

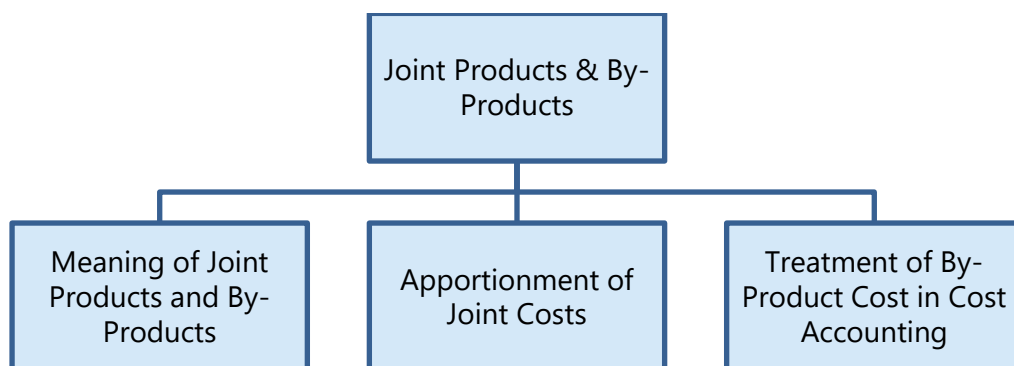
JOINT PRODUCTS AND BY PRODUCTS



LEARNING OUTCOMES

- ◆ Discuss the meaning of Joint products and By products.
- ◆ Differentiate between joint products and by products.
- ◆ Discuss the various methods of apportionment of joint costs to joint products and to by products.
- ◆ State the treatment of by product's cost in cost accounting.

CHAPTER OVERVIEW





1. MEANING OF JOINT PRODUCTS AND BY PRODUCTS

Agricultural product industries, chemical process industries, sugar industries, and extractive industries are some of the industries where two or more products of equal or unequal importance are produced either simultaneously or in the course of processing operation of a main product.

In all such industries, the management is faced with the problems such as, valuation of inventory, pricing of product and income determination, problem of taking decision in matters of further processing of by-products and/or joint products after a certain stage etc. In fact, the various problems relate to

- (i) apportionment of common costs incurred for various products and
- (ii) aspects other than mere apportionment of costs incurred upto the point of separation.

Before taking up the above problems, we first define the various necessary concepts.

(i) Joint Products - Joint products represent **"two or more products separated in the course of the same processing operation** usually requiring further processing, each product being in such proportion that no single product can be designated as a major product".

In other words, two or more products of equal importance, produced, simultaneously from the same process, with each having a significant relative sale value are known as joint products. For example, in the oil industry, gasoline, fuel oil, lubricants, paraffin, coal tar, asphalt and kerosene are all produced from crude petroleum. These are known as joint products.

(ii) By-Products - These are defined as **"products recovered from material discarded in a main process**, or from the production of some major products, where the material value is to be considered at the time of severance from the main product." So in a nutshell By product is a ***product which is recovered incidentally from the material used in the manufacture of main or desired products, such a by-product having either a net realisable value or a usable value which is relatively insignificant in comparison with the saleable value of the main or desired products. By-product may be further processed to***

increase their realisable value Thus by-products emerge as a result of processing operation of another product or they are produced from the scrap or waste of materials of a process. In short a by-product is a secondary or subsidiary product which emanates as a result of manufacture of the main product.

The point at which they are separated from the main product or products is known as split-off point. The expenses of processing are joint till the split –off point.

Split of Point – this is a point in a production process where joint products emerging from the process gets separately identifiable.

Split of Point has its importance in the joint product costing as joint cost incurred up to this point only and needs to be borne jointly by the products emerging from the common process.

Any cost incurred after Split of Point is a product specific cost and to be borne by the product concerned.

Examples of by-products are molasses in the manufacture of sugar, tar, ammonia and benzole obtained on carbonisation of coal and glycerin obtained in the manufacture of soap.

Distinction between Joint-Product and By-Product - The main points of distinction as apparent from the definitions of Joint Products and By-Products are:

- (a) Joint products are of equal importance whereas by-products are of small economic value.
- (b) Joint products are produced simultaneously but the by-products are produced incidentally in addition to the main products.

(iii) Co-Products - Joint products and co-products are used synonymously in common parlance, but strictly speaking a distinction can be made between two. Co-products may be defined as **two or more products which are contemporary but do not emerge necessarily from the same material in the same process**. For instance, wheat and gram produced in two separate farms with separate processing of cultivation are the co-products. Similarly, timber boards made from different trees are co-products.



2. APPORTIONMENT OF JOINT COSTS

Joint product costs occur in many industries such as petroleum, oil refinery, textiles, dairy, food processing and many other process industries. The management of business concerns require accurate and reliable cost information related with the joint products to make managerial decisions such as to process further or to sell at split-off stage. To arrive at either decision, it is necessary to know the share of joint costs to be apportioned to the different joint products.

Joint costs are the expenditures incurred upto the point of separation i.e. split-off point. Joint Cost is the resources spent by a manufacturer/producer for producing more than one product from processing a common input. These costs include raw material, labour, power, fuel, depreciation and overhead costs towards the production of the joint products.

The main problem faced in the case of joint products/ by-products is the apportionment of this joint costs to joint products/ or by products. For costs incurred after the split off point there is no problem, as these costs can be directly allocated to individual joint products or by-products.



