The budgeted margin of safety in terms of sales value.

Ans:—(a) ₹ 31000, ₹ 14000, ₹ 28000, (b) ₹ 88500, ₹ 42667, ₹ 130000
(c) ₹ 46500, ₹ 37333, ₹ 70000]

Q.20 A company is having the following given detail regarding its three products.

	Products		
	A	B	C
	₹	₹	₹
Selling price per unit	20	16	12
Raw material consumed per unit	10	6	4
Labour cost required per unit	2	3	2
Variable other costs per unit	2	3	1

The fixed cost for a production period is ₹ 80000

The expected production and sales during the coming two periods during which the cost structure the selling price is expected to be same is given as under:–

	A	B	C
Period I (units)	10000	10000	10000
Period II (units)	20000	4000	6000

You as a cost accountant are required to present:–

- (i) Statement of profitability for the coming two periods.
- (ii) Statement why profit in the second period is more in comparison with the first period though the total production in quantity (total) of the three products is the same in both the periods.

Ans:– [Period I: ₹ 70000, Period II: ₹ 86000, 6000 unit of B, 4000 units of C production is decreased and capacity so released is utilized in production of A having higher contribution per unit]

Q.21. The following set of information is presented to you by your client AB Ltd. producing two products X and Y.

	X	Y
	₹	₹
1. Direct material (per unit)	30	27
2. Direct wages (per unit)	9	6
3. Fixed expenses during the period are expected to be ₹ 2400		
4. Variable expenses are allocated to products at the rate of 100% of direct wages.		
5. Sales price (per unit)	X	Y
	₹ 60	₹ 45
6. Proposed sales mixes:		
(i) 100 units of X and 200 units of Y.		
(ii) 150 units of X and 150 units of Y		
(iii) 200 units of X and 100 units of Y		

As a cost accountant you are requested to present to management of AB Ltd the following:

- (a) The unit marginal cost and unit contribution.
- (b) The total contribution and resultant profit from each of the above sales mixes.
- (c) The proposed sales mixes to earn ₹ 720 and ₹ 900 with the total sales of X and Y being 300 units.

Ans: [(a) Marginal cost A= ₹ 48, ₹ 39, Cont. A= ₹ 12, B= ₹ 6

(b) (i) ₹ Nil, (ii) ₹ 300 (iii) ₹ 600

(c) * (i) 220 units of X and 80 units of Y (ii) 250 units of X and 50 units of Y]

* Hint let x be the number of units produced of X and (300–x) of Y

Then $12x + 6(300 - x) = 2400 + 720$

$12x - 6x + 1800 = 3120$

$$6x=1320$$

$$x=220$$

i.e. units of x =220 units, So units of Y = 300–220=80

Q. 22

Find the fixed cost and the profit from the data given below :

	₹
Sales	1,00,000
Marginal cost	75,000
Break-even point (sales)	75,000
Ans: [Fixed cost = ₹ 18,750, Profit = ₹ 6250]	

Q.23. Two competing companies ABC Ltd and XYZ Ltd produce and sell the same type of product in the same market. For the year ended March, 1975, their forecast profit and Loss accounts are as follows.

	XYZ Ltd		ABC Ltd
	₹		₹
Sales	300000	₹	300000
Less variable Cost of sales: ₹ 180000			240000
Fixed Cost ₹ 75000	255000	25000	265000
Forecasted net profit (₹)	45000		35000

You are required to compute

- P/v ratio
- Break–even sales volume

Ans:– [(i) 40%, 20%, (ii) ₹ 187,500, ₹ 1,25,000]

Q.24 AT Ltd operating at 80% level of activity furnishes the following information for 2008–09

	Products		
	A	B	C
Selling price per unit (₹)	10	12	20
Profit as percentage on selling price (%)	25	33.33	20
Units produced and sold	10000	15000	5000
Fixed costs (₹)	40000	45000	25000

During the year 2009–10 the variable costs are expected to increase by 10%. There will, however, be no change in fixed costs, the selling prices and the units to be produced and sold. The sales potential for each of the products is unlimited.

- (i) You are required to prepare a statement showing the P/v ratio, break-even point and margin of safety for 2008-09 and 2009-10 for the company as a whole.
- (ii) The company intends to increase the production of only one of three products to reach the full capacity level by utilizing the spare capacity available. Assuming that all the three products take the same machine time, advise with reasons, so as to which of the three products should be produced so that the overall profitability is the maximum.

Ans:	2008-09	2009-10
(i) P/v ratio	56.58%	52.24%
B.E.P	₹ 194415	₹ 210567
Margin of safety	₹ 185585	169433
(ii) Product 'C' as it gives highest contribution of ₹ 7.90 as compared to A and B i.e. ₹ 6.15 and ₹ 6.50 respectively.		

Q.25 The following is the detail regarding the production of a product 'N' of the company M Ltd.

At 80% of the production capacity

Units of product 'N' produced	=	60000
Raw material required for the product 'N'	= ₹ 8	
Labour cost required per unit of 'N'	= ₹ 6	
Other variable cost per unit of 'N'	= ₹ 6	
(100% of Labour cost)		

Total Fixed cost = ₹ 2,60,000

Selling price per unit in the national market = ₹ 26

The company has been offered by a foreign customer to supply the product at sale price ₹ 23, for a supply of 10,000 units at present and if quality is accepted for a regular supply of 15000 units for which the company is having available capacity. For this the management estimates an increase in the labour cost @ ₹ 0.25 per unit and similar increase in other variable costs. Fixed cost for this foreign order is expected to increase by ₹ 20000.

Now you are, as a cost accountant required to analysis the situation and report.

- (a) Present total profitability of the company to the management without the foreign order.
- (b) Whether the foreign order should be accepted or rejected?

Ans: [(a) Present Profit = ₹ 100000, (b) The order should be accepted.]

Q.26 (a) A Company manufactures and sells four types of products under brand names Active, Beautiful, Handsome, Smart.

The sales in value comprises of:-

Brand	Brand Percentage
Active	30%
Beautiful	40%
Handsome	20%
Smart	10%

100%

The total budgeted sales at 100% are 5,00,000 per month

The operating costs are:

Brand	Brand Percentage
Active	60 % of selling price
Beautiful	70 % of selling price
Handsome	80 % of selling price
Smart	40 % of selling price

The fixed costs are ₹ 140000 per month. Calculate the break-even point for the products on an overall basis.

(b) It has been proposed to change the sales mix as follows and total sales per month ₹ 600000.

Brand	Brand Percentage
Active	25%
Beautiful	40%
Handsome	25%
Smart	10%
	100%

Assuming that this proposal is implemented, calculate the new break-even point.

Ans: [(a) P/v ratio 34%, BEP ₹ 411765 (b)P/v ratio 33%, BEP = ₹ 4,24,242.]

Q.27. Your Company manufactures a single product and sells it at a price of ₹ 80 per unit. The variable cost per unit is ₹ 48 and the annual fixed cost amounts to ₹ 18 lakhs. Based on these data. You are required to work out the following:

- Present P/v ratio and Break-even sales.
- Increase in the volume of sales required if the profit is sought to be ₹ 3.6 lakh.
- Percentage increase/decrease in sales volume treating two situations independently.
 - to off set an increase of ₹ 4 per unit in variable cost and
 - an increase in selling price by 10% without affecting the quantum of existing profit.

Ans: [(i) P/v ratio 40%, B.E.P sales = ₹ 45 lakhs, (ii) ₹ 9 lakhs
(iii) 14.28%, 12%]

Q.28: Sales managers of two companies compare notes and find their sales turnover for last year was the same Viz: ₹ 10 lakhs and the profits they made also were the same being 10% of turnover. In one company the fixed costs were double the variable costs. While in the other, it was costs quite opposite the variable costs were double the fixed costs. As an accountant, do you think that they are equally profitable?

If not, discuss their relative vulnerability to market conditions.

[CA Final].

Ans: [P/v ratio I : 70%, II : 40%
 B.E. point ₹ 8.57 lakhs, and ₹ 7.50 lakhs
 Margin of safety 14.3% and 25 %]

Hint: [Let x be the variable cost in first company

$$\begin{aligned}
 \text{so, } 10,00,000 - x - 2x &= 100000 \\
 \Rightarrow 3x &= 900000 \\
 \Rightarrow x &= 300000 \text{ i.e. variable cost} = ₹ 300000 \\
 \text{Marginal cost/sales} &= 30\% \\
 \text{so P/v ratio} &= 70\% \\
 \text{Fixed cost} &= 2x = 2 \times 300000 = ₹ 600000 \\
 \text{B.E. point sales} &= \frac{600000}{0.70} = 8,57,143 \text{ (approx.)} \\
 \text{Margin of safety} &= 1000000 - 857143 = ₹ 142857 \\
 \text{MOS percentage} &= \frac{142857}{1000000} \times 100 = 14.28\% \text{ (approx.)}
 \end{aligned}$$

Similarly solve for second company.

Q.29: A company is presenting to you the data given below and seeking your good advice as a cost accountant. Please advise the company management about the priority in which the machine capacity if available could be utilized to increase the overall profitability of the company in the production of three possible products.

	Product		
	X	Y	Z
	₹	₹	₹
(i)Raw material required per unit	15	18	25
(ii)Labour cost required per unit	9	10	12
(iii)Other variable cost per unit	6	7	8
(iv)Selling price per unit	50	45	54
Machine hours required per unit (Limited) (hours)	10 hrs.	8 hrs.	4 hrs.

The fixed expenses of the company are ₹ 50000.

Ans:- [Priority I–Z, II–X, III–Y]

Q.30: A multiproduct company has the following costs and the output data for the last year.

	Product		
	P	Q	R
Sales Mix	35%	34%	31%

	₹	₹	₹
Selling price per unit	20	25	30
Variable cost per unit	10	15	18
Total fixed cost (₹)	1,17,500		
Total sales (₹)	5,00,000		

The company proposes to replace the product by the product S. Estimated cost and output data are:

	Products		
	P	Q	S
Sales Mix	40%	25%	35%
	₹	₹	₹
Selling price per unit	20	25	30
Variable cost per unit	10	15	13.5
Total fixed cost (₹)	1,17,500		
Total sales (₹)	5,00,000		

Analyses the proposal change and suggest what decision the company should take.

Ans: [The company should take the decision in favour of change because S is the most profitable having P/v ratio 55%]

Q.31:– A company is facing the problem of reduction in selling price in the market and management is worried about maintaining the last year profit in the coming period. Now you as a cost accountant are approached to suggest the target sales in various situations to maintain the same level of profit.

- (i) Reduction in price 5%
- (ii) Reduction in price 10%
- (iv) Reduction in price 12%.

The last year data:

	₹	₹
Total sales (5000 units)		500000
Variable cost (5000 units)	300000	
Total fixed cost	<u>50000</u>	
		<u>350000</u>
Total profit		150000

Ans: [(i) sales 542857 (ii) ₹ 600000 (iii) ₹ 628571]

Q.32: The following is the budget of XYZ Ltd.

Fixed	Variable	Total

	₹	₹	₹
Budgeted sales:			50,00,000
(200000 units @ ₹25 each)			
Budgeted Costs:			
Direct material	-----	9,00,000	
Direct labour	-----	10,00,000	
Factory overheads	7,00,000	3,00,000	
Administration overheads	6,00,000	1,00,000	
Distribution overheads	5,00,000	3,00,000	
Total	18,00,000	26,00,000	44,00,000
Budgeted Profit			6,00,000

Compute the break-even point in the following independent situations if :-

- a 10% increase is effected in fixed costs.
- a 10 % increase is effected in variable costs.
- a 10% increase is effected in sales price which will result in reduction in units sold by 5%.
- a 10% increase in fixed cost and 5% decrease in variable costs is affected.

[C.S. Final Dec, 1986]

Ans: $\left[\begin{array}{llll} \text{(i) ₹ 41,25,000} & \text{(ii) ₹ 42,05,607} & \text{(iii) ₹ 34,13,793} & \text{(iv) ₹ 39,13,043} \\ \text{units 165,000} & \text{units 1,68,224} & \text{units 1,24,138} & \text{units 1,56,522} \end{array} \right]$

Q.33:- On a turnover of ₹ 20 crores in 1984 a large manufacturing company earned a profit of 10% before interest and depreciation which were fixed. The product mix was as under:-

Product	Mix%	P/v ratio	Raw material% on sales
	total sales	%	value
P	10	30	40%
Q	30	20	35%
R	20	40	50%
S	40	10	60%

Interest and depreciation amounted to ₹ 150 lacs and ₹ 77 lacs respectively.

Due to fluctuations in prices in the international market, the company anticipates that the cost of raw materials which are imported will increase by 10% during 1985. The company has been able to secure a license for the import of raw material of a value of ₹ 1023 lacs at 1985 prices. In order to contract the increase in cost of raw materials the company is contemplating to revise its product mix. The market survey report-recently prepared indicates that the sales potential of each of the products P,Q and R can be increased up to 30% of the total sales value of 1984. There is no inventory of finished goods or work in process in both the years. Required.

- Set an optional product mix for 1985 and find the profitability.
- What percentage increase in overall prices is required in 1985 to raise the sales value to maintain the margin of safety at 10%

[C.A. Final, May, 1985]

Ans: [P: 600 lacs, Q: 600 lacs, R: 600 lacs, S:300 lacs sales price increase required 4.12%]

Hint: Working

(i)Product	Year 1984 (₹ crores)					Year 1985 (₹ crores)					
	Sales ₹	V.cost % ₹		Raw mat.. ₹	Other cost ₹	Raw mater. at increased prices ₹	Other cost ₹	Total V.C. ₹	Cont. ₹	Cont./Ma terial cost	Ran k
P	2	70%	1.4	0.8	0.6	0.88	0.6	1.48	0.52	0.5909	II
Q	6	80%	4.8	2.1	2.7	2.31	2.7	5.01	0.99	0.4285	III
R	4	60%	2.4	2.0	0.4	2.20	0.4	2.60	1.40	0.6363	I
S	8	90%	7.2	4.8	2.4	5.28	2.4	7.68	0.32	0.0606	IV
Total	20		15.8	9.7	6.1	10.67	6.1	16.77	3.23		

(iii) Allocation of available raw material in 1985

Rank	sales as expected	New sales ₹ crores	Raw material used	Balanced raw material
I	R	6	3.30	10.23 – 3.3 = 6.93
II	P	6	2.64	7.23 – 2.64 = 4.29
III	Q	6	2.31	4.59 – 2.31 = 1.98
IV	R	3	1.98	– –

		Sales Crores ₹	(Cont. Crores ₹)
Total cont. =		P	6
		Q	6
		R	6
		S	3
			0.12
			4.77
		*Less F.cost	4.47
		Profit	0.30

$$\begin{aligned}
 \text{*Fixed cost} &= \text{cont.} \pm \text{Profit/Loss} \\
 &= (20 - 15.8) \pm (2.00 - 2.27) = \\
 &\text{Cont. + Loss} \\
 &= 4.2 + 0.27 = 4.47
 \end{aligned}$$

Q.34: A company has a project to install a new machine exclusively for manufacture of a new product which is expected to have good demand and reasonably high margin, maximum possible annual sales may not exceed ₹ 50 lakhs and if there is competition it may fall considerably. The company has obtained quotations and short listed two offers for the new machine. Details in respect of the two models are given below:–

	Machine Models	
	M ₁	M ₂
Maximum possible sales per year (₹)	50 lakhs	50 lakhs
Fixed cost per year (₹)	5 lakhs	8 lakhs
Estimated profit for maximum sales (₹)	15 lakhs	17 lakhs

You are required to calculate:

- Break–even sales of each machine
- Sales at which both models will give same profit.
- Range of sales over which one models is better than the other.

Ans: $\left[\begin{array}{l} \text{(i) } M_1 = ₹ 12.50 \text{ lakhs, } M_2 = ₹ 16 \text{ lakhs} \\ \text{(ii) } ₹ 30 \text{ lakhs} \\ \text{(iii) } M_1 - \text{up to sales of } ₹ 30 \text{ lakhs} \\ M_2 - \text{Sales exceed } ₹ 30 \text{ lakhs} \end{array} \right]$

Q.35: An umbrella manufacturer makes an average profit of ₹ 2.50 per unit on a selling price of ₹ 14.30 by producing and selling 60000 units at 60 percent of potential capacity.

His cost of sales per unit is as follows:

Direct material ₹ 3.50 factory overhead ₹ 6.25 (50% fixed)

Direct wages ₹ 1.25 sales overhead ₹ 0.80 (25% variable)

During the current year, he intends to produce the same number but estimates that his fixed costs would go up by 10% while the rates of direct wages and direct materials will increase by 8% and 6% respectively. However the selling price cannot be changed.

Under this situation he obtains an offer for a further 20% of his potential capacity (a) What minimum price would you recommend for acceptance of the offer to ensure the manufacturer an overall profit of ₹ 1,67,300? (b) The company obtains an export order for a further 30% of the potential capacity at a price ₹ 9 per unit. Should this order be accepted? (c) What will be your answer if the export order is at ₹ 8.25 per unit (instead of ₹ 9 per unit) for a further 30% of the potential capacity?

[B.com Hons Delhi, 2011]

Ans: [(a) ₹ 11.30 (b) Accept the order (c) Order should not be accepted]

Q.36: Mansarover Auto products produces and sales two small components P and Q used in automobiles.

The details regarding the unit income and cost of these components are as under:–

Products

	P	Q
	₹	₹
Selling Price	12	20
Direct Material	2	4
Direct Labour	2	1
Variable factory overheads	2	4
Fixed factory overheads	2	4
Total cost of goods sold	8	13
Gross profit per unit	4	7

Factory overheads both fixed and variable have been accounted for on a machine hour basis.

As far as can be determined the sales outlook is such that the plant could operate at full capacity on either or both products. Both P and Q are processed through the same cost centers. Selling costs are all fixed.

Which product should be preferred? Give a brief explanation in support of your answer.

[B.com Hons Delhi, 2005]

Ans:— [Product Q is preferred as gives more contribution per unit. If judged from machine hour base then the product P is preferred]

Q.37: Lacquer painter undertake painting jobs of car, scooter, buses etc. The paint material of desired shades are purchased from market and then painted by spray gun in paint shop by skilled painters the budget for next year is given below:

	₹
Paint Material 100 kiloliters	15,00,000
Direct labour 25000 hours	5,00,000
Variable overheads for 25000 hours	10,00,000
Total variable costs	30,00,000
Fixed Overheads	20,00,000
Total expected costs	50,00,000
Profit 25%	12,50,000
Expected job work revenue	62,50,000

The firm always faces problems in getting paint material from markets as the customer needs only a particular shade. The skilled labour is also sometimes not available due to rush of jobs.

A customer wants to get his moped painted urgently. It is estimated that one liter paint is sufficient for painting the moped. Four labour hours will be required to complete the job.

Required:

- What should be the painting charges if fixed costs are absorbed on the basis of variable costs and profit at 25% on total costs?
- What should be the charges in case the skilled labour is a limiting factor?
- What should be the charges in case the paint material is the limiting factor?
- Which price out of above three would you recommended to the customer and why?
- Would your answer to (iv) above differ if the customer has no urgency?

Ans:— [(i) ₹ 531.25 (ii) ₹ 775 (iii) ₹ 287.50 (iv) ₹ 775
(v) ₹ 531.25]

Q.38: (a) The following particulars are extracted from the records of a company.

	Product A	Product B
	Per unit	Per unit
Sales	₹ 10	₹ 120
Consumption of material	2 kg	3 kg
Material cost	₹ 10	₹ 15
Direct wages cost	₹ 15	₹ 10
Direct expenses	₹ 5	₹ 6
Machine hours used	3	2
Overhead expenses:		
Fixed	₹ 5	₹ 10
Variable	₹ 15	₹ 20

Direct wages per hour is ₹ 5. Comment on the profitability of each products (both uses the same raw material)
When Total sales potential is limited.

- Raw material is in short supply.
- Production capacity (in terms of machine hours) is the limiting factor.
- Assuming Raw material as the key factor, availability of which is 10000 kg and maximum sales potential of each product being 3500 units, find out the product mix which will yield maximum profit.

Ans:—

(i)	Ranking when sale potential is limited B–I, A–II
(ii)	When raw material is in short supply, A–I, B–I
(iii)	When machine hour is the limiting factor B–I, A–II
(iv)	Product mix A:B :: 3500:1000 max profit= ₹ 2,34,000

Q.39: A company is producing three types of biscuit packets and facing the problem of supply of labour of the required skill. The maximum consumption of each type of the biscuit is 15000. packets per month. The present production data regarding the three is given as under:

	Biscuit Type		
	Sweet	Salty	Fifty–fifty
Number of units produced (Packet)	10000	15000	12000
	₹	₹	₹
Selling price per packet	28	25	22
Raw material required per packet	10	11	06
Labour required @ ₹ 2 per hour	6	4	4
Other variable costs @ 100% of labour cost	6	4	4
Fixed overheads	3	3	3
The maximum skilled labour available	= 84000 Hours per month		

You are required to:

- Prepare a profitability report depending upon the present product mix.
- Give a priority to the products in which if the limited key factor is available, the products can be produced.

(c) Show the maximum profitability that can be attained depending upon the suitable product mix.

Ans: [₹ 135000, (b) C–I, B– II, A–III (c) ₹ 147000]

Q.40 Fixing the price to earn a desired level of profit

The following detail is given by the management of a company regarding the production and sale of its product at two capacity levels.

	Capacity	
	50%	60%
Number of units produced	37500	45000
Raw material required (₹)	13,12,500	15,75,000
Labour cost required (₹)	5,62,500	6,75,000
Other overhead costs (₹)	7,62,500	8,75,000
Selling price of the product: (₹)	100	
Other Fixed overhead expenses: (₹)	10,00,000	

The company desires to increase the sale in the market, but this is not possible as estimated by the sale promotion department. It can be possible as informed by the department by decreasing the price of the product. You are now consulted by the management to estimate the price that can be settled to earn an overall profit of ₹ 600,000 at 80% capacity level.

Ans: [₹ 95 per unit, 60000 units]

Q.41: (Alternative Proposal for utilization of capacity)

Zenith Enterprises Ltd. is engaged in manufacturing and selling two products A and B. Following information are available from the records of the company:–

(1) Budgeted Data (Monthly)

Products	A		B	
Capacity	40%		30%	
Production units	4000		6000	
Cost per unit:	₹	₹	₹	₹
Direct material:	150		80	
Conversion cost:				
Variable	360		300	
Fixed	90	600	120	500
Selling price per unit		750		425
Profit/Loss		150		(75)

(2) In the subsequent period , the following changes are envisaged:

- Direct material cost of product A and B to increase by 20%
- Selling price of Product A to increase by 10%.
- Selling price of Product B to increase by 30%.

