1. A company manufactures 10,000 units of a product per month. The cost of placing an order is ₹ 200. The purchase price of the raw material is ₹ 20 per kg. The re-order period is 4 to 8 weeks. The consumption of raw materials varies from 200 kg to 900 kg per week, the average consumption being 550 kg. The carrying cost of inventory is 20% per annum.

   You are required to CALCULATE:

   (i) Re-order quantity

   (ii) Re-order level

   (iii) Maximum level

   (iv) Minimum level

   (v) Average stock level

   Answer:

   (i) Reorder Quantity(ROQ) = 1,691 kg. *(Refer to working note)*

   (ii) Reorder level (ROL) = Maximum usage × Maximum re-order period

   = 900 kg. × 8 weeks = 7,200 kg.

   (iii) Maximum level = ROL + ROQ – (Min. usage × Min. re-order period)

   = 7,200 kg. + 1,691 kg. – (200 kg.× 4 weeks)

   = 8,091 kg.

   (iv) Minimum level = ROL – (Normal usage × Normal re-order period)

   = 7,200 kg. – (550 kg. × 6 weeks)

   = 3,900 kg.

   (v) Average stock level = 1/2(Maximum level + Minimum level)

   = $\frac{1}{2}$ (8,091 kg. + 3,900 kg.) = 5,995.5 kg.

   OR

   Minimum Stock Level + ½ Reorder quantity

   = 3,900 kg. + $\frac{1}{2}$ × 1,691 kg. = 4,745.5 kg.

   Working Note:

   Annual consumption of raw material (A) = (550 kg. × 52 weeks) = 28,600 kg. Cost of placing an order (O) = Rs. 200

   Carrying cost per kg. per annum (C) = ₹ 20 × 20% = ₹ 4

   Economic order quantity (EOQ) = $\sqrt{\frac{2AO}{C}}$

   $= \sqrt{\frac{2 \times 28{,}600 \text{ kgs.} \times \text{Rs.}200}{4}}$

   = 1691 kg (approx.)

2. A company uses three raw materials Pi, Qu and Ar for a particular product for which the following data applies:

Raw Material	Usage per unit of product (Kg.)	Re-order Quantity (Kg.)	Price per Kg. (Rs.)	Delivery period (in weeks)			Re-order level (Kg.)	Minimum level (Kg.)
				Minimu	Averag	Maximu		
Pi	5	10,000	0.10	1	2	3	8,000	?
Qu	2	5,000	0.30	3	4	5	4,750	?
Ar	3	10,000	0.15	2	3	4	?	2,000

Weekly production varies from 350 to 450 units, averaging 400 units of the said product. WHAT would be the following quantities:

i. Minimum Stock of Pi?

ii. Maximum Stock of Qu?

iii. Re-order level of Ar?

iv. Average stock level of Pi?

Answer:

(i) Minimum stock of Pi

Re-order level – (Average consumption × Average time required to obtain delivery)

= 8,000 kg. – (400 units × 5 kg. × 2 weeks) = 4,000 kg.

(ii) Maximum stock of Qu

Re-order level – (Min. Consumption × Min. delivery period) + Re-order quantity

= 4,750 kg. – (350 units × 2 kg. × 3 weeks) + 5,000 kg.

= 9,750 - 2,100 = 7,650 kg.

(iii) Re-order level of Ar

Maximum delivery period × Maximum Usage

= 4 weeks × (450 units × 3 kg.) = 5,400 kg.

OR

= Minimum stock of Ar + (Average consumption × Average delivery time)

= 2,000 kg. + [(400 units × 3 kg.) × 3 weeks] = 5,600 kg.

(iv) Average stock level of Pi

= Minimum stock level of Pi + ½ Reorder Quantity

= 4,000 kg + ½ 10,000 kg = 9,000 kg

Or = (Minimum stock Level + Maximum Stock Level)/2

= (4,000 + 16,250) /2 = 10,250 kg

Working note

Maximum stock of Pi = ROL + ROQ – (Minimum consumption × Minimum delivery period)

= 8,000 kg. + 10,000 kg. – [(350 units × 5 kg.) × 1 week] = 16,250 kg.

3. The following data are available in respect of material X for the year ended 31st March, 2021:

(₹)

Opening stock	9,00,000
Purchases during the year	1,70,00,000
Closing stock	11,00,000

(i) CALCULATE:

(a) Inventory turnover ratio, and

(b) The number of days for which the average inventory is held.

(ii) INTERPRET the ratio calculated as above if the industry inventory turnover rate is 10.