3. METHODS OF APPORTIONMENT OF JOINT COST TO JOINT PRODUCTS

Proper apportionment of joint cost over the joint products is of considerable importance, as this affects (a) Valuation of closing inventory; (b) Pricing of products; and (c) Profit or loss on the sale of different products. **As the relations between materials, processes and joint products are complex and unobservable, there is no way to determine the cost of the different production factors used in the processes for the production of each of the joint products. Therefore, the costs incurred in the manufacture of each of the joint products cannot be correctly identified.**

It can only be apportioned to the joint products by using some rational methods

The commonly used methods for apportioning total process costs upto the point of separation over the joint products are as follows:

- (i) **Physical Units Method**
- (ii) **Net Realisable Value at split-off point**
- (iii) **Using Technical Estimates**

Some other methods, which managers may also use for making decisions are:

- (i) Market value at the point of separation
- (ii) Market value after further processing
- (iii) Average unit cost method
- (iv) Contribution margin method

(i) Physical Unit Method: This method is based on the assumption that the joint products are capable of being measured in the same units. Accordingly, **joint costs here are apportioned on the basis of some physical base, such as weight, numbers etc.** In other words, the basis used for apportioning joint cost over the joint products is the physical volume the joint products at the point of separation. Any loss arises during the joint production process is also apportioned over the products on the same basis.. ***In situation where physical units are different, the joint products must be converted to a common unit of measurement. In case, the same cannot be converted to a common unit of measurement, this method cannot be applied.*** The main defect of this method is that it gives equal importance and value to all the joint products.

This method of apportioning is mostly followed when sale price of all the products is uniform.

ILLUSTRATION 1

A coke manufacturing company produces the following products by using 5,000 tonnes of coal @ ₹1,100 per tonne into a common process.

Coke	3,500 tonnes
Tar	1,200 tonnes
Sulphate of ammonia	52 tonnes
Benzol	48 tonnes

PREPARE a statement apportioning the joint cost amongst the products on the basis of the physical unit method.

SOLUTION

	Products					
	Coke	Tar	Sulphate of ammonia	Benzole	Wastage	Total
Output (in tonne)	3,500	1,200	52	48	200	5,000
Wastage (in tonne) (Refer Note-1)	146	50	2	2	(200)	
Input (in tonne)	3,646	1,250	54	50	-	5,000
Share of Joint Cost @ ₹1,100 per tonne (in ₹)	40,10,600	13,75,000	59,400	55,000	-	55,00,000

Note-1: Apportionment of wastage of 200 tonnes over the four products on the basis of physical weights (3,500:1,200:52:48) is as follows:

$$\text{Coke:} \quad \frac{200}{4,800} \times 3,500 \text{ tonnes} = 146 \text{ tonnes}$$

$$\text{Tar :} \quad \frac{200}{4,800} \times 1,200 \text{ tonnes} = 50 \text{ tonnes}$$

$$\text{Sulphate of ammonia:} \quad \frac{200}{4,800} \times 52 \text{ tonnes} = 2 \text{ tonnes}$$

$$\text{Benzole :} \quad \frac{200}{4,800} \times 48 \text{ tonnes} = 2 \text{ tonnes}$$

(ii) Net Realisable Value at Split-off Point Method: To arrive at the sales value at the split-off point, following are deducted from the sales value of joint products at final stage i.e. after processing:

(i) directly attributable Selling and distribution expenses like freight, royalty, commission, etc. and

(ii) Post split- off processing cost.

This method has advantage as relative sales value serves as a proxy for relative benefit received by each product from the joint cost. When selling prices for all products exist at split off, the sales value at split off method is the preferred technique. It is a relatively simple technique that depends on a common basis for cost allocation – revenues

The resultant figure so obtained is known as net realisable value of joint products. Joint costs are apportioned in the ratio of net realisable value.

	Product- A Amount (₹)	Product- B Amount (₹)	Product- C Amount (₹)
Sales Value (Units after processing × Selling Price)	xxx	xxx	xxx
Less: Profit Margin	(xxx)	(xxx)	(xxx)
Less: Selling & Distribution costs	(xxx)	(xxx)	(xxx)
Less: Post split-off cost	(xxx)	(xxx)	(xxx)
Net Realisable Value	xxx	xxx	xxx

Example -1: An entity incurs a joint cost of ₹ 64,500 in producing two products A (200 units) and B (200 units) and earns a sales revenue of ₹ 86,000 by selling @ ₹ 170 per unit of product A and product B @ ₹ 260 per unit. Further processing costs for products A and B are ₹ 4,000 and ₹ 32,000 respectively the Joint cost can be apportioned to products A and B as follows:

	Product- A Amount (₹)	Product- B Amount (₹)
Sales Value	34,000 (₹170 × 200 units)	52,000 (₹260 × 200 units)
Less: Post split-off cost (Further processing cost)	(4,000)	(32,000)
Net Realisable Value	30,000	20,000
Apportionment of Joint Cost of ₹64,500 in ratio of 3:2	38,700	25,800

The net realisable value at split-off point method is widely used in the industries. **This method is used when the realisable value of joint products at split-off is not known.**

(iii) Using Technical Estimates: This method uses technical estimates to apportion the joint costs over the joint products. This method is used when the result obtained by the above methods does not match with the resources consumed by joint products or the realisable value of the joint products are not readily available.

Other Methods

The followings are the methods which are used by management for taking managerial decisions:

(i) Market value at the point of separation: This method is used for the apportionment of joint costs to joint products upto the split off point. It is difficult to apply this method if the market value of the products at the point of separation is not available. **It is a useful method when the realisable value of joint products at split-off (point of separation) is known and where further processing costs are incurred disproportionately.**

To determine the apportionment of joint costs over joint products, a factor known as multiplying factor is determined. This multiplying factor on multiplication with the sales values of each joint product gives rise to the proportion of joint cost.

$$\text{Multiply in factor} : \frac{\text{Joint Cost}}{\text{Total Sales Revenue}} \times 100$$

Total Sales Revenue is sum of production quantity multiplied by the market price for each of the joint products.

Example – 2: An entity incurs a joint cost of ₹ 64,500 in producing two products A (200 units) and B (200 units) and earns a sales revenue of ₹ 86,000 by selling @ ₹ 170 per unit of product A and product B @ ₹ 260 per unit.

The multiplying factor in this case is obtained by dividing the total joint cost by total sales revenue and finally multiplying the figure so obtained by 100. The multiplying factor based on the data can be computed as follows:

$$\text{Multiplying Factor: } \frac{₹ 64,500}{₹ 86,000} \times 100 = 75\%$$

$$\begin{aligned} \text{Joint cost apportioned over product A} &= \text{Sales revenue of product A} \times 75\% \\ &= ₹ 34,000 \times 75\% = ₹ 25,500 \end{aligned}$$

$$\begin{aligned} \text{Joint cost apportioned over product B} &= \text{Sales revenue of product B} \times 75\% \\ &= ₹ 52,000 \times 75\% = ₹ 39,000 \end{aligned}$$

Alternatively - This joint cost may be apportioned in the ratio of sales values of different joint products.