(3) The management is contemplating to utilize 30% capacity presently lying idle and for this the following alternative proposals are to be considered.

- Further sale of Product A is possible, but the additional output can be sold at ₹ 600 per unit. Efficiency for this additional production will decrease by 10%.

- (b) Product B is expected to have a ready market at a price of ₹ 510 per unit. The additional output is possible at the same efficiency level as budgeted:
- (c) A new product C may be introduced for which the following data are available.

Direct Material cost per unit	₹ 480.00
Selling price per unit	₹ 1200.00

Conversion cost of product C is the same as that of Product B. However an additional amount ₹ 50000 is to be incurred for advertisement. Production rate of C is also same as that of Product B.

(4) Following additional information also needed to be considered:

- a) Present allocation of capacity of 40% to product A and 30% to Product B cannot be altered. However, the idle capacity of 30% can be utilized for any of product A, B and C.
- b) Fixed expenses are not to increase on account of utilization of additional 30% capacity (except for the advertisement expenses as stated above).

You are required to prepare a comparative statement for providing information to management giving your comments on the profitability of the three proposals as stated above.

Ans: [Proposal III (c) may be considered as the most profitable proposal as the contribution as well the profit of the same is higher than the other proposals]

Contribution ₹ 2470 thousands.

Manufacturing Vs Sub-Contracting – Special Key factor Situation

Q.42: HAZY Ltd manufactures four products P,Q,R and S. The direct costs of production are estimated at:

	P	Q	R	S
Material (₹)	36	38	42	24

Labour:

Assembly (at ₹4 per hour) (₹)	8	12	16	16
Machinist (at ₹6 per hour) (₹)	12	24	18	36

Total Fixed cost are dependent on output levels as follows:

Production (units)	Total Fixed Costs
Up to 50000	₹ 4,00,000
50,001 to 75000	₹ 5,00,000
75,001 to 100000	₹ 6,00,000

The sales director estimates that demand for their products in the next year will be as follows:

	P	Q	R	S
Units	18000	30,000	27000	15,000

Selling price per unit (₹)	68	90	91	94

The production manager states that the capacity of the existing machines is 2,10,000 hours per annum, though this will be increased to 3,00,000 hours in two years time when new plant which is currently on order will be delivered. Meanwhile, a local firm has offered to manufacture any of the products on a sub-contract basis at the following prices:

P	₹ 63
Q	₹ 80
R	₹ 72
S	₹ 82

Required: Advise the management to what extent the services of the subcontractor should be utilized in order to meet the expected demand of P, Q, R and S.

- (a) Prepare a statement showing the profit you would expect if your advice is followed.
- (c) Discuss briefly the reasoning you have applied in making your recommendation.

Ans: [(a) Sub-contract 27000 units of R (b) Net Profit: ₹ 9,43,000

6000 units of S

(c) R is always to be subcontracted the capacity if available should be utilized in the production of S].

Hint: Working Statement showing the contribution per unit if manufactured

	P	Q	R	S
Variable cost:				
Material (₹)	36	38	42	24
Labour:				
Assembly (at ₹4 per hour) (₹)	8	12	16	16
Machine (at ₹6 per hour) (₹)	12	24	18	36
Total variable cost (₹)	56	74	76	76
Sales price per unit (₹)	68	90	91	94
Contribution per unit consumption of	12	16	15	18
limiting factor (₹ per unit)[Machine hours]	12÷2	16÷4	15÷3	18÷6
	=6	=4	=5	=3
Ranking in order of max. cont.	I	III	II	IV

Marginal cost and subcontracting

price comparison	Marginal Cost	Subcontracting
	price	Diff.

P(₹)	56	63	7
Q(₹)	74	80	6
R(₹)	76	72	– 4
S(₹)	76	82	6

It is clear from above, the product R should be sub contracted and should not be made by the company and if the machine capacity is available the ranking in production should be P, Q and S.

Utilization of machine hour capacity

Product	Rank	Units	Hours. Per unit	Hours utilized	Balance hours.
P	I	18000	2	36000	210000–36000 = 174000
Q	II	30000	4	120000	174000 – 120000 = 54000
S	III	9000	3	54000	-----

Total Contribution:

Product	Units Manufactured	Units Subcontracted	Contribution (₹)		
			manufacture	Sub. Cont.	Total
P	18000	-----	216000	-----	216000
Q	30000	-----	480000	-----	480000
S	9000	6000	162000	6000×(94 –82) =72000	234000
R	-----	27000	-----	27000× (91–72) = 513000	513000
57000 units				Total (₹) :	14,43,000
				Fixed Cost:	5,00,000
					<u>9,43,000</u>

Another plan to maximum profit:

Product	Units manufacturing	Units Subcontracted	Contribution (₹)		Total
			Manufacture	Sub Contract	
P	18000	—	216000	—	216000
Q	30000	—	480000	—	480000
S	2000	13000	36000	156000	192000
R	—	27000	—	513000	513000
Total	50000			Contribution	1401000
				F.cost	400000
				Profit (₹)	10,01,000

Most Profitable mix. Labour in short supply

Q.43: The directions of ABC Ltd manufactures of products A, B, and C, have asked for advice on the product mix of the company. The following information is given:

		Products		
Standard cost per unit		A	B	C
Direct material (₹)		20	60	40
Variable overhead		6	4	10
Direct Labour:		Hours	Hours	Hours
Department	Rate/hour			
1	(₹) 1	28	16	30
2	(₹) 2	5	6	10
3	(₹) 1	16	8	30
Current production per annum (units)		10000	5000	6000
Selling price per unit : (₹)		100	136	180
Forecast of sales for next year (units)		12000	7000	9000
Fixed overhead per annum (₹) = 4,00,000				

Further, the type of Labour required in Department 2 is in short supply and it is not possible to increase the manpower of this department beyond its present level.

You are required to prepare a statement showing the most profitable mix of the products to be made and sold. The statement which should be presented in two parts should show:

- (i) The profit expected on the current budgeted production and
- (ii) The profit which could be expected if the most profitable mix was produced.

[CA Final, Nov, 1978)].

Ans: [(i) (₹) 2,80,000 (ii) (₹) 3,34,000]

Q 44 : Dreamland Ltd. Produces and sells three types of beds code named A, B and C. The profit per unit is presented below by the accountant :

	A	B	C
	₹	₹	₹
Selling price	120	100	110
Material X @ ₹ 2/kg	10	20	30
Material Y @ ₹ 1/kg	10	5	12
Labour I @ ₹ 2.5/hr	20	15	30
Labour II @ ₹ 1.5/hr	30	15	6
Variable overheads	10	5	2
Fixed cost 25 p/hr.	7	4	4
Cost per unit	87	64	84
Profit per unit	33	36	26
Projected sales volume (units)	200	300	100
Budgeted profit (₹)	6600	10800	2600

Upon investigation, it was revealed that whereas there was sufficient stock of material Y to satisfy the entire demand, only 2000 kgs of X were in stock. Even though both grades of labour are hired and paid for only when required, it is now felt that in the forthcoming period the availability is going to be :

Grade I 5000 hours

Grade II 5000 hours

It is not possible to sanction overtime.

The material prices of ₹ 2 and ₹ 1 for X and Y respectively are the current market prices and both materials can be obtained freely at these prices.

On 10 June, 10 days after commencement of the period. The accountant was asked to advise whether to accept the offer for sale of obsolete stock of material Z for ₹ 10000 or whether to convert and sell it for ₹ 18,750

Material Z was purchased in error two years ago for ₹ 9,000 and since been kept in stock as it did not give rise to extra storage cost.

The other costs associated with the conversion and sale are :

Material X	1,000 kgs
Labour grade II	1,000 hours
Variable overheads	₹ 3,000
Attributable fixed cost	₹ 1,250

The existing fixed costs of dreamland of ₹ 3,000 will not increase as a result of conversion.

Required :

(a) In view of findings revealed by the investigation about the possible input constraints, ascertain the best product mix and determine the maximum profit before selling or converting Z .

(b) What is the maximum rate dreamland should be prepared to pay for one additional hour of : (i) grade I labour. (ii) grade II labour

(c) What is opportunity cost of one hour of grade II labour before considering the conversion ? Explain fully.

(d) Comment on the desirability of converting Z, presenting a tableau show how much better off or worse off the company would be ? (CIMA London)

For answer see solution of the question given in the book at serial number 44 of the chapter.

The Formulae used in Cost volume profit analysis technique.

(i) Main Profit equation

$$\text{Sales} = \text{Fixed Cost} + \text{Variable}$$

$$\text{Total cost} = \text{Fixed cost} + \text{Variable cost}$$

$$\text{If sales} > \text{Total Cost} \quad \text{then profit}$$

$$\text{If Total Cost} > \text{Sales} \quad \text{then Loss.}$$

(ii) (a) Methods of finding out total contribution

$$\text{as we know } S = F.C + V.C + \text{Profit}$$

$$(S - V.C) = F.C + \text{Profit}$$

$$\text{so (Sales - Variable Cost) = (Fixed Cost + Profit)}$$

$$\text{So contribution} = \text{Sales} - \text{Variable Cost}$$

$$\text{or} = \text{Fixed cost} + \text{Profit}$$

(b) If number of units and selling price, variable cost per unit is given

$$\text{Then cont. per unit} = \text{Selling price per unit} - \text{variable cost per unit}$$

$$C = S - V$$

$$\begin{aligned}\text{Total contribution} &= \text{Number of units sold} \times \text{cont. per unit} \\ &= N \times (S - V)\end{aligned}$$

(iii) P/v ratio :

(a) When contribution per unit and selling price per unit has been either given or found out.

$$\text{P/v ratio} = \frac{C}{S} \times 100$$

(b) When total sales and total contribution is either given or found out then.

$$\text{P/v ratio} = \frac{\text{Sales} - \text{Variable cost}}{\text{Sales}} \times 100$$

(iv) Break-even point:-

It can be found out through formula.

$$(a) \text{ Break-even point (units)} = \frac{\text{Fixed cost}}{\text{Cont. per unit}}$$

$$\begin{aligned}(b) \text{ Break-even point (sales value)} &= \frac{\text{Fixed cost}}{\frac{P}{v} \text{ ratio}} \\ \text{or} &= \frac{\text{Fixed cost}}{\text{Cont. per unit}} \times \text{Selling price}\end{aligned}$$

(v) P/v ratio when sales of two periods and profit of two periods are given

$$= \frac{\text{Diff. in profits of the periods}}{\text{Difference in sales of the periods}} \times 100$$

(vi) Margin of safety :

$$\text{MOS} = \text{Sales} - \text{B.E.P sales}$$

$$\text{M.O.S} = \frac{\text{Profit}}{\frac{P}{v} \text{ ratio}}$$

(vii) Sales to get desired level of profit

$$\text{Sales (units)} = \frac{\text{Fixed cost} + \text{Profit desired}}{\text{Cont. per unit}}$$

$$\text{Sales (Value)} = \frac{\text{F. cost} + \text{desired profit}}{\frac{P}{v} \text{ ratio}}$$

Solution to problems on cost – volume profit analyses

Q1. Sales = ₹ 500000

Variable cost = ₹ 300000

$$\begin{aligned}(i) \text{ Contribution} &= \text{sales} - \text{variable cost} \\ &= 500000 - 300000 \\ &= ₹ 200000\end{aligned}$$

$$\begin{aligned}(ii) \text{ P/V ratio} &= \frac{\text{Contribution}}{\text{sales}} \times 100 \\ &= \frac{200000}{500000} \times 100\end{aligned}$$

$$=40\%$$

Q.2 Fixed cost = ₹ 1,50,000

Selling price = ₹ 25

Variable cost per unit = ₹ 10

(i) Contribution per unit = selling price – variable cost per unit

$$= 25 - 10$$

$$= ₹ 15$$

(ii) P/V ratio = $\frac{\text{contribution per unit}}{\text{selling price}} \times 100$

$$= \frac{15}{25} \times 100$$

$$= 60\%$$

(iii) B.E.P in units = $\frac{\text{Fixed Cost}}{\text{Contribution Per Unit}}$

$$= \frac{150000}{15}$$

$$= 10,000 \text{ units}$$

Q3. Selling price = ₹ 19

Raw material per unit of product = ₹ 7

Direct labour per unit of product = ₹ 3

Variable over heads per unit of product = ₹ 3

(i) Marginal cost = 7+3+3

$$= ₹ 13$$

(ii) Marginal cost to sales ratio

$$= \frac{13}{19} \times 100$$

$$= 68.42\%$$

(iii) Contribution per unit = 19 – 13

$$= ₹ 6$$

Contribution to sale ratio = $\frac{6}{19} \times 100$

$$= 31.58\%$$

(iv) B.E point (unit) = $\frac{\text{fixed cost}}{\text{contribution per unit}}$

$$= \frac{18000}{6}$$

$$= 30000 \text{ units}$$

B.E. print (sale value) = 30000 × 19

$$= ₹ 570000$$

$$\text{or } \frac{18000}{C/S \text{ ratio}} = \frac{18000}{\frac{6}{19} \times 100}$$

$$= \frac{18000}{31.58\%}$$

$$= ₹ 570000$$

Q4. Fixed cost = ₹ 12000

B.E.P sale = ₹ 60000

First of all let us find out the P/V ratio

$$= \frac{\text{Fixed Cost}}{\frac{P}{V} \text{ ratio}} = B.E.P \text{ (sales)}$$

$$\frac{12000}{P/V \text{ ratio}} = B.E.P \text{ sales}$$

$$\frac{12000}{P/V \text{ ratio}} = 60000$$

$$P/V \text{ Ratio} = \frac{12000}{60000} \times 100$$

$$= 20\%$$

$$\frac{\text{Contribution}}{\frac{P}{V} \text{ ratio}} = \text{total sales}$$

$$(\because S = F + V + P)$$

$$\frac{F+P}{20\%} = \text{total sales}$$

$$(\because S - V = F + P)$$

$$\frac{12000+1000}{20\%} = \text{Total sales}$$

$$\text{Total sales} = \frac{13000}{20\%}$$

$$= ₹ 65000$$

$$\text{Margin of safety} = \text{total sales} - B.E.P \text{ sales}$$

$$= 65000 - 60000$$

$$= ₹ 5000$$

$$\text{Variable cost} = \text{sales} - \text{fixed cost} - \text{profit}$$

$$= 65000 - 12000 - 1000$$

$$= ₹ 52000$$

Q5. Variable cost = 55% of selling price

$$\text{or } V = 0.55 \times S$$

$$P/V \text{ ratio} = \frac{S-V}{S} \times 100$$

$$= \frac{S - 0.55 \times S}{S} \times 100$$

$$= 0.45 \times 100$$

$$= 45\%$$

$$\text{Fixed cost} = ₹ 450000$$

$$\text{Margin of safety} = \text{total sales} - \text{break even point sales}$$

$$= 1250000 - \frac{450000}{0.45}$$

$$= 1250000 - 1000000$$

$$= ₹ 2,50,000$$

Q6. Margin of safety = ₹ 20000

$$S \times 40\% = 20000$$

$$S = \frac{20000}{40\%}$$

$$\text{Sales} = 50000$$

$$P/V \text{ ratio} = 30\%$$

$$\text{So profit} = 20000 \times \frac{P}{V} \text{ ratio}$$

$$= 20000 \times 30\%$$

$$= ₹ 6000$$

$$\text{Break even point sales} = \text{total sales} - \text{M.O safety}$$

$$= 50000 - 20000$$

$$= ₹ 30000$$

$$\text{Now } \frac{\text{Fixed cost}}{\text{P/V ratio}} = \text{B.E.P sales}$$

$$\frac{\text{Fixed cost}}{30\%} = 30000$$

$$\text{Fixed cost} = 30000 \times 30\%$$

$$= ₹ 9000$$

Q.7 Change in profit = 27000 – 15000

$$= ₹ 12000$$

$$\text{Change in volume of sales} = 120000 - 100000$$

$$= ₹ 20000$$

$$\text{P/V ratio} = \frac{\text{change in profit}}{\text{change in volum of sales}} \times 100$$

$$= \frac{12000}{20000} \times 100$$

$$= 60\%$$

$$\text{Total contribution in period I} = 100000 \times 60\% = ₹ 60,000$$

$$\text{We know that F+P} = \text{contribution}$$

$$\text{F} + 15000 = 60000$$

$$\text{Fixed cost} = ₹ 45000$$

$$\text{Variable cost to selling price ratio} = 100 - \text{P/V ratio}$$

$$= 100 - 60$$

$$= 40\%$$

Q.8 (i) We know that

$$\frac{\text{Fixed cost}}{\text{P/V ratio}} = \text{break even point sales}$$

$$\Rightarrow \text{P/V ratio} = \frac{\text{Fixed cost}}{\text{break even point sale}}$$

$$= \frac{40000}{160000}$$

$$= 25\%$$

$$\text{Contribution at 200000 sales} = 200000 \times 25\%$$

$$= ₹ 50000$$

$$\text{And F+P} = \text{contribution}$$

$$\text{P} = \text{contribution} - \text{fixed cost}$$

$$\text{Profit} = 50000 - 40000$$

$$\text{Profit} = ₹ 10000$$

(ii) Fixed cost = ₹ 20000

$$\text{Profit} = ₹ 10000$$

$$\text{Contribution} = \text{F} + \text{P}$$

$$= 20000 + 10000$$

$$= ₹ 30000$$

$$\text{P/V ratio} = \frac{\text{F.Cost}}{\text{B.E.P Sales}}$$

$$\text{P/V ratio} = \frac{20000}{40000} \times 100$$

$$\text{P/V ratio} = 50\%$$

$$\text{So sales} \times 50\% = \text{total contribution}$$

So sales $\times 50\%$ = 30000

$$\text{Sales} = \frac{30000}{50\%}$$

$$= ₹ 60000$$

(iii) Variable cost ratio = 70%

So P/V ratio = 100–70

$$= 30\%$$

We know that

$$\text{Break even point sales} = \frac{\text{fixed cost}}{\frac{P}{V} \text{ ratio}}$$

$$60\% \text{ of } S = \frac{90000}{0.3}$$

$$0.6 S = \frac{90000}{0.3}$$

$$S = \frac{90000 \times 100}{18}$$

$$\text{Sales} = ₹ 5,00,000$$

Total sales at 75% capacity = 75% of 500000

$$= ₹ 375000$$

Total contribution at 75% capacity

$$= 30\% \text{ of } 375000$$

$$= ₹ 112500$$

$$\text{AS } F + P = 112500$$

$$P = 112500 - F$$

$$P = 112500 - 90000$$

$$\text{Profit} = ₹ 22500$$

(IV) We know margin of safety = total sales – B.E.P sales

$$\Rightarrow 40\% \text{ of } S = S - \frac{F \cdot \text{cost}}{P/V \text{ ratio}}$$

$$40\% \text{ of } 100000 = 100000 - \frac{F \cdot \text{Cost}}{P/V \text{ ratio}}$$

$$40000 = 100000 - \frac{F \cdot C}{0.5}$$

$$\Rightarrow F \cdot C = 60000 \times 0.5$$

$$\text{Fixed cost} = ₹ 30,000$$

Also $F + P = \text{contribution}$

$$F + P = 50\% \text{ of } 100000$$

$$30000 + P = 50000$$

$$P = 50000 - 30000$$

$$\text{Profit} = ₹ 20000$$

Q9 Contribution = F + P

$$= 50000 + 50000$$

$$= ₹ 100000$$

$$P/V \text{ ratio} = \frac{\text{contribution}}{\text{total sales}} \times 100$$

$$= \frac{100000}{500000} \times 100$$

$$= 20\%$$

$$\begin{aligned}\text{Break even point sales} &= \frac{\text{fixed cost}}{\text{P/V ratio}} \\ &= \frac{50000}{0.2} \\ &= 250000\end{aligned}$$

$$\begin{aligned}\text{Margin of safety} &= \text{total sales} - \text{B.E.P sales} \\ &= 500000 - 2,50,000 \\ &= ₹ 2,50,000\end{aligned}$$

Q10.

- (i) P/V ratio will not change unless there is change in the variable cost per unit, it is independent of sales volume.
- (ii) P/V ratio depends upon selling price and variable cost per unit so with change in fixed cost p/v ratio will be unaffected
- (iii) Decreases in variable cost per unit will increase the P/V ratio
e.g. let variable cost to sales ratio = 60%
P/V ratio = 40%
When variable cost decrease, let it becomes 55%. Then P/V ratio will become $(100-55) = 45\%$
- (iv) Decrease in contribution margin will decrease the P/V ratio.
Let contribution = ₹ 40, selling price ₹ 100
P/V ratio = $\frac{40}{100} \times 100 = 40\%$
Contribution decrease and becomes say ₹ 39
Then P/V ratio = $\frac{39}{100} \times 100$
 $= 39\%$
- (v) Increase in selling price will increase the P/V ratio
Let selling price = ₹ 10
Variable cost per unit = ₹ 4
Say selling price become = ₹ 11
Then original P/V ratio $\frac{10-4}{10} \times 100$
After increase in selling price
P/V ratio = $\frac{11-4}{11} \times 100$
 $= \frac{7}{11} \times 100 = 63.63\%$
- (vi) A decrease in fixed cost will not effect the P/V ratio
Fixed cost change will effect only the break even point.
P/V ratio = $\frac{s-v}{s} \times 100$ *the expression is independent of fixed cost.*
- (vii) 10% increase in selling price and variable cost will not effect the P/V ratio.
e.g. let $S = ₹ 100$ $P/V \text{ ratio} = \frac{s-v}{s} \times 100$
 $V = ₹ 50$ $= \frac{100-50}{100} \times 100$
 $= 50\%$

10% increase in S
New selling price $S = 100 \times 1.1$
 $= ₹ 110$

10% increase in variable cost v

$$= 50 \times 1.1$$

$$= ₹ 55$$

$$\text{New P/V ratio} = \frac{s-v}{s} = \frac{110-55}{110} \times 100$$

$$\frac{55}{110} \times 100$$

$$= 50\%$$

- (viii) 10% increase in selling price per unit and 10% decrease in sales volume will increase the P/V ratio .

