

PAPER – 5 : COST MANAGEMENT

QUESTIONS

1. (a) Discuss briefly the Advantage of network (PERT/CPM)
- (b) A project has the following characteristics:

Activity	Preceding Activity	Expected completion time (in weeks)
A	None	5
B	A	2
C	A	6
D	B	12
E	D	10
F	D	9
G	D	5
H	B	9
I	C,E	1
J	G	2
K	F,I,J	3
L	K	9
M	H,G	7
N	M	8

- (a) Draw a PERT network for this project.
 - (b) Find the critical path and the project completion time.
 - (c) Prepare an activity schedule showing the ES, EF, LS, LF and slack for each activity.
 - (d) Will the critical path change if activity G takes 10 weeks instead of 5 weeks? If so, what will be the new critical path?
2. Sky Ltd. produces an article by blending two basic raw materials. The following standards have been set up for raw materials:

Materials	Standards Mix	Standard price per kg.
X	40 %	Rs. 4.00
Y	60 %	Rs. 3.00

The standard loss in processing is 15%. During September, 2007 the company produced 1700 kg of finished output.

The position of stock and purchase for the month of September, 2007 is as under:

Material	Stock on 1.9.2007	Stock on 30.9.2007	Purchase during September, 2007	
	Kg.	Kg.	Kg.	Cost
X	35	5	800	Rs. 3400
Y	40	50	1200	Rs. 3000

Calculate the following variance:

- (a) Materials price variance; (b) Materials usage variance;
- (c) Materials yield variance; (d) Materials mix variance;
- (e) Total materials cost variance.

Assume first in first out method for issue of material. The opening stock is to be valued at standard price.

3. (a) What is Opportunity Cost? Explain with suitable examples.
- (b) What are the areas in which differential cost technique is used in managerial decision .
- (c) The Directors of Domestic Ltd. are considering a new type of Kitchen Gadget which their Research Department has developed. The expenditure so far on research has been Rs. 40,000 and a Consultant's report has been prepared at a cost of Rs. 7,500. The report provides the following information:

A. Cost of Production per unit	Rs.
Materials	22.50
Labour	37.50
Fixed overheads (based on company's normal allocation rates)	<u>10.00</u>
	<u>70.00</u>

- B. Anticipated additional fixed costs:

Rent for additional space Rs. 75,000 per annum.

Other additional Fixed costs Rs. 37,500 per annum.

A new machine will be built with the available facilities at a cost of Rs. 60,000 (Materials Rs. 50,000 and Labour Rs. 10,000). The materials are readily available in stores which are regularly used. However, these are to be immediately replenished. The price of these materials has since risen by 40%. Scrap value of the machine at the end of 10th year is 10,000. The product scraps generated can be disposed off at the end of year 10 for a price of Rs. 71,920.

The estimated demand for product is as follows:

Year 1-5		Year 6-10	
Demand (units)	Probability	Demand (units)	Probability
20,000	0.10	12,000	0.2
10,000	0.65	8,000	0.5
6,000	0.25	2,000	0.3

It is expected that the commercial life of the Gadget will be no longer than 10 years and the after tax cost of Capital is 10%. The full cost of the machine will be depreciated on straight line basis which is allowed for taxation also, over a period of 10 years. Tax rate is 40%. DCF Factors

1-5 Years (cumulative)	3.79
6-10 Years (cumulative)	2.355
10th Year	0.386

Compute minimum Selling Price of the Gadget.

4. Variance analysis involves the separation of individual cost variances into component parts. The benefit that may be derived from variance analysis depends on the interpretation and investigation of the component variances. A company has recently been carrying out a study on its use of variance analysis. Required

Explain, with the aid of simple numeric examples, for each of the following variance analysis exercises: their logic, purpose and limitation; and how the management accountant should go about investigating the component variances disclosed.

- (a) The separation of the fixed overhead volume variance into capacity utilisation and efficiency components.
 - (b) The separation of the materials usage variance into materials mixture and materials yield components.
 - (c) The separation of the labour rate variance into planning and operational components.
5. INZ Ltd recently began production of a new product, M, which required the investment of Rs.16,00,000 in assets. The costs of producing and selling 80,000 units of Product M are estimated as follows:

Variable Costs

Direct Materials	Rs.	10.00	Per unit
Direct labour		6.00	
Factory overhead		4.00	
Selling and administrative expenses		5.00	
Total	Rs.	<u>25.00</u>	Per unit

Fixed costs:

Factory Overheads	Rs.	800,000
Selling and administrative expenses		400,000

INZ Ltd is currently considering establishing a selling price for product M. The president of INZ Ltd has decided to use the cost-plus approach to product pricing and has indicated that Product M must earn a 10% rate of return on invested assets.

Required:

- (i) Determine the amount of desired profit from the production and sale of Product M.
- (ii) Assuming that the total cost concept is used, determine (a) the cost amount per unit, (b) the mark-up percentage, and (c) the selling price of Product M.
- (iii) Assuming that the product cost concept is used, determine (a) the cost amount per unit, (b) the mark up percentage, and (c) the selling price of product M.
- (iv) Assuming that the variable cost concept is used, determine (a) the cost amount per unit, (b) the mark up percentage, and (c) the selling price of product M.
- (v) Assuming that for the current year, the selling price of Product M was Rs42 per unit. To date, 60,000 units have been produced and sold, and analysis of the domestic market indicated that 15,000 additional units are expected to be sold during the remainder of the year. Recently, INZ Ltd received an offer from Wong Ltd. for 4,000 units of Product M at Rs28 each. Wong Ltd. will market the units in Korea under its own brand name, and no additional selling and administrative expenses associated with the sale will be incurred by INZ Ltd. The additional business is not expected to affect the domestic sales of Product M, and the additional units could be produced during the current year, using existing capacity. (a) Prepare a differential analysis report of the proposed sale to Wong Ltd. (b) Based upon the report in (a), should the proposal be accepted?

6. Hawley Ltd. manufactures Product S for national distribution. The standard costs for the manufacturer of Product S were as follows:

	Standard Costs	Actual Costs
Direct materials	1,500 kgs. at Rs. 35	1,600 kgs. at Rs. 32
Direct labour	4,800 hours at Rs. 11	4,500 hours at Rs. 11.80
Factory overhead	Rates per labour hour, based on 100% of normal capacity of 5,500 labour hours:	
	Variable cost, Rs. 2.40	Rs. 12,300 variable cost
	Fixed cost, Rs. 3.50	Rs. 19,250 fixed cost

Required:

- Determine the quantity variance, price variance, and total direct materials cost variance for Product S.
 - Determine the time variance, rate variance, and total labour cost variance for Product S.
 - Determine the controllable variance, volume variance, and total factory overhead cost variance for Product S.
7. The following table gives the activities in a construction project and other relevant information:

Activity	Immediate Predecessor(s)	Time (days)		Direct Cost (Rs)	
		Normal	Crash	Normal	Crash
A	--	4	3	60	90
B	--	6	4	150	250
C	--	2	1	38	60
D	A	5	3	150	250
E	C	2	2	100	100
F	A	7	5	115	175
G	D, B, E	4	2	100	240

Indirect costs vary as follows:

Days :	15	14	13	12	11	10	9	8	7	6
Cost :	600	500	400	250	175	100	75	50	35	25

- Draw an arrow diagram for the project.
 - Determine the project duration which will return in minimum total project cost.
8. A Car Hire company has one car at each of 5 depots a, b, c, d and e. A customer in each of the 5 towns A, B, C, D and E requires a car. The distance (in miles) between the deposits (origins) and the towns (destination) where the customers are (is given in the following distance matrix).

	a	b	c	d	e
A	160	130	175	190	200
B	135	120	130	160	175
C	140	110	125	170	185
D	50	50	80	80	110
E	55	35	80	80	105

How the cars should be assigned to the customers so as to minimize the distance travelled.

9. (a) Define ;

- (i) Cost Driver
- (ii) Activity Cost Pool

(b) The hypothetical Instruments Ltd. assembles and tests a number of electronic instrument products including printed-circuit boards. Every board has various parts (Diodes, Capacitors and Integrated circuits) inserted on it.

It is currently producing two products- Board X and Board Y, using the same equipment and similar processes. An extract of production and cost data for these products in one period is given below:

(a) Direct manufacturing costs:

	Board X (Rs.)	Board Y(Rs.)
Direct materials	6,000	2,800
Direct manufacturing labour	320	560

(b) Indirect manufacturing costs:

- Procurement (purchasing) Support (overheads): allocated to products on the basis of 50 percent of their direct material costs.
- Production support (overheads): allocated to products on the basis of 700 per cent of their direct manufacturing labour costs.

(c) Budgeted indirect cost allocation rates in each activity area:

Activity area	Indirect cost allocation rate
	Rs.
1. Materials handling	20 per part
2. Machinery insertion of parts	5 per insertion
3. Manual insertion of parts	40 per insertion
4. Wave soldering	500 per board
5. Quality testing	500 per test-hour

Relative use of resources of the activity areas:

Activity area	Board X	Board Y
1. Materials handling *	81 parts	121 parts
2. Machinery insertion of parts	70 insertions	90 insertions
3. Manual insertion of parts	10 insertions	30 insertions
4. Wave soldering	1 board	1 board
5. Quality testing	1.5 hour	6.5 hour

* The number of parts includes the raw printed circuit board (counted as one part) plus the number of component parts to be inserted on the board.

You are required to calculate the products costs of the Hypothetical Instruments Ltd. with:

- (a) Traditional Costing System and
- (b) Activity-Based Costing System.