(ii) Market value after further processing: Here the basis of apportionment of joint cost is the total sales value of finished products and involves the same principle as discussed above.

Example – 3: Suppose that in the example – 2 given above, if sales prices of products A and B after further processing are ₹ 200 and ₹ 300 respectively the joint cost apportioned over Products A and B is as follows:

The pre-separation costs of ₹ 64,500 will be apportioned in the ratio of (2: 3) as follows:

Market sales value after further processing

	(₹)
A : 200 units × ₹ 200	= 40,000
B : 200 units × ₹ 300	= <u>60,000</u>
	<u>1,00,000</u>

Joint cost apportionment:

$$\begin{aligned} \text{A} &= ₹ 64,500 \times \frac{₹ 40,000}{₹ 1,00,000} = ₹ 25,800 \\ \text{B} &= ₹ 64,500 \times \frac{₹ 60,000}{₹ 1,00,000} = ₹ 38,700 \end{aligned}$$

The use of this method is unfair where further processing costs after the point of separation are disproportionate or when all the joint products are not subjected to further processing. The net realisable value method which is discussed as above overcomes the shortcoming of this method.

(iii) Average Unit Cost Method: Under this method, total process cost (upto the point of separation) is divided by total units of joint products produced. On division average cost per unit of production is obtained.

Average unit cost = Total process cost (upto the point of separation) ÷ Total units of joint product produced.

This is a simple method. The effect of application of this method is that **all joint products will have uniform cost per unit**. If this method is used as the basis for price fixation, then all the products may have more or less the same price. Under this method customers of high quality items are benefitted as they have to pay less price on their purchase.

[Note: Students may note that the physical unit method also follows the same steps of calculation as followed under Average unit cost method, ultimately giving the same outcome.]

ILLUSTRATION 2

FIND OUT the cost of joint products A, B and C using average unit cost method from the following data:

(a) Pre-separation Joint Cost ₹ 60,000

(b) Production data:

Products	Units produced
A	500
B	200
C	<u>300</u>
	<u>1,000</u>

SOLUTION

$$\text{Average cost per unit} = \frac{\text{Total joint costs}}{\text{Units produced}} = \frac{\text{₹ 60,000}}{1,000 \text{ units}} = \text{₹ 60}$$

The joint costs apportioned @ ₹ 60 are as follows:

Products	Units	Cost per unit (₹)	Value (₹)
A	500	60	30,000
B	200	60	12,000
C	300	60	18,000
			60,000

(iv) Contribution Margin Method: According to this method, joint costs are segregated into two parts - variable and fixed. The variable costs are apportioned over the joint products on the basis of units produced (average method) or physical quantities. In case the products are further processed after the point of separation, then all variable cost incurred be added to the variable costs determined earlier. In this way total variable cost is arrived which is deducted from their respective sales values to ascertain their contribution. The fixed costs are then apportioned over the joint products on the basis of the contribution ratios.

Summary of different types of method of apportioning joint costs that can be used under certain circumstances:

Physical Unit Method	When sale price of all the products is uniform.
Net Realisable Value (NRV) at Split-off Point Method	When the realisable value of joint products at split-off is not known.
Technical Estimates	When the result obtained by Net Realisable Value (NRV) at Split-off Point Method does not match with the resources consumed by joint products.
Market value at the point of separation	Where further processing costs are incurred disproportionately.
Market value after further processing	Where further processing costs after the point of separation are proportionate and all the joint products are subject to further processing.
Average Unit Cost Method	When units produced have same unit.

ILLUSTRATION 3

FIND OUT the cost of joint products A and B using contribution margin method from the following data :

Sales

A : 100 kg @ ₹ 60 per kg.

B : 120 kg @ ₹ 30 per kg.

Joint costs

Marginal cost ₹ 4,400

Fixed cost ₹ 3,900

SOLUTION

The marginal cost (variable cost) of ₹ 4,400 is apportioned over the joint products A and B in the ratio of their physical quantity i.e 100 : 120

$$\text{Marginal cost for Product A : ₹ 4,400} \times \frac{100}{220} = ₹ 2,000$$

$$\text{Marginal cost for Product B : ₹ 4,400} \times \frac{120}{220} = ₹ 2,400$$

The fixed cost of ₹ 3,900 is apportioned over the joint products A and B in the ratio of their contribution margin i.e. 40 : 12

(Refer to working note)

$$\text{Product A : ₹ 3,900} \times \frac{40}{52} = ₹ 3,000$$

$$\text{Product B : ₹ 3,900} \times \frac{12}{52} = ₹ 900$$

Working Note:

Computation of contribution margin ratio

Products	Sales revenue	Marginal cost	Contribution
	(₹)	(₹)	(₹)
A	6,000	2,000	4,000
B	3,600	2,400 (Refer to above)	1,200

Contribution ratio is 40 : 12

ILLUSTRATION 4

Inorganic Chemicals purchases salt and processes it into more refined products such as Caustic Soda, Chlorine and PVC. In the month of July, Inorganic Chemicals purchased Salt for ₹ 40,000. Conversion cost of ₹ 60,000 were incurred upto the split off point, at which time two sealable products were produced. Chlorine can be further processed into PVC.

The July production and sales information is as follows:

	Production (in tonne)	Sales Quantity (in tonne)	Selling price per tonne (₹)
Caustic Soda	1,200	1,200	50
Chlorine	800	—	—
PVC	500	500	200

All 800 tonnes of Chlorine were further processed, at an incremental cost of ₹ 20,000 to yield 500 tonnes of PVC. There was no beginning or ending inventories of Caustic Soda, Chlorine or PVC in July.

There is active market for Chlorine. Inorganic Chemicals could have sold all its July production of Chlorine at ₹ 75 per tonne.