Reason: volume does not effect the P/V ratio P/V ratio depends upon selling price and variable cost

e.g. : let selling price per unit = ₹ 100

Variable cost = ₹ 50

$$\text{P/V ratio} = \frac{100-50}{5} \times 100 = 50\%$$

Let there is an increase of 20% in selling price

New selling price s, = $100 \times (1 + 20\%)$

$$= ₹ 120$$

Variable cost v = ₹ 50

$$\text{New P/V ratio} = \frac{s-v}{s} \times 100$$

$$= \frac{120-50}{120} \times 100$$

$$= \frac{70}{120} \times 100$$

$$= 58.33\%$$

So net effect is increase in P/V ratio

- (ix) 50% increase in the variable cost will decrease the P/V ratio.

e.g. let S = ₹ 100

$$V = ₹ 50$$

$$\text{P/V ratio} = \frac{100-50}{100} \times 100$$

$$= 50\%$$

New let V say = ₹ 60

$$\text{New P/V ratio} = \frac{100-60}{100} \times 100$$

$$= \frac{40}{100} \times 100$$

$$= 40\%$$

Q11.(i)

	Units	Average cost ₹	Total cost ₹
	4000	3.5	14000
	3000	4	12000
Subtract	1000		2000

$$\text{Variable cost} = ₹ \frac{2000}{1000}$$

$$= ₹ 2 \text{ per unit}$$

Fixed cost = total cost – variable cost

$$= 14000 - 8000$$

$$= ₹ 6000$$

$$\frac{\text{Fixed cost}}{\text{Contribution}} = \text{B.E.P sales (in units)}$$

$$\frac{6000}{S-2} = 5000$$

$$S-2 = 1.2$$

$$S = ₹ 3.2$$

$$\text{P/V ratio} = \frac{s-v}{s} \times 100$$

$$= \frac{3.2-2}{3.2} \times 100$$

$$= \frac{1.2}{3.2} \times 100$$

$$= 37.5\%$$

(ii) Contribution per unit for product A = ₹ 1

For product B = ₹ 2

$$\text{Combined contribution per lot} = (2 \times 1) + (1 \times 2)$$

$$= 2+2$$

$$= ₹ 4$$

$$\text{Fixed cost} = ₹ 20000$$

$$\text{Break even point in lots} = \frac{20000}{4}$$

$$= 5000 \text{ lots}$$

$$\text{No of units of A at B.E.P} = 5000 \times 2$$

$$= 10000 \text{ units}$$

$$\text{No of units of B at B.E.P} = 5000 \times 1$$

$$= 5000 \text{ units}$$

(iii) We know that

$$\text{Total sales} - \text{break even point sales} = \text{margin of safety}$$

$$S - \text{B.E.P} = 40\%$$

$$S - \text{B.E.P} = 0.4 S$$

$$0.6 S = \text{B.E.P}$$

$$0.6 S = \frac{\text{F.cost}}{\text{contribution}} \times \text{sales}$$

$$\text{Contribution} = \frac{\text{F.cost}}{0.6}$$

$$\text{We know contribution} - \text{F. cost} = \text{profit}$$

$$\frac{\text{F.C}}{0.6} - \text{F.C.} = 20000$$

$$\frac{0.4}{0.6} \text{F.C.} = 20000$$

$$\text{F .cost} = 20000 \times \frac{0.6}{0.4}$$

$$= ₹ 30000$$

Q12. Fixed cost = ₹ 20000

$$\text{Profit} = ₹ 10000$$

$$\text{B.E point} = ₹ 40000$$

$$\text{P/V ratio} = \frac{\text{Fixed cost}}{\text{B.E point sales}} \times 100$$

$$= \frac{20000}{40000} \times 100$$

$$= 50\%$$

$$\frac{\text{Contribution}}{\text{Sales}} \times 100 = \frac{P}{V} \text{ratio}$$

$$\begin{aligned} \Rightarrow \text{Sales} &= \frac{\text{contribution}}{\frac{P}{V} \text{ratio}} \\ &= \frac{F+P}{P/V \text{ratio}} \\ &= \frac{20000+10000}{50\%} \\ &= \frac{30000}{0.5} = ₹ 60,000 \end{aligned}$$

$$\text{Margin of safety} = \text{total sales} - \text{B.E.P sales}$$

$$= 60000 - 40000$$

$$= ₹ 20000$$

Q13. Contribution = sales – variable cost

$$= 300000 - (100000 + 60000 + 40000)$$

$$= 300000 - 200000$$

$$= ₹ 100000$$

$$P/V \text{ ratio} = \frac{\text{contribution}}{\text{sales}} \times 100$$

$$= \frac{100000}{300000} \times 100$$

$$= \frac{100}{3} \%$$

$$\text{B.E.P sales} = \frac{\text{Fixed cost}}{P/V \text{ratio}}$$

$$= \frac{75000}{\frac{100}{3} \%}$$

$$= 75000 \times 3$$

$$= ₹ 2,25,000$$

Q14. Selling price per units $s = ₹ 30$

$$\text{Variable cost per unit } v = ₹ (10+5+5) = ₹ 20$$

$$P/V \text{ ratio} = \frac{s-v}{s} \times 100$$

$$= \frac{30-20}{30} \times 100$$

$$= \frac{10}{30} \times 100$$

$$= 33\frac{1}{3} \%$$

$$\text{Break even point sales} = \frac{\text{fixed cost}}{p/v \text{ratio}}$$

$$= \frac{100000}{33\frac{1}{3} \%}$$

$$= ₹ 300000$$

$$\text{Total sales} = 2 \times 300000$$

$$= ₹ 600000$$

(as B.E.P occurs at 50% of sales)

$$\text{Margin of safety} = \text{total sales} - \text{B.E.P sales}$$

$$= (75\% \text{ of } 600000) - 300000$$

$$= 450000 - 300000$$

$$= ₹ 150000$$

$$\begin{aligned}\text{Margin of safety in units} &= \frac{150000}{30} \\ &= 5000 \text{ units}\end{aligned}$$

Q15.

	Sales (₹)	Total cost (₹)
1 st half	2400000	2180000
2 nd half	3000000	2600000
Difference	600000	420000

$$\begin{aligned}\text{For ₹ 3000000 sales variable cost} &= \frac{420000}{600000} \times 3000000 \\ &= ₹ 21,00,000\end{aligned}$$

$$\begin{aligned}\text{Fixed cost} &= 2600000 - 2100000 \\ (\text{half yearly}) &= 500000 \\ \text{Total fixed cost} &= 2 \times 500000 \\ &= ₹ 1000000\end{aligned}$$

$$\begin{aligned}\text{P/V ratio} &= \frac{3000000 - 2100000}{3000000} \times 100 \\ &= \frac{900000}{3000000} \times 100 = 30\%\end{aligned}$$

$$\begin{aligned}\text{Break even point} &= \frac{f.\text{cost}}{p.\text{ratio}} = \frac{1000000}{30\%} \\ &= ₹ 3333333\end{aligned}$$

$$\begin{aligned}\text{Margin of safety} &= 5400000 - 3333333 \\ &= ₹ 2066667\end{aligned}$$

$$\begin{aligned}\text{Margin of safety as per centage of sales} &= \frac{2066667}{5400000} \times 100 \\ &= 38.3\%\end{aligned}$$

Q16. Sales price $s = ₹ 20$

$$\begin{aligned}\text{Variable cost } v &= 11 + 3 \\ &= ₹ 14\end{aligned}$$

$$\begin{aligned}\text{P/V ratio} &= \frac{s-v}{s} \times 100 = \frac{20-14}{20} \times 100 \\ &= 30\%\end{aligned}$$

$$\begin{aligned}\text{Total fixed cost} &= 540000 + 252000 \\ &= ₹ 792000\end{aligned}$$

$$\begin{aligned}\text{B.E point in rupees} &= \frac{792000}{30\%} \\ &= ₹ 26,40,000\end{aligned}$$

$$\begin{aligned}\text{No of units to be sold to earn a profit of ₹ 60000} &= \frac{F+p}{\text{contribution per units}} \\ &= \frac{792000 + 60000}{20 - 14} = 1,42,000\end{aligned}$$

Q17. Fixed expenses = ₹ 25000

$$\text{Sales value} = ₹ 100000$$

$$\text{Profit} = ₹ 25000$$

$$\begin{aligned}\text{Total contribution} &= F + P \\ &= 25000 + 25000\end{aligned}$$

$$= ₹ 50000$$

$$(i) \quad a. \quad P/V \text{ ratio} = \frac{\text{total contribution}}{\text{sales value}} \times 100$$

$$= \frac{50000}{100000} \times 100$$

$$= 50\%$$

$$b. \text{ Break even point sales} = \frac{\text{fixed expenses}}{\frac{p/v}{ratio}}$$

$$= \frac{25000}{50\%}$$

$$= ₹ 50000$$

$$c. \text{ Margin of safety} = \text{total sales} - \text{B.E.P point sales}$$

$$= 100000 - 50000$$

$$= ₹ 50000$$

$$(ii) \quad \text{Expected sales volume for the second half of the year}$$

$$= \frac{F \pm P}{P/v \text{ Ratio}}$$

$$= \frac{25000 - 5000}{50\%}$$

$$= \frac{20000}{50\%}$$

$$= ₹ 40000$$

$$(iii) \quad a. \text{ Break even point for the whole year} = \frac{\text{fixed expenses}}{p/v \text{ Ratio}}$$

$$= \frac{50000}{0.5} = ₹ 100000$$

$$b. \text{ Margin of safety} = \text{total sales} - \text{B.E.P sales}$$

$$= (100000 + 40000) - 100000$$

$$= ₹ 40000$$

$$Q18. \quad \text{Selling price after a trade discount} = 25 + (1 - 4\%)$$

$$= 25 \times 0.96$$

$$= ₹ 24$$

$$\text{Total variable cost} = ₹ (8 + 5 + (5 \times 0.6))$$

$$= ₹ 16$$

$$\text{Contribution per units} = 24 - 16$$

$$= ₹ 8$$

$$\text{Fixed overheads} = ₹ 24000$$

$$\text{B.E point (in units)} = \frac{\text{fixed overheads}}{\text{contribution per unit}}$$

$$= \frac{24000}{8} = 3000 \text{ units}$$

$$\text{B.E point (in sales value)} = 3000 \times 24 = ₹ 72000$$

$$15\% \text{ sales above B.E.P sales} = 72000 \times 0.15 = ₹ 10800$$

$$\text{Profit} = 10800 \times p/v \text{ ratio}$$

$$= 10800 \times \frac{8}{24} = ₹ 3600$$

$$20\% \text{ sales above B.E.P sales} = 72000 \times 20\%$$

$$= ₹ 14400$$

$$\text{Profit} = 14400 \times \frac{p}{v} \text{ ratio}$$

$$= 14400 \times \frac{8}{24} = ₹ 4800$$

Q19.

	Product		
	X	Y	Z
Budgeted selling price (per unit(₹))	9	8	10
Budgeted variable cost (per unit(₹))	3	5	6
Contribution per unit (₹)	6	3	4
Budgeted sales (units)	15000	10000	20000
Budgeted total contribution (₹)	90000	30000	80000
Budgeted fixed expenses (₹)	59000	16000	52000
Budgeted profit (₹)	31000	14000	28000
Budgeted break even point (₹)			
$\frac{(\text{Fixed expenses} \times \text{selling price})}{\text{Contribution per unit}}$			
For X = $59000 \times \frac{9}{6}$ (₹)	88500	42667	130000
Budgeted margin of safety (₹)	46500	37333	70000
(Total sales – B.E.P. sales)			
For X = $(15000 \times 9 - 88500)$			

20. (i) Statement of profitability

	Products			
	A	B	C	
Selling price per unit (₹)	20	16	12	
Variable cost per unit(₹) for A=(10+2+2)	14	12	7	
Contribution per unit (₹)	6	4	5	
Sales during period unit I	10000	10000	10000	
Sales during period unit II	20000	4000	6000	Total
				(₹)
Total contribution for period I(₹)	60000	40000	50000	150000
Total contribution for period II (₹)	120000	16000	30000	166000
Profit for period I(₹) (150000–80000)				70,000
Profit for period II(₹) (166000–80000)				86,000

- (i) Profit in period II is more than profit in 1st period .The reason is product A is having highest contribution per unit and in period II 6000 units of B and 4000 units of C are diverted to the production of product A. so total contribution has increased and so profit .

Q21.

(a) Statement showing units marginal cost and unit contribution .

		Product	
		X	Y
		₹	₹
Sales Price (₹)		60	45
Unit marginal cost:	₹		₹
(i) Direct material	30		27
(ii) Direct wages	9		6
(iii) Variable expenses	9		6
		48	39
Unit Contribution (₹)		12	6

$$\begin{aligned}
 \text{(b) (i) Total contribution} &= (100 \times 12 + 200 \times 6) \\
 &= 1200 + 1200 \\
 &= ₹ 2400
 \end{aligned}$$

$$\begin{aligned}
 \text{Profit} &= \text{Total contribution} - \text{Fixed cost} \\
 &= 2400 - 2400 \\
 &= \text{Nil}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii) Total contribution} &= (150 \times 12 + 150 \times 6) \\
 &= (1800 + 900) \\
 &= ₹ 2700 \\
 \text{Profit} &= 2700 - 2400 \\
 &= ₹ 300
 \end{aligned}$$

$$\begin{aligned}
 \text{(iii) Total contribution} &= (200 \times 12 + 100 \times 6) \\
 &= (2400 + 600) \\
 \text{Profit} &= 3000 - 2400 \\
 &= ₹ 600
 \end{aligned}$$

(C) Proposed sales mix to earn ₹ 720

(i) Let x be the units of X sold

$$\begin{aligned}
 \therefore (x \times 12) + (300 - x) \times 6 &= 720 + 2400 \\
 12x + 1800 - 6x &= 3120 \\
 6x &= 1320 \\
 X &= 220
 \end{aligned}$$

So to earn ₹ 720, 220 units of X and 80 units of Y should be sold .

(ii) Sales mix to earn ₹ 900

Let y be the units of X sold

$$\begin{aligned}
 \therefore (y \times 12) + (300 - y) \times 6 &= 900 + 2400 \\
 12y + 1800 - 6y &= 3300 \\
 6y &= 1500 \\
 Y &= 250
 \end{aligned}$$

So to earn ₹ 900, 250 units of X and 50 units of Y should be sold .

Q22. Sales = ₹ 100000
 Marginal cost = ₹ 75000
 Contribution = 100000–75000= ₹ 25000
 $P/V \text{ ratio} = \frac{25000}{100000} \times 100 = 25\%$
 Break-even point (₹)=75000
 We know that

$$\frac{\text{Fixed cost}}{P/vratio} = B.E.P(sales)$$

$$\frac{\text{Fixed cost}}{25\%} = 75000$$

$$\text{Fixed cost} = 75000 \times 25\%$$

$$= ₹ 18750$$

$$\text{Profit} = (\text{sales} - B.E.P \text{ sales}) \times P/Vratio$$

$$= (100000 - 75000) \times 25\%$$

$$= ₹ 6250$$

Q23.

	Company		
	XYZ Ltd.		ABC Ltd.
Fixed cost (₹)	75000		25000
Net profit (₹)	45000		35000
Total contribution (₹)	120000		60000
P/V ratio: $\frac{120000}{300000} \times 100$	40%	$\frac{60000}{300000} \times 100$	20%
B.E point sales volume ₹ $\frac{75000}{40\%}$	187500	$\frac{25000}{20\%}$	125000

Q24.

Statement showing P/V ratio B.E.P margin of safety

	Year 2008–2009				Year 2009–10			
	Product				Product			Total (₹)
	A	B	C	Total (₹)	A	B	C	
Selling price per unit(₹)	10	12	20		10	12	20	
Profit per units ₹	2.5	4	4					
Fixed cost per unit= $\frac{40000}{10000}$								
₹	4.0	3	5					
Variable cost ₹	3.5	5	11		3.85	55	12.1	
Contribution per unit								
₹(F+P)	6.5	7	9		6.15	6.5	7.9	
Total contribution								
A=(10000× 6.5)	65000	105000	45000	215000	61500	97500	39500	198500
Total sales value	100000	180000	100000	380000	100000	180000	100000	380000
A=10000× 10								
P/V ratio :				56.58%				52.24%
B.E.P sales:								
$\frac{f.c}{P/Vratio}=\frac{110000}{56.58\%}$ (₹)				194415				210567

Margin of safety (₹)	185585				169433
Ranking on the basis of cont. per unit		III	II	I	

- (ii) Spare capacity should be utilized to produce the product C with highest contribution per unit to increase over profit .

Q25.

- (a) Profitability statement at 80% of capacity

Selling Price	=	₹ 26
Variable Cost:		
(8+6+6)	=	₹ 20
Contribution per Unit	=	₹ 6

$$\begin{aligned}\text{Total contribution} &= 60000 \times 6 \\ &= ₹ 360000\end{aligned}$$

$$\text{Fixed cost} = ₹ 260000$$

$$\text{Total profit} = ₹ 100000$$

- (b) Relevant cost (per units) Raw material = ₹ 8
(For foreign order) Labour cost = ₹ 6.25
Other variable costs = 6.25
Relevant fixed cost per unit = ₹ 2.00
(20000 ÷ 10000)
Total relevant cost (per unit) = 22.50
Selling price = 23.00

Selling price is more than the relevant cost so the order should be accepted .The capacity also exists up to 15000 units.

Q26.

- (a)

	Brand Name				Total
	Active (₹)	Beautiful (₹)	Handsome (₹)	Smart (₹)	(₹)
Sales :	150000	200000	100000	50000	500000
Operating costs :	90000	140000	80000	20000	330000
Contribution	60000	60000	20000	30000	170000
P/V ratio $\frac{170000}{500000} \times 100$					34%
Fixed cost (₹)					140000
B.E.P sales (₹) $\frac{140000}{34\%}$					411765

- (b)

Brand name

	Active (₹)	Beautiful (₹)	Handsome (₹)	Smart (₹)	Total (₹)
Sales :	150000	240000	150000	60000	600000
Operating costs:	90000	168000	120000	24000	402000
Contribution	60000	72000	30000	36000	198000
P/V ratio $\frac{198000}{600000} \times 100$					33%
B.E.P sales (₹) $\frac{140000}{33\%}$					4,24,242

Q27. (i) Contribution per unit = 80–48

$$= ₹ 32$$

$$\text{P/V ratio} = \frac{32}{80} \times 100 = 40\%$$

$$\text{B.E.P sales} = \frac{18}{40\%} = 45 \text{ lakhs}$$

(ii) Sales required to have profit ₹ 3.6 lakhs

$$= \frac{18+3.6}{40\%} = 45$$

$$= \frac{21.6}{48\%} - 45 = 54 - 45$$

$$= ₹ 9 \text{ lakhs}$$

(iii)

(a) New contribution = 80 – (48+4)

$$= ₹ 28$$

$$\text{New P/V ratio} = \frac{28}{80} \times 100$$

$$= 35\%$$

Sales required to earn a profit of (₹) 3.6 lakhs

$$= \frac{21.6}{35\%} = ₹ 61714 \text{ lakhs}$$

$$\% \text{ increase in sales} = \frac{61.714-54}{54} \times 100$$

$$= 14.28\% (\text{approx.})$$

(b) New contribution = (80 × 1.1) – 48

$$= 88-48 = ₹ 40$$

$$\text{New P/V ratio} = \frac{40}{88} \times 100 = 45.45\%$$

$$\text{Sales required} = \frac{21.6}{40} \times 88$$

$$= (₹) 47.52 \text{ lakhs}$$

$$\% \text{ decrease in sales} = \frac{54-47.52}{54} \times 100$$

$$= 12\%$$

Q28. Sales = ₹ 10,00,000

Profit = 10% of sales = 100000

Let x be the variable cost in the first company

$$\text{So } 1000000 - F - V = 100000$$

$$\text{But } F = 2V$$

$$10,00,000 - 2x - x = 100000$$

$$3x = 900000$$

$$x = 300000$$

$$\text{Variable cost / sales ratio} = \frac{300000}{1000000} \times 100$$

$$= 30\%$$

$$\text{P/V ratio} = 100 - 30$$

$$= 70\%$$

$$\text{Fixed cost} = 2x$$

$$= 2 \times 300000$$

$$= 600000$$

$$\text{B.E.P sales} = \frac{600000}{70\%} = ₹ 857143$$

$$\text{Margin of safety} = 1000000 - 857143 = ₹ 142857 \quad \% \text{ MOS} = \frac{142857}{1000000} \times 100$$

$$= 14.3 \%$$

For 2nd company

$$V = 2F \text{ given}$$

$$\text{We know } 1000000 - F - V = 100000$$

$$F + V = 900000$$

$$\frac{V}{2} + V = 900000$$

$$V = 600000$$

$$\text{Variable cost to sales ratio} = 60\%$$

$$\text{So P/V ratio} = 100 - 60$$

$$= 40\%$$

$$\text{B.E.P sales} = \frac{300000}{40\%} = ₹ 750000$$

$$\text{Margin of safety} = 1000000 - 750000 = ₹ 250000$$

$$\% \text{ Margin of safety} = \frac{250000}{1000000} \times 100 = 25\%$$

29.

	Product		
	X	Y	Z
Selling price per unit(₹)	50	45	54
Variable cost (₹):			
Raw material	15	18	25
Labour cost	9	10	12
Other variable cost	6	7	8
	30	35	45
Contribution unit (₹)	20	10	9
Machine hour required per machine hour	10	8	4
Contribution per unit per machine hour	2	1.25	2.25
Ranking	II	III	I

Priority of utilizing the available capacity 1st Z, 2nd X and 3rd Y.

Q30. Profit statement of the company for the last year

	Product			
	P	Q	R	Total
Sales mix	35%	34%	31%	(₹)
Sales (₹)	175000	170000	155000	500000
Variable cost (₹)	87500	102000	93000	282500
Fixed Cost (₹)				117500
Profit (₹)				100000

Profitability statement as per proposal sales mix

	Product			
	P	Q	R	Total
Sales mix	40%	25%	35%	(₹)
Sales (₹)	200000	125000	175000	500000
Variable cost (₹)	100000	75000	78750	253750
Fixed Cost (₹)				117500
Profit (₹)				128750

Proposal to replace S is acceptable to increase overall profit of the company .

$$\begin{aligned} \text{P/V ratio for S} &= \frac{30-13.5}{30} \times 100 \\ &= \frac{16.5}{30} \times 100 = 55\% \end{aligned}$$

Q.31 Statement showing the sales required to maintain last year profit in various situations.

	Situation		
	(i)	(ii)	(iii)
Reduction in price(₹)	5%	10%	12%
Reduced price (₹)	95	90	88
Variable cost (₹)	60	60	60
Contribution per unit (₹)	35	30	28
P/V ratio (₹)	36.84%	33.33%	83.81%
Fixed cost (₹)	50000	50000	50000
Profit (₹)	150000	150000	150000
Sales required to maintain same profit (₹)	542857	600000	628571
(i) $200000 \times \frac{95}{35}$			
(ii) $200000 \times \frac{90}{30}$			
(iii) $200000 \times \frac{88}{28}$			

Q32.