Comment on their relative suitability for decision-making.

10. (a) What is meant by Learning Curve effect? Mention some important applications of this phenomenon in cost and management accounting.
- (b) A company developed and manufactured a new machine. The manufacture of the first machine took 800 direct labour hours. The direct wages rate is Rs.20 per hour. The company experienced a learning curve effect of 80% (index is – 0.3219). The first piece was used as a demonstration piece and was not intended for sale. On the basis of the demonstration, the company obtained an order for the manufacture of 20 machines. The direct material cost is Rs. 16,000 per machine. The variable overhead rate is Rs.25 per direct labour hour. The fixed overheads on absorption costing amounted to Rs.40 per direct labour hour. The selling price is to include a profit margin of 20% on selling price. Subsequently, after the delivery of the 20 machines, the company received a repeat order for supply of 30 machines.

Required:

- (i) Calculate the selling price per machine of the first lot of 20 machines.
 - (ii) What reduction in selling price can the company allow in respect of the repeat order?
- (c) A company manufactures 80 units of a product per day. The sales of the product follow a pattern of demand which has the following distribution.

Sales in units	Probability
74	0.10
76	0.15
78	0.22
80	0.30
82	0.18
84	0.05

The selling price is Rs. 75 per unit. The variable cost is Rs. 45 and the total cost is Rs. 55 per unit. Any unsold product can be disposed of as scrap at Rs. 30 per unit. If the demand is not met, a penalty of Rs. 5 per unit is payable by the company. In view of the loss arising from the unsold units, the company is contemplating to restrict its daily production to 76 units. Using the following random numbers, simulate the sales for 10 days and determine the average profit per day if the company produces (i) 80 units per day and (ii) 76 units per day.

Random numbers are 41, 65, 14, 35, 81, 20, 79, 93, 71 and 14.

11. (a) State the benefits of product life cycle costing.
- (b) A and B are two divisions under the same group of companies. The production capacity of A is 4,000 kilolitres per month. Division A, however, will be able, due to external demand considerations, to utilise 75% of its capacity per month during the year. It will sell one third of its production to Division B and the balance quantity will be sold in the market. The variable cost is Rs. 780 per kilolitre and the fixed cost is Rs. 2,40,000 per month. The current policy of the group is to use market price as the transfer price between the two divisions. Division B uses the output of division A as raw materials to produce a branded product which is sold in cans of 25 litre capacity at a price of Rs. 40 per can.

The direct production costs are as under:

- Raw materials received from Division A at a transfer price of Re.1 per litre.
- Variable costs amount to Rs.6 per can.
- Fixed costs amount to Rs.1,60,000 per month.
- Market study has revealed that Division B can increase its sale of the branded product by 80% in volume if the selling price is reduced by Rs. 5 per can. Division A proposes that Division B should increase the sales to that extent.

Required:

- (i) Calculate the monthly profit of both Division A and B separately and the company as a whole, if:
 - (a) the sales are at the present level;
 - (b) the sales of Division B are increased in volume by 80% by reducing the selling price by Rs. 5 per can.
 - (ii) Recommend, with supporting calculations, a suitable transfer price which will be acceptable to Division B so as to maintain the profit as originally envisaged.
12. A company manufactures a single product in its factory utilising 60% of its capacity. The selling price and cost details are given below:

	Rs
Sales (6,000 units)	5,40,000
Direct materials	96,000
Direct labour	1,20,000
Direct expenses	18,000
Fixed overheads:	
Factory	2,00,000
Administration	21,000
Selling and distribution	25,000

An analysis of fixed factory and selling & distribution overheads reveals that 12.5% of factory overheads and 20% of selling and distribution overheads are variable with production and sales. Administration overheads are wholly fixed.

Since existing product could not achieve budgeted level for two consecutive years, the Company decides to introduce a new product with marginal investment but largely using present plant and machinery.

The cost estimates of the new products are as follows:

Cost elements	Rs. per unit
Direct materials	16.00
Direct labour	15.00
Direct expenses	1.50
Variable factory overheads	2.00
Variable selling and distribution overheads	1.50

It is expected that 2,000 units of the new products can be sold at a price of Rs. 60 per unit. The fixed factory overheads are expected to increase by 10%, while fixed selling and distribution expenses will go up by Rs. 12,500 annually. Administration overheads remain unchanged. However, there will be an increase of working capital to the extent of Rs. 75,000, which would

take the total project cost to Rs. 8.75 lakhs.

The company considers that 20% pre-tax and interest return on investment is the minimum acceptable to justify and new investment.

Required:

- (i) Should the new product be introduced?
 - (ii) Given the data above and making any assumptions that you consider appropriate, are there any further observations or recommendations you wish to make?
13. Priyanshu Enterprise has three factories at location A, B and C which supplies three warehouses located at D, E and F. Monthly factory capacities are 10, 80 and 15 units, respectively. Monthly warehouse requirements are 75, 20 and 50 units respectively. Unit shipping costs (in Rs.) are given here.

Factory	Warehouse		
	D	E	F
A	5	1	7
B	6	4	6
C	3	2	5

The penalty costs for not satisfying demand at the warehouses D, E and F are Rs. 5, Rs. 3 and Rs.2 per unit respectively. Determine the optimal distribution for Priyanshu, using VAM algorithms.

14. A company has four factories situated in different locations in the country and four sales agencies located in four other locations in the country. The cost of production (Rs. Per unit), the sales price (Rs. Per unit), Shipping cost (Rs. Per unit) in the cells of matrix, monthly capacities and monthly requirements are given below:

Factory	Sales agency				Monthly capacity (Units)	Cost of production
	1	2	3	4		
A	7	5	6	4	10	10
B	3	5	4	2	15	15
C	4	6	4	5	20	16
D	8	7	6	5	15	15
Monthly Requirements (Unit)		8	12	18	22	
Sales Price		20	22	25	15	

Find the monthly production and distribution schedule which will maximize profits

15. A Ltd. has a manufacturing division which makes a product to which the following details relate:

		Per Unit
Materials	: 5 Kgs. at Rs.2	Rs. 10
Direct labour	: 12 hours at Rs.2	Rs. 24
Variable overheads	: 12 hours at Re.1	Rs. 12

Relevant fixed overheads are budgeted at Rs. 10,000 per month and planned output is 2,000 units per month. The selling price is Rs. 55 per unit.

An incentive scheme is in operation in the division concerned whereby employees are paid a bonus of 15% of the standard cost of materials saved and 50% of direct labour time saved values at standard direct labour hour rate.

During a recent month when output was 1,800 units, the following actual results were recorded:

	Rs.
Direct material used (8,500 kg.)	17,200
Direct wages (20,000 hours)	42,000
Variable overhead	22,000
Fixed overhead	<u>9,800</u>
	91,000
Net profit	<u>4,000</u>
Sales	<u>95,000</u>

- (a) Calculate the variance which occurred during the month.
 - (b) Calculate the total bonus payments to employees in the division.
16. The Eicher Corporation is a highly decentralized company. Each division manager has full authority for sourcing decisions and selling decisions. The Machining Division of Eicher has been the major supplier of the 2,000 crankshafts that the Tractor Division needs each year.
- The Tractor Division, however, has just announced that it plans to purchase all its crankshafts in the forthcoming year from two external suppliers at Rs. 2,000 per crankshafts. The Machining Division of Eicher recently increased its price for the forthcoming year to Rs. 2,200 per unit (from Rs. 2,000 per unit in the current year).
- Amit Bhatia, manager of the Machining Division, feels that the 10% price increase is justified. It results from a higher depreciation charge on some new specialized equipment used to manufacture crankshafts and an increase in labour cost. Amit wants the president of Eicher Corporation to direct the Tractor Division to buy all its crankshafts from the Machining Division at the price of Rs. 2,200. The incremental cost per unit that Eicher incurs to produce each crankshaft is the Machining Division's variable cost of Rs. 1,900. The fixed cost per crankshaft in the Machining Division is Rs. 200.
- Required:
1. Compute the advantage or disadvantage in terms of annual operating income to the Eicher Corporation as a whole if the Tractor Division buys crankshafts internally from the Machining Division under each of the following cases.
 - a. The Machining Division has no alternative use for the facilities used to manufacture crankshafts.
 - b. The Machining Division can use the facilities for other production operations, which will result in annual cash operating savings of Rs. 2,90,000.
 - c. The Machining Division has no alternative use for its facilities, and the external supplier drops the price to Rs. 1,850 per crankshaft.
 2. As per the president of Eicher, how would you respond to Amit Jain request to order the Tractor Division to purchase its entire crankshaft from the Machining Division? Would your response differ according to the scenarios described in a, b and c of requirement 1? Explain.
17. At the beginning of the year, Kare Company initiated a quality-improvement program. Considerable effort was expended to reduce the number of defective units produced. By the end of the year, reports from the production manger revealed that scrap and rework had both decreased. The president of the company was pleased to hear of the success but wanted some assessment of the financial impact of the improvements. To make this assessment, the following data were collected for the current and preceding years:

	Preceding Year (2007)	Current Year (2008)
Sales	Rs. 10,000,000	Rs. 10,000,000
Scrap	400,000	300,000
Rework	600,000	400,000
Product inspection	100,000	125,000
Product warranty	800,000	600,000
Quality training	40,000	80,000
Materials inspection	60,000	40,000

Required:

1. Classify the costs as prevention, appraisal, internal failure, or external failure.
 2. Compute quality cost as a percentage of sales for each of the two years. By how much has profit increased because of quality improvements? Assuming that quality costs can be reduced to 2.5 percent of sales, how much additional profit is available through improvements (assume that sales revenues will remain the same)?
18. Consider 2 different types of food stuffs; say F1 and F2 assume that these food stuffs contain vitamins V1, V2, V3. Minimum daily requirements of these vitamins are 1 mg of V1, 50 mg of V2 and 10 mg of V3. Suppose that the food stuffs F1 contain 1 mg of V1, 100 mg of V2 and 10 mg of V3, where as food stuffs F2 contains 1 mg of V1, 10 mg of V2, 100 mg of V3. Cost 1 unit of Food stuffs F1 is Rs.1 and that of F2 is Rs. 1.5. Formulate and solve by graphical method of above L.P.P to minimize the cost.
19. MNP Ltd. produces a Chocolate almond bar. Each bar sells for Rs. 20. The variable cost for each bar (sugar, chocolate, almonds, wrapper, labour) total Rs. 12.50. The total fixed costs are Rs. 30,00,000. During the year, 10, 00,000 bars were sold. The CEO of MNP Ltd., not fully satisfied with the profit performance of Chocolate bar, was considering the following options to increase the bar's profitability.
- (i) Increase advertising;
 - (ii) Improve the quality of ingredients and, simultaneously, increase the selling price;
 - (iii) Increase the selling price.
 - (iv) Combination of three.