Required :

- (1) *SHOW how joint cost of ₹1,00,000 would be apportioned between Caustic Soda and Chlorine under each of following methods:*
 - (a) *sales value at split- off point ;*
 - (b) *physical unit method, and*
 - (c) *estimated net realisable value.*
- (2) *Lifetime Swimming Pool Products offers to purchase 800 tonnes of Chlorine in August at ₹ 75 per tonne. This sale of Chlorine would mean that no PVC would be produced in August. EXPLAIN how the acceptance of this offer for the month of August would affect operating income?*

SOLUTION**1. (a) Sales value at split-off point method**

Products	Sales (in Tonne)	Selling Price per Tonne (₹)	Sales Revenue (₹)	Joint Cost Apportioned (₹)
Caustic Soda	1,200	50	60,000	50,000
Chlorine	800	75	60,000	50,000
			1,20,000	1,00,000

Apportionment of joint cost

$$= \frac{\text{Total joint cost}}{\text{Total sale value}} \times \text{Sale revenue of each product}$$

$$\begin{aligned} \text{Joint cost apportioned to Caustic Soda} &= \frac{\text{₹ } 1,00,000}{\text{₹ } 1,20,000} \times \text{₹ } 60,000 \\ &= \text{₹ } 50,000 \end{aligned}$$

$$\begin{aligned} \text{Joint cost apportioned to Chlorine} &= \frac{\text{₹ } 1,00,000}{\text{₹ } 1,20,000} \times \text{₹ } 60,000 \\ &= \text{₹ } 50,000 \end{aligned}$$

(b) Physical measure method

Products	Sales (in Tonne)	Joint Cost Apportioned (₹)
Caustic Soda	1,200	60,000
Chlorine	800	40,000
		1,00,000

Apportioned joint cost

$$= \frac{\text{Total joint cost}}{\text{Total physical value}} \times \text{Physical units of each product}$$

Joint cost apportioned to Caustic Soda

$$\begin{aligned} &= \frac{\text{₹ } 1,00,000}{2,000 \text{ tonnes}} \times 1,200 \text{ tonnes} \\ &= \text{₹ } 60,000 \end{aligned}$$

$$\begin{aligned}\text{Joint cost apportioned to chlorine} &= \frac{\text{₹ } 1,00,000}{2,000 \text{ tonnes}} \times 800 \text{ tonnes} \\ &= \text{₹ } 40,000\end{aligned}$$

(c) **Estimated net realisable value method:**

	Caustic Soda Amount (₹)	Chlorine Amount (₹)
Sales Value	60,000 (₹50 × 1,200 tonnes)	1,00,000 (₹200 × 500 tonnes)
Less: Post split-off cost (Further processing cost)	-	(20,000)
Net Realisable Value	60,000	80,000
Apportionment of Joint Cost of ₹1,00,000 in ratio of 3:4	42,857	57,143

2. Incremental revenue from further processing of Chlorine into PVC
 (500 tonnes × ₹200 – 800 tonnes × ₹75) ₹40,000
 Less : Incremental cost of further processing
 of Chlorine into PVC ₹20,000
 Incremental operating income from further processing ₹20,000

The operating income of Inorganic Chemicals will be reduced by ₹20,000 in August if it sells 800 tonnes of Chlorine to Lifetime Swimming Pool Products, instead of further processing of Chlorine into PVC for sale.



4. METHODS OF APPORTIONMENT OF JOINT COST TO BY PRODUCTS

The following methods may be adopted for the accounting of by-products and arriving at the cost of production of the main product:

- (i) **Net Realisable Value method:** The realisation on **the disposal of the by-product may be deducted from the total cost of production** so as to arrive at the cost of the main product. For example, the amount realised by the sale of molasses in a sugar factory goes to reduce the cost of sugar produced in the factory.

When the by-product requires some additional processing and expenses are incurred in making it saleable to the best advantage of the concern, the expenses so incurred should be deducted from the total value realised from the sale of the by-product and only the net realisations should be deducted from the total cost of production to arrive at the cost of production of the main product. Separate accounts should be maintained for collecting additional expenses incurred on:

- (a) further processing of the by-product, and
- (b) selling, distribution and administration expenses attributable to the by-product.

(ii) Standard cost in Technical Estimates: By-products may be valued at standard costs. The standard may be determined by averaging costs recorded in the past and making technical estimates of the number of units of original raw material going into the main product and the number forming the by-product or by adopting some other consistent basis.

This method may be adopted where the by-product is not saleable in the condition in which it emerges or comparative prices of similar products are not available.

(iii) Comparative price: Under this method, the value of the by-product is ascertained with reference to the price of a similar or an alternative material.

Suppose in a large automobile plant, a blast furnace not only produces the steel required for the car bodies but also produces gas which is utilised in the factory. This gas can be valued at the price which would have been paid to a gas company if the factory were to buy it from outside sources.

(iv) Re-use basis: In some cases, the by-product may be of such a nature that it can be reprocessed in the same process as part of the input of the process. In that case the value put on the by-product should be same as that of the materials introduced into the process. If, however, the by-product can be put into an earlier process only, the value should be the same as for the materials introduced into the process.



5. TREATMENT OF BY-PRODUCT COST IN COST ACCOUNTING

By-product cost can be dealt in cost accounting in the following ways:

(a) When they are of small total value: When the by-products are of small total value, the amount realised from their sale **may be dealt in any one the following two ways:**

1. The sales value of the by-products may be **credited to the Costing Profit and Loss Account** and no credit be given in the Cost Accounts. The credit to the Costing Profit and Loss Account here is treated either as miscellaneous income or as additional sales revenue.
2. The sale proceeds of the by-product may be **treated as deductions from the total costs**. The sale proceeds in fact should be deducted either from the production cost or from the cost of sales.

(b) When the by-products are of considerable total value: Where by-products are of considerable total value, **they may be regarded as joint products rather than as by-products**. To determine exact cost of by-products the costs incurred upto the point of separation, should be apportioned over by-products and joint products by using a logical basis. In this case, the joint costs may be divided over joint products and by-products by using relative market values; physical output method (at the point of split off) or ultimate selling prices (if sold).

(c) Where they require further processing: In this case, the net realisable value of the by-product at the split-off point may be arrived at by subtracting the further processing cost from the realisable value of by-products.