Statement showing the B.E. point in various situation

	Situation			
	(i)	(ii)	(iii)	(iv)
Budgeted sales(₹)	5000000	5000000	5225000*(4)	5000000
Variable cost (₹)	2600000	2860000(2)	2470000(3)	2470000(3)
Contribution (₹)	2400000	2140000	2755000	2530000
Fixed cost (₹)	1980000*(1)	1800000	1800000	1980000
Break even point sales (₹)	4125000(5)	4205607	3413798	3913043
Break even point sales (unit) (₹)	165000(6)	168224	124138	156522

Working Notes :- (1) 10% increase in fixed cost –

$$= 1800000 \times (1.1) = ₹ 1980000$$

$$(2) 10\% \text{ increase in variable cost} = 2600000 \times (1.1) = ₹ 2860000$$

$$(3) 5\% \text{ decrease in variable cost} = 2600000 \times (0.95) = ₹ 2470000$$

$$(4) 10\% \text{ increase in selling price and } 5\% \text{ decrease in sales (units)}$$

$$= 5000000 \times (1.1)(0.95)$$

$$= ₹ 5225000$$

$$(5) \text{ B.E.P sales (in value(₹))} = \frac{\text{Fixed cost}}{\text{contribution}} \times \text{sales}$$

$$= \frac{1980000}{2400000} \times 5000000 = (₹) 4125000$$

$$(6) \text{ B.E.P sales (in units)} = \frac{4125000}{25} = 165000$$

Similarly in other cases

33.

Year 1984

Product	Sales mix	Sales (₹)crores	P/V ratio (₹)crores	Variable cost ratio(₹) crores	Raw material cost (₹) crores	other variable cost(₹) crores
P	10%	2	30%=0.6	70%=1.4	40%=0.8	0.6
Q	30%	6	20%=1.2	80%=4.8	35%=2.1	2.7
R	20%	4	40%=1.6	60%=2.4	50%=2.0	0.4
S	40%	8	10%=0.8	90%=7.2	60%=4.8	2.4
		20	4.2	15.8	9.7	6.1

Revised figure after 10% increase in material price					
Revised material cost ratio	Revised material cost(₹)crosses	Revised variable cost (₹)crosses	P/V (revised)	Contribution to material	Ranking

40×1.1=44%	0.88	1.48	25%	59.09%= $\frac{2-1.48}{0.88} \times 100$	II
35×1.1=38.5%	2.31	5.01	16.5%	42.86%	III
50×1.1=55%	2.20	2.60	35%	63.64%	I
60×1.1=66%	5.28	7.68	4%	6.06%	IV

Profit required in 1984(Before interests & tax) =10% of 20 cores
=2 cores

Fixed cost before interest and fax = contribution – profit
= 4.2–2
= ₹ 2.2 crosses

Total fixed cost =2.20+1.50+0.77
=4.47 crore

Statement of optimal product mix in 1985 and profitability

Product	sales (₹) crores	Material required (₹) crores	p/v ratio	Total contribution (₹) crores
R	6*	3.30	35%	2.10
P	6*	2.64	26%	1.56
Q	6*	2.31	16.5%	0.99
S	3	1.98(Balancing figure)	4%	0.12
	21.0	10.23		4.77

(₹)Crores

Total contribution	=	4.77
Fixed cost	=	4.47
Profit	=	0.30

$$P/V \text{ ratio} = \frac{4.77}{21} \times 100 = 22.71\%$$

$$B.E.P \text{ sales} = 4.47 \times \frac{21}{4.77} = ₹ 19.68 \text{ crore}$$

Margin of safety = 10%of sales

Sales – margin of safety =B.E.P sales

$$S - 0.1 S = 19.68$$

$$S = \frac{19.68}{0.9} = ₹ 21.866 \text{ crores}$$

% increase in sales price to achieve the target .

$$= \frac{21.866-21}{21} \times 100$$

$$= 4.12\%$$

* It is given that sale of each product can be increased to 30% of total sales in 1984 hence ₹ 6 crores if possible .

34.

	Machine Model	
	M1	M2
Maximum possible sales (₹ lacks)	50	50
Fixed cost per year (₹ lacks)	5	8
Estimated profit for maximum sales(₹ lacks)	15	17
Contribution (₹ lacks)	20	25
P/V ratio M1= $\frac{20}{50} \times 100$	40%	50%
M2= $\frac{25}{50} \times 100$		
(i) B.E point sales (₹ lakhs)	12.5	16
[M1= $\frac{5}{40\%}$, M2= $\frac{8}{50\%}$]		

(ii) Let S be the sales at which both machine gave same profit then

$$\begin{aligned}(S \times 40\% - 5) &= (S \times 50\% - 8) \\ 0.4S - 5 &= 0.5S - 8 \\ 0.1S &= 3 \\ S &= \frac{3}{0.1}\end{aligned}$$

* Sales = 30 lakes

(iii) At 30 lakhs sales both machines are equally profitable below 30 lakhs sales the machine with maximum breakeven point sales is preferred. So machine M1 will be selected and above 30 lakhs of sales Machine M2 having 50% P/V ratio is preferred.

35.

	Cost per unit	
	Variable (₹)	Fixed (₹)
Direct material	3.500	-----
Direct wages	1.250	-----
Factory over heads	3.125	3.125
Sales overheads	0.200	0.600
Total	8.075	3.725

$$\text{Total fixed cost} = 3.725 \times 60000$$

$$= ₹ 2,23,500$$

Increase in direct material $6\% = 3.5 \times 6\%$

$$= ₹ 0.21$$

Increase in direct wages $8\% = 1.25 \times 8\%$

$$= ₹ 0.10$$

Total revised variable cost = 8.075+0.21+0.1

$$= ₹ 8.385$$

$$\text{Total revised fixed cost} = 223500 \times (1.1)$$

$$= ₹ 245850$$

- (a) Let x be the selling price to be quoted for further 20,000 unit of sales then

$$[20000x + 60000 \times 14.30] - (80000 \times 8.385) - 245850 = 167300$$

$$20000x + 858000 - 670800 - 245850 = 167300$$

$$20000x = 225950$$

$$X = \frac{225950}{20000}$$

$$= 11.30$$

So selling price for 20000 units should be ₹ 11.30

- (b) Variable cost per unit = ₹ 8.385

Export order price per unit = ₹ 9.0

The export order is acceptable because fixed overheads are irrelevant to the decision

- (c) Variable cost per unit = ₹ 8.385

Export order price = ₹ 8.25

The order should not be accepted

36.

	Product	
	P	Q
Selling price (₹)	12	20
Direct material (₹)	2	4
Direct labour(₹)	2	1
Variable factory over heads (₹)	2	4
	6	9
Contribution (per unit) (₹)	6	11
Contribution per machine time (₹)	6	5.5

Time ratio P:Q::1:2 [$p = \frac{6}{1}$, $Q = \frac{11}{2}$]

- (i) If machine time availability is not a constraint then product Q having more per unit contribution should be product up to the maximum absorption level.
- (ii) If machine time availability is limited then product P with more contribution per machine time should be produced up to maximum absorption level .

37.

₹

(i) Material cost : 15.00

$$\left[\frac{1500000}{100000} = 15.00 \right]$$

Direct labour : 80.00

$$\left[\frac{500000}{25000} \times 4 \right]$$

Variable over heads : 160.00

$$\left[\frac{1000000}{25000} \times 4 \right] :$$

Absorbed fixed over heads : 170.00

$$\left[\frac{2000000}{3000000} \times (15 + 80 + 160) \right]$$

Total cost : 425.00

Profit margin: 106.25

Painting charges(₹): 531.25

(ii) When skilled labour is limiting factor

Material cost : 15.00

Direct labour : 80.00

Variable overheads : 160.00

Fixed over heads (₹) 320.00

$[\frac{2000000}{25000} \times 4]$

Total cost 575.00

Profit margin: 200.00

$(\frac{1250000}{25000} \times 4)$

Painting change (₹) 775.00

(iii) When paint material is the limiting factor

Material cost (₹): 15.00

Direct labour(₹) : 80.00

Variable over heads (₹) 160.00

Fixed over heads (₹) : 20.00

$[\frac{2000000}{100000} \times 1]$

Total cost (₹) : 275.00

Profit margin : 12.50

$[\frac{1250000}{100000} \times 1]$

Painting charges : 287.50

(iv) Material cost is very small in comparison with the skilled labour time cost. So in the question skilled labour time is the main decisive factor over the material cost. So the paint change should be ₹ 775.

(v) As the customer has no urgency in painting the moped , the customer should be charged ₹ 531.25 as fixed overheads are absorbed on variable cost basis and a profit margin 25% above cost is maintained .

Q38.

	Product	
	A	B
Selling price unit(₹)	100	120
Material cost (₹)	10	15
Direct wages (₹)	15	10
Direct expenses(₹)	5	6
Variable over heads expenses (₹)	15	20
	45	51
Contribution per unit(₹)	55	69
Contribution per kg of raw material hour (₹)	27.50	23
A: $\frac{55}{2}$ =(₹)27.50		
B: $\frac{69}{3}$ =(₹)23		
Contribution per machine hour	18.33	34.50

$$A: \frac{55}{2} = (\text{₹}) 27.50$$

$$B: \frac{69}{2} = (\text{₹}) 34.50$$

- (i) Ranking when sales potential is limiting factor.

Product B: 1

Product A: 2

- (ii) Ranking when raw material is in short supply

Product A: 1

Product B: 2

- (iii) Ranking when machine hour is limiting factor

Product B: 1

Product A: 2

- (iv) When raw material is the key factor and supply is limited to 10000 kg.

Product	Units produced	Raw material required (kg)	Balance raw material (kg)
A	3500 (max.)	7000	3000
B	$\frac{3000}{3} = 1000$	3000	—

Profit statement

Total contribution (₹) } 261,500

A = 3500 × 55 = 192500

B = 1000 × 69 = 69000

Fixed over head expense (₹) 27500

(Not given, so assumed on the basis of
units produced)

3500 × 5 = ₹ 17500

1000 × 10 = ₹ 10000

Profit (₹) 234,000

39.

	Biscuit Type		
	Sweet	Salty	Fifty-Fifty
Selling price per packet (₹)	28	25	22
Raw material required (₹): 10	11	06	
Labour required (₹): 6	4	4	
Other variable overheads (₹) 6	4	4	
Marginal Cost (₹)	22	19	14
Contribution per packet (₹)	6	6	8
Hours required	3	2	2
Contribution per hour (₹)	2	3	4

- (a) Profitability statement as per present position

Total contribution :

$$\begin{array}{rcl}
 & \text{₹} & \\
 \text{Sweet : } 6 \times 10000 = & 60,000 & \\
 \text{Salty : } 6 \times 15000 = & 90,000 & \\
 \text{Fifty-fifty: } 8 \times 12000 = & 96,000 & \\
 & \text{= } 246,000 &
 \end{array}$$

Fixed over heads:(₹)

$$\text{Sweet : } 3 \times 10000 = 30000$$

$$\text{Salty : } 3 \times 15000 = 45000$$

$$\text{Fifty fifty : } 3 \times 12000 = 36000$$

$$\begin{array}{rcl}
 & 1,11,000 & \\
 \text{Profit : } & \hline
 & 1,35,000 &
 \end{array}$$

(b)

	Product (biscuit type)		
	Sweet	Salty	Fifty fifty
Contribution			
Per hour : (₹)	2	3	4
Rank :	III	II	I

(c) Statement showing allocation of key limiting factor and production of various types of biscuits

Biscuit type	Maxine production	Labour hour required	Balance labour hours
Fifty –fifty	15000	30,000	54000
Salty	15000	30,000	24,000
Sweet $\frac{24000}{3}$	8000	24,000	
		<u>84000</u>	

Profitability statement

Total contribution :	(₹)	
Fifty – fifty : $15000 \times 8 =$	120000	
Salty: $15000 \times 6 =$	90000	
Sweet : $8000 \times 6 =$	48000	
	<u>258,000</u>	
Fixed cost :(₹)	111000	
Profit :(₹)	<u>147000</u>	

Q.40 Statement of cost and profit at various levels of capacity

	50%	60%	100%	80%
Number of units Produced	37500	45000	75000	60000
Costs:	₹	₹	₹	₹
Raw material :(₹)	1312500	1575000	2625000	2100000
Labour Cost (₹)	562500	675000	1125000	900000
Other over head cost variable	562500	675000	1125000	900000
Total variable coat	2437500	2925000	4875000	3900000
Fixed over head cost(₹)	1200000	1200000	1200000	1200000
(₹) (200000+1000000)				
Total cost (₹)	3637500	4125000	6075000	5100000
Profit (₹)	112500	375000	1425000	600000
Total sales (₹)	3750000	4500000	7500000	5700000

Price that can be quoted $= \frac{5700000}{60000} = ₹ 95$ per unit

Method of splitting other overhead costs into fixed and variable

Other overhead cost at 60% capacity = 875000

at 50% capacity = 762500

Other over head variable cost at 10% = 1,12,500 at 100% $= \frac{112500}{0.1} = 1125000$

Variable cost at 50% capacity = 562500

So fixed cost = 762500 – 562500

= ₹ 200000

Q.41 Comparative statement of proposal for utilizing 30% capacity in different alternatives

	a	b	C
Direct material (₹)	180	96	480
Conversion cost (variable)	400	300	300
Marginal cost	580	396	780
Selling price	600	510	1200
Contribution(₹)	20	114	420
Units produced conditional at 30% capacity	3000	6000	6000
Total contribution (₹)	60000	684000	2520000
Addition fixed cost required	—	—	50,000
Increase in profit on utilization of additional capacity (₹)	60000	684000	2470000

Proposal C is the most profitable hence should be advised to be implemented.

Q42.

Statement showing contribution per unit if manufactured

Per unit cost	P	Q	R	S
Material (₹)	36	38	42	24
Labour(₹) Assembly	8	12	16	16
Machine	12	24	18	36
Total variable cost (₹)	56	74	76	76
Selling price (₹)	68	90	91	94
Contribution per units (₹)	12	16	15	18
Machine hour required	2	4	3	6
Contribution per machine hour (₹)	6	4	5	3
Ranking on the basis of cont. Per machine hour	1	III	II	IV

Statement of comparison of marginal cost and subcontracting cost

Product	Marginal cost (₹)	Subcontracting cost (₹)	Difference
P	56	63	7
Q	74	80	6
R	76	72	−4
S	76	82	6

The product R has marginal cost higher than contractor 's price offered so if should be subcontracted.

(a) Statement showing the extent of services of contractor can be utilized.

Product	No. of units	Machine hrs. used	Balance machine hours	Subcontracting units	Contribution per units(₹)	Total contribution (₹)
P	18000	36000	174000	—	12	216000
Q	30000	120000	54000	—	16	480000
S	9000	54000	—	6000	18and12	234000
R	—	—	—	27000	19	513000
	57000					1443000
				Fixed cost		500000
				Profit ₹		943000

(b) profit ₹ 943000

(c) R having high marginal cost than subcontractor's price should always be subtracted

Q43.

(i) Profit statement on current budgeted production

	Products			Total (₹)
	A	B	C	
Direst material (₹)	20	60	40	
Variable over heads	6	4	10	
Direct labour				

department 1(₹)	28	16	30	
Department2(₹)	10	12	20	
Department3(₹)	16	8	30	
Marginal cast(₹)	80	100	130	
Selling price(₹)	100	136	180	
Contribution(₹)	20	36	50	
Budgeted production (units) (₹)	10000	5000	6000	
Total contribution(₹)	200000	180000	300000	680000
Fixed over heads(₹)				400000
Profit (₹)				280000

Ranking the product mix for optimum utilization of available limited factor of production.

	Product		
	A	B	C
Contribution per unit	20	36	50
Required hours per unit of department –2 (limited supply)	5	6	10
Contribution per hour of department –2	4	6	5
Ranking priority	III	I	II

Available hours in department 2=(10000× 5 + 5000 × 6 + 6000 × 10) = 140,000 hours statement of production of products with optimum utilization of available limited factor.

Product	Unity to be product	Hours required	Balance hours
B	7000	42000	98000
C	9000	90000	8000
$A \frac{8000}{5} =$	1600	8000	—

Profitability statement

Total contribution (₹)

A $1600 \times 20 = 32,000$

B $7000 \times 36 = 252000$

C $9000 \times 50 = 450000$ 734000

Fixed over heads (₹) 400000

Profit (₹) 334000

Q 44 :

Let us first of all find the constraint in the given problem

(1) As the material can be obtained freely from the market whenever required, so the material is not a constraint.

(2) In case of labour

(a) Grade I labour

Required :

$$\text{Product A} = 200 \times \left(\frac{20}{2.5}\right) = 200 \times 8 = 1,600 \text{ hours}$$

$$\text{Product B} = 300 \times \left(\frac{15}{2.5}\right) = 300 \times 6 = 1,800 \text{ hours}$$

$$\text{Product C} = 100 \times \left(\frac{30}{2.5}\right) = 100 \times 12 = 1,200 \text{ hours}$$

$$\text{Total} = 4,600 \text{ hours}$$

$$\text{Available hours} = 5,000 \text{ hours}$$

It is not also an effective constraint.

(b) Grade II labour

Required :

$$\text{Product A} = 200 \times \left(\frac{30}{1.5}\right) = 200 \times 20 = 4,000 \text{ hours}$$

$$\text{Product B} = 300 \times \left(\frac{15}{1.5}\right) = 300 \times 10 = 3,000 \text{ hours}$$

$$\text{Product C} = 100 \times \left(\frac{6}{1.5}\right) = 100 \times 4 = 400 \text{ hours}$$

$$\text{Total} = 7,400 \text{ hours}$$

$$\text{Available hours} = 5,000 \text{ hours}$$

It is an effective constraint.

(a) Schedule of best product mix and profitability :

	A	B	C
	₹	₹	₹
Selling price	120	100	110
Variable cost	80	60	80
Contribution	40	40	30
Contribution per hour (grade II)	$\frac{40}{20} = 2$	$\frac{40}{10} = 4$	$\frac{30}{4} = 7.5$
Ranking	3	2	1
Products to maximize profit	80	300	100
Product Units Hours Balance			
C (Max.) =	100	400	4600
B (Max.) =	300	3000	1600
A (Bal.) =	80	1600	0
Total contribution	3200	12000	3000 = ₹ 18,200
Total profit =	18200 – (7×200 + 4×300 + 4×100) = 18,200 – 3000 = ₹ 15,200		

(b) Maximum rate that the dreamland should pay for an additional hour.

(i) In case of grade I type of labour there is sufficient availability, so no need to pay extra for this type of labour.

(ii) For grade II type of labour available hours are less than required, so the company should pay extra for it. The external cost for this type if available is ₹ 1.5 and its contribution in case of A is ₹ 2.00. So the maximum the company can pay for an extra labour hour is ₹ (1.50 + 2.00) = ₹ 3.50

(c) Opportunity cost for grade II type of labour. As opportunity cost is the amount of benefit foregone per unit hour in case of grade II labour for not utilizing in production in the company. Its value per hour is Internal ₹ 2.00 and external ₹ 1.50.

(d) Statement of profitability for conversion of Z and sale in the market.

Cost	₹
Material Cost Z	9,000
Material X (1000 × 2)	2,000
Labour grade II (1000 × 1.5)	1,500
Variable overheads	3,000
Attributable fixed cost	1,250
Internal opportunity Cost (Labour)	2,000
Total Cost on manufacturing	18,750
Total revenue earned on sale	18,750
Profit/Loss	Nil

As on converting the product Z and selling, the revenue earned is equal to the total costs incurred on conversion i.e. no profit or loss on conversion, whereas if it is sold as it is in the market it will earn ₹ 1,000 (10,000 – 9,000), so it is better to sell it in the market as it is without converting further.

Note : Students should note here that if grade II type of labour is not a constraint as it is given in the question and its supply is not limited, then answer to (d) will be different as per the calculation given below :

Cost	₹
Material cost Z	9,000
Material X (1000×2)	2,000
Labour grade II (1000×1.5)	1,500
Variable overheads	3,000
Attributable fixed cost	1,250
Total Cost	16,750
Sales value	18,750
Profit	2,000

Now profit on conversion of product Z is ₹ 2,000 is more than selling it as it is in the market which is ₹ 1,000, the company will be advised to further process and sell rather to sell the obsolete stock of Z in the market.



9. Cost Analysis and Decision Making

All the decisions taken at any management level is always in the long term interest of the organization. Profit earning is the ultimate motive of the particular and in general of all the business units. Quantitative and qualitative are the two techniques to arrive at a particular decision, keeping in mind the ultimate goal. In majority of cases the quantitative analysis to arrive at a decision are helpful. In quantitative analysis technique cost analysis is very much helpful. So, it becomes necessary to understand the concepts of various types of cost i.e. fixed, variable, marginal, sunk, relevant, irrelevant cost etc. Let us take one by one and try to understand how these effect the decision making process at the management level.

- 1) Fixed cost: It is the part of cost which do not change with volume of output for particular capacity constraint. It is independent of units of production such as building rent, interest on raised capital, depreciation of the machinery depending upon the life of machinery etc. In majority of cases of decision making though not always this type of cost is ignored, but if it becomes relevant for a particular situation these are also considered.
- 2) Variable cost: This type of cost is directly related to the level of production. This cost vary with change in output. As more and more units of the product are produced the variable cost go on increasing. For example if one kilogram of raw material is required in the manufacture of a product unit and if we want to produce 10 units of the product then 10 kilogram of raw material will be required and similar will be the case with direct labour and direct expenses. These costs i.e. variable costs play an important role in taking majority of decisions by the management.
- 3) Marginal cost: The cost required to produce one extra unit of a product is known as marginal cost generally variable cost is considered to be the marginal cost because for a particular capacity level fixed cost do not change and there is only a variation in variable cost. But beyond the capacity level the fixed cost will also change and variable cost change will not only be the marginal cost. So in decision making process i.e. make or buy, accept or reject an order, marginal cost will be the relevant cost and not only the variable cost alone.
- 4) Out of pocket cost: This type of cost involves the cash payment. Depreciation on machinery does not involve any cash payment i.e. no cash transaction is there. Out of pocket cost play an important role in certain events in decision making. In accepting an order and quoting a price to the customers, capturing a market in competition which may lead the company to earn more profits in future out of pocket costs are taken into account.
- 5) Sunk Costs: These are irrecoverable costs. Such costs are historical which are incurred in the past and are not relevant to the decision making. The written down value of a plant less its salvage value is the sunk cost. Thus expenditure which has taken place and is irrecoverable in a particular situation is treated as sunk cost. These costs are not taken to arrive at a decision because costs have been incurred and have no effect further. Another specific feature is that the sunk costs are not affected by increase or decrease in the volume of production.
- 6) Opportunity cost: In the decision making process opportunity cost play an important role. For engaging the machine on production of 'A' product we have to forgo the production of 'B' product. What profit of 'B' for not producing it is sacrificed for the product 'A'. So opportunity cost refers to the value of sacrifice made or benefit of opportunity forgone in accepting the alternative course of action.
 - a) The opportunity cost of investing funds for the production of a product is the rate of interest that could have earned if the same amount of funds were deposited in the bank.
 - b) If a machine can produce the products A as well as the product B in place of A if not produced. In this case the opportunity cost of the product A is the benefit forgone for not producing the product B.