Required:

- (i) The sales manager is confident that an advertising campaign could double sales volume. If the Company CEO's goal is to increase this year's profits by 50% over last year's, what is the maximum amount that can be spent on advertising?
- (ii) Assume that the company improves the quality of its ingredients, thus increasing variable cost to Rs. 15. Answer the following questions:
 - (a) How much the selling price be increased to maintain the same break-even point?
 - (b) What will be the new price, if the company wants to increase the old contribution margin ratio by 50%?
- (iii) The company has decided to increase its selling price to Rs. 25. The sales volume drops from 10,00,000 to 8,00,000 bars. Was the decision to increase the price a good one? Compute the sale volume that would be needed at the new price for the company to earn the same profit as last year.
- (iv) The sales manager is convinced that by improving the quality of ingredients (Increasing variable cost to Rs. 15) and by advertising the improved quality (advertising amount would

be increased by Rs. 50,00,000), sales volume could be doubled. He has also indicated that a price increase would not affect the ability to double sales volume as long as the price increase is not more than 20% of the current selling price... Compute the selling price that would be needed to achieve the goal of increasing profits by 50%. Is the sales manager plan feasible? What selling price would you choose? Why?

20. (a) Explain in brief impact of Just –In –Time system on product prices.
- (b) ABC Co. Ltd. has an annual turnover of Rs.6,00,00,000 from a range of products. Material costs and conversion costs account for 30% and 25% of annual turnover respectively.

Other information relating to the company is as follows:

- (i) Stock values are currently at a constant level, being:
 - (a) Raw material stock: 10% of the material element of annual turnover.
 - (b) Work-in-progress: 15% of the material element of annual turnover together with a proportionate element of conversion costs allowing for 60% completion of work-in-progress as to conversion costs and 100% completion as to material cost. The material cost: conversion cost ratio is constant for all products.
 - (c) Finished goods stock: 12% of the material element of annual turnover together with a proportionate element of conversion cost.
- (ii) Holding and acquisition costs of materials comprise of fixed costs of Rs. 2,00,000 plus variable costs of Rs. 0.10 per Re. of stock held.
- (iii) Movement and control costs of work-in-progress comprise of fixed costs of Rs. 2,80,000 per annum plus variable costs of Rs. 0.05 per Re. of material value of work-in-progress.
- (iv) Holding and control costs of finished goods comprise fixed costs of Rs. 3,60,000 per annum plus variable costs of Rs. 0.02 per Re. of finished goods (material cost + conversion cost).
- (v) Financial charges due to the impact of stock holding on working capital requirement are incurred at 20% per annum on the value of stocks held.

ABC Co. Ltd. is considering a number of changes which is estimated to affect stock levels and costs as follows:

1. Raw material stock: Negotiate delivery from suppliers on a just-in-time basis. Stock levels will be reduced to 20% of the present level. Fixed costs of holding and acquiring stock will be reduced to 20% of the present level and variable costs to Rs.0.07 per Rs. of stock held.
2. Work-in-progress: Convert the layout of the production area into a 'dedicated cell' format for each product type instead of the existing system which comprises groups of similar machines to which each product type must be taken. Work-in-progress volume will be reduced to 20% of the present level with the same stage of completion as at present. Fixed costs of movement and control will be reduced to 40% of the present level and variable costs to Rs.0.03 per Rs. of material value of work-in-progress.
3. Finished goods stock: Improvement control of the flow of each product type from the production area will enable stocks to be reduced to 25% of the present level. Fixed costs of holding and control will be reduced to 40% of the present level and variable costs to Rs.0.01 per Rs. of finished goods held.

Required:

Calculate the annual estimated financial savings from the proposed changes in each of raw material stock, work-in-progress and finished goods stock.

21. Aerodec, Ltd., manufactures and sells two types of wooden deck chairs: Deluxe and Tourist. Annual sales in units, Direct labour-hours (DLHs) per unit and Total labour-hours per year are

provided below:

	Total Hours
Deluxe deck chair (2000 units × 5 Direct Labour Hours per unit)	10,000
Tourist deck chair (10,000 units × 4 Direct Labour Hours per unit)	40,000
Total direct labour-hours	<u>50,000</u>

Costs for materials and labour for one unit of each product are given below:

	Deluxe (Rs.)	Tourist (Rs.)
Direct materials	25	17
Direct labour (at Rs. 12 per Direct labour hour)	60	48

Manufacturing overhead costs total Rs. 8,00,000 each year. The breakdown of these costs among the company's six activity cost pools is given below. The activity measures are shown in brackets.

Activities and Activity Measures	Estimated overhead cost	Expected Activity		
		Total	Deluxe	Tourist
Labour related (Direct labour-hours)	80,000	50,000	10,000	40,000
Machine setups (Number of setups)	1,50,000	5,000	3,000	2,000
Parts administration (Number of parts)	1,60,000	80	50	30
Production orders (Number of orders)	70,000	400	100	300
Material receipts (Number of receipts)	90,000	750	150	600
General factory (Machine hours)	2,50,000	40,000	12,000	28,000
	<u>8,00,000</u>			

Required:

- (i) Classify each of Aerodec's activities as a Unit level, Batch level, Product level, or Facility level activity.
- (ii) Assume that the company's applies overhead cost to products on the basis of direct labour hours.
 - (a) Compute the predetermined overhead rate that would be used.
 - (b) Determine the unit product cost of each product, using the predetermined overhead rate computed in (ii) (a) above.
- (iii) Assume that the company uses Activity Based Costing to compute overhead rates.
 - (a) Compute the activity rate (i.e. predetermined overhead rate) for each of the six centres listed above.
 - (b) Using the rates developed in (iii) (a) above, determine the amount of overhead cost that would be assigned to a unit of each product.
 - (c) Determine the unit product cost of each product and compare this cost to the cost computed in (ii) (a) above.

22. G. Ltd. produces four products. A conventional product costing system is used at present. Now, use of activity based costing (ABC) system is being considered. Details of the four products and relevant information are given below for one period:

Product	A	B	C	D
Output in units	240	200	160	240
Costs per unit:	Rs.	Rs.	Rs.	Rs.
Direct material	80	100	60	120
Direct labour	56	42	28	42
Machine hours (per unit)	8	6	4	6

The four products are similar and are usually produced in production runs of 20 units and sold in batches of 10 units.

The production overhead is currently absorbed by using a machine hour rate, and the total of the production overhead for the period has been analysed as follows:

	Rs.
Machine department costs (rent, depreciation and supervision)	20,860
Set-up costs	10,500
Stores receiving	7,200
Inspection / Quality control	4,200
Output handling and despatch	9,240
	<u>52,000</u>

The 'cost drivers' to be used for the overhead costs are as listed below:

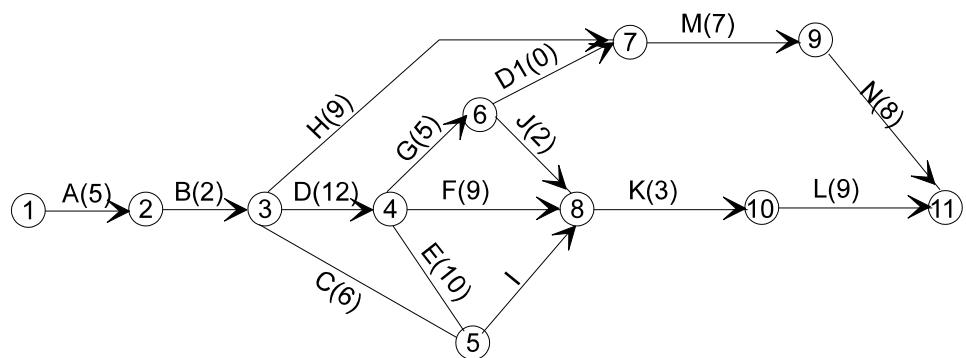
Cost	Cost Driver
Set up costs	Number of production runs
Stores receiving	Requisitions raised
Inspection / Quality control	Number of production runs
Output handling and despatch	Orders executed

The number of requisitions raised on the stores was 20 for each product and the number of orders executed was 84, each order being for a batch of 10 of a product. You are required:

- to calculate the total costs for each product if all overhead costs are absorbed on a machine hour basis;
 - to calculate the total costs for each product, using activity-based costing system;
 - to calculate and list the unit product costs from your figures in (a) and (b) above, to show the differences and to comment briefly on any conclusions which may be drawn which could have pricing and profit implications.
23. (a) List and define four types of product quality cost.
- (b) Define Total Quality Management (TQM). Explain in brief six C_s of T.Q.M. for its successful implementation.