If total sales value of by-products at split-off point is small, it may be treated as per the provisions discussed above under (a).

In the contrary case, the amount realised from the sale of by-products will be considerable and thus it may be treated as discussed under (b).

SUMMARY

- ♦ **Joint Products.** Two or more products of equal importance, produced, simultaneously from the same process, with each having a significant relative sale value are known as joint products.
- ♦ **Co-Products.** Two or more products which are contemporary but do not emerge necessarily from the same material in the same process.
- ♦ **By-Products.** Products recovered from material discarded in a main process, or from the production of some major products.
- ♦ **Methods of apportioning joint cost over joint products:**

The commonly used methods for apportioning total process costs upto the point of separation over the joint products are as follows:

 - (i) Physical Units Method
 - (ii) Net Realisable Value at split-off point
 - (iii) Using Technical Estimates

Some other methods, which managers may also use for making decisions are:

 - (i) Market value at the point of separation
 - (ii) Market value after further processing
 - (iii) Average unit cost method
 - (iv) Contribution margin method
- ♦ **Methods of apportioning joint cost over by-products:**
 - (i) **Net Realisable Value Method-** The realisation on the disposal of the by-product may be deducted from the total cost of production so as to arrive at the cost of the main product.
 - (ii) **Standard cost in technical estimates-** The standard may be determined by averaging costs recorded in the past and making technical estimates of the number of units of original raw material going into the main product and the number forming the by-product or by adopting some other consistent basis.

This method may be adopted where the by-product is not saleable in the condition in which it emerges or comparative prices of similar products are not available.

- (iii) **Comparative price-** Value of the by-product is ascertained with reference to the price of a similar or an alternative material.
- (iv) **Re-use basis-** The value put on the by-product should be same as that of the materials introduced into the process.

♦ **Treatment of By-Product Cost in Cost-Accounting**

(i) **When they are of small total value:**

1. The sales value of the by-products **may be credited to the Profit and Loss Account** and no credit be given in the Cost Accounts. The credit to the Profit and Loss Account here is treated either as miscellaneous income or as additional sales revenue.
2. The sale proceeds of the by-product **may be treated as deductions from the total costs.** The sale proceeds in fact should be deducted either from the production cost or from the cost of sales.

(ii) **When the by-products are of considerable total value - The joint costs may be divided over joint products and by-products** by using relative market values; physical output method (at the point of split off) or ultimate selling prices (if sold).

(iii) **Where they require further processing** -The net realisable value of the by-product at the split-off point may be arrived at by subtracting the further processing cost from the realisable value of by-products.

If total sales value of by-products at split-off point is small, it may be treated as per the provisions discussed above under (i).

In the contrary case, the amount realised from the sale of by-products will be considerable and thus it may be treated as discussed under (ii).

TEST YOUR KNOWLEDGE

Multiple Choice Questions (MCQs)

1. *In sugar manufacturing industries molasses is also produced along with sugar. Molasses may be of smaller value as compared with the value of sugar and is known as:*
 - (a) *Common product*
 - (b) *By- product*
 - (c) *Joint product*
 - (d) *None of them*
2. *Method of apportioning joint costs on the basis of output of each joint product at the point of split off is:*
 - (a) *Sales value method*
 - (b) *Physical unit method*
 - (c) *Average cost method*
 - (d) *Marginal cost and contribution method*
3. *In the Net realisable value method, for apportioning joint costs over the joint products, the basis of apportionment would be:*
 - (a) *Selling price per unit of each of the joint products*
 - (b) *Selling price multiplied by units sold of each of the joint products*
 - (c) *Sales value of each joint product less further processing costs of individual products*
 - (d) *Both (b) and (c)*
4. *The main purpose of accounting of joint products and by- products is to:*
 - (a) *Determine the opportunity cost*
 - (b) *Determine the replacement cost*
 - (c) *Determine profit or loss on each product line*
 - (d) *None of the above*

5. *Under net realizable value method of apportioning joint costs to joint products, the selling & distribution cost is:*
 - (a) *Added to joint cost*
 - (b) *Deducted from further processing cost*
 - (c) *Deducted from sales value*
 - (d) *Ignored*
6. *Which of the following is a co-product:*
 - (a) *Diesel and Petrol in an oil refinery*
 - (b) *Edible oils and oil cakes*
 - (c) *Curd and butter in a dairy*
 - (d) *Mustard oil and Sunflower oil in an oil processing company.*
7. *Which of the following is an example of by-product*
 - (a) *Diesel and Petrol in an oil refinery*
 - (b) *Edible oils and oil cakes*
 - (c) *Curd and butter in a dairy*
 - (d) *Mustard seeds and mustard oil.*
8. *Which of following method can be used when the joint products are of unequal quantity and used for captive consumption:*
 - (a) *Technical estimates, using market value of similar goods*
 - (b) *Net Realisable value method*
 - (c) *Physical Units method*
 - (d) *Market value at split-off method.*
9. *Which of the following statement is not correct in relation to Co-products:*
 - (a) *Co-products may also have joint products*
 - (b) *Costing for co-products are done according to process costing method*

- (c) Co-products do not have any by-products
 - (d) Co-products are treated as a separate cost object for costing purpose.
10. When a by-product does not have any realisable value, the cost of by-product is:
- (a) Transferred to Costing Profit & Loss A/c
 - (b) By-product cost is borne by the good units
 - (c) By-product cost is ignored
 - (d) By-product cost is determined taking value of similar goods
11. SG Ltd manufactures two products from a joint milling process. The two products developed are Mine support (MS) and Commercial building (CB). A standard production run incurs joint costs of ₹ 1,00,000 and results in 60,000 units of MS and 90,000 units of CB. Each MS sells for ₹ 200 per unit, and each CB sells for ₹ 450 per unit.
- Assuming no further processing work is done after the split-off point, the amount of joint cost allocated to Commercial building (CB) on a physical quantity allocation basis would be:
- (a) ₹ 60,000.
 - (b) ₹ 180,000.
 - (c) ₹ 225,000.
 - (d) ₹ 120,000.
12. Kay Company manufactures two hair care lotions, Livi and Sili, out of a joint process. The joint (common) costs incurred are ₹ 6,30,000 for a standard production run that generates 1,80,000 gallons of Livi and 1,20,000 gallons of Sili. Livi sells for ₹ 240 per gallon, and Sili sells for ₹ 390 per gallon.
- If additional processing costs beyond the split-off point are ₹ 140 per gallon for Livi and ₹ 90 per gallon for Sili, the amount of joint cost of each production run allocated to Livi on a physical-quantity basis is:
- (a) ₹ 340,000.
 - (b) ₹ 378,000.