- c) The saleable value of an obsolete stock lying is the opportunity cost of the stock if it is used for the production of another product. In the decision making if the sale value of the stock (obsolete) is more than the benefit earned after using it to produce the possible product, then the decision will be in the favour of sale rather using it to produce the product.
- 7) Differential cost: It is the change in cost that occurs due to change in the volume of production. This may be due to change in the method of production. The difference in the cost due to increase or decrease in the volume of production or change in the majority of production is the differential cost. In the majority of decisions which are taken at the management level this type of cost taken at the management level. This type of cost play an important role and is taken into consideration to arrive at an appropriate decision. The main aim of the management in quantitative decisions is to earn maximum profits or we can say increase in the cost should be less than the increase in revenue earned.
- 8) Imputed costs or notional costs: These costs are those which do not involve any cash outlay. Though there is no cash outlay but such costs are taken into consideration while arriving at a particular decision. Rent of the premises owned by the proprietor is an example of such cost. As the premises used in business is owned by the proprietor, no rent on it is to be given to any person. In decision making process these costs are not ignored. Another example of such cost is interest on the capital owned by the proprietor. Here also interest is not to be paid, but in decision making process interest is considered to arrive at an appropriate decision. In project evaluation process and deciding an alternative course of action these costs play an important role.
- 9) Avoidable and unavoidable costs: Avoidable costs are those costs which can be eliminated in a particular course of action. For example if we want to discontinue the production of a product then direct labour, direct material and other direct expenses can be eliminated and not required to be incurred so these are avoidable cost. Unavoidable costs on the other side are those which cannot be eliminated or ignored even if the production is discontinued e.g. the salary of the manager will have to be paid even if we discontinue the production of the one of the products. Let there are three products A,B,C which are produced by a business unit and the management is considering discontinue the product A and the unit is paying a particular amount of factory rent. Though the production of A is discontinued same amount of rent will be paid and the salary of the manager will also have to be paid as before, so these costs are unavoidable. So the costs which can be eliminated or avoided are avoidable and which cannot be eliminated are unavoidable costs. These costs play an important role and are taken into consideration while taking a decision in the wider interest of the business unit.
- 10) Replacement cost: In some situations we want to replace an asset or material. It is the cost which have to be incurred to purchase an identical asset in place of an old one. In decision making process these costs are also taken into consideration if such a situation arises.
- 11) Relevant costs and Irrelevant costs: The costs which are calculated in the decision making process and are necessary to be counted are the relevant costs. If there is change in the amount of a particular type of cost in taking a particular type of decision then this will become a relevant cost to the decision. We cannot pin point a cost to be relevant or not, it depends upon the particular problem or situation whether it is relevant or not. Fixed cost are generally considered irrelevant costs but situation may arise in the problem in decision making, fixed costs also changes so will become relevant cost in arriving at the final result. Irrelevant costs are those costs which do not take part or counted in taking various types of decisions. For example if we are to take a decision whether to increase the volume of production that could be sold at a lesser market price and the fixed costs remains the same or are unaffected by change in the volume of production then fixed cost is irrelevant cost. In production process material which is in regular use, the relevant cost is the replacement cost. For material that

is not in regular use, the realizable value is the relevant cost. If in a situation if it is possible to use a non – moving material in place of another material, then the value of the later material will become the relevant cost for taking decisions on the first material.

Similarly in taking the decision of use in most profitable product mix of scarce resource the contribution per unit of the scarce resource will become the relevant in arriving at the decision. So in different situations one type of cost may relevant or irrelevant depending upon its variation in the problem.

Illustration 1

A factory operates at full machine capacity to produce an assembly type product with 3 components parts. Data concerning one unit of the product is as follows:

Components Parts	Machine hours	Costs		
		Variable	Fixed	Total
Items		₹	₹	₹
A	5	24	8	32
B	8	28	10	38
C	10	30	30	60
Assembly		50	20	70
		132	68	200

Selling price ₹ 250

There is a big demand of the product in the market. What is produced can be sold but machine capacity is the limiting factor. If one component is purchased from the market the released capacity can be diverted to the produce the other (Same machine can produce any of the components). If component parts A B and C can be purchased from the market at ₹ 50, ₹ 60 and ₹ 80 per unit respectively, guide which one should be purchased.

Solution:

	Component Parts		
	A	B	C
	₹	₹	₹
Market price	50	60	80
Variable cost	24	28	30
Contribution	26	32	50
Machine hours used	5	8	10
Contribution / hours	5.2	4	5
Ranking (In descending order of contribution per hour)	I	III	II

Decision: The component B is giving the minimum contribution per hour and the problem is to discontinue one of the components and the released capacity can be utilized to produce any of the three components, so it should be discontinued.

Fixed costs are sunk costs are not affected by the decision under reference and so are ignored.

Illustration 2

The company management is considering to accept an export order and sought your advice as a cost accountants whether to accept or reject the order.

The company at the moment is working at its 70% capacity. The other data is given as under

Element of cost

(Per unit ₹)	₹
Direct material	18
Direct Labour	22
Direct Expenses	15
Fixed expenses (absorbed)	40
	95
Selling price	
	120
Profit	
	25

The company is producing 70,000 units and the price offered by foreign customer is ₹75 per unit and will purchase 20,000 units now as well as in future. Advise the company the right way and show the working.

Solution:

Elements of cost (Per unit ₹)	₹
Direct material	18
Direct Labour	22
Direct expenses	15
Marginal cost	
	55
Export price	75
Contribution per unit	
	20

$$\text{Installed overall capacity} = \frac{70000}{70\%} = 100000 \text{ units}$$

Present operating capacity = 70000 units

Balance capacity = 30000 units

Required units by outsider = 20000 units
customers

Advice: 1) The company should accept the order as the export order is within the capacity constraint.

2) Fixed cost has already been incurred and absorbed and there is no effect of accepting or rejecting the order.

So are not a part of the decision.

3) The company will fetch an extra profit of 400000 (20,000 × 20) after accepting the order.

Illustration 3:

X Co Ltd manufactures and sells only two types of products A and B. An increase in the sale of one depresses the sale of the other on the unit basis and vice – versa. Following data in respect of a period is presented to you.

Product	Per Unit	
	A	B
	₹	₹
Selling Price	45	55
Fixed overheads	₹	₹
(4,80,000 allocated on 1:2 basis)	4	8

Variable cost of sales	24		30	
Sales commission (20% on sales)	9	37	11	49
Net profit		8		6

Required: (a) Work out the number of units of A and B produced in the above data. (b) Show clearly the actual operating results (c) State with arguments whether the management should increase the sale of A or B. (d) If the units of A actually sold are increased by 20% or alternatively decreased by 10% how would this increase or decrease affect the quantum of profit or loss?

Solution :

	Per Unit	
	A	B
	₹	₹
Selling Price	45	55
	₹	₹
Variable cost of sales	24	30
Sales commission (20% of selling price)	9	11
	33	41
Contribution	12	14
Fixed cost	4	8
(₹480000 allocated on 1:2 basis)		
Net Profit	8	6

- (a) For A
- ₹
- Total fixed cost allocated $= \frac{480000}{3}$
- $= 1,60,000$
- Fixed cost Per unit $= 4$
- No of units of product A $= \frac{160000}{4}$
- For B: $= 40,000$ units
- Total fixed cost allocated $= \frac{480000}{3} \times 2$
- $= 320000$
- Fixed cost per unit of B $= ₹ 8$
- No. of units of the product B $= \frac{320000}{8}$
- $= 40,000$

- (b) Actual operating results
- Total contribution ₹
- For A $= 40000 \times 12$
- $= 480000$
- For B $= 40000 \times 14$
- $= 560000$

$$\begin{aligned}
 \text{So total contribution} &= 480000 + 560000 \\
 &= 10,40,000 \\
 \text{Fixed cost} &= 480000 \\
 \text{Net Profit} &= 560000
 \end{aligned}$$

(c) Contribution per unit for the product B is more than that of the product A and fixed cost is irrelevant to the problem, management should increase the production of the product B.

(d) (i) affect of increase of 20% of sale of product A

$$\begin{aligned}
 \text{Increase in the units of product A} &= 20\% \text{ of } 40000 \\
 &= 8000 \text{ units}
 \end{aligned}$$

decrease in the units of product B

with increase in product A = 8000 units

$$\begin{aligned}
 \text{Net affect on profit} &= (8000 \times 12) - (8000 \times 14) \\
 &= 96000 - 112,000 \\
 &= (₹ - 16,000) \\
 \text{Total Profit} &= 560000 - 16000 \\
 &= ₹544000
 \end{aligned}$$

(ii) affect of decrease of 10% of sale of product A

$$\begin{aligned}
 \text{Decrease in the units of product A} &= 10\% \text{ of } 40,000 \\
 &= 4000 \text{ units}
 \end{aligned}$$

Increase in the units of product B = 4000 units

with decrease in units of A

$$\begin{aligned}
 \text{Net affect on profit} &= - (4000 \times 12) + (4000 \times 14) \\
 &= 56000 - 48000 \\
 &= 8000
 \end{aligned}$$

$$\begin{aligned}
 \text{Total Profit} &= 560000 + 8000 \\
 &= ₹ 5,68,000
 \end{aligned}$$

Illustration 4

Last year data of a company producing a product is given as under for 200000 units.

	Per unit of Product	
	₹	
Manufacturing cost	₹	
(i) Variable	6	
(ii) Fixed	2	8
Selling and distribution cost		
(i) Variable	4	
(ii) Fixed	3	7
Total cost		15
Selling price		21

The product is no longer in demand this year. There is a stock of 4500 units of the product. The company has now two option: (i) To sell the product at a reduced price through the normal distribution channel.

(ii) To ask someone to take them on 'as is where basis' and it will cost ₹4500 to the company.

You are required to suggest the company the alternative course of action. Should the company scrap the item or sell them at reduced price? If your decision is in favour of latter, recommend a minimum price at which the product should be sold.

Solution:

In the given problem manufacturing cost fixed and variable have already been incurred and so in arriving at a decision these are irrelevant to the problem. Fixed selling and distribution cost are also not relevant to the decision. Only selling and distribution costs which are variable are relevant.

- (i) If the company scrap the product to some one and ask to take the product 'as is where is basis' the company has to further spend ₹4500 i.e. 1 per unit. So there is further loss of ₹4500. So the company should sell the product at a reduced price through normal distribution channel.
- (ii) The minimum price recommended is ₹3 (₹4 – ₹1) per unit. Any price above ₹3 will add to the profit of the company.

Illustration 5

A company is having three independent proposals and you are to recommend one of the best proposals. Showing them your working on each one, guide the company to the final result. The data given by the company as a whole is as under:

		Products	
		A	B
No of units of product produced		25,000	50,000
		₹	₹
Sales Value	₹	1,50,000	4,50,000
Direct material cost:	25,000		1,00,000
Direct labour cost:	25,000		1,00,000
Variable overheads:	12,500		50,000
Fixed overheads	37,500	1,00,000	1,00,000
			3,50,000
Net profit:		50,000	1,00,000

The various alternatives before the company are

- (a) Increase the production of B by 10,000 units. For increasing the production of B company has to decrease the production of A by 15000 units.
- (b) To reduce the price of A by ₹0.50 and sell 25% more units of the product A.
- (c) To produce 30,000 units of A and 50,500 units of the product B and sell in the market.

Solution:

		Products	
		A	B
No. of units produced		25,000	50,000
		₹	₹
Selling price		6	9
	₹		
D.M. Cost	1.00	2.00	
D.L. Cost	1.00	2.00	
variable overheads	0.5	1.00	
Marginal cost		2.5	5
Contribution cost		3.5	4

Fixed cost

37500

100000

Present Profit:

$$\begin{aligned}\text{Total cost for A} &= 25000 \times 3.5 \\ &= 87500\end{aligned}$$

$$\begin{aligned}\text{Total cont. for B} &= 50000 \times 4 \\ &= 2,00,000\end{aligned}$$

$$\begin{aligned}\text{So profit} &= 87500 + 200000 - 137500 \\ &= 150000\end{aligned}$$

(a) Increase in production of B = 10000 unit

$$\begin{aligned}\text{Increase in Contribution} &= 10000 \times 4 \\ &= ₹40,000\end{aligned}$$

Decrease in production of A = 15000 units

$$\text{Decrease in contribution} = ₹52500 \quad (15000 \times 3.5)$$

$$\begin{aligned}\text{Net decrease in contribution} &= 52500 - 40000 \\ &= ₹12500\end{aligned}$$

$$\text{Decrease in profit} = ₹ 12500$$

(b)

$$\text{Reduction in price of A} = 0.50$$

$$\text{New contribution} = 3.5 - 0.5 = 3.0$$

$$\text{Increase in sale of A} = 6250$$

$$\text{Total new contribution of A} = 93750$$

$$\text{Earlier contribution of A} = 87500$$

$$\text{Net increase in contribution} = ₹6250$$

$$\text{Net increase in profit} = ₹6,250$$

(c)

Increase in contribution of product A

$$= ₹ 17500 \quad [5000 \times 3.5]$$

Increase in contribution of product B

$$= ₹2000$$

$$\text{Total increase in contribution} = 17500 + 2000$$

$$= ₹ 19500$$

Suggestion : The third proposal gives the maximum profit so is recommended to be implement. Fixed costs as are irrelevant to the decision are ignored.

Make or buy decisions:

In certain concerns, so many components are needed in the manufacture of a final product. These components are generally purchased from the outside suppliers because this need a specific portion of the concern's capacity. But sometimes the cost of purchasing compels the management to think whether to purchase or make the component within the unit. Capacity constraint is one of the factor to think over. If the capacity allows and the management quantitatively find that manufacturing the component is cheaper than to purchase, so it should be manufactured. While arriving at an appropriate decision the management has to take into account various relevant cost related to the decision. Fixed costs are generally incurred earlier do not become the part of the decision. Variable cost, ordering cost, purchase price, cost of transportation are the relevant to the managerial decisions. Sometimes quantitative analysis only do not become the basis of the decision making, but qualitative analysis also becomes necessary in many particular type of situations. These considerations are as follows:

- (i) Quality of the component supplied by the outsiders.
- (ii) Regularity of supply and time bound supply is assured or not.
- (iii) Adverse affects of possible labour relations in case of purchase due to loss of employment.
- (iv) Keeping in view the secrecy of the manufacture of the product. In purchasing the product or a component it should be kept in mind whether there is a possibility of leakage of technical know how of manufacture of the final product. If there is any such possibility the management should insist on making rather purchasing in wider interests.

Illustration 6: A company is manufacturing a component X on its own and is now considering whether it should be made or purchased from a reliable supplier. The data relating to the component is given as under

Units of component X required to be manufactured are 20,000

	₹
Direct material used	1,00,000
Direct labour cost	1,00,000
Variable overheads	50,000
Fixed overheads	2,00,000

Outside supplier offered to send the component at ₹ 16 per unit. If the offer is accepted then there will be a reduction in the fixed overheads to the extent of ₹60,000. You, advice the management to take the decision in the following situations.

- (i) The released capacity in the event of purchasing remains idle.
- (ii) The capacity so released can be rented out at ₹20000 to any other manufacturer.

Solution:

	Total cost ₹	Per unit cost ₹
Direct material cost	100000	5
Direct Labour cost	100000	5
Variable overheads	50000	2.50

Fixed cost	200000	10.00
Total cost	4,50,000	22.50

(i) Marginal cost $= 5 + 5 + 2.50$
 $= ₹ 12.50$

Purchase cost $= ₹ 16$

Reduction in fixed cost per unit $= ₹ 3$

$(60000 \div 20000)$

Cash outflow in event of purchase $= ₹ 13$

Manufacturing cost is less than the purchase cost so it will be beneficial to manufacture.

(ii) If the released capacity can be rented out

Then purchase cost $= ₹ 13 - 1$

$= ₹ 12$

The decision will be to purchase the component from outside supplier

Fixed costs are irrelevant to the decision.

Illustration 7:

A company is using a part named 005 in the manufacture of the main product A. The part is also prepared by the company at its own. The data relating to it is as follows.

	Per unit ₹
Direct material	10.00
Direct Labour	10.00
Variable expenses	3.50
Allocated fixed cost	4.50
Total:	28.00

You are to advise the management whether it should purchase the part 005 from the market which is easily available at a price of ₹25. Should you advise similarly if a supplier promises an uninterrupted supply of the part at a much lower price of ₹23 from the market.

Solution:

	Per unit ₹
Direct material	10.00
Direct Labour	10.00
Variable expenses	3.50
Marginal cost	<u>23.50</u>

Purchase Price = ₹25

(i) Fixed costs are the committed costs and do not form a part of the decision.

Purchase price is more than the marginal cost. So the management is advised to make the part at its own rather purchasing.

- (ii) The outside supplier from the market has offered to supply the part at lower price of ₹23 and has agreed an uninterrupted supply in future. So the management in this situation is advised to purchase the product from the worthy supplier. The management is further advised to check the quality of the product before closing down the manufacture.

Illustration 8:

(Make or Buy)

The management of an engineering company manufacturing a range of products is considering next year's production, purchase and sales budgets. Shown below are the budgeted total unit costs for two of the components and two of the products manufactured by the company.

	Component 12 Per unit	Component 14 Per unit	Product VW Per unit	Product XY Per unit
Direct material	₹ 18	₹ 26	₹ 12	₹ 28
Direct labour	16	4	12	24
Variable overheads	8	2	6	12
Fixed overheads	20	5	15	30
	62	37	45	94

Component 12 and 14 are incorporated into other products manufactured and sold by the company, but not the two products shown above. It is possible to purchase component 12 and 14 from another company for ₹ 60 per unit and ₹ 30 per unit respectively.

The anticipated selling prices of products VW and XY are ₹ 33 and ₹ 85 respectively.

Required:

- Advise the management of the company whether it would be profitable to:
 - Purchase either of the above components.
 - Sell either of the above products
- State clearly and where appropriate comment upon the assumptions you have made in answering 'a' above.
- Consider how the following additional information would affect your advice in 'a' above.
 - Next year's budgeted production requirements for the two components are 7,000 units of component 12 and 6000 units of component 14, Next year budgeted sales for the two products are product VW 5,000 units and product XY 4,000 units.
 - A special machine is used exclusively by the above two components and two products and for technical reasons the machine can only be allowed to operate for 80,000 machine hours next years.

The budgeted usage of the machine is:

Component 12 – 8 machine hours Products VW – 6 machine hours

Component 14 – 2 machine hours Product XY – 12 machine hours

The operating cost of the machine have been included in the unit costs shown in 'a' above.

(CIMA London – Adapted)

Solution : (a)

	Component 12 ₹.	Component 14 ₹.	Product VW ₹.	Product XY ₹.
Variable cost	42 (18+16+8)	32 (26+4+2)	30 (12+12+6)	64 (28+24+12)
Purchase price	60	30		
Selling Price			33	85

Fixed costs have been apportioned do not change with the decision so are not considered in the decision taking process.

- (i) In comparing the above data purchasing the component 14 will be profitable to the company and making the component, 12 within the company will be profitable.
- (ii) Selling of the two products at price ₹ 33 and ₹ 85 in the market are profitable to the company.
- (b) (i) Fixed costs are already incurred, apportioned and so not taken into consideration so are irrelevant to the decision making process.

(ii) No additional costs are incurred in either purchasing and selling of the components or products such as quality checking or any additional selling cost, advertisement quality checking or any additional selling cost, advertisement etc.

(iii) Variable cost are varying with the units of production there is no elements such as semi variable with basis wage plus bonus per unit.

(iv) There is not limitation of capacity to produce the components and the products.

- (c) When there is capacity and production constraints

	Component 12	Product VW	Product XY	Total
Machine hours per unit	8	6	12	
Budgeted units	7,000	5,000	4,000	
Hours required	56,000	30,000	48,000	1,34,000
Contribution per unit (₹.)	18	3	21	
Contribution per machine hour (₹)	2.25	0.50	1.75	
Ranking	1	3	2	
Machine hours available				80,000
Short fall:				54,000
Units required to be produced	7,000	Nil	2000	

Working : Available machine hours = 80000

Hou[₹] used in production of 7000

units of component 12 (Maximum) = 56000

Balance hours = 24000

Units of product XY that

can be produced = $24000 \div 12 = 2000$

Component 14 is not considered because it is beneficial to purchase it from the market.

The strategy eliminates product VW. Quantitate analysis is as shown above, but management should not ignore the qualitative future aspects while arriving at an appropriate end decision in the wider interests of the company.

Illustration 9 : You are management accountant of zeta Ltd with several product departments function as profit centres. Each manager of the department is fully authorized to decide the matters of sale of the products and services of his department.

Department A purchased a component C from the department B. Department B has fixed price of C at ₹ 40 per unit with effect from 1st January, 1985, while department A proposes to purchase the component C at ₹ 35 from the market. Department A requires 30,000 unit annually. The cost of department B for the product C is ₹ 30 variable cost per unit and ₹ 6 fixed cost per unit. Manager of department B has approached the managing director to ask department A to have their requirements product from his department the cost increase is due to installation of a new machine utilized to make C resulting in higher depreciation. If department A does not purchase from department B then the latter can utilize the facilities to an alternative use resulting in an annual saving of ₹ 125000

You are required to comment on : – Will the company benefit as a whole if department A purchase the company C from the market instead of from the department B ?