SUGGESTED ANSWERS/HINTS

1. (a) Advantages of Network (PERT/CPM)
- 1. The network techniques help the management in planning the complicated projects, controlling the implementation of the plan and keeping the plan up-to-date. They also help in locating the potential trouble spots and in taking corrective measures.
 - 2. The network provides a number of checks and safeguards against going astray in developing the plan for the project and thus there are little chances of oversight of certain activities and events.
 - 3. The flexibility of the networks permits the management to make the necessary alterations and refinements as and when needed. These allocations may be made during deployment of resources or reviewing.
 - 4. The networks clearly designate the responsibilities of different supervisors. Supervisors of an activity know his time schedule precisely and also the supervisions of other activities with whom he has to coordinate.
 - 5. These techniques help the management in achieving the objective with minimum of time and least cost and also in predicting the probable project duration and the associated costs.
 - 6. Applications of PERT and CPM have resulted in saving of time which directly results in saving of cost. Saving in time or early completion of the project results in earlier return of revenue and introduction of the product or process ahead of the competitors, resulting in increased profits.
 - 7. Application of network techniques has resulted in better managerial control, improved utilization of resources, improved communication and progress reporting and better decision making.
- (b) (a) The network for the given project is
(Network Diagram)



(b) The various paths and their lengths are as follows:

Path	Length (weeks)
(i) 1-2-5-8-10-11	24
(ii) 1-2-3-7-9-11	31
(iii) 1-2-3-4-6-7-9-11	39
(iv) 1-2-3-4-6-8-10-11	38
(v) 1-2-3-4-8-10-11	40
(vi) 1-2-3-4-5-8-10-11	42

Thus, the critical path in 1-2-3-4-5-8-10-11 and the duration of the project in 42 weeks.

(c) Determination of Earliest and Latest Times

Activity	Duration	ES	EF	LS	LF	Slack
A	5	0	5	0	5	0
B	2	5	7	5	7	0
C	6	5	11	23	29	18
D	12	7	19	7	19	0
E	10	19	29	19	29	0
F	9	19	28	21	30	2
G	5	19	24	22	27	3
H	9	7	16	18	27	11
I	1	29	30	29	30	0
J	2	24	26	28	30	4
K	3	30	33	30	33	0
L	9	33	42	33	42	0
M	7	24	31	27	34	3
N	8	31	39	34	42	3

- (d) If activity G (4-6) takes 10 weeks instead of 5, the lengths of the path (iii) and (iv) would become 44 and 43 weeks respectively. In that case path 1-2-3-4-6-7-9-11 would become critical.

2. Material used:

$$X-35 \text{ kg.} + 800 \text{ kg.} - 5 \text{ kg.} = 830 \text{ kg.}$$

$$Y-40 \text{ kg.} + 1200 \text{ kg.} - 50 \text{ kg.} = 1190 \text{ kg.}$$

For materials cost variance:

A Actual cost of materials used:

$$X-35 \text{ kg.} \times \text{Rs. } 4 = \text{Rs. } 140.00$$

$$795 \text{ kg.} \times (3,400/800) = 3,378.75$$

$$Y - 40 \text{ kg.} \times \text{Rs. } 3 = 12.00$$

$$1,150 \text{ kg.} \times (3,000/1,200) = \underline{2,875.00} \quad 6,513.75$$

B Standard cost of materials used:

$$X - 830 \text{ kg.} \times \text{Rs. } 4 = \text{Rs. } 3,320.00$$

$$Y - 1,190 \text{ kg} \times 3 = \underline{3,570.00} \quad 6,890.00$$

C Standard cost of material, if it had been used in standard proportion.

$$X - (40/100) \times 2020 \times \text{Rs. } 4 = \text{Rs. } 3,232$$

$$Y - (60/100) \times 2020 \times 3 = \underline{3,636} \quad 6,868.00$$

D Standard material cost of output.

$$\text{Suppose total weight of mix (input)} = 100 \text{ kg}$$

$$\text{Therefore, } X - 40 \text{ kg} \times 4 = 160$$

$$Y - \underline{60} \text{ kg} \times 3 = 180$$

$$\underline{100} \text{ kg.} \quad 340$$

Less loss 15%

$$\text{For output 85 kg. the cost (standard)} = \text{Rs. } 340$$

For output 1,700 kg. the cost	=	$(340 / 85) \times 1,700 = 6,800$
Material price variance	=	$A - B = 6,513.75 - 6,890.00 = \text{Rs.}376.25 \text{ (F)}$
Materials Mix Variance	=	$B - C = 6,890.00 - 6,868.00 = 22.00 \text{ (A)}$
Materials Yield Variance	=	$C - D = 6,868.00 - 6,800.00 = 68 \text{ (A)}$
Materials Usage Variance	=	$B - D = 6,890.00 - 6,800.00 = 90 \text{ (A)}$
Total Materials Cost Variance	=	$A - D = 6,513.75 - 6,500.00 = 286.25 \text{ (F)}$

Materials Price Variance can also be calculated on the basis of quantity of materials purchased instead of materials used. In that case materials price variance will be calculated as follows:

A - Actual cost of material purchase	=	Rs. 3,400.00
X – 800 kg x Rs. 4.25	=	3,000.00
Y – 1,200 kg x Rs. 2.50	=	6,400.00

B - Standard cost of materials purchased

X – 800 kg. x Rs. 4.00	=	3,200
Y – 1,200 kg. x Rs. 3.00	=	3,600
		6,800

Materials Price Variance based on quantity purchase = $A - B = 6,400 - 6,800 = \text{Rs. } 400 \text{ (F)}$

This will not form part of total material cost variance in usual way.

3. (a) Opportunity Cost : It is the cost of Opportunity lost by diversion of an input factor from one use to another. It is the measure of the benefit of Opportunity foregone. The introduction of opportunity cost concept is helpful to the management in making profitability calculations when one or more of the inputs required by one or more of the alternative courses of action are already available. These inputs may nevertheless have a cost and this is measured by the sacrifice made by the alternative action chosen or the cost that is given up in order to make them available for the current proposal.

The examples of Opportunity cost are :-

- (i) The opportunity cost of using a machine to produce a particular product is the foregone earnings that would have been possible if the machine was used to produce other products.
 - (ii) The opportunity cost of funds invested in a business is the interest that could have been earned by investing the funds in alternative avenues say Bank deposit.
 - (iii) The opportunity cost of one's time is the salary which he would have earned by his profession.
- (b) The differential cost technique is used for making the following managerial decisions.
- (i) Whether to process a product further or not: Many companies manufacture certain products which can be sold as such or can be subjected to further processing. It is also possible that waste emanating from one operation can be sold after further processing. In such cases, the matter for consideration is whether the incremental revenues arising from further processing is sufficient to cover the incremental cost involved.
 - (ii) Dropping or adding a product line: Often a firm manufacturing a number of products may find that one or more of its products are not profitable. In such cases, the firm may have two alternatives as under :-
 - (iii) To drop the non-remunerative product and leave the capacity unutilized.
 - (iv) To drop the non-remunerative product and to utilize the capacity freed to manufacture of a more remunerative product.

(c)

Particulars	Year	Year	Year	
	0	1-5	6-10	10
Outflow	80,000			
(Refer to working note 1)				
Inflow				
Sales volume (units)		10,000	7,000	
(Refer to working note2)				
Selling price (Rs.)		X	X	
Total sales revenue : (Rs.) (A)		10,000X	7,000X	
Cost				
Materials and labour cost (Rs.)		6,00,000	4,20,000	
Incremental fixed overhead		1,12,500	1,12,500	
Depreciation of machine		<u>8,000</u>	<u>8,000</u>	
Total cost: (Rs.) (B)		<u>7,20,500</u>	<u>5,40,500</u>	
Profit before tax : (Rs.) (A) – (B)		(10,000X – 7,20,500)	(7,000X – 5,40,500)	
Less : Tax @ 40%		(4000 X – 2,88,200)	(2800 X – 2,16,200)	
Profit after tax				
before depreciation		(6000 X –4,24,300)	(4200 X –3,16,300)	
Salvage / Scrap (Rs.)				6,000
Values net of tax				<u>43,152</u>
Net Flows : (C)	(80000)	(6000 X – 424300)	(4200 X – 316300)	49,152
DCF Factors: (D)		3.79	2.355	0.386
Discounted Value of (80,000)		(6,000 X –	(4,200 X –	6,000 × 0.386
				+
Cash Inflows: (C) × (D)		4,24,000)3.79	3,16,300)2.355	43,152 × 0.386

Sum of the discounted inflows:

$$[22740 X + 9891 X] - [16,08,097 + 744887] + [2316 + 16657]$$

$$= [32631 X - 23,34,011]$$

Sum of the discounted cash outflows = Rs.80,000

Net cash inflows:

$$= \text{Rs.} 32,631 X - \text{Rs.} 23,34,011 - \text{Rs.} 80,000$$

Minimum selling price: For determining minimum selling price the net cash inflows should be zero i.e.

$$32,631 X = \text{Rs. } 24,14,011$$

$$\text{or } X = \text{Rs. } 73.98 \text{ or (Rs.74)}$$

Notes:

1. (i) Expenditure on R & D and consulting reports are treated as sunk costs.
- (ii) Relevant cost of the machine is based on replenished purchased materials

= Rs. 50,000 + 40% of Rs.50,000 (increase) + labour cost

= Rs. 70,000 + Rs.10,000 = Rs. 80,000

2. Expected sales volume

1-5 yrs = $(20000 \times 0.1) + (10,000 \times 0.65) + (6000 \times 0.25) = 10,000$ units

6-10 yrs = $[12000 \times 0.2] + [8000 \times 0.5] + [2000 \times 0.3] = 7000$ units

4. (a) The fixed overhead volume variance shows the amount of over- or under absorption of fixed overheads based upon the actual level of output compared with the budgeted level of output. The capacity utilisation component arises because of the change in the level of output at a fixed (budgeted) overhead rate of absorption. The efficiency component occurs when the actual rate of overhead absorption is greater or less than that budgeted for a given level of output. This may be illustrated by the following example.