- (c) ₹ 232,000.
 - (d) ₹ 580,000.
13. *For the purpose of allocating joint costs to joint products, the sales price at point of sale, reduced by cost to complete after split-off, is assumed to be equal to the:*
- (a) *Joint costs*
 - (b) *Sales price less a normal profit margin at point of sale*
 - (c) *Net sales value at split off*
 - (d) *Total costs.*

Theoretical Questions

1. *DISTINGUISH between Joint products and By-products.*
2. *DISCUSS the treatment of byproduct cost in Cost Accounting.*
3. *How apportionment of joint costs upto the point of separation amongst the joint products using net realizable value method is done? DISCUSS.*
4. *DESCRIBE briefly, how joint costs upto the point of separation may be apportioned amongst the joint products under the following methods:*
 - (i) *Average unit cost method*
 - (ii) *Contribution margin method*
 - (iii) *Market value at the point of separation*
 - (iv) *Market value after further processing*
 - (v) *Net realizable value method.*

Practical Problems

1. *Smile company produces two main products and a by-product out of a joint process. The ratio of output quantities to input quantities of direct material used in the joint process remains consistent on yearly basis. Company has employed the physical volume method to allocate joint production costs to the main products. The net realizable value of the by-product is used to reduce the joint production costs before the joint costs are allocated to the*

main products. Details of company's operation are given in the table below. During the month, company incurred joint production costs of ₹ 10,00,000/- The main products are not marketable at the split off point and thus have to be processed further.

Particulars	Product-A	Product-B	By product
Monthly output in kg.	60,000	1,20,000	50,000
Selling price per kg.	₹ 50	₹ 30	₹ 5
Process costs	₹ 2,00,000	₹ 3,00,000	

FIND OUT the amount of joint product cost that Smile company would allocate to the product-B by using the physical volume method to allocate joint production costs?

2. Sun-moon Ltd. produces and sells the following products:

Products	Units	Selling price at split-off point (₹)	Selling price after further processing (₹)
A	2,00,000	17	25
B	30,000	13	17
C	25,000	8	12
D	20,000	10	-
E	75,000	14	20

Raw material costs ₹35,90,000 and other manufacturing expenses cost ₹ 5,47,000 in the manufacturing process which are absorbed on the products on the basis of their 'Net realisable value'. The further processing costs of A, B, C and E are ₹ 12,50,000; ₹ 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 the coming year:

- Statement showing income forecast of the company assuming that none of its products are to be further processed.
- Statement showing income 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 maximise its profits? If yes, then submit a statement showing income forecast arising out of adoption of that plan.

3. 'Buttery Butter' is engaged in the production of Buttermilk, Butter and Ghee. It purchases processed cream and let it through the process of churning until it separates into buttermilk and butter. For the month of January, 'Buttery Butter' purchased 50 Kilolitre processed cream @ ₹ 100 per 1000 ml. Conversion cost of ₹ 1,00,000 were incurred up-to the split off point, where two saleable products were produced i.e. buttermilk and butter. Butter can be further processed into Ghee.

The January production and sales information is as follows:

Products	Production (in Kilolitre/tonne)	Sales Quantity (in Kilolitre/tonne)	Selling price per Litre/Kg (₹)
Buttermilk	28	28	30
Butter	20	—	—
Ghee	16	16	480

All 20 tonne of butter were further processed at an incremental cost of ₹ 1,20,000 to yield 16 Kilolitre of Ghee. There was no opening or closing inventories of buttermilk, butter or ghee in the month of January.

Required:

- SHOW how joint cost would be apportioned between Buttermilk and Butter under Estimated Net Realisable Value method.
 - 'Healthy Bones' offers to purchase 20 tonne of butter in February at ₹ 360 per kg. In case 'Buttery Butter' accepts this offer, no Ghee would be produced in February. SUGGEST whether 'Buttery Butter' shall accept the offer affecting its operating income or further process butter to make Ghee itself?
4. NN Manufacturing company uses joint production process that produces three products at the split off point. Joint productions costs during September were ₹ 8,40,000. Product information for September was as follows:

Particulars	Product A	Product B	Product C
Units produced	1,500	3,000	4,500
Units sold	2,000	6,000	7,500
Sales prices:			
At the split-off	₹ 100		
After further processing	₹ 150	₹ 175	₹ 50
Costs to process after split-off	₹ 1,50,000	₹ 1,50,000	₹ 1,50,000

Assume that product C is treated as a by-product and the company accounts for the by-product at net realizable value as a reduction of joint cost. Assume also that Product B&C must be processed further before they can be sold. FIND OUT the total cost of Product A in September if joint cost allocation is based on net realizable values?

5. RST Limited produces three joint products X, Y and Z. The products are processed further. Pre-separation costs are apportioned on the basis of weight of output of each joint product. The following data are provided for a particular month:

Cost incurred up to separation point: ₹ 10,000

	Product X	Product Y	Product Z
Output (in Litre)	100	70	80
	₹	₹	₹
Cost incurred after separation point	2,000	1,200	800

Selling Price per Litre:

After further processing	50	80	60
At pre-separation point (estimated)	25	70	45

You are required to:

- Prepare a statement showing profit or loss made by each product after further processing using the presently adopted method of apportionment of pre-separation cost.
- Advise the management whether, on purely financial consideration, the three products are to be processed further or not.