- (a) If alternative use for the facilities of department B exists.
 (b) If such alternative does not exist. (ICWA final)

Solution :	₹
Variable cost per unit :	30
Fixed cost per unit :	6
(total cost per unit :	36
Inter department transfer price	40
Net benefit to department B.(per unit)	4
Market price of the product	35

- (a) when the department A purchase the component from the market and there is an alternative use of the facility and saving of ₹ 125000

The company as a whole will go into a loss of ₹ 55000 i.e. fixed cost – annual saving in not using the facility

$$= 180000 - 125000$$

$$= ₹ 55000$$

- (b) If there is no saving to department B.

Then there is an annual loss of ₹ 180000 i.e. fixed cost incurred in department B, to the company as a whole.

Solving problems by comparing differential cost and revenue.

A company is having full capacity of production 100000 units of a product and seeking your advice at what capacity level should the company operate the data presented by the company is given as under.

	Capacity level		
	50%	80%	100%
	₹	₹	₹
Fixed cost	50000	70000	90000
Variable cost per unit	2	2	1.9
Selling price per unit	4	3.5	3.3

Solution: –

Schedule of showing differential cost and incremental revenue at capacity levels.

Revenue at capacity levels

Capacity level ₹	Units produced ₹	Total sales value ₹	Variable cost ₹	Fixed cost ₹	Total cost ₹	Differential cost ₹	Incremental revenue ₹
50%	50,000	200,000	100,000	50,000	150,000	—	
80%	80,000	280,000	1,60,000	70,000	2,30,000	80,000	80,000
100%	100,000	3,30,000	1,90,000	90,000	2,80,000	50,000	50,000

Advice: When the company is operating at 50% of the total capacity and is producing 50,000 units is making a profit of ₹50,000 (₹200000 – ₹150,000)

When the company operates at increased capacity of 80% and 100% producing 80000 units and 1,00,000 units respectively. In each case differential cost is equal to the increase in the revenue. So there is no addition in the profit. So company is advised to stick to 50000 units and to operate at 5% of capacity.

Illustration 10.

A company has the following data in producing a product. The management is seeking an advice at which level of output it should produce and sell the product in the market.

Units Produced. (In lakhs)	S. price/unit ₹.	Fixed cost ₹. lakhs	Variable cost ₹. lakhs
0.20	210	30	40
0.80	200	30	120
1.40	190	32	210
2.00	170	32	270
2.60	150	40	310
3.20	130	40	340

Solution:

Units Produced lakhs	Selling price / unit ₹.	Total sales ravine ₹. lakhs	Fixed cost ₹. Lakhs	Total variable
0.20	210	42	30	40
0.80	200	160	30	120
1.40	190	266	32	210
2.00	170	340	32	270
2.60	150	390	40	310
3.20	130	416	40	340

Total cost ₹ lakhs	Differential cost ₹ lakhs	Incremental revenue ₹ lakhs
70	—	—
150	80	118
242	92	106
302	60	74
350	48	50
380	30	26

When the data as depicted in the above table is compared and scrutinized with the increase in output of the company. The revenue and the cost of production tends to increase. When we compare on differential cost and increment in revenue basis with increase in output, we see up to the output increase to the level 260000 units the increase in revenue is more than the differential cost. But for another increase in output to the level 60000 i.e. on 320000 units, there is an increase in revenue of ₹ 26 lakhs. So the company should operate at an output of 260000 units. At this level of output the company will earn maximum total profit.

Accept or Reject an order:

Sometimes situation arise when company has received a special order form national or foreign customers and company has to decide whether to accept the order or not to accept the order. Various consideration are to be kept in mind to arrive at a right decision because these special orders are generally at lesser price then those prevailing in the market. Both quantitative and qualitative analysis are necessary to be done before any decision. In deciding in such a situation the relevant and irrelevant cost concept will be helpful. Absorption costing method used may give misleading results. For example the fixed cost which have already been absorbed by the present capacity should not be taken into consideration by the present capacity should not be taken into consideration in taking such decisions or price fixation in such special orders. Marginal cost concept or differential cost concept are more helpful than the others. Along with the quantitative analysis to arrive at an appropriate and right decision qualitative analysis is also necessary. These order are as already discussed are generally at a lower price than the present prevailing market price so something if negotiated with the home or local customs may adversely affect the existing customer relations and the company may lose in future. The capacity constrain is also another factor to be decided upon in such decisions. These order are on temporary basis or are not permanent or always in future. The capacity increase is sometimes possible through further capital investment and when the order is over then capital investment may become idle and the company may incur a loss on realization.

Illustration 11.

The cost sheet of a product is given a follows:

Cost	₹
Direct material	10.00
Direct wages	6.00
Factory overheads :	
Fixed	1.00
Variable	2.00
Administration expenses:	1.50

Selling and distribution		
	Over heads	
	Fixed	0.50
	Variable	1.00
Total cost (per unit)		22.00

The company is producing 90000 units and has the capacity to produce a further 10000 units. At the moment the company is selling the product to the local customers at a selling price of ₹ 27.50 at a mark up of 25% on cost. Meantime a foreign customer has approached to send the product at a much lower price of ₹ 21. In accepting the order the company has to further incur ₹ 0.50 per unit as export expenses. Now analyze whether the company should accept the export order or reject as it is at a much lower price.

Solution: –

Working

Cost	₹
Direct Material	10.00
Direct Wages	6.00
Factory overheads variable	2.00
Selling and distribution overheads variable	1.00
Marginal cost:	19.00
Export expenses per unit:	0.50
Cost increase per unit:	19.50
Export price:	21.00
Saving per unit (Export):	1.50
No. of Units:	10,000
Total increase in Profit:	₹ 15,000

Depending upon the above quantitative analysis the company should accept the export order, because the order is within the capacity of the production unit. All the other costs except the variable are already absorbed.

Illustration 12. A company is approached by local customer to supply a special eatable pieces for the children. The order is not going to affect the present sale, but a special equipment costing ₹ 500 is required to meet the order. The order is for 1000 eatables (Special design). Offer price is ₹ 5 per piece. The following is present position of the company.

	₹
Direct material@1.50	15000
Direct Labour@1.00	10000
Fixed overheads:	30000
Total	55000
Sales	80000
Profit	25,000

Analyze above and recommend accordingly, accept or reject the order.

Solution: –

Cost	₹ Per Unit
Direct material	1.50
Direct Labour	1.00
Special equipment cost per unit (500 ÷ 1000)	0.50
Marginal cost	3.00
Offered price	5.00

The order should be accepted because its acceptance will not affect the sale of others and there will an addition of ₹ 2000 to the overall profit of the company. Fixed overhead is irrelevant cost to the decision.

Choice of an alternative: –

Sometime a situation arises to produce a product by more than one technique and the management has to decide one of the best to the company. Cost analysis is helpful in such problems. Capacity constraints market constraints, the total cost are taken into consideration at the time of decision.

Illustration 13. The Hi-tech Manufacturing Company is presently evaluating two possible techniques for manufacturing a toy and makes available to you the following information.

	Technique I	Technique II
	₹	₹
Variable cost per unit	28	30
Selling price of the toy	40	40
Total fixed cost:	4600000	3700000
Selling in units:	430000	500000
Anticipated sales:	400000	400000

You are required to suggest:

- Which technique should be chosen?
- Would you change your answer if you are informed that the capacity in two techniques are
For technique I. – 600000, technique II – 550000

Solution: –

	Technique I	Technique II
	₹	₹
(i) Selling Price Per Unit	40	40
variable cost per unit	28	30
Contribution (per unit)	12	10
Total Contribution for anticipated sales (400000)	4800000	4000000
Fixed Cost	4600000	3700000

Profit	200000	300000
Technique II is preferred to I		
Taking capacity constraints into consideration	I Tech.	II Tech.
	₹	₹
Total contribution at 100% capacity	5160000	5000000
Less fixed cost	4600000	3700000
Profit	560000	1300000

The decision is in favour of 2nd which is more profitable.

(iii) When the capacity of production changes then

	Technique I	Technique II
Total contribution at 100% capacity	7200000	5500000
I 600000x12		
II 550000x10		
Fixed cost	4600000	3700000
Net Profit	2600000	1800000

The decision is in favour of technique I in changed conditions.

Decision in level of production: –

Generally activity level i.e. the level of production of the companies is less than the full capacity. The fixed cost remains the same at different levels of production within the maximum capacity. To sell the more and the more units in the market the company has to vary the prices of the units. The problem arises at which capacity level the company should function and stick production so as to earn maximum profit. In such cases as the fixed cost generally do not change are not a part of decision. The marginal cost and the contribution level becomes the part of the decision making process.

Illustration 14. Depending on the last year's experiences the budgeted forecast data of a company at various levels of activity is given as under.

Activity Level	Selling Price Per Unit
	₹
50%	40
60%	39
70%	38
80%	34
90%	31
100	28

Fixed cost at 100% capacity level is ₹ 200000 and at this level the company can produce 100000 units of a product. The various other costs are

	₹
(i) Direct material	15
(ii) Direct Labour Cost	10
(iii) Other variable cost	5
Total	30

guide the company as you desire the level of activity.

Solution: –

	Level of activity					
	50%	60%	70%	80%	90%	100%
	₹	₹	₹	₹	₹	₹
Material cost per unit	15	15	15	15	15	15
Direct labour cost per unit	10	10	10	10	10	10
Other variable cost per unit	5	5	5	5	5	5
Marginal cost	30	30	30	30	30	30
Selling Price per unit	40	39	38	34	31	28
Contribution per unit	10	9	8	4	1	– 2
Total contribution	500000	540000	560000	320000	90000	– 200000

Suggestion: – The company should function at 70% level of capacity here the total contribution is maximum. Fixed cost do not vary so are not a part of the decision making process.

Profit at 70% of Capacity:

Total units produced=	70000
Contribution per unit=	₹ 8
Total contribution =	₹ 560000
Fixed cost=	200000
Profit =	360000

Which is maximum than any other level of activity.

Miscellaneous Examples.

Make or buy decision

Illustration 15. The estimated costs of producing 6000 units of a component are

	Per unit	Total
	₹	₹
Direct material	10	60000
Direct Labour	8	48000
Applied variable factory overheads	9	54000
Applied Fixed factory overheads {@ ₹ 1.5 per direct labour rupee}	12	72000
Total	39	234000

The same component can be purchased from market at prices of ₹ 29 per unit. If the components is purchased from market 25% of the fixed factory overhead will be saved.

Recommend whether the component should be purchased from the market?

Solution: –

	Per unit (₹)		Total (₹)	
	Make	Buy	Make	Buy
Direct material cost	10		60000	
Direct Labour cost	8		48000	
Variable factory overhead	9		54000	
Relevant fixed cost	3		18000	
Purchase Price	–	29	–	1,74,000
Total relevant costs	30	29	180,000	1,74,000

On comparing the two i.e. make or buy, buying cost is ₹ 174000 for 6000 units of the product whereas making cost is ₹ 180000. So decision is in the favour of purchase the product from the market, because there is a saving of ₹ 6000. The fixed cost to the tune of ₹ 54000 is not relevant because it has been incurred earlier and unavoidable.

Illustration 16.

Coleman Company owns a machine that produces the component for the products the company makes and sells. The company uses 1,800 units of this component in production each year. The costs of making one unit of this component are

	₹
Direct material	7
Variable manufacturing overhead	6
Direct Labour	4
Fixed manufacturing overheads	5

The fixed overheads costs are unavoidable, and the unit costs are based on the present annual usage of 1,800 units of the component. An outside supplies has offered to sell Coleman this component for ₹18 per unit and can supply all the units it needs.

- A. If Coleman buys the component from the outside supplier instead of making it, how much will net income change?

Should Coleman make or buy the component?

Use the incremental approach to justify your answer.

- B. Suppose Coleman could rent the machine to another company for ₹ 5,000 per year. How would you response to change to part A of the problem? Use incremental approach to justify your answer.

Solution: –

A: When the component is not made in the company, it will not have to increase the costs will changes with the volume of production

Total variable cost =	7+6+4 = ₹ 17
Saving in cost if component is not made =	₹ 17 per unit
Total saving if the component is not made =	₹ 30,600
Total cost of buying the component =	₹ 32,400 (₹ 18x1800)

Cost of buying the component is more than the saving if not made. So company should make the component rather to purchase. Fixed cost is irrelevant to the particular decision.

B: The machine can be rent to another company at an annual rent of ₹ 5,000.

Total saving if the component is not made =	₹ 30,600
Increase in annual rent to the company =	₹ 5000
Total saving =	₹ 35600

So the company should not make the component and should purchase the component at a cost of ₹ 18 per unit Increase is net income= 35600 – 32400 = ₹ 3200. We can also solve it on the basis of opportunity cost.

Process further or sale at split off point

Illustration 17. Product A and B are produced in a joint process. At split off point product A is complete and ready for sale where as he product B can be processed further. The following is additional information given. Advice.

Product	A	B
Quantity in units	5000	10000
Selling price per unit	₹ 10	₹ 2.5
Selling price after further process	–	₹ 5
Additional cost after the split off	–	₹ 20000

Solution: –

Additional revenue on further process	=	2.5x10000
	=	₹ 25000
Addition cost on further process	=	₹ 20000
Incremental profit on further processing	=	₹ 25000 – ₹ 20000
	=	₹ 5000

The decision is in favour of further processing as it will add an additional ₹ 5000 to the total profit.

Illustration 18. A company has three divisions: Petal, bud and flower. Results of a year are presented below: –

	Petal	Bud	Flower	Total
Units Sold	3000	5000	2000	10000
Revenue	₹ 70000	₹ 50000	₹ 40000	₹ 160000
Variable Costs	₹ 32000	₹ 26000	₹ 16000	₹ 74000
Direct Fixed Costs	₹ 14000	₹ 19000	₹ 12000	₹ 45000

Allocated Fixed Costs	₹ 6000	₹ 10000	₹ 4000	₹ 20000
Net Income	₹ 18000	(₹ 5000)	₹ 8000	₹ 21000

The variable costs are directly attributable to the products produced for the specific department. All the allocated fixed costs will continue even if a division is discontinued. Direct fixed costs are based on the number of units to be sold. Bud division is going into a loss of ₹ 5000 and company feels that it should be discontinued. If the division is closed the sale of the petal division will increase by 20% and that of flower division will remain the same. You are required to analyze the effect of discontinuing the bud division on the company. Whether company should act as desired?

Solution: –

When the bud division is closed down the allocated fixed cost will remain the same, but direct fixed cost will not be incurred anymore.

Increase in revenue	=	20% of 70000 – 50000
	=	14000 – 50000
	=	(₹ – 36000)
Increase in saving of variable cost	=	₹ 26000 – 20% of 32000
	=	₹ 26000 – 6400
	=	₹ 19600
Increase in saving of direct fixed cost as shown in the question	=	
		₹ 19000
Total saving cost	=	₹ 19600 + 19000
	=	₹ 38600
Net profit increase	=	₹ 38600 – 36000
	=	₹ 2600

Total profit will increase to the tune of ₹ 2600, so the decision to close down bud department division is right and in the favour of overall profit of the company.

(Optimum product mix)

Illustration 19. A company produces three products and is reviewing the production and sales budgets for the next accounting period. Following information is available for the three products.

	Product X	Product Y	Product Z
Contribution per unit	₹ 12	₹ 10	₹ 6
Machine hours required per unit	6 hours	2 hours	1 hour
Estimated sale demand	200 units	200 units	200 units
Machine hours required	1200 hours	400 hours	200 hours

Machine capacity is limited to 1200 hours and is insufficient to meet total sale demand.

- (i) You have been asked to advise to which product should be produced during the period.
- (ii) State one assumption in which products mix advised by you in (i) above based on contribution per unit of limiting factor will not hold good.

Solution: —

	Products		
	X	Y	Z
Contribution per unit	₹ 12	₹ 10	₹ 6
Machine hours required per unit	6 hours	2 hours	1 hour
Contribution per machine hour	₹ 2	₹ 5	₹ 6
Ranking	3rd	2nd	1st

Optimum product mix :

Production	Machine hours used	Balance machine hours	
200 units of Z	200x1 = 200	1200 –	1000
		=200	
200 units of Y	200x2 =400	1000– 400=	600
100 units of X	100x6 =600	600 – 600=	0
(i) 200 units of Z, 200 units of Y and 100 units of X should be produced to get the maximum contribution depending upon the optimum utilization of the limiting factors which is the machine hour capacity.			

The total contribution is: –

		Total (₹)
200 units of Z =	₹ 200×6	1200
200 units of Y =	₹ 200×10	2000
100 units of X =	₹ 100×12	1200
Total Contribution:		4400

- (ii) It is necessary to consider other qualitative factors before the proposed production program is implemented. For example, customer goodwill will be lost causing a fall in future sales if company is unable to supply all three products to say 150 of its regular customers. Company's relation with customers may compel the management to take a sub – optimal decision in a temporary situation.

Illustration 20. X Ltd. manufactures a standard product, the marginal costs (per unit) of which are as follows:

	₹
Direct material	160
Direct wages	120
Variable overheads	20
	300

Its annual budget includes the following:

Output: 40000 units	₹
Fixed overheads:	
Production:	8000000
Administration:	4800000
Marketing:	4000000
	16800000
Contribution:	2,00,00,000

Recently top management of the organization has started thinking in terms of revising its budget and some alternative in the form of proposal (Stated below) were discussed in its last board meeting.

Proposal I: – The organization expects a profit of ₹ 48,00,000 and wants to know the selling price to be quoted for the purpose. It is estimated that (a) an increase in advertising expenditure of ₹ 9,44,000 would result in a 10% increase in sales volume and (b) Fixed production overheads and marketing overheads would increase by ₹ 2,00,000 and ₹ 1,36,000 respectively.

Proposal II: – The organization expects that with an additional advertising expenditure, sales would go up by 20% and a profit margin of 5% on sales would be obtained. Under the circumstances, fixed production overheads and marketing overheads are expected to increase by ₹ 3,20,000 and ₹ 2,00,000 respectively. The organization wants to know the additional expenditure on advertisement required with a view to achieving the result.

You are required to draw up forecast statements for each of these alternatives and determine the selling price per unit to be quoted (Proposal I) and the additional expenditure on advertisement requirement required (Proposal II).

Solution: –

	₹	
Direct material per unit	160	
Direct wages	120	
Variable overheads	20	
	300	
Contribution per unit, (₹ 200,00,000 ÷ 40000)	500	
Selling price per unit	800	
Proposal I		
Expected Profit	₹ 48,00,000	
Fixed overheads:		
Production:	₹ 80,00,000	
Administration:	₹ 48,00,000	
Marketing:	₹ 40,00,000	
Total:	1,68,00,000	
For 10% increase in output i.e. 40000x(1.1)	44,000 units	
Increase in adv. exp. =	9,44,000	
Fixed production overheads increase:	2,00,000	
Marketing overheads increase:	1,36,000	
Total fixed overheads:	1,80,80,000	
Selling price that can be quoted =		$\frac{F + V + P}{\text{Sales (units)}}$
	=	$\frac{1,80,80,000 + (44,000 \times 300) + 48,00,000}{44,000}$
	=	₹ 820
Proposal II Increase in sales volume =	20%	
Units sold =	40000x(1.20)	
	=	48,000 units
Present Selling Price =	₹ 800	

$$\begin{aligned}
 \text{Profit margin} &= 15\% \text{ of S.P.} \\
 \text{Total cost per unit} &= 800 \times (0.85) \\
 &= ₹ 680 \\
 \text{Additional Production overheads} &= ₹ 3,20,000 \\
 \text{Additional marketing overheads} &= ₹ 2,00,000 \\
 \text{Present overheads cost} &= ₹ 168,00,000 \\
 \text{Total} &= ₹ 173,20,000 \\
 \text{The required addition in advertisement expenditure} &= \\
 &= (680 - 300) \times 48000 - 173,20,000 \\
 &= ₹ 920,000 \\
 \text{Profit margin} &= 120 \times 48000 \\
 &= ₹ 57,60,000
 \end{aligned}$$

Illustration 21: A chemical factory produces four products from a single raw material. The cost of raw material for a year is ₹ 67000 and initial processing costs amounted to ₹ 1,28,000. All the four products viz A,B,C and D are produced simultaneously at a single split – off point. Product C is sold immediately without any further processing. A, B and D are processed further. The output, sales and further processing costs are.

Products	Output in units	Sales	Further processing cost
A	400,000	₹ 192,000	₹ 40,000
B	89,725	₹ 58,000	₹ 32,000
C	5,000	₹ 8,000	—
D	9,000	₹ 60,000	₹ 1,000

If these products were sold at the split – off point the prices attained per unit would be A= ₹ 6.32, B= ₹ 0.40, C= ₹ 1.60, D= ₹ 5.00

Using the concept of relevancy of costs and differential costs advice your management. Whether further processing should be undertaken or not.

(I.C., W.A. – Final)

Solution: –

Product A: –

$$\begin{aligned}
 \text{Price at split off point} &= ₹ 0.32 \\
 \text{Price after the split off point} &= ₹ 0.48 \\
 &\quad (192000 \div 400000) \\
 \text{Difference in price per unit} &= ₹ 0.16 \\
 \text{Increment in revenue if processed further} &= ₹ 0.16 \times 400000 = ₹ 64,000 \\
 \text{Increase in cost on further processing} &= ₹ 40,000
 \end{aligned}$$

The revenue increase is more than increase in cost so the product A should be processed further after the split – off point.

In this decision raw material cost, processing cost before split off point are irrelevant, so are not the part of the decision.

Product B: –

$$\begin{aligned}
 \text{Sales value after split off point} &= ₹ 58,000 \\
 \text{Sales value at the split – off point} &= ₹ (0.40 \times 8975)
 \end{aligned}$$

$$= ₹ 35890$$

$$\text{Increase in revenue after split off point} = 58000 - 35890 = ₹ 22110$$

$$\text{Further processing cost} = ₹ 32000$$

Further processing cost is more than increase in the revenue after split off point. So, it is not recommended to process product B further.

Product D:

$$\text{Sales value after split off point} = ₹ 60,000$$

$$\text{Sales value at the split – off point} = ₹ (5 \times 9000)$$

$$= ₹ 45000$$

$$\text{Increase in revenue after split off point} = 60000 - 45000 = ₹ 15000$$

$$\text{Further processing cost} = ₹ 1000$$

Further processing cost is less than the increase in revenue after split off point. So, product D should be processed further.

Illustration 22: Bathing care Ltd manufactures and sells soaps under the brand names. Elite, Lovely, Fresh and Janata. Then Janata Soap is very popular as it is of good quality and at the same time reasonably priced. The company produces and sells per annum on an average 50,000 cakes of Elite, 100000 cakes of Lovely, 75000 cakes of fresh and 200000 cakes of Janata at unit selling price of ₹ 3.50, ₹ 3.00, ₹ 2.50, ₹ 1.50 respectively.