XYZ Ltd	Budget	Actual
Fixed overheads	Rs. 1,00,000	Rs. 1,01,000
Level of output	500 units	520 units
Labour used	2,000 hours	2,020 hours

The fixed overhead volume variance is Rs. 4,000 favourable, i.e. 20 units $\times$ 4 hours per unit $\times$ Rs. 50 per hour.

The capacity component is Rs. 1,000 favourable, i.e. 20 hours $\times$ Rs. 50 per hour.

The efficiency component is Rs. 3,000 favourable, i.e. 60 hours $\times$ Rs. 50 per hour.

The purpose of this subdivision of the variance is to aid management's understanding of the causes of the variance to enable management by exception.

Investigation of the capacity variance would look at the level of customer orders and any capacity constraints within the organisation. The efficiency variance investigation would look at the control and utilisation of labour. The limitations of this subdivision are:

It is only possible for an absorption costing system; it may be difficult to decide which costs are truly fixed in nature; the use of labour hours as a driver of fixed costs may not be meaningful in modern manufacturing environments.

- (b) The materials usage variance shows the standard cost of the variation in quantity of materials used from the standard for a given level of output. The mixture component arises from the standard for a given level of output. The mixture component arises from using different relative proportions of the constituent raw materials from the budget. The yield component reflects any difference between the actual output achieved and that expected based upon the standard operation. For example:

	Standard	Actual
Input for 100 kg of product XY	60 kg of X at Rs. 100 per kg. 40 kg of Y at Rs. 130 per kg.	64 kg of X at Rs. 100 per kg. 38 kg of Y at Rs. 125 per kg.

The material usage variance is Rs. 140 adverse, i.e. 2 kg Y $\times$ Rs. 130 – 4 kg X $\times$ Rs 100.

The material mixture component is Rs. 84 favourable, i.e. 2.8 kg X $\times$ Rs. 130 – 2.8 kg X $\times$ Rs. 100.

The material yield component is Rs. 224 adverse, i.e. 2 kg of XY at standard cost of $(0.6 \times 100 + 0.4 \times 130)$. The purpose is the same as for part (a). The limitation is that this model assumes that there is no change in the quality of the product XY produced from different proportions of X and Y. This is not likely to be true in actual practice where side chemical

reactions may become more prevalent which may render the product unsuitable for its intended purpose. Investigation of the variances would consider:

Mixture variance: ingredients used , material control and wastage;

Yield variance: efficiency of equipment and the quality of materials used.

- (c) The labour rate variance is the difference between the actual cost incurred for the actual hours worked and the cost for working the actual amount of hours using the budgeted labour rate. The operational component arises from any changes in the rate of pay , which were a consequence of the way labour was operated, e.g. allowing a discretionary extra payment for poor working conditions. The planning component shows the change in labour rate due to inadequacies or inaccuracies in the preparation of the original budget. For example, the anticipated annual pay rise may have been different from that obtained from the workforce:

Actual hours worked	100
Actual wages paid	Rs. 500
Original standard wage rate	Rs. 4 per hour
Revised standard wage rate for the period	Rs. 5.20 per hour

The labour rate variance is Rs. 100 adverse i.e. $(500 - (4 \times 100))$

The operational component is Rs. 20 favourable, i.e. $(500 - (5.20 \times 100))$

The planning component is Rs. 120 adverse, i.e. (100×1.20)

Again, the purpose is the same as for part (a). The limitation for this subdivision is that it is rare for there to be a controllable (operational) reason for the labour rate variance. In general labour rates are fixed by the market place, i.e. they are uncontrollable (planning) variances. Thus, this subdivision is an unnecessary complication that will rarely provide an insight which is an improvement on that provided by the labour rate variance. However, any investigation would focus on the establishment of wage rates and labour recruitment, whereas investigation of the operational variance would look at the actual payment of wages and control of payroll.

5. 1. Rs. 1,60,000 (Rs. 16,00,000 x 10%)

2. a. Total costs:

Variable (Rs. 25 x 80,000 units)	Rs. 20,00,000
Fixed (Rs. 8,00,000 + Rs. 4,00,000)	12,00,000
Total	<u>Rs. 32,00,000</u>

Cost amount per unit: Rs. 32,00,000 ÷ 80,000 units = Rs. 40.00

- b. Markup percentage = $\frac{\text{Desired Profit}}{\text{Total costs}}$

$$\text{Markup percentage} = \frac{\text{Rs. 160,000}}{\text{Rs. 32,00,000}} = 5\%$$

- c. Cost amount per unit Rs. 40.00
 Markup (Rs. 40 x 5%) 2.00
 Selling price Rs. 42.00

3. a. Total manufacturing costs:

Variable (Rs. 20 x 80,000 units)	Rs. 16,00,000
Fixed factory overhead	8,00,000

Total Rs. 24,00,000

Cost amount per unit: Rs. 24,00,000 ÷ 80,000 units = Rs. 30.00

b. Markup percentage = $\frac{DP + \text{Ttl S \& A Exp}}{\text{Ttl mnfg costs}}$

$$= \frac{\text{Rs. 1,60,000} + \text{Rs. 4,00,000} + (\text{Rs. 5} \times 80,000 \text{ units})}{\text{Rs. 24,00,000}}$$

$$= \frac{\text{Rs. 1,60,000} + \text{Rs. 4,00,000} + \text{Rs. 4,00,000}}{\text{Rs. 24,00,000}}$$

$$\text{Markup percentage} = \frac{\text{Rs. 9,60,000}}{\text{Rs. 24,00,000}} = 40\%$$

c.	Cost amount per unit	Rs. 30.00
	Markup (Rs. 30 x 40%)	12.00
	Selling price	Rs. 42.00

4. a. Variable cost amount per unit : Rs 25
Total variable costs: Rs. 25 x 80,000 units = Rs. 20,00,000

b. Markup percentage = $\frac{\text{Desired profit} + \text{total fixed costs}}{\text{Total variable costs}}$

$$\text{Markup percentage} = \frac{\text{Rs. 1,60,000} + \text{Rs. 8,00,000} + \text{Rs. 4,00,000}}{\text{Rs. 20,00,000}} =$$

$$\text{Markup percentage} = \frac{\text{Rs. 13,60,000}}{\text{Rs. 20,00,000}} = 68\%$$

c.	Cost amount per unit	Rs. 25.00
	Markup (Rs. 25 x 68%)	17.00
	Selling price	Rs. 42.00

5. a. Proposal to sell to Wong Ltd
Differential revenue from accepting offer:
Revenue from sale of 4,000 additional units at Rs. 28 Rs. 1,12,000
Differential cost from accepting offer:
Variable production costs of 4,000 additional units at Rs. 20 80,000
Differential income form accepting offer Rs. 32,000
- b. The proposal should be accepted.

6. 1.

Direct Materials Cost Variance

1.

Quantity variance:

Actual quantity 1,600 kgs.

Standard quantity 1,500

Variance - unfavourable 100 kgs. x standard price, Rs. 35 Rs. 3,500

Price Variance:

Actual price Rs. 32.00 per kg

Standard price 35.00

Variance - favourable Rs. (3.00) per kg x actual quantity, 1,600 (4,800)

Total direct materials cost variance – favourable Rs. (1,300)

2.

Direct labour Cost Variance

Time variance:

Actual time 4,500 hours

Standard time 4,800 hours

Variance - favourable (300) hours x standard rate, Rs.11 Rs. (3,300)

Rate Variance:

Actual rate Rs.11.80

Standard rate 11.00

Variance - unfavourable Rs. 0.80 per hour x actual time, 4,500 hrs. 3,600

Total direct labour cost variance – unfavourable Rs. 300

3.