6. OPR Ltd. purchases crude vegetable oil. It does refining of the same. The refining process results in four products at the split-off point - S, P, N and A. Product 'A' is fully processed at the split-off point. Product S, P and N can be individually further refined into SK, PM, and NL respectively. The joint cost of purchasing the crude vegetable oil and processing it were ₹ 40,000 which is apportioned on the basis of Sales Value at split-off point. Other details are as follows:

Product	Further processing costs (₹)	Sales at split-off point (₹)	Sales after further processing (₹)
S	80,000	20,000	1,20,000
P	32,000	12,000	40,000
N	36,000	28,000	48,000
A	-	20,000	-

You are required to identify the products which can be further processed for maximizing profits and make suitable suggestions.

ANSWERS/ SOLUTIONS

Answers to the MCQs

1.	(b)	2.	(b)	3.	(d)	4.	(c)	5.	(c)	6.	(d)
7.	(b)	8.	(a)	9.	(c)	10.	(b)	11.	(a)	12.	(b)
13.	(c)										

Answers to the Theoretical Questions

1. Please refer paragraph 1
2. Please refer paragraph 5
3. Please refer paragraph 3
4. Please refer paragraph 3

Answers to the Practical Problems

1. Calculation of Net joint costs to be allocated:

Particulars	Amount (₹)
Joint Costs	10,00,000
Less: Net Realizable value of by-product (50,000×5)	2,50,000
Net joint costs to be allocated	7,50,000

Therefore, amount of joint product cost that Smile company would allocate to the product-B by using the physical volume method to allocate joint production costs:

$$= \frac{\text{Physical quantity of Product-B}}{\text{Total Quantity}} \times \text{Net joint costs to be allocated}$$

$$= \frac{1,20,000 \text{ units}}{1,80,000 \text{ units}} \times ₹7,50,000 = ₹5,00,000$$

2. Working Note:

Apportionment of joint costs on the basis of Net Realisable Value method

Products	Sales Value (₹)	Post separation Cost (₹)	Net Realisable Value (₹)	Apportioned Cost (₹)
A	50,00,000 (2,00,000 units × ₹ 25)	12,50,000	37,50,000	26,25,000
B	5,10,000 (30,000 units × ₹ 17)	1,50,000	3,60,000	2,52,000
C	3,00,000 (25,000 units × ₹ 12)	50,000	2,50,000	1,75,000
D	2,00,000 (20,000 units × ₹ 10)	—	2,00,000	1,40,000
E	15,00,000 (75,000 units × ₹ 20)	1,50,000	13,50,000	9,45,000
			59,10,000	41,37,000

Total joint cost = Raw material costs + Manufacturing expenses

$$= ₹ 35,90,000 + ₹ 5,47,000 = ₹ 41,37,000$$

Apportioned joint cost

$$= \frac{\text{Total joint cost}}{\text{Total net realisable value}} \times \text{Net realisable value of each product}$$

Apportioned joint cost for Product A

$$= \frac{₹ 41,37,000}{₹ 59,10,000} \times ₹ 37,50,000 = ₹ 26,25,000$$

Similarly, the apportioned joint cost for products B, C, D and E are ₹ 2,52,000, ₹ 1,75,000, ₹ 1,40,000 and ₹ 9,45,000 respectively.

(a) Statement showing income forecast of the company assuming that none of its products are further processed

	Products					Total (₹)
	A (₹)	B (₹)	C (₹)	D (₹)	E (₹)	
Sales revenue	34,00,000 (₹17 × 2,00,000)	3,90,000 (₹13 × 30,000)	2,00,000 (₹8 × 25,000)	2,00,000 (₹10 × 20,000)	10,50,000 (₹14 × 75,000)	52,40,000
Less: Apportioned Costs (Refer Working note)	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000	41,37,000
	7,75,000	1,38,000	25,000	60,000	1,05,000	11,03,000
Less: Fixed Cost						4,73,000
Profit						6,30,000

- (b) Statement showing income forecast of the company: assuming that products A, B, C and E are further processed (Refer to working note)

	Products					Total (₹)
	A (₹)	B (₹)	C (₹)	D (₹)	E (₹)	
A. Sales revenue	50,00,000	5,10,000	3,00,000	2,00,000	15,00,000	75,10,000
B. Apportioned Costs	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000	41,37,000
C. Further processing cost	12,50,000	1,50,000	50,000	-	1,50,000	16,00,000
D. Total processing cost (B+ C)	38,75,000	4,02,000	2,25,000	1,40,000	10,95,000	57,37,000
E. Excess of sales revenue (A-D)	11,25,000	1,08,000	75,000	60,000	4,05,000	17,73,000
F. Fixed Cost						4,73,000
G. Profit (E - F)						13,00,000

Suggested production plan for maximising profits:

On comparing the figures of excess of revenue over cost of manufacturing in the above statements one observes that the concern is earning more after further processing of A, C and E products but is losing a sum of ₹ 30,000 in the case of product B (if it is processed further). Hence the best production plan will be to sell A, C and E after further processing and B and D at the point of split off. The profit statement based on this suggested production plan is as below :

Profit statement based on suggested production plan

	Products					Total (₹)
	A (₹)	B (₹)	C (₹)	D (₹)	E (₹)	
A. Sales revenue	50,00,000	3,90,000	3,00,000	2,00,000	15,00,000	73,90,000
B. Apportioned Costs	26,25,000	2,52,000	1,75,000	1,40,000	9,45,000	41,37,000
C. Further processing cost	12,50,000	-	50,000	-	1,50,000	14,50,000
D. Total processing cost (B+ C)	38,75,000	2,52,000	2,25,000	1,40,000	10,95,000	55,87,000
E. Excess of sales revenue (A-D)	11,25,000	1,38,000	75,000	60,000	4,05,000	18,03,000
F. Fixed Cost						4,73,000
G. Profit (E - F)						13,30,000

Hence the profit of the company has increased by ₹ 30,000.