At this level of production and sales, the unit cost of a cake of each brand of soap is as follows (Expressed in paise)

	Elite	Lovely	Fresh	Janata
Direct Material:	50	40	35	45
Direct Labour:	20	20	15	10
Production expenses				
Fixed:	20	25	20	20
Variable:	10	10	5	5
Admn. Expenses				
Fixed:	30	40	25	30
Variable:	15	5	10	5
Selling and Distribution Expenses:				
Fixed:	80	60	45	10
Variable:	45	20	25	5
Total cost:	270	220	180	130

The company has a lot of unutilized capacity and there is ample scope for improving production and sales volumes. Bathing care Ltd has built in name for its products in the market and with proper sale effort it should be possible to sell whatever is produced by the company. The production manager sees no problems.

The sales manager puts up a bold scheme for almost quadrupling the present profits of the company:

- (i) An exclusive advertisement campaign has to be undertaken to promote the sale of Janata Soap and this is estimated to cost ₹ 48,500
- (ii) At the same time the selling price of a cake of Janata soap should be reduced to ₹ 1.00

By adopting this sales strategy, the sales manager is confident that he would be able to double the present sales volume of Janata soap and with each 100,000 cakes of Janata, he would be able to push the sales of 30,000 cakes of Elite, 70000 cakes of Lovely and 50000 cakes of Fresh in the market.

As a cost Accountant of the company submit your report to the Managing Director on the feasibility of the sales manager scheme with figures of the present profit and those of the future if the scheme is accepted.

(I.C.W.A – Final)

Solution: –

	<u>Soap Brand</u>			
	Elite	Lovely	Fresh	Janata
	₹	₹	₹	₹
Selling Price	3.50	3.00	2.50	1.50
Variable cost: ₹	₹	₹	₹	₹
Direct material	0.50	0.40	0.35	0.45
Direct Labour	0.20	0.20	0.15	0.10
Production expenses	0.10	0.10	0.05	0.05
Admn. Expenses	0.15	0.05	0.10	0.05
Selling & Distribution expenses	0.45	0.20	0.25	0.05
	1.40	0.95	0.90	0.70
Contribution per cake	2.10	2.05	1.60	0.8
₹	₹	₹	₹	₹
Fixed cost				
Production	0.20	0.25	0.20	0.20
Admn. Expenses	0.30	0.40	0.25	0.30
Selling & Distribution				
Expenses:	0.80	0.60	0.45	0.10
	1.30	1.25	0.90	0.60
Profit per unit	0.80	0.80	0.70	0.20
Units sold	50,000	10,00,000	75,000	2,00,000

Present Profit: ₹	
Elite 50000×0.80=	40,000
Lovely 10000×0.8=	80,000
Fresh 75000×0.70=	52,500
Janata 200000×0.20=	40000
Total Profit=	2,12,500

$$\begin{aligned}
 \text{Present Fixed Cost} &= (50000 \times 1.30) + (100000 \times 1.25) + (75000 \times 0.90) + (200000 \times 0.60) \\
 &= 65000 + 125000 + 67500 + 120000 \\
 &= ₹ 3,77,500
 \end{aligned}$$

Under New Strategy

Janata Brand

Selling Price=	1.00
Variable Cost =	0.70
New Contribution =	0.30
total sale of Janata brand =	400,000
Elite brand =	1,10,000 (50000+60000)
Lovely brand =	2,40,000
Fresh brand =	1,75,000

Increase in total contribution	₹
Janata =	$[400000 \times 0.30 - 200000 \times 0.80]$
=	- 40,000
Elite brand	
(600000×2.10)	= 126000
Lovely brand	
(140000×2.50)	= 287,000
Fresh brand	
(100000×1.60)	= 160000
Total increase in contribution:	₹ 533000
Increase in Fixed cost:	₹ 48500
Net profit increase:	₹ 4,84,500
Pre strategy profit:	₹ 2,12,500
Net profit after adopting the new strategy:	₹ 6,97,000

Illustration 23: P.Q.R. Ltd makes a single product which it sells for ₹ 30 per unit and there is great demand for the product.

The variable cost of the product is ₹ 16 as detailed below: –

	₹
Direct material:	8
Direct Labour (2 hours):	4
Variable overheads:	4
Total	16

The Labour force is currently working at full capacity and no extra time can be made available Mr. J.M. Pal a customer has approached the company with the request for the manufacture of special order at ₹ 8000.

The cost of the order would be ₹ 3000 for Direct Material and 600 labour hours will be required and variable overhead per hour shall be ₹ 2. should the order be accepted?

(ICWA Final Dec.1988)

Solution: –

Existing position	₹	
Selling price:		30
Less marginal cost:	₹	
(i) Direct material:	8	
(ii) Direct Labour (2 hours):	4	
(iii) Variable overheads:	4	
		16
Contribution:		
		14
Contribution per Labour Hour (14 ÷ 2):	₹ 7	

As the labour is the limiting factor and no extra time is available, so if the labour is diverted to the special order. The company will have to lose ₹ 7 per labour hour required.

Valuation of the order		₹
Value of the special order	=	8000
Less relevant cost :		₹
(i) Direct material		3000
(ii) Direct Labour		1200
(600 hours @ ₹ 2 per hour)		
(iii) Variable overheads:		1200
(@ ₹ 2 for 600 hours)		
(iv) Opportunity cost:		4200
(Loss in present profit)/Contribution		
(₹ 600×7)		
		9600
Loss in numerical terms on accepting the order		
		₹ 1600

The order should not be accepted as it is not in favour of the company and impact adversely on the present customer relations.

Illustration 24: As a cost consultant you are asked to look into the proposed decision of Apple products Ltd to temporarily suspend operation due to depressed market conditions.

The data available are: –

	Capacity	Utilization
	60%	80%
	(₹ '000)	
Direct material:	180	240
Direct Labour:	240	320

Production Overheads:	126	138
Administration overheads:	62	66
Selling & Distribution overheads:	68	74
	<u>676</u>	<u>838</u>

The company is likely to operate at 50% capacity only, and turnover is expected to be ₹ 4,95,000. Market researches indicates that the recession will be over in a year and can effect a sale of ₹ 9,00,000 utilizing 75% of the capacity. If operations are suspended for a year the following costs will be incurred: –

- Fixed cost would be reduced to ₹ 40,000
- Settlement with labour force will cost ₹ 35,000
- Maintenance of plant will continue and cost ₹ 10,000
- Cost of re – opening will be ₹ 10,000

Draft a report to the management on the feasibility of temporarily suspending or otherwise, of the business for one year.

(ICWA Final)

Solution: –

Position at 50% and 75% of capacity levels

	50% capacity	75% Capacity
	Current Year	Next Year
	₹	₹
Direct material:	1,50,000	2,25,000
Direct Labour:	2,00,000	3,00,000
Production overheads		
Variable	30,000	45,000
Administration overheads		
Variable	10,000	15,000
Selling and Distribution		
Overheads variable	<u>15,000</u>	<u>2,25,000</u>
Marginal cost:	405,000	607,500
Sales:	<u>495,000</u>	<u>900,000</u>
Contribution:	90,000	2,92,500
Fixed costs ₹ :		
Production overheads:	90,000*	
Admn. overheads:	50,000**	
Selling & Distribution overheads:	50,000***	
	<u>190,000</u>	<u>190,000</u>
Profit/Loss	(– ₹ 100,000)	₹ 1,02,500
Temporary suspending costs: ₹		
Fixed cost:	40,000	
Labour force settlement:	35,000	
Maintenance of plant:	10,000	

Cost of re – opening:	10,000
Total:	95,000

We see from the above quantitative analysis that if the company is presently operating at 50% of the overall capacity, the company has to incurred a loss of ₹ 100,000. If the company suspends production then the cost of closing and re – opening is ₹ 95,000. On suspending production temporarily there is a benefit of ₹ 5,000 rather operating at 50% level.

Advice: The Company should not stop production because the quantitative decision in favour of suspending temporary production will adversely affect the relations of the company with customers, suppliers, labour and various other employees. There is a meagre difference of ₹ 5,000 which will be off – set in next year, as the company will begin to work at 75% of the capacity level.

Working Note: – * Bifurcation of Fixed and variable production overheads.

	₹
At 60% of capacity =	126,000
At 80% of capacity =	138,000
$x \times 0.2 =$	12000
$x =$	60,000
Variable production overheads at 100% capacity =	₹ 60,000
At 60% of capacity =	60% of 60000
	= 36000
So fixed production overheads=	126000 – 36000
	= ₹ 90,000
**Administration overheads at 60% capacity =	₹ 62,000
At 80% capacity =	₹ 66,000
Difference: $x \times 0.2 =$	4000
$x =$	$\frac{4000}{0.2}$
$x =$	20,000
Variable admn. overheads at 100% capacity =	₹ 20,000
Variable overheads at 60% of capacity =	60% of 20000
	= ₹ 12,000
So, Fixed Admn. overheads =	62000 – 12000
	= ₹ 50,000
*** Selling & Distribution overheads at 60% capacity=	₹ 68,000
at 80% capacity =	₹ 74,000
Difference: $x \times 0.2 =$	6000
$x =$	$\frac{6000}{0.2}$
$x =$	₹ 30,000
Variable S & Dist. overheads at 100% level =	₹ 30,000
at 60% level =	60% of 30,000
	= ₹ 18,000

$$\begin{aligned}\text{So, Fixed S \& D overheads} &= 68000 - 18000 \\ &= ₹ 50,000\end{aligned}$$

Illustration 25: An ancillary industry has received an order from a large industry for the manufacture of one lakh components @ ₹ 600 for 1000 numbers for which there is a rising demand. The raw materials required are mild steel strips and spring steel strips which will be drawn in press for making components by using tools and dies. Calculate the estimated cost of production and margin of profit, if any from the following data and submit your recommendations as to whether the order should be accepted or not.

- (i) 0.30 M. Ton and 0.20 M. Ton of mild steel strip and spring steel strip respectively are required to complete the order. The strips are available in the form of coils.
- (ii) Raw Material:
 - (a) Mild Steel (i) ₹ 2100 per M. Ton if purchased in quantities of more than one M. Ton (ii) ₹ 2200 per M. Ton if purchased in quantities of less than one M. Ton.
 - (b) Spring steel (i) ₹ 4200 per M. ton if purchased in quantities of more than one M. Ton (ii) ₹ 4500 per M. Ton if purchased in quantities of less than one M. Ton.
- (iii) Manufacture period 2 months for one lakh no's of components.
- (iv) Wages: ₹ 4500 per month.
- (v) Capital cost of existing press (Capacity exists). (Assume depreciation at 10% per annum) – ₹ 1.20 lakhs
- (vi) Additional special equipment required – ₹ 2000 (Depreciation 10% per annum)
- (vii) Estimated cost of manufacture of special tools and dies ₹ 30,000
(Life is estimated to cover manufacture of one million components)
- (viii) Recurring expenses for grinding of tools and dies to complete the order – ₹ 1000
- (ix) Cleaning and phosphating cost – 5 paise for each component.
- (x) Supervision and overhead expenses of the shop – ₹ 1000 per month.
- (xi) Share of other services and administrative section – ₹ 1500 per month.
- (xii) Selling and Distribution Expenses – 5% of the total cost.
- (xiii) Provision of rejection by customers – 10% (I.C.W.A. Final)

Solution: – For production of one lakh units of components

Raw material		₹
Mild Steel Strip	₹	
0.30M.Tonne @ ₹ 2200 per M. Ton	660	
Spring steel strip		
0.20M.Tonne @ ₹ 4500 per M. Ton	900	1560
Wages – @ ₹ 4500 per month for 2 months		9000
Depreciation on capital @ 10% per annum for 2 months		2000
Depreciation on special equipment @ 10% per annum for 2 months:		33
Cost of manufacture of special tools for one lakh components = $\frac{30000}{10,00,000} \times$		3000
100000		
Expenses one grinding of tools and dies:		1000

Cleaning and phosphating cost @ 5 paise per component:	5000
Supervision and overhead expenses of the shop for two months:	2000
Services and admn. section expenses for two months :	3000
Total:	26,593
Selling and distribution expenses @ 5% of	1,330
Total cost :	27,923
Provision of rejection 10% of sales or 11% of cost	3,072
Total :	30,995
Sales @ @ ₹ 600 per 1000 components	60,000
$= \frac{600}{1000} \times 10000$	
Profit if accepted:	29,005

The order should be accepted as the acceptance will give a profit of ₹ 29005 in total.

Assumption: (i) It is assumed that the depreciated asset can either be further used for further orders or can be sold at the depreciated value.

(ii) Similar orders are expected in future also.

Illustration 26: Product B is one of a number of products produced and sold by Gyro Ltd. The following information relates to product B

- (a) Production/Sales per period: 2000 units
- (b) Selling Price/Unit : ₹ 10
- (c) Variable costs/unit: ₹ 6.30
- (d) Fixed costs of ₹ 5400 per period which are avoidable if production of Product B should cease.
- (e) A ₹ 12000 share of general company costs which will remain if the product is discontinued.

Required: Showing all appropriate calculations answer the following: –

- (a) Discuss a claim by one management member that production and sale of product B should be discontinued.
- (b) At what production sales level will product B break even?
- (c) Product B can be replaced by product Y on the basis of one unit of Y for two units of B.
Product Y has a selling price of ₹ 16 and a contribution/sales ratio of 0.3. Should the substitution be implemented?
 - (i) If 500 units of B are to be replaced?
 - (ii) If all units of B are to be replaced? (CIMA London – Adapted)

Solution: –

	₹
Selling price of Product B	10.00
Variable cost/unit	6.30
Contribution per unit	3.70
Total contribution 2000×3.70=	7400

Avoidable fixed cost	5400
(Linked to production)	_____
Balance Profit:	2000
Share of general company cost allocated:	12000
Net Loss:	10000

(a) The product should not be discontinued because its discontinuation will adversely affect the overall profit of the company to the tune of ₹ 2000.

$$\begin{aligned}
 \text{(b) Contribution per unit of Product B} &= ₹ 3.70 \\
 \text{Total fixed cost} &= 5400 + 12000 \\
 &= ₹ 17400 \\
 \text{BEP (in units)} &= \frac{17400}{3.7} \\
 &= 4703 \text{ units } (4702.7)
 \end{aligned}$$

$$\begin{aligned}
 \text{(c) Gain in contribution from Product Y} &= 16 \times 0.3 \\
 &= ₹ 4.8
 \end{aligned}$$

(c/s , or P/v ratio is 0.3)

(i) When 500 units of B are replaced

₹

$$\text{Loss in contribution} = 500 \times 3.7 = 1850$$

$$\text{Gain in contribution} = 250 \times 4.8 = \underline{1200}$$

$$\text{Net Loss} = 650$$

There is net loss if replacement of 500 units of B with that of product Y are accepted.

The fixed expenses of ₹ 5400 will also have to be incurred if product B is continued.

(iii) When whole of product B are replaced with product Y.

	₹
Loss in contribution on discontinuation of product B:	2000
Gain in contribution on replacement by product Y (1000x4.8):	4800
Net gain in contribution:	<u>2800</u>

This proposal should be accepted in order to add more profit of the company.

Share of company expenses ₹ 12000 are ignored because there is no effect whether the product B is produced or not.

Illustration 27: (a) Next year's forecasted trading results for Caribee Ltd, a small company manufacturing three different types of products, are shown below:

	Product A	Product B	Product C	Total
Selling price per unit	₹ 10	₹ 12	₹ 8	
Sales (₹ '000)	₹ 100	₹ 96	₹ 32	₹ 228
Variable cost of sales:	40	38	13	91
Prime Cost:				
Variable overheads:	20	18	11	49
Share of general fixed overheads:	30	27	10	67

Profit/Loss	10	13	(2)	21

Required:

- (i) Explain how the company's forecasted profits would be affected if product C were discontinued. It should be assumed that sales of the remaining products would not be affected, any other assumptions made should be included with your explanation.
- (ii) Additional advertisement for products B would cost ₹ 8000 next year; this amount is not included in the forecasts shown above. Calculate the minimum extra sales in units of product B required to cover this additional cost.
- (iii) Calculate the increase in sales volume of product A necessary to compensate for a 10% reduction in selling price of the product. Carefully explain why the increase in volume is proportionately greater than reduction in selling price.
- (c) The production director of Carbee Ltd has just been informed that next year's supplies of a material used in manufacture of each of the three products will be restricted to 92000 kg; no substitute material is available and estimated consumption of this restricted material, per product is

Product A	8 kg per unit
Product B	4 kg per unit
Product C	1 kg per unit

The Sales director estimates that the maximum demand for each product is that which is shown in the original forecast (a) above. Also decide that advertising or adjustment to selling price are not possible.

Assume that stocks of material, work in progress or finished goods cannot be carried.

Required: Calculate the optimum quantities of product A, B and C which should be manufactured next year in order to maximize company profits.

(CIMA – London – Adapted)

Solution: a (i)

Companies forecasted profit

	Product A	Product B	Total
Sales (₹'000)	100	96	196
Selling price per unit (₹)	10	12	—
Unit sold	10,000	8,000	18,000
Prime Cost per unit (₹)	4	4.75	
Variable overheads per unit (₹)	2	2.25	
Contribution per unit	4	5	
Total contribution(₹)	40,000	40,000	80,000
Fixed cost Allocated	(10000×4)	(8000×5)	
			67,000

Product A: 30,000 }
 Product B: 27,000 }
 Product C: 10,000 }

Net Profit (₹)

13,000

There is reduction in the total net profit than before closing down production of product c, because of loss of contribution ₹ 8000 (per unit cont. ₹ 2 (8 – 3.25 – 2.75) for 4000 units of product C) and the allocated fixed cost remaining the same.

(ii) Additional advertisement ₹ 8000

(Product B)

Contribution per unit of product B= ₹ 5

Extra units of product B to offset effect of additional cost

$$= \frac{8000}{5} = 1600 \text{ units}$$

(iii) Reduction in selling price of product A = 10%

New selling price = 10 × 0.9

New contribution = 12 – 9

= ₹3 per unit

Former total contribution = ₹ 40,000

(For product A)

Units required to maintain former contribution

$$= \frac{40000}{3}$$

$$= 13,333\frac{1}{3}$$

$$\% \text{ increase in sale of production A} = \frac{\frac{10000}{3}}{10000} \times 100$$

$$= 33\frac{1}{3}\%$$

So % increase in sale of units of product A is more than % reduction in selling price.

(b).

	Products		
	A	B	C
Selling price per unit (₹)	10	12	8
Variable cost (₹)	6	7	6
Contribution per unit (₹)	4	5	2
Raw material required per unit in Kg	8	4	1
Contribution / Kg	0.5	1.25	2

Ranking	III	II	I
Maximum demand	10,000	8,000	4,000
(Units)			

Available quantity of raw material = 92000 Kg

Raw material used in production of 4000 units of product C

$$= 4000 \times 1$$

$$= 4000 \text{ Kg}$$

$$\text{Balance Raw material} = 92000 - 4000 = 88000$$

Raw material used in Production

$$\text{of 8000 units of product B} = 32000$$

$$\text{Balance quantity of raw material} = \underline{56000}$$

Units of product that can be produced of product A

$$= \frac{56000}{8} = 7000 \text{ units}$$

Total contribution

$$\text{Product A} = 7000 \times 4 = 28000$$

$$\text{Product B} = 8000 \times 5 = 40000$$

$$\text{Product C} = 4000 \times 2 = 8000$$

$$\text{Total} = \underline{76000}$$

Questions:

1. What do you mean by Differential cost in the decision making process?
2. What are semi variable costs?
3. Find out the fixed portion of costs from the data given:

Total cost at 60% of capacity = ₹ 30,000

Total cost at 75% of capacity = ₹ 36,000

Ans: ₹ 6000

4. Explain the concept of opportunity cost
5. What are relevant and irrelevant costs in managerial decision process?
6. Differentiate between marginal costing and differential costing.
7. Write short notes on the following
 - (i) Relevant cost
 - (ii) Sunk cost
 - (iii) Opportunity cost
 - (iv) Policy cost (I.C.W.A. Final)
8. Briefly explain the relevant considerations involved in taking managerial decisions in respect of:
 - (a) Make or buy
 - (b) Choosing channels of distribution for a product. (CA Final)
9. Distinguish between Relevant cost and opportunity cost. (ICWA Final)

10. Explain how differential cost analysis is helpful in the decision making process.

Numerical Problems:

1. A company is producing 6000 units of product and present the following data:

	Per unit ₹	Total ₹
Direct Material	10	60,000
Direct Labour	8	48,000
Applied variable Factory Overheads	9	54,000
Applied Fixed factory overheads	12	72,000
Total	39	234,000

The company receives an offer to purchase the product from the market at ₹ 29. On doing so the company can save 25% of the applied fixed factory over heads. Quantitatively analyse whether the company should purchase the product or not?

(Ans: The Company should buy from market saving ₹ 6000)

2. A Company is producing two products corn, Broccoli and considering to cease the production of one which is less profitable. On doing so the production sale of the other can increase by 40%. Fixed cost saving on not producing will be ₹ 100 and service of an employee which is added in the overhead can be terminated which was given ₹ 200 at the moment. Equipment, rent and other allocated overhead are unavoidable. Advice accordingly

	Corn ₹	Broccoli ₹	Total ₹
Sales	8,000	12,000	20,000
Food material	2000	2500	4500
Direct Labour	1200	2000	3200
Equipment rent	2600	300	2900
Other allocated overheads	2100	1000	3100
Profit/ Loss	100	6200	6300

(Ans: The production of corn should not be stopped. Loss of ₹ 1500 in profit)

Decrease in total contribution = ₹ 1800 [7500×0.4 – 4800]

Saving in F. Cost = ₹ 300

Decrease in Profit = ₹ 1500

3. Sk Company manufacture and sells the three products A, B, and C Data for these is given as:

	Product		
	A	B	C
Quantity (Units)	8000	20,000	28000
Selling price (₹)	20	15	32
Variable cost per unit (₹)	18	11	24
Fixed cost ₹ 1,68,000			

Fixed cost is allocated on the basis of the number of units produced.