Factory Overhead Cost Variance

Variance factory overhead – controllable variance:

Actual variable overhead cost incurred Rs.12,300

Budgeted variable factory overhead for 4,800 hours 11,520*

Variance – unfavourable Rs. 780

Fixed factory overhead – volume variance:

Budgeted hours at 100% of normal capacity 5,500 hours

Standard hours for actual production 4,800 hours

Productive capacity not used 700 hours

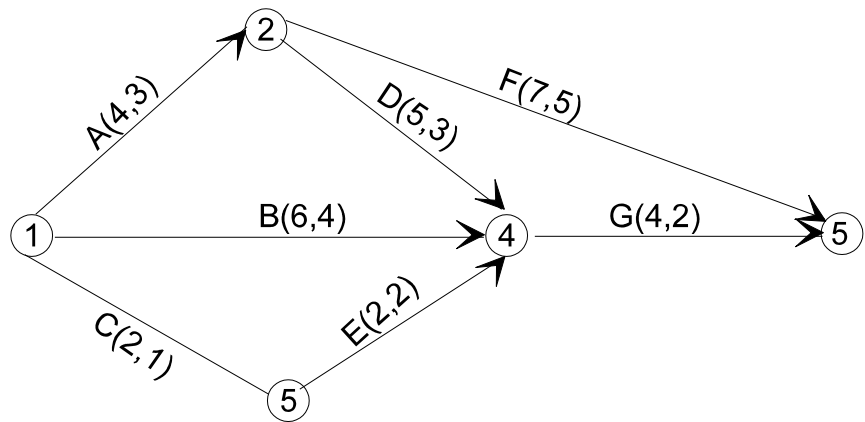
Standard fixed factory overhead cost rate X Rs. 3.50

Variance -unfavourable 2,450

Total factory overhead cost variance-unfavourable Rs. 3,230

*4,800 hrs. x Rs. 2.40 = Rs. 11,520

7. (a) The arrow diagram for the project is



(b) From the diagram we have

Path	Length	
	Normal Time	Crash Time
1-2-5	11	8* (critical)
1-2-4-5	13* (critical)	8* (critical)
1-4-5	10	6
1-3-4-5	8	5

Thus, the normal duration is 13 days while the minimum completion time of the project is 8 days.

Crashing cost = $\frac{\text{Crash cost} - \text{Normal cost}}{\text{Normal time} - \text{Crash time}}$

Accordingly, for activity A, we have

Crashing cost = $\frac{90 - 60}{4 - 3}$ Rs. 30 per day

For the various activities, the crashing costs are:

Activity	Node	Cost per day (Rs.)
A	1-2	30
B	1-4	50
C	1-3	22
D	2-4	50
E	3-4	–
F	2-5	30
G	4-5	70

Crashing: The step wise crashing is as following table:

Crashing	Critical Path	Options	Cost	Decision	Duration after crashing
I	1-2-4-5	(i) 1-2	30	Crash 1-2	12
		(ii) 2-4	50		
		(iii) 4-5	70		

II	1-2-4-5	(i) 2-4	50	Crash 2-4	11
		4-5	70		
III	1-2-4-5	(i) 2-4	50	Crash 2-4	10
		(ii) 4-5	70		
IV	1-2-5	(i) 2-5, 4-5	100	Crash 2-5, 4-5	9
	1-2-4-5				
	1-4-5				
V	1-2-5	(i) 2-5, 4-5	100	Crash 2-5, 4-5	8
	1-2-4-5				
	1-4-5				

The length of various paths after each crashing is given here:

Path	Normal length	Length after crashing				
		I	II	III	IV	V
1-2-5	11	10	10	10	9	8
1-2-4-5	13	12	11	10	9	8
1-4-5	10	10	10	10	9	8
1-3-4-5	8	8	8	8	7	6

Cost of completing the project in 13,12,... Days in determination of total cost:

Project Duration (days)	Direct Cost			Indirect Cost	Total Cost (Rs)
	Normal	Crashing	Total		
13	713	0	713	400	1113
12	713	30	743	250	993
11	713	80	793	175	968
10	713	130	843	100	943*(Min)
9	713	230	943	75	1018
8	713	330	1043	50	1093

8.

Table I

	a	b	c	d	e
A	30	0	45	60	70
B	15	0	10	40	55
C	30	0	15	60	75
D	0	0	30	30	60
E	20	0	45	45	70

Table II

	a	b	c	d	e
A	30	0	35	30	15
B	15	0	0	10	0
C	30	0	5	30	20
D	0	0	20	0	5
E	20	0	35	15	15

In table II, the number of minimum lines = $N = 3$

The order of matrix = $n = 5$

Therefore, $N < n$

Table III

	a	b	c	d	e
A	25	0	30	15	10
B	15	5	0	10	0
C	25	0	0	25	15
D	0	5	20	0	5
E	15	0	30	10	10

Here $N < n$

Table IV

	a	b	c	d	e
A	15	0	30	15	10
B	5	5	0	0	0
C	15	0	0	15	15
D	0	15	30	0	15
E	5	0	30	0	10

Here $N = n$

Therefore, we can set minimum assignment schedule

	a	b	c	d	e
A		0			
B			⊗	⊗	0
C		0	0		
D	0			⊗	
E		⊗		0	

Town depots

A →b

B →e

C →c

D →a

E →d

Therefore, Minimum distance travelled

= 130 + 175 + 125 + 50 + 80

= 560 miles

9. (a) (i) Cost Driver: A cost driver is a characteristic of an event or activity that results in the incurrence of costs.
- (ii) Activity Cost Pool: In Activity Based Costing system, the activity cost drivers are for assigning the cost of `activities to cost objects.
- (b) (a) Manufacturing product costs with Traditional Costing System

	Board X	Board Y
	Rs.	Rs.
Direct Manufacturing costs:		
Direct materials	6,000	2,800
Direct manufacturing labour	320	560
	6,320	3,360
Indirect Manufacturing costs:		
Procurements / purchases overheads (support)	3,000	1,400
(50% of direct material cost)		
Production overheads (support)		
(700% of direct manufacturing labour cost)	2,240	3,920
	5,240	5,320
Total manufacturing costs	11,560	8,680

(b) Product costs with Activity-Based Costing

	Board X Rs.	Board Y Rs.
Direct Manufacturing costs:		
Direct materials	6,000	2,800
Direct manufacturing labour	<u>320</u>	<u>560</u>
Total Direct manufacturing costs: (A)	<u>6,320</u>	<u>3,360</u>
Indirect Manufacturing costs:		
Materials handling [(X, 81 parts; Y 121 parts) × Rs. 20]	1,620	2,420
Machine insertion of parts [(X, 70 insertions; Y, 90 insertions) × Rs. 5]	350	450
Manual insertion of parts [(X, 10 insertions; Y, 30 insertions) × Rs. 40]	400	1,200
Wave soldering [(X, 1 board; Y, 1 board) × Rs 500]	500	500
Quality testing [(X, 1.5 hours; Y, 6.5 hours} × Rs 500]	<u>750</u>	<u>3,250</u>
Total Indirect manufacturing costs: (B)	<u>3,620</u>	<u>7,820</u>
Total manufacturing costs: (A) + (B)	<u>9,940</u>	<u>11,180</u>

Thus, the ABC system results in the following product costs:

	Board X Rs.	Board Y Rs.
Direct job costs	6,320	3,360
Indirect job costs	<u>3,620</u>	<u>7,820</u>
Total job costs	<u>9,940</u>	<u>11,180</u>

Comment: Different factors were causing/ driving costs in individual activity areas but the traditional costing system did not provide information about those differences. The numbers with this system are of limited use or even a detriment in decision-making. The costing system tended to "over cost" the intensely competitive high-volume product, X by loading too much of the indirect manufacturing costs on high-volume products and too little on low-volume products.

The ABC system is a more refined costing system and reports cost numbers that better measure the way jobs/ products/ customers and so on differently use resources of the company. Moreover, it points to opportunities for cost reductions. For instance, ABC reveals three reasons why Board X costs less: (i) it has fewer parts, (ii) it has a higher percentage of total insertions made by machine which are cheaper than insertions made manually, and (iii) it requires less time.

10. (a) Learning is the process during which a person acquires the skill to do a job. When a job is taken up for the first time, the worker is new to the job and he takes considerable time to complete it because his performance is not at its best. But, when the same job is repeated he is able to improve his performance because of the skill he has acquired by doing a similar job earlier. This phenomenon is known as learning effect. It applies only to labour oriented operations. The "learning curve theory" is expressed by the equation: $y = ax^b$

where, y = Cumulative average time when x units of products are made

a = Time taken for the first unit

b = The learning index represented by
[log learning effect) / Log 2]

Some applications of learning curve in Cost and Management Accounting are:

- (i) Setting labour standard times.
 - (ii) Helps in budgeting and profit planning
 - (iii) Helps in pricing successive batches / contract
 - (iv) Helps in negotiations and bargaining because of declining unit time and cost.
 - (v) Forecasting and preparing cost estimates, etc.
- (b) First machine – Labour hours = 800

Order for 20 machines

Total machines 21

Labour hours = $800 (21)^{-0.3219}$

= $\log 800 - 0.3219 (\log 21)$

= 2.4775

Antilog of 0.4775 = 3002

Average hours = 300.2 per machine

Repeat order 30 machines

Total machines 51

Labour hours = $800 (21)^{-0.3219}$

= $\log 800 - 0.3219 (\log 51)$

= 225.7 hours per machine

Net machines	1	21	51
Hours per unit	800	300.2	225.7
Total hours	800	6,304.2	11,510.7
Incremental hours		5,504.2	5,206.5
Costs machines		20	30
Direct materials $16,000 \times 20$		3,20,000	4,80,000
$16,000 \times 30$			
Direct labour 5504.2×20		1,10,084	1,04,130
$5,206.5 \times 20$			
Variable overheads @ 25/- per hr		1,37,605	1,30,163
Fixed Overheads @ 40/- per hour		<u>2,20,168</u>	<u>2,08,260</u>
Total		<u>7,87,857</u>	<u>9,22,553</u>
Cost per unit		39,392.85	30,751.77
Selling price (20% profit on S.P.)		49,241	38,440

Reduction in price for repeat order = Rs.10,801.