Answer:

(a) Inventory turnover ratio (Refer to working note)

$$= \frac{\text{Cost of stock of raw material consumed}}{\text{Average stock of raw material}}$$

$$= \frac{₹1,68,00,000}{₹10,00,000} = 16.8$$

(b) Average number of days for which the average inventory is held

= 365 / Inventory turnover ratio

= 365 days / 16.8 = 21.73 days

Working Note:

Particulars	**(₹)**
Opening stock of raw material	9,00,000
Add: Material purchases during the year Less: Closing stock of raw material	1,70,00,000 11,00,000
	1,68,00,000

The Inventory turnover ratio for material X is 16.8 which mean an inventory item takes only 21.73 or 22 days to issue from stores for production process. The rate is better than the industry rate which is 10 time or 36.5 days. This inventory turnover ratio indicates better inventory management system and good demand for the final product in market.

4. A company deals in trading of a toy car 'Terminato'. The annual demand for the toy car is 9,680 units. The company incurs fixed order placement and transportation cost of ₹ 200 each time an order is placed. Each toy costs ₹ 400 and the trader has a carrying cost of 20 percent p.a.

   The company has been offered a quantity discount of 5% on the purchase of 'Terminato' provided the order size is 4,840 units at a time.

   Required:

   i. COMPUTE the economic order quantity

   ii. STATE whether the quantity discount offer can be accepted.

   Answer:

   Calculation of Economic Order Quantity

   $$EOQ = \sqrt{\frac{2AO}{C}}$$

   $$= \sqrt{2 \text{ X } 9{,}680 \text{ units X } 200 \text{ Rs} / 400 \text{ Rs X } 20\%}$$

   = 220 units

Particulars	EOQ	Discount Policy
Ordering Cost	8,800	400
	[(9,680 units/220 units) X ₹ 200]	[(9,680 units/4,840 units) X ₹ 200]
Carrying Cost	8,800	1,83,920
	(220 units X½ X ₹ 400 X 20%)	(4,840 units X½ X ₹ 380 X 20%)
Purchase Cost	38,72,000	36,78,400
	(9,680 units X ₹ 400)	(9,680 units X ₹ 380)
Total Cost	**38,89,600**	**38,62,720**

   Advise – The total cost of inventory is lower if quantity discount is accepted. The company would save ₹ 26,880 (₹ 38,89,600 - ₹ 38,62,720).

5. A company manufactures a product from a raw material, which is purchased at Rs.180 per kg. The company incurs a handling cost of Rs.1,460 plus freight of Rs.940 per order. The incremental carrying cost of inventory of raw material is Rs.2.5 per kg per month. In addition, the cost of working capital finance on the investment in inventory of raw material is Rs.18per kg per annum. The annual production of the product is 1,00,000 units and 2.5 units are obtained from one kg. of raw material.

   Required:

   a. CALCULATE the economic order quantity of raw materials.

   b. DETERMINE, how frequently company should order for procurement be placed.

   c. If the company proposes to rationalize placement of orders on quarterly basis, DETERMINE

the percentage of discount in the price of raw materials should be negotiated? Assume 360 days in a year.

Answer:

(i) Calculation of Economic Order Quantity (E.O.Q)

Annual requirement (usage) of raw material in kg.= 1,00,000 units / 2.5 units per kg = 40,000 kg.

Ordering Cost (Handling & freight cost) (O) = Rs.1,460 + Rs.940 = Rs.2,400 Carrying cost per unit per annum (C) i.e. inventory carrying cost + working capital cost = (Rs.2.5 × 12 months) + Rs.18 = Rs.48 per kg

$$EOQ = \sqrt{\frac{2AO}{C}}$$

$$= \sqrt{2 \text{ X } 40{,}000 \text{ kgs X } 2{,}400 \text{ Rs} / \text{Rs } 48} = 2{,}000 \text{ kg}$$

(ii) Frequency of placing orders for procurement:

Annual consumption (A) = 40,000 kg.

Quantity per order (E.O.Q) = 2,000 kg.

No of orders per annum (A/EOQ) = 40,000 kg / 2,000 kg = 20 orders

Frequency of order (in days) = 360 days / 20 orders = 18 days

(ii) Percentage of discount in the price of raw materials to be negotiated:

Particulars	On Quarterly Basis	On E.O.Q Basis
1. Annual Usage (in Kg.)	40,000 kg.	40,000 kg.
2. Size of the order	10,000 kg.	2,000 kg.
3. No. of orders (1 ÷ 2)	4	20
4. Cost of placing orders or Ordering	Rs.9,600	Rs.48,000
5. Inventory carrying cost (Average	Rs.2,40,000	Rs.48,000
6. Total Cost (4 + 5)	Rs.2,49,600	Rs.96,000

When order is placed on quarterly basis the ordering cost and carrying cost increased by Rs.1,53,600 (Rs.2,49,600 - Rs.96,000).