Sales manager proposes to drop the production of the product A and present the calculation as follows:

	₹
Selling price of product A	= 20
Variable cost per unit	= 18
Contribution per unit	= <u>2</u>
Allocated fixed cost per unit	= 3
Loss per unit	= <u>1</u>

You as a costing expert are asked to analyse and present your report on each of the following points to the management

- Should the production of product A be dropped assuming there does not exist any use of released capacity?
- If the production of A is dropped, how much production of product B (in units) should be produced?
- If the company wants product A to be as profitable as that of product B, recommend a selling price of product A.
- Assuming that the sale of product B cannot be increased when product A is dropped. However another new product D can be added. The selling price and variable cost per unit for the new added product are estimated to be ₹ 20 and ₹ 19.40 respectively. 24000 units of the product can be produced and sold in the market. Sales Manager is in favour of adding the new product. You please advise the company depending upon your calculations.

Ans. [(i) Production of product A should not be dropped because loss of contribution ₹ 16000)
(ii) 4000 units of product B should be produced & sold
(iii) ₹ 28
(iv) It is not recommended to introduce the new product D it will further decrease contribution ₹ 1600]

4. Auto parts Ltd is producing 50000 units of a part used in the manufacture of Motor part.

One unit of the part require

	₹
Material per unit	: 400
Labour (25% fixed)	: 300
Other expenses: variable	: 100
Fixed	: 240
Total	: 1040

- (i) An outside seller of the product part has offered to supply at ₹ 770. Should the part be purchased from outside?
- (ii) Suppose the resources so released if the part is purchased, can be utilised for production of another part whose market value is ₹ 585. The material required in this product per unit will be ₹ 200 and all the other variable cost i.e. labour and other expense per unit remaining the same. If same quantity i.e. 50,000 parts of the new can be produced, discuss whether it would be advisable to divert the resources to manufacture the new product?

Ans: (i) The company should not purchase the part from the market, because it is having marginal cost ₹ 725 whereas market price is ₹ 770.

(ii) It is advised to divert the resources to the new product production.

5. From the following particulars, find the most profitable product mix and prepare a statement of profitability of that product mix: –

	Product A	Product B	Product C	
All three				the
Units budgeted to be produced and sold	1,800	3,000	1,200	
Selling price per unit (₹)	60	55	50	
Direct material	5Kg	3 kg	4kg	
Direct Labour	4hour	3hour	2 hour	
Variable overheads (₹)	7	13	8	
Fixed overheads (₹)	10	10	10	
Cost of Direct material per kg (₹)	4	4	4	
Direct Labour hour rate (₹)	2	2	2	
Maximum possible units of sales	4,000	5,000	1,500	

products are produced from the same direct material using the same type of machines and labour. Direct labour, which is the key factor is limited to 18,600 hours.

Ans: (Production C – 1500 units, B = 5000 units, A = 150 units

Profit = ₹ 96,750)

6. The annual budget of a company at 60% and 80% level of performance is given as under:

	60%	80%
Level of performance	(₹ '000)	(₹ '000)
Direct material	360	480
Direct Labour	480	640
Production overhead	252	276
Administration overhead	124	132
Selling & Distribution overhead	136	148
	1352	1676

The company is in great difficulty at the present moment in selling its product and is now operating at 50% level.

The sales revenue for the year is estimated at ₹ 9,90,000. The directors are seriously considering suspending till the market pick up.

Market research undertaken by the company reveals that there is every indication in about twelve months time the sale will pick up and the company can comfortably operates at 75% level of performance and earns the sale income of ₹ 18 lakhs in that year.

Sales personnel of the company do not want to suspend operation for fear of adverse reaction in the market but the director want to decide the issue purely on financial consideration.

If the manufacturing and other operations are suspended for a year it is estimated that:

- (a) The present fixed cost could be reduced to ₹ 2,20,000 per annum.
- (b) Settlement cost of personal not required would amount to ₹ 1,50,000

The maintenance of plant has to go on and that would cost ₹ 20,000.

- (c) On resuming operation, the cost connected with opening after a shutdown would amount to ₹ 80,000.

Submit a report to the director and indicate these in based on purely financial considerations, whether it would be advisable or not to suspend the company's operations in the current year?

(ICWA – Final)

7. A firm's production capacity is (One lac) 1,00,00 units of a product and is operating at 50% of the capacity and presented the following data.

	Pre unit	Total
	₹	₹ (in thousands)
Selling price	29.00	1450
manufacturing cost	20.00	1000
Gross Profit	9.00	450
Selling & distribution cost	5.50	275
	3.59	175

The manufacturing cost shown above consists ₹ 400,000 fixed and balance variable and selling & Distribution cost to be ₹ 150000 as fixed and balance variable transportation cost. A foreign firm has approached the manufacturing firm to purchase 40000 units of product at ₹ 14 per unit and to pay all the transportation variable costs. The manager is thinking whether to accept the order at such a price than the prevailing market price. You as a costing expert advise the management a rightful decision in favour of the firm.

(Accept the order saving ₹ 80000)

8. A Company is having with it a versatile machine that can produce any of the four products A, B, C and D and sell it in the market. The annual depreciation of the machine is ₹ 25,000 and operational cost of ₹ 15000 in producing any one of the products.

Product A whose 5000 units can be produced and sold @ ₹ 250 per unit has other related costs associated to its production ₹ 125 per unit.

4000 units of product B can be produced on the same machine whose selling price is ₹ 325 and the related cost ₹ 160 per unit.

3500 units of the product C can be produced and sold at selling price ₹ 370 whose related cost is ₹ 185 per unit.

4200 units of the product D can be produced and sold at selling price of ₹ 310 and related cost of ₹ 150.

Which of the products is more profitable to the company. What will be the opportunity cost for its production?

Ans:

D should be produced opportunity cost is ₹ 6,60,000

9. XYZ Ltd. has to spend ₹ 75,000 on a research project and expects that when completed in a further year the results of that research can be sold for ₹ 100000. In trying to decide whether to proceed the business identifies the additional expenses necessary to complete the research.

Materials : ₹ 30,000 This material (already in store and is paid for) is very toxic and will have to be disposed off in sealed containers at a cost of ₹ 2500.

Labour : 20,000. The research project uses highly skilled labour taken from the production department of the company. If they are working on normal production the company could earn ₹ 25000 additional contribution to profit in the next year after paying the skilled labour.

Research Staff: ₹ 30000. The research unit will close down after the project has been completed and voluntary retirement pay has already been agreed at ₹ 12,500.

General Overheads: ₹ 20,000. The research unit is apportioned a share of total fixed costs of the business.

The management accountant of the company has presented the following analysis and recommended against continuation since the analysis shows that the company would lose ₹ 25,000 more by continuing the project than by abandoning now.

The managing Director seeks your opinion as the group management accountant about the analysis presented by the Management Accountant.

	Abandon now		Complete
	₹		₹
Sales	-----		1,00,000
Cost to date	75,000	75,000	
Additional costs:			
Material		30,000	
Labour		20,000	
Research Staff	—	30,000	
Overheads	—	20,000	
Loss in contribution	—	25,000	
			200,000
Net Loss	75000		100,000

Notes for Solution

(I.C.W.A. Final)

Relevant and irrelevant to the decision.

Relevant costs: 1. ₹ 2500 is the relevant cost if the project is to be discontinued.

2. ₹ 20,000 on Labour which is to be incurred for the further completion of the project.

3. ₹ 25000 is the opportunity cost if the project is to be completed.

4. ₹ 30000 to the research staff is relevant cost of completion.

5. ₹ 12,500 is the relevant cost if the project is to be abandoned.

Irrelevant Costs: 1. ₹ 30,000 on material as has been already paid for is irrelevant cost.

2. ₹ 75,000 already spend on research and development is irrelevant for decision.

3. ₹ 20,000 on general overheads is an irrelevant cost as it has been apportioned on the project.

Abandon Now: (Cost)		₹
Cost of disposing off the material	=	2,500
Voluntary retirement pay to research staff(agreed)	=	12500
Total :		<u>15,000</u>

Continue: (Cost)		₹
Labour cost for completion	=	20,000
Opportunity cost	=	25,000
Research staff expenditure	=	<u>30,000</u>

	Total	=	75,000
Sale of project on completion		=	100000
Gain on completion		=	25000

So the project should be completed because of net gain of ₹ 25000 after completion otherwise there is a further loss of ₹ 15000.

10. ABC Ltd given you the data relating to product. A whose 10,000 units are produced at the moment.

	₹	Total ₹
Direct Material (per unit)	0.60	6,000
Direct Labour (Per unit)	0.40	4,000
Fixed overheads (per unit)	1.00	10,000
	2.00	20,000
Profit	1.00	10,000
Selling price :	3.00	
Total Sales (₹)		30,000

- (a) (i) A foreign customer approached the company to purchase 5000 units of product at ₹ 1.20 per unit and for this the company has to bear additional shipping costs and duties amounting to ₹ 0.12 per unit.
(ii) A local customer has offered to take 5000 units of the product at ₹ 1.00 unit.

You are required to analyse and tell which one of the orders is to be accepted?

- b) The sales department of the company is of the view that the company can sell more and more units of the product if the price is reduced and present the sales data as:

at ₹ 3.00 per unit	10000 units
at ₹ 2.50 per unit	14000 units
at ₹ 2.20 per unit	19000 units
at ₹ 2.00 per unit	22000 units

Analyse the above proposal through differential cost, differential revenue analysis and recommend a price and sale volume in the benefit of the company.

Ans: $\left[\begin{array}{l} \text{(a) Accept the foreign order addition to total profit} \\ \text{₹ 400 (b) price ₹ 2.20, sales volume 19000 units} \end{array} \right]$

11. Present the following information to show to management.

- (i) The marginal product cost and contribution per unit.
- (ii) The total contribution and profit resulting from each of the following sales mixtures:

Products	₹ (Per unit)
Direct Material A	10
Direct Material B	9
Direct Wages A	3
Direct Wages B	2
Fixed expenses	₹ 800

(Variable expenses are allotted to products at 100% of the direct wages)

Sales Price	₹
A	20
B	15

Sales mixtures:

- (a) 100 units of product A and 200 units of B.
- (b) 150 units of product A and 150 units of B.
- (c) 200 units of product A and 100 units of B

(CIMA – London – Adopted)

Ans:

(i)	marginal cost per unit	Product A – ₹ 16
(ii)		Product B – ₹ 13
	Contribution per unit	Product A - ₹ 4
		Product B - ₹ 2
(iii)	(a) Total contribution – ₹ 800	Profit – Nil
	(b) Total contribution – ₹ 900	Profit – ₹ 100
	(c) Total contribution – ₹ 1000	Profit – ₹ 200

Solutions :

Q.1

Relevant cost	₹
(Per unit) :	
1. Direct material :	10
2. Direct Labour :	8
3. Applied variable factory over heads:	9
4. Saving in applied fixed over heads 25% of 12	3
Total (If manufactured) :	30
Purchase cost (₹)	29

The company should purchase from market as purchase cost is less than relevant manufacturing cost.

Total saving if purchased from market: ₹ (30 – 29)× 6000

$$= ₹ 6000$$

Q2.

	Corn	Broccoli
Sales (₹)	8000	12000
Food material	2000	2500
Direct labour	1200	2000
total variable cost (₹) :	3200	4500
Contribution	4800	7500
P/V ratio	60%	62.5%

Corn is less profitable

Statement of profit /loss if corn is discontinued.

Increase or decrease in contribution (₹) =

Increase in contribution of broccoli	₹
=	75000 × 0.4
=	3000

Decrease in contribution on

Discontinuing corn (₹)	=	4800
Decrease in contribution (₹)	=	1800

Saving in fixed over heads :	$= (100+200)$	$=$	300
Total decrease in contribution (₹)		$=$	1500

The production of corn should not be stopped.

Equipment rent, other allocated cost are not part of decision as these are unavoidable.

Q.3

	Product		
	A	B	C
Quantity(units)	8000	20000	28000
Selling price (₹)	20	15	32
Variable cost	18	11	24
Contribution per unit	2	4	8
Allocate fixed cost (₹)	3	3	3
Profit/loss per unit (₹)	(1)	1	5

- (i) Loss in contribution if production of A is dropped
- $$= ₹ 2 \times 8000$$
- $$= ₹ 16000$$

Fixed cost are irrelevant to the decision

So there is an overall loss of ₹ 16000 if the production of A is dropped.

- (ii) Loss in contribution if A is not produced
- $$= ₹ 2 \times 8000$$
- $$= ₹ 16000$$

To recover the loss in contribution the production of B

should be increased to $= (16000 \div 4)$

$$= 4000 \text{ units}$$

- (iii) The selling price of product A recommended to be as
- Profitable as B $= * \frac{20000 \times 4}{8000} + 18$

$$= ₹ 10+18$$

$$= ₹ 28$$

$$*Contribution + variable cost = [(20000 \times 4) \div 8000] + 18$$

$$(Required) = ₹ 10+18$$

$$= ₹ 28$$

(iv) Additions to contribution on 'D'

$$\text{Introduction the new product (₹) : } (20 - 19.40) \times 24000$$

$$= ₹ 14400$$

$$\text{Contribution foregone} = ₹ 16000$$

$$\text{Total loss in contribution} = ₹ 1600$$

It is not recommended to introduce the new product –D

Q.4

Material cost of the product (₹)	=	400
Variable labour cost (₹)	=	225
Other variable expenses (₹)	=	100
Total variable cost per unit (₹)	=	<u>725</u>

Purchase cost per unit from outside supplier (₹) = 770

- (i) As purchase cost is more than the variable product cost it is not beneficial to purchase the product from outside.
- (ii) If the resources so released can be utilized
Market value of other part to be produced = ₹ 585.

Less :

Material cost	₹ = 200	
Other variable cost		
(a) Labour =	225	
(b) Variable		
Expenses=	<u>100</u>	<u>325</u>
Contribution per unit (₹)		<u>60</u>

Purchase cost per unit of product (offered by supplier) = ₹ 770

Contribution by new product manufactured = ₹ 60

Total purchase cost per unit = ₹ 710

Marginal cost per unit of the product manufacture = ₹ 725

In this case i.e. when resources released can be utilized for production of another product. The company should purchase product from the market.

Q.5

Particular	Product A	Product B	Product C
Unit product (budgeted)	1800	3000	1200
selling price per unit (₹):	60	55	50
Direct material per unit (₹)	20	12	16
Direct labour per unit (₹) :	8	6	4
Variable over heads (₹):	7	13	8
Marginal cost (₹)	35	31	28
Contribution per unit (₹):	25	24	22
Direct labour (hour)	4	3	2
contribution per hour	6.25	8	11
Ranking on the basis of contribution per hour	iii	ii	i

Statement showing allocation of limited resources (labour hours)

Units of product produced	Labour hours required	Balance labour hours
Product – C:1500	3000	18600 – 300=15600
Product – B: 5000	15000	15600 – 15000=600
Product – A 150	600	600 – 600= – – – – –
(600 ÷ 4)		

Profitability statement

₹

Total contribution

Product A = 150×25=3,750

Product B = 5000×24=120000

Product C = 1500×22=33000

		156750
Fixed cost = 10 × (1800 + 3000 + 1200)	=	60000

Profit (₹)	=	96750

Q.6

Level of performance	60%	80%	50%	75%
	('000)	('000)	('000)	('000)
Direct material (₹)	360	480	300	450
Direct labour (₹)	480	640	400	600
Production over heads (variable)(₹)	72	96	60	90
Admn. Overheads (₹)	24	32	20	30
Selling and distribution over heads (variable)(₹)	36	48	30	45
Total variable cost (₹)	972	1296	810	1215

Fixed cost	(₹ '000)
Production over heads =	180
Admn over heads =	100
Selling & distribution =	<u>100</u>

	380	380	380	380
Total Cost	1352	1676	1190	1595
Present sales at 50% working =	990			
Expected sales at 75% capacity =	1800			
Profit/loss (₹) =	(-200) 205			

If continued at 50% capacity loss = ₹ 200000

If discontinued and suspended costs incurred =

(a)	Fixed cost	=	₹ 220000
(b)	Settlement with personal not required	=	₹ 150000
(c)	Maintenance cost	=	₹ 20000

(d) Reopening cost	= ₹ 80000
Total cost	= ₹ 470000

Report:

To: Whom it may concern

Respected sir,

The company at present is working at 50% of capacity, Its total sales are ₹ 990000 and total cost incurred is ₹ 1190000 and so there is a net loss of ₹ 20000 the cost of shut down and reopening is ₹ 470000. It is not in the benefit of the company to shut down and it is further estimated that the company in the coming future will function at 75% of capacity and total sales would be ₹ 1800000 and will earn a profit of ₹ 205000 every year. So in my opinion keeping wider interest of the company, temporary suspending idea should be dropped and company should continue production to save image and earn profit in the near future.

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Cost Accountants

Q.7

	Operating capacity	
	50%	100%
Variable manufacturing cost (₹)	600000	1200000
Variable selling & Distribution cost (₹)	125000	250000
Total variable (₹)	725000	1450000
Fixed cost:		
manufacturing (₹) =	400000	
Selling & distribution (₹)	<u>150000</u>	
	550000	550000
Total cost (₹) =	1275000	2000000
Sales at 50% capacity =	2900000	
Profit (₹) =	<u>1725000</u>	
Variable cost (₹) =	725000	
Variable cost / unit (₹)	$\frac{725000}{50000}$	
	= ₹14.50	

Variable cost excluding variable	= $\frac{600000}{50000}$	]
Selling & distribution	= ₹ 12	

Purchase price offered by foreign customer = ₹ 14

The order of foreign customer is acceptable

Total saving = $(14 - 12) \times 40000$

= ₹ 80000

As the capacity exist and local market can be satisfied, so order should be accepted

Q8 Statement of comparison of total possible contribution.

Particular	Product			
	A	B	C	D
Selling price (₹)	250	325	370	310
Variable cost per unit (₹)	125	160	185	150
Contribution unit (₹)	125	165	185	160
Maximum possible contribution (₹) A=125× 5000, B=165×4000, C=185×3500, D=160×4200	625000	660000	647500	672000

As the machine can produce any of the products so the product with maximum possible contribution should be produced. So machine should produce product D. In producing the product D, it will have to forego the contribution for not producing product B.

So the machine should produce product D and the opportunity cost attached = ₹ 660000

Q.9 Comparative statement for decision making

Abandon now		Continue
	₹	₹
(a) Cost of disposing of material not used.	2500	_____
(b) Voluntary retirement pay agreed.	12500	_____
(c) Labour	_____	20000
(d) Opportunity cost	_____	25000
(e) Research staff expenditure	_____	30000

Total Cost :	15000	75000
Sale price of project	—	100000
Profit / loss	(–15000)	25000

The project should be completed to earn ₹ 25000 in future, otherwise will have to incur a further loss of ₹ 15000

Note: —

Costs which are irrelevant to the decision.

- (i) ₹ 75000 already insures on the project.
- (ii) ₹ 30000 already spent on material.
- (iii) ₹ 20000 general overheads allocated to the project

Q.10

(a)		₹
(i) Direct material (per unit)	=	0.60
Direct labour (per unit)	=	0.40
Additional shipping cost & duties (per unit)	=	0.12
Total marginal cost	=	1.12
Sales price to foreign customer		1.20
Contribution per unit	=	0.08
Total contribution for 5000 units	=	0.08×5000
		= ₹ 400
(ii) Sale price for local customer	=	₹ 1.00
Marginal cost	=	₹ 1.00
Contribution (per unit)	=	₹ 0
Total contribution for 5000 units	=	₹ 0×5000
	=	₹ 0

From the above analysis foreign customers offered should be accepted fixed overheads are irrelevant in the particular decision.

(b) Differential cost analysis.

Schedule showing differential cost and incremental revenue at different price

Price ₹ Per unit	No of units sold	Variable cost ₹	Fixed overheads ₹	Total cost ₹	Differential Cost ₹	Total revenue	Incremental revenue ₹
3.00	10000	10000	10000	20000	—	30000	—
2.50	14000	14000	10000	24000	4000	35000	5000
2.20	19000	19000	10000	29000	5000	41800	6800
2.00	22000	22000	10000	32000	3000	44000	2200

The price ₹ 2.20 per unit where the company can sell 19000 units is beneficial. Here incremental cost is ₹ 5000 and incremental revenue is ₹ 6800.

Q11.

(i)

	Product	
	A	B
Selling price (per unit) ₹	20	15
Direct material (per unit) ₹	10	9
Direct wages (per units) ₹	3	2
Variable Expense (per unit) ₹	3	2
Marginal cost (per units) ₹	16	13
Contribution (per units) ₹	4	2

(ii) Total contribution and profit statement in various product mixes

(a) 100 units of 'A' and 200 units of 'B'

Total contribution = (100 × 4 + 200 × 2)	=	₹ 800
Total fixed Expenses	=	800
Total profit	=	Nil

(b) 150 units of A' and 150 units of B

Total contribution = (150 × 4 + 150 × 2)	=	₹ 900
Total fixed cost	=	₹ 800
Total profit	=	₹ 100

(c) 200 units of A and 100 units of B

Total contribution =(200×4+100×2)	= ₹ 1000
Total fixed	= ₹ 800
Total profit	<u>₹ 200</u>



Formulae useful in project evaluation and investment decisions.

1. Formula to know the instalment of a sum (loan) taken for a certain time period from an institution (Diminishing Balance Method)

Let loan raised = P

Rate of interest per period of return = r %

Period for which loan is raised = n

Instalment of return = I

$$\text{Then } I = \frac{P \times \left(1 + \frac{r}{100}\right)^n \times \left(\frac{r}{100}\right)}{\left(1 + \frac{r}{100}\right)^n - 1}$$

2. Formula to know cumulative value of recurring deposit for a certain period of time.

Let recurring deposit amount = I

Rate of interest per period of deposit = r %

Time period of recurring deposit = n

Cumulative balance after passage of time period n = C

$$\text{Then } C = \frac{I \times \left(\left(1 + \frac{r}{100}\right)^n - 1 \right) \times \left(1 + \frac{r}{100}\right)}{\left(\frac{r}{100}\right)}$$

3. Compounded value of a single investment after a certain time period

Let P be the amount deposited.

Rate of interest per period = r%

Time period = n

Compounded value = C

$$\text{Then } C = P \left(1 + \frac{r}{100}\right)^n$$

4. Present value of an amount receivable after nth time period.

Let amount receivable after a certain time period = A

Rate of interest per period = r %

Time period = n

Present value of amount receivable after the time period = P

$$\text{Then } P = \frac{A}{\left(1 + \frac{r}{100}\right)^n}$$

5. Present value of an amount repeatedly received for a certain time period.

Let repeatedly received amount = I

Rate of interest per period = r %

Time period = n

Present value = P

$$\text{Then } P = \frac{I \times \left(\left(1 + \frac{r}{100} \right)^n - 1 \right)}{\left(1 + \frac{r}{100} \right)^n \times \left(\frac{r}{100} \right)}$$