(c) Random number allocation

Sales in units	Probability	Cumulative Probability	Random Nos. allocated
74	0.10	0.10	00-09
76	0.15	0.25	10-24
78	0.22	0.47	25-46
80	0.30	0.77	47-76
82	0.18	0.95	77-94
84	0.05	1.00	95-99

Simulation:

Contribution (75-45)= Rs. 30

Scrap sales loss per unit (S.P. – V.C) = (Rs. 30 – Rs. 45) = (Rs. 15)

Fixed costs per day = 80 units × Rs. 10 = Rs. 800

(i) 80 units per day

R. No.	Sales units	Contribution @Rs. 30	Scrap loss @ Rs.15/- p.u.	Penalty at Rs.5/-	Net Contribution (Rs.)
41	78	2340	30		2310
65	80	2400	-		2400
14	76	2280	60		2220
35	78	2340	30		2310
81	82	2400	-	10	2390
20	76	2280	60		2220
79	82	2400	-	10	2390
93	82	2400	-	10	2390
71	80	2400	-		2400
14	76	2280	60		<u>2220</u>
					<u>23250</u>
				Average cost per day	<u>2325</u>
			Less: Fixed costs per day		<u>800</u>
			Profit		<u>1525</u>

Daily production 76 units

R. No.	Sales units	Contribution @ Rs.30 p.u.	Scrap loss @ Rs.15 p.u.	Penalty @ Rs.5	Net contribution Rs.
41	78	2280		10	2270
65	80	2280		20	2260
14	76	2280			2280

35	78	2280	10	2270
81	82	2280	30	2250
20	76	2280		2280
79	82	2280	30	2250
93	82	2280	30	2250
71	80	2280	20	2260
14	76	2280		<u>2280</u>
				<u>22650</u>
		Average/day		2265
		Fixed		<u>800</u>
		costs/day		<u>1465</u>
		Net Profit/day		

Note: Wherever sales are greater than the production of 76 units, sales and consequently the contribution are restricted to production units of 76.

11. (a) The benefits of product life cycle costing are:

- There are a number of factors that need to be managed to maximise return. These aspects can be duly considered.
- Better decisions should flow from a more accurate and realistic assessment of revenues and costs within a particular life cycle.
- Product life cycle thinking can promote long term rewarding in contrast to short term profitability.
- It provides an overall framework for considering the total incremental costs over the entire life span of a product which in turn facilitates analysis of parts of the whole where cost effectiveness can be improved.

(b) (i) A Division

Total capacity per month	4,000 Kl.
Utilisation	75%
Production per month	3,000 Kl.
1/3 to Division B	1,000 Kl.

Each can contain 25 litres

$$\text{No. of cans} = \frac{10,00,000}{25 \text{ litres}} = 40,000 \text{ cans per month.}$$

Profitability per month:

Rs.'000

B Division

Sales 40,000 cans@ Rs.40	1,600
Costs R Materials @ Re. 1 per litre on 1,000 Kl.	1,000
Other variable costs 40,000 × Rs.6	240
Fixed costs	<u>160</u>
Total cost	<u>1,400</u>

Profit: (A)	200
A Division	
Sales 3,000 Kl @ Rs.1,000 per Kl.	3,000
Raw materials 3,000 Kl × Rs.780	2,340
Fixed costs	<u>240</u>
Total	<u>2,580</u>
Profit (B)	420
Profit of a Company as a whole: (A+B)	620
With 80% increase in volume	
B Division	
Sales $\frac{40,000 \times 180}{100} = 72,000$ cans	<u>2,520</u>
S.P. (Rs.40 – Rs.5) = Rs.35	
Cost Raw Materials 1,800 × 1,000 per kl	1,800
Other variable costs	432
(72,000 cans × Rs.6)	
Fixed costs	160
Total cost	2,392
Profit	128
A Division	
Sales 3,800 kl × 1,000	<u>3,800</u>
Cost of Raw materials 3,800 × Rs.780	2,964
Fixed costs	<u>240</u>
Total	3,204
Profit	<u>596</u>
Company as a whole	724

- (ii) The present transfer price based on market price does not offer any incentive to B Division to take increased quantity of raw material from division A because it reduces the profitability of B Division from Rs. 2,00,000 to Rs. 1,28,000. A division has idle capacity due to market constraints. Hence A division can reduce the transfer price to an extent which covers its variable costs. The variable cost of A division is

$$\frac{780}{1,000} \times 25 = \text{Rs.19.50 per can.}$$

The loss of profit for B division is Rs. 72,000. It works out to $\frac{72,000}{72,000} = \text{Re. 1 per can.}$

Thus the transfer price can be set above Rs. 19.50 and at or below Rs. 24 per can (Rs. 25 – Re. 1). If the transfer price is set at Rs. 24 per can B division will earn the same profit as originally envisaged of Rs. 2,00,000. Hence, a transfer price of Rs. 24 per can or Rs. 0.96 per litre is recommended.

12. Statement showing Profits from existing and new product

	<u>Existing</u>		<u>New</u>		Total Amount
Sales quantity (units)	6,000		2,000		
	Amount	Per unit	Amount	Per unit	
	Rs.	Rs.	Rs.		Rs.
Sales value: (A)	5,40,000	90	1,20,000	60.00	6,60,000
Less: Variable costs:					
Direct materials	96,000	16	32,000	16.00	
Direct labour	1,20,000	20	30,000	15.00	
Direct expenses	18,000	3	3,000	1.50	
Variable overheads	30,000	5	7,000	3.50	
Total variable cost : (B)	2,64,000	44	72,000	36.00	3,36,000
Contribution : (C) (A – B)	2,76,000	46	48,000	24.00	3,24,000
Less: Fixed overheads:					
Factory	1,75,000		17,500		
Administration	21,000		—		
Selling and distribution	20,000		12,500		
Total fixed cost: (D)	2,16,000		30,000		2,46,000
Profit: {(C) – (D)}	60,000		18,000		78,000

Notes:

- Contribution percentages = Existing Product 51.1%; New Product 40%
- Variable overheads comprise of variable content of factory, selling and distribution overheads.
- Only incremental fixed overheads are charged to new product.
 - The introduction of new product may be accepted, since its profitability exceeds the minimum acceptable threshold of 20%. The computation is as follows:
Incremental profit = Rs.18,000; Incremental investment = Rs.75,000
Profitability is therefore $\text{Rs.18,000} \div \text{Rs.75,000} = 24\%$

(ii) Other observations and recommendations:

At current 60% capacity utilisation, the company makes a profit of Rs. 60,000. The original investment works out to Rs.8 lakhs (i.e. Rs.8.75 lakhs less Rs.0.75 lakhs being incremental for new product). On this basis, profitability works out only to 7.5%. against the minimum expectation of 20%. Even with the addition of the new product, the return is only 8.9% (Profit of Rs.78,000 upon a total investment of Rs.8.75 lakhs). Thus, while the new product introduction does improve the profitability, overall returns are not good enough.

A detailed study is recommended to ascertain the reasons for this low profitability. A good starting point will be a comparison of key assumptions in the project when it was approved (presumably with an expected return of 20% or higher) with achieved results. For example, have there been drastic policy changes affecting the product, have the sales volume and prices been over-estimated, any changes in the competitive scenario, or whether any significant drop in manufacturing efficiencies etc. This line of enquiry

may help to identify potential areas for cost reduction and profit improvement. One apparent area for cost investigation is the factory overheads and direct labour expenses. Manning at the factory may have to be critically examined. All non-value adding activities may have to be isolated and eliminated after due scrutiny. Similarly, management could also consider whether any of the ancillary operations could be outsourced for better quality and / or lower costs. A further option may be to explore contract manufacture for others, so that capacity utilisation in the factory may be improved and profits increased.

13. This problem is an unbalanced transportation problem in which aggregate requirements are 145 units while aggregate supplies are 105 units. The problem is balanced by adding a dummy row with supply value of 40 units and cost elements equal to 5, 3 and 2 under columns D, E and F respectively. The initial feasible solution to this problem using VAM is contained in the following table.

Initial Feasible solution : Optimal

From \ To	D	E	F	SS	ui
A	5 -2	10 1	7 -4	10	0
B	60 6	10 4	10 6	80	3
C	15 3	2 -1	5 -2	15	0
Dummy	5 -3	3 -3	40 2	40	-1
DD	75	20	50	145	
Vj	3	1	3		

Total cost : $1 \times 10 + 6 \times 60 + 4 \times 10 + 6 \times 10 + 3 \times 15 + 2 \times 40 = \text{Rs. } 595$

Upon testing, the solution is found to be optimal,

Since all $u_{ij} \leq 0$

Thus, the transportation schedule would be as follows:

From A to E : 10 units, B to D : 60 units, B to E and F: 10 units each, and C to D: 15 units, while 40 units to F would not be supplied.

14. Using the given information, we may derive the profit matrix indicating the profit per unit obtainable when produced and sold in various combinations of factories and sales agencies. For example, a unit produced in factory A costs Rs. 10 and its shipping to sales agency I costs Rs. 7, where it sells for Rs. 20. Accordingly, a unit produced in factory A and sold in agency I would yield a profit of Rs. $20 - (\text{Rs. } 10 + \text{Rs. } 7) = \text{Rs. } 3$. The profit matrix is given the following table.

Profit Matrix

Factory	Sales Agency				Supply
	1	2	3	4	
A	3	7	9	4	10
B	2	2	6	1	15
C	0	0	5	-3	20
D	-3	0	4	-2	15
Demand	8	12	18	22	60

To solve the problem, we first convert profit matrix into an opportunity loss matrix, by subtracting each element from the largest value, equal to 9. The opportunity loss matrix is the following table. The table also contains initial solution using VAM.