So, discount required = Rs.1,53,600

Total annual purchase = 40,000 kg. × Rs.180 = Rs.72,00,000

So, Percentage of discount to be negotiated = $\frac{\text{Rs.1,53,600}}{\text{Rs.72,00,000}} \times 100 = 2.13\%$

6. A Ltd. manufactures a product X which requires two raw materials A and B in a ratio of 1:4. The sales department has estimated a demand of 5,00,000 units for the product for the year. To produce one unit of finished product, 4 units of material A is required.

Stock position at the beginning of the year is as below:

Product- X	12,000 units
Material A	24,000 units
Material B	52,000 units

To place an order the company has to spend Rs.15,000. The company is financing its working capital using a bank cash credit @13% p.a.

Product X is sold at Rs.1,040 per unit. Material A and B are purchased at Rs.150 and Rs.200 respectively.

Required:

COMPUTE economic order quantity (EOQ):

i. If purchase order for the both materials is placed separately.

ii. If purchase order for the both materials is not placed separately.

Answer:

Annual production of Product X = Annual demand – Opening stock

= 5,00,000 – 12,000 = 4,88,000 units

Annual requirement for raw materials = Annual production× Material per unit – Opening stock of material

Material A = 4,88,000 × 4 units – 24,000 units = 19,28,000 units

Material B = 4,88,000 × 16 units – 52,000 units = 77,56,000 units

(i) Computation of EOQ when purchase order for the both materials is placed separately

$$EOQ = \sqrt{\frac{2\times \text{Annual Requirement for material} \times \text{Ordering cost}}{\text{Carrying cost per unit per annum}}}$$

$$\text{Material A} = \sqrt{\frac{2\times 19,28,000\text{ units}\times \text{Rs.}15,000}{13\%\text{ of Rs.}150}} = \sqrt{\frac{38,56,000\times \text{Rs.}15,000}{\text{Rs.}19.5}}$$

$$= 54,462 \text{ units}$$

$$\text{Material B} = \sqrt{\frac{2\times 77,56,000\text{ units}\times \text{Rs.}15,000}{13\%\text{ of Rs.}200}} = \sqrt{\frac{1,55,12,000\times \text{Rs.}15,000}{\text{Rs.}26}}$$

= 94,600 units

(ii) Computation of EOQ when purchase order for the both materials is not placed separately

$$\text{Material A \& B} = \sqrt{\frac{2\times(19,28,000+77,56,000)\text{ units}\times\text{Rs.}15,000}{13\%\text{ of Rs.}190^{*}}}$$

* $\frac{(\text{Rs.}150\times19,28,000)+(\text{Rs.}200\times77,56,000)}{(19,28,000+77,56,000)}$ = Rs 190

$$\sqrt{\frac{1,93,68,000\times\text{Rs.}15,000}{\text{Rs.}24.7}}$$

= 1,08,452 units

Material A = 1,08,452 X 19,28,000 / 96,84,000 = 21,592 units

Material B = 1,08,452 X 77,56,000 / 96,84,000 = 86,860 units

7. HBL Limited produces product 'M' which has a quarterly demand of 20,000 units. Each product requires 3 kg. and 4 kg. of material X and Y respectively. Material X is supplied by a local supplier and can be procured at factory stores at any time, hence, no need to keep inventory for material X. The material Y is not locally available, it requires to be purchased from other states in a specially designed truck container with a capacity of 10 tons.

The cost and other information related with the materials are as follows:

Particulars	Material –X	Material-Y
Purchase price per kg. (excluding GST)	₹140	₹640
Rate of GST	18%	18%
Freight per trip (fixed, irrespective of quantity)	-	₹ 28,000
Loss of materials in transit*	-	2%
Loss in process*	4%	5%

*On purchased quantity

Other information:

- The company has to pay 15% p.a. to bank for cash credit facility.
- Input credit is available on GST paid on materials.

Required:

a. CALCULATE cost per kg. of material X and Y

b. CALCULATE the Economic Order quantity for both the materials.