3. (i) Estimated Net Realisable Value Method:

	Buttermilk Amount (₹)	Butter Amount (₹)
Sales Value	8,40,000 (₹ 30 × 28 × 1000)	76,80,000 (₹ 480 × 16 × 1000)
Less: Post split-off cost (Further processing cost)	-	(1,20,000)
Net Realisable Value	8,40,000	75,60,000
Apportionment of Joint Cost of ₹ 51,00,000* in ratio of 1:9	5,10,000	45,90,000

* [(₹ 100 × 50 × 1000) + ₹ 1,00,000] = ₹ 51,00,000

(ii) Incremental revenue from further processing of Butter into Ghee	
(₹ 480 × 16 × 1000 - ₹ 360 × 20 × 1000)	₹ 4,80,000
Less: Incremental cost of further processing of Butter into Ghee	₹ 1,20,000
Incremental operating income from further processing	₹ 3,60,000

The operating income of 'Buttery Butter' will be reduced by ₹ 3,60,000 in February if it sells 20 tonne of Butter to 'Healthy Bones', instead of further processing of Butter into Ghee for sale. Thus, 'Buttery Butter' is advised not to accept the offer and further process butter to make Ghee itself.

4. Product A can be sold at the split-off point, because the question says that "Products B and C must be processed further before they can be sold." Since product A is not included in that, we know that Product A can be sold at the split-off point. Furthermore, the cost to process Product A after the split-off point is ₹ 150,000, whereas the additional revenue to be earned by processing it further is only ₹ 75,000 (₹ 50 increase in selling price per unit multiplied by the 1,500 units produced during September). Therefore, Product A will not be processed further, and we use the sales value at split-off for A for allocating the joint costs. The sales value at the split-off for A is ₹ 100 × 1,500 units, or ₹ 1,50,000.

Since Product B must be processed further, we use its net realizable value for the joint cost allocation. The net realizable value of Product B is ₹ 3,75,000 [(₹ 175 selling price after further processing × 3,000 units produced) – ₹ 1,50,000 in further processing costs].

Product C, the by-product, must also be processed further to be sold. The net realizable value of Product C is ₹ 75,000 [(₹ 50 sales price after further processing × 4,500 units produced) – ₹ 1,50,000 in further processing costs].

Joint production costs total ₹ 8,40,000. Since the by-product C is accounted for as a reduction to the joint costs, the joint costs to be allocated are ₹ 7,65,000 (₹ 8,40,000 minus the ₹ 75,000 NRV of Product C), to be allocated between Product A (sales value ₹ 1,50,000) and Product B (net realizable value ₹ 3,75,000). So, the total on which the allocation of the joint costs is based is ₹ 1,50,000 + 3,75,000 = ₹ 5,25,000. Product A represents 28.571% of the total (₹ 1,50,000 ÷ ₹ 5,25,000).

Since Product A has no further processing costs, the total cost of Product A is equal to its allocated joint costs, which are 28.571% of the net joint costs of ₹ 7,65,000, or ₹ 2,18,568.

5. (i) **Statement showing profit/loss by each product after further processing products**

	Product X (in ₹)	Product Y (in ₹)	Product Z (in ₹)
Sales value after further processing	5,000	5,600	4,800
Less: Further processing cost	2,000	1,200	800
Less: Joint Cost* (as apportioned)	4,000	2,800	3,200
Profit/(loss)	(1,000)	1,600	800

* Statement showing apportionment of joint cost on the basis of physical units

	Product X (in ₹)	Product Y (in ₹)	Product Z (in ₹)	Total (₹)
Output (in litre)	100	70	80	250
Weight	0.4 (100/250)	0.28 (70/250)	0.32 (80/250)	
Joint cost apportioned	4,000	2,800	3,200	

(ii) **Decision whether to process further or not**

	Product X (in ₹)	Product Y (in ₹)	Product Z (in ₹)
Incremental Revenue	2,500 [(50-25) × 100]	700 [(80-70) × 70]	1,200 [(60-45) × 80]
Less: Further processing cost	2,000	1,200	800
Incremental profit / (loss)	500	(500)	400

	Product X (in ₹)	Product Y (in ₹)	Product Z (in ₹)	Total
Sales	2500	4900	3600	11000
Pre separation costs	4000	2800	3200	10000
Profit/(Loss)	(1500)	2100	400	1000

It is advisable to further process only product X and Z and to sale product Y at the point of separation.

6. Statement of Comparison of Profits before and after further processing

	S (₹)	P (₹)	N (₹)	A (₹)	Total (₹)
A. Sales at split off point	20,000	12,000	28,000	20,000	80,000
B. Apportioned Joint Costs (Refer Working Note)	10,000	6,000	14,000	10,000	40,000
C. Profit at split-off point	10,000	6,000	14,000	10,000	40,000
D. Sales after further processing	1,20,000	40,000	48,000	-	2,08,000
E. Further processing cost	80,000	32,000	36,000	-	1,48,000
F. Apportioned Joint Costs (Refer Working Note)	10,000	6,000	14,000	-	-
G. Profit if further processing (D – E + F)	30000	2,000	(-) 2,000	-	-
H. Increase/ decrease in profit after further processing (G-C)	20,000	- 4000	- 16,000	-	-

Suggested Product to be further processed for maximising profits:

On comparing the figures of "Profit if no further processing" and "Profits if further processing", one observes that OPR Ltd. is earning more after further processing of Product S only i.e. ₹ 20,000. Hence, for maximizing profits, only Product S should be further processed and Product P, N and A should be sold at split-off point.

Working Note:

Apportionment of joint costs on the basis of Sales Value at split-off point

$$\text{Apportioned joint cost} = \frac{\text{Total Joint Cost}}{\text{Total Sales value at split - off point}} \times \text{Sales value of each product}$$

Where,

$$\text{Total Joint cost} = ₹ 40,000$$

$$\text{Total sales at split off point (S, P, N and A)} = 20,000 + 12,000 + 28,000 + 20,000 = ₹ 80,000$$

$$\text{Share of S in joint cost} = \frac{₹ 40,000}{₹ 80,000} \times ₹ 20,000 = ₹ 10,000$$

$$\text{Share of P in joint cost} = \frac{₹ 40,000}{₹ 80,000} \times ₹ 12,000 = ₹ 6,000$$

$$\text{Share of N in joint cost} = \frac{₹ 40,000}{₹ 80,000} \times ₹ 28,000 = ₹ 14,000$$

$$\text{Share of A in joint cost} = \frac{₹ 40,000}{₹ 80,000} \times ₹ 20,000 = ₹ 10,000$$