Answer:

Working Notes:

a. Annual purchase quantity for material X and Y:

Annual demand for product M- 20,000 units × 4 = 80,000 units

Particulars	Mat-X	Mat-Y
Quantity required for per unit of product M	3 kg.	4 kg.
Net quantity for materials required	2,40,000 kg.	3,20,000 kg.
Add: Loss in transit	-	6,881 kg.
Add: Loss in process	10,000 kg.	17,204 kg.
Purchase Quantity	2,50,000 kg	3,44,085 kg

Note: Input credit is available hence GST is not included in cost of material.

Calculation of cost per kg. of material X and Y:

Particulars	Mat-X	Mat-Y
Purchase quantity	2,50,000 kg.	3,44,085 kg.
Rate per kg.	₹140	₹640
Purchase price	₹3,50,00,000	₹22,02,14,400
Add: Freight	0	₹9,80,000*
Total cost	₹3,50,00,000	₹22,11,94,400
Net Quantity	2,40,000 kg.	3,20,000 kg
Cost per kg.	₹145.83	₹691.23

*Number of Trucks = $\frac{3,44,085 \text{ kg}}{10 \text{ ton X } 1,000}$ = 34.40 truck i.e. 35 trucks

Therefore, total freight = 35 trucks × ₹28,000 = ₹9,80,000

(i) Calculation of Economic Order Quantity (EOQ) for Mat.-X and Y:

$$EOQ = \sqrt{\frac{2 \times \text{Annual Requirement} \times \text{Order cost}}{\text{Carrying cost per unit p.a.}}}$$

Particulars	Mat-X	Mat-Y
Annual Requirement	2,50,000 kg.	3,44,085 kg.
Ordering cost	0	₹28,000
Cost per unit	₹145.83	₹691.23
Carrying cost	15%	15%
Carrying cost per unit p.a.	0*	₹103.68
EOQ	0	13,632.62 kg.

8. The following information is available relating to the stock out of firm :

Stock out (units)	No of times	Probability
800	2	0.04
600	3	0.06
400	5	0.10
200	10	0.20

0	30	0.60
Total	50	1.00

The selling price of each unit is ₹ 200. The carrying cost is ₹ 19/unit. The stock out cost is ₹ 50/unit.

i. If the firm wishes to never miss a sale, what should be the safety stock?what is the total cost associated with this level of safety stock ? what are the associated costs with safety stock of 600, 400, 200 and 0 units respectively.

ii. What is the optimal safety stock level?

Answer:

Safety stock	Demand during stock out	Probability	Stock out units	Stock out cost 50	Expected stock out cost	Total stock out cost	Carrying cost	Total cost
800	-	-	-	-	-	-	15200	15200
600	800	0.04	200	10000	400	400	11400	11800
400	800	0.04	400	20000	800	1400	7600	9000
	600	0.06	200	10000	600			
200	800	0.04	600	30000	1200			
	600	0.06	400	20000	1200	3400	3800	7200
	400	0.10	200	10000	1000			
0	800	0.04	800	40000	1600			
	600	0.06	600	30000	1800	7400	0	7600
	400	0.10	400	20000	2000			
	200	0.2	200	10000	2000			

9. Classify material in ABC classification

Number	Annual consumption in pieces	Unit price in paise
1	30,000	10
2	2,80,000	15
3	3,000	10
4	1,10,000	5
5	4,000	5
6	2,20,000	10

7	15,000	5
8	80,000	5
9	60,000	15
10	8,000	10

Answer:

Statement showing ranking of items

Number	Consumption	% of total quantity	Unit price	Total Cost	% of total cost	Rank according to total cost
1	30,000	3.70	10	3,000	3.43	6
2	2,80,000	34.57	15	42,000	47.97	1
3	3,000	0.37	10	300	0.34	9
4	1,10,000	13.58	5	5,500	6.28	4
5	4,000	0.493	5	200	0.228	10
6	2,20,000	27.16	10	22,000	25.128	2
7	15,000	1.85	5	750	0.856	8
8	80,000	9.88	5	4,000	4.568	5
9	60,000	7.4	15	9,000	10.28	3
10	8,000	0.99	10	800	0.913	7
	8,10,000			87,550		

ABC analysis

Ranking	Item Number	% of total units	Cost	% of total cost	Category
1	2	34.57	42,000	47.97	A
2	6	27.16	22,000	25.128	
		Total	**64,000**	**73.098**	
3	9	7.4	9,000	10.28	
4	4	13.58	5,500	6.28	B
5	8	9.88	4,000	4.568	

		Total	**18,500**	**21.128**	
6	1	3.70	3,000	3.43	
7	10	0.99	800	0.913	
8	7	1.85	750	0.856	
9	3	0.37	300	0.34	C
10	5	0.493	200	0.228	
		Total	**5,050**	**5.767**	