Opportunity Loss Matrix : Initial solution – VAM

Factory	Sales Agency				Supply	ui
	1	2	3	4		
A	6 (-1)	10 2	0 (0)	5 (-1)	10	0
B	7 (2)	7 (-1)	3 (1)	15 8	15	4
C	2 9	18 9	12 4	(-4)	20	4
D	6 12	2 9	5 (2)	7 11	15	7
Demand	8	12	18	22	60	
Vj	5	2	0	4		

The solution is tested for optimality and found to be non-optimal. The improved solution is the following table, which is tested and found to be optimal.

Opportunity Loss Matrix : Optimal solution

Factory	Sales Agency				Supply	4i
	1	2	3	4		
A	6 (-3)	10 2	0 (-2)	5 (-1)	10	0
B	7 0	7 (-1)	3 (-1)	15 8	15	4
C	8 9	9 (-1)	12 4	12 (-2)	20	6
D	12 (-2)	2 9	6 5	7 11	15	7
Demand	8	12	18	22	60	
Vj	3	2	-2	4		

We may now express the optimal solution as follows:

From: Factory	To: Sales Agency	Units	Profit (Loss)
A	2	10	70
B	4	15	15
C	1	8	0
	3	12	60
D	2	2	0
	3	6	24
	4	7	(14)
Total			155

It may be noted here that the optimal solution given above is not unique.

Since Δij O for the cell B1, the problem has multiple optimal solutions.

15. Working Notes:

(i) Data for calculating Material Variance

Actual output: 1,800 units

Standard data for actual output			Actual data for actual output		
Material Qty. kg	Rate per kg. Rs.	Amount Rs	Material Qty. kg.	Rate per kg. Rs.	Amount Rs.
9,000	2	18,000	8,500	2.0235	17,200

(ii) Data for calculating Labour Variance

Standard data for actual output			Actual data for actual output		
Labour Hrs.	Rate per hour. Rs.	Amount Rs	Labour Hrs.	Rate per hour. Rs.	Amount Rs.
21,600	2	43,200	20,000	2.10	42,000

(iii) Data for calculating Fixed Overhead Variances

Budgeted fixed overhead (Rs.)	10,000	Actual fixed overhead (Rs.)	9,800
Budgeted output (units)	2,000	Actual output (units)	1,800
Budgeted hours	24,000	Actual hours	20,000
Budgeted days	30	Actual days	30
Standard hours for one unit	12 hours		
Standard rate (per unit)		Rs. 5/-	
Standard rate (per hour)		0.4166666 P	
Standard hours per day		800 hours	

(iv) Data for calculating Variable Overhead Variances

Budgeted variable overhead (Rs.)	20,000	Actual variable overhead (Rs.)	22,000
Standard rate per unit	Rs. 12/-	Actual hours	20,000 hrs.
Standard hours per unit	12 hours	Actual output	1,800 units

(v) Data for calculating Sales Margin Variances

Budgeted sales	Budgeted Margin per unit	Amount Rs.	Actual sales	Actual Margin per unit	Amount Rs.
2,000 units	4	8,000	1,800 units	1.77777	3,200

Calculation of variances:

$$\begin{aligned}
 \text{Material cost variance} &= \text{Standard cost} - \text{Actual cost} \\
 &= \text{Rs. } 18,000 - \text{Rs. } 17,200 \\
 &= \text{Rs. } 800 \text{ (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Material price variance} &= \text{A.Q. (Standard price} - \text{Actual price)} \\
 &= 8,500 \text{ kg.} \times (\text{Rs. } 2 - 2.0235) \\
 &= \text{Rs. } 200 \text{ (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Material usage variance} &= \text{S.P. (Standard Qty. for actual output – Actual Qty.)} \\
 &= \text{Rs. 2 (9,000 kg. – 8,500 kg.)} \\
 &= \text{Rs. 1,000 (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Labour cost variance} &= \text{Standard cost – Actual cost} \\
 &= \text{Rs. 43,200 – Rs. 42,000} \\
 &= \text{Rs. 1,200 (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Labour rate variance} &= \text{A.H. (Standard rate – Actual rate)} \\
 &= 20,000 \text{ hrs. (Rs.2 – Rs. 2.10)} \\
 &= \text{Rs. 2,000 (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Labour efficiency variance} &= \text{S.R. (Standard hrs. for actual output – Actual hrs.)} \\
 &= \text{Rs. 2 (21,600 hrs. – 20,000 hrs.)} \\
 &= \text{Rs. 3,200 (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total fixed overhead cost variance} &= \text{Overhead recovered by actual output – Actual Fixed Overhead} \\
 &= (1,800 \text{ units} \times \text{Rs. 5} – \text{Rs. 9,800}) \\
 &= \text{Rs. 800 (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Fixed overhead expenditure variance} &= \text{Budgeted fixed overhead – Actual fixed overhead} \\
 &= (\text{Rs. 10,000} – \text{Rs. 9,800}) \\
 &= \text{Rs. 200 (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Fixed overhead volume variance} &= \text{Standard rate per unit (Budgeted output – Actual output)} \\
 &= \text{Rs. 5(2,000 units – 1,800 units)} \\
 &= \text{Rs. 1,000 (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Fixed overhead efficiency variance} &= \text{Standard rate per unit} \times \left(\frac{\text{Standard output in Actual hours}}{\text{Standard output}} – \frac{\text{Actual output}}{\text{Standard output}} \right) \\
 &= \text{Rs. 5} \times \left(\frac{20,000 \text{ hrs.}}{12 \text{ hrs.}} – 1,800 \text{ units} \right) \\
 &= \text{Rs. 666.67 (Fav.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Fixed overhead capacity variance} &= \text{Standard rate per hour} \times (\text{Budgeted hours – Actual hours}) \\
 &= \text{Rs.0.4166666 (24,000 hrs. – 20,000 hrs.)} \\
 &= \text{Rs. 1666.67 p (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total variable overhead variance} &= \text{Standard variable overhead – Actual variable overhead} \\
 &= (1,800 \text{ units} \times \text{Rs. 12} – \text{Rs. 22,000}) \\
 &= \text{Rs. 400 (Adv.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Variable overhead expenditure variance} &= \text{Budgeted variable overhead – Actual variable overhead} \\
 &= \text{Rs. 20,000 – Rs. 22,000} \\
 &= \text{Rs. 2,000 (Adv.)}
 \end{aligned}$$

$$\begin{aligned} \text{Variable overhead efficiency variance} &= \frac{\text{Standard variable overhead per unit}}{\times} \left(\frac{\text{Standard output in Actual hours}}{\text{Actual output}} - 1 \right) \\ &= \text{Rs. } 12 (1666.666 - 1,800) \\ &= \text{Rs. } 1,600 (\text{Fav.}) \end{aligned}$$

$$\begin{aligned} \text{Total sales margin variance} &= \text{Budgeted Margin} - \text{Actual Margin} \\ &= \text{Rs. } 8,000 - \text{Rs. } 3,200 \\ &= \text{Rs. } 4,800 (\text{Adv.}) \end{aligned}$$

$$\begin{aligned} \text{Sales margin price variance} &= \text{Actual sales (Budgeted margin p.u. - Actual Margin p.u.)} \\ &= 1,800 \text{ units (Rs. } 4 - \text{Rs. } 1.7777) \\ &= \text{Rs. } 4,000 (\text{Adv.}) \end{aligned}$$

$$\begin{aligned} \text{Sales margin volume variance} &= \text{Budgeted Margin p.u.} \times [\text{Bud. sales qty.} - \text{Actual sales qty.}] \\ &= \text{Rs. } 4 \times (2,000 - 1,800) \\ &= \text{Rs. } 800 (\text{Adv.}) \end{aligned}$$

Reconciliation Statement

	Rs. (Fav.)	Rs. (Adv.)	Rs.
Budgeted profit		8,000	
Adjustment of Variance:			
Sales margin price variance	—	4,000	
Sales margin volume variance	—	800	
Material price variance	—	200	
Material usage variance	1,000	—	
Labour rate variance		—	2,000
Labour efficiency variance	3,200	—	
Variable overhead efficiency variance	1,600	—	
Variable overhead expenditure variance	—	2,000	
Fixed overhead expenditure variance	200	—	
Fixed overhead efficiency variance	666.67	—	
Fixed overhead capacity variance	—	1,666.67	
Net	6,666.67	10,666.67	(4,000)
Actual profit for the period			Rs. 4,000

(b) Calculation of Bonus Payments to Employees:

	Rs.
Material saved (15% × Rs. 1,000)	150
Labour saved (50% × Rs. 3,200)	<u>1,600</u>

16. 1. Computations for the Tractor Division buying crankshafts internally for one year are

Case			
	a	b	c
Total purchase costs if buying from an external supplier (2,000 shafts x Rs. 2,000, Rs. 2,000, Rs. 1,850 per shaft)	Rs. 40,00,000	Rs. 40,00,000	Rs. 37,00,000
Incremental costs if buying from the Machining Division (2,000 shafts x Rs. 1,900 per shaft)	38,00,000	38,00,000	38,00,000
Total opportunity costs of the Machining Division	—	2,90,000	—
Total relevant costs	Rs. 38,00,000	Rs.40,90,000	Rs. 38,00,000
Annual operating income advantage (disadvantage) to Eicher of buying from the Machining Division	Rs. 2,00,000	Rs. (90,000)	Rs. (1,00,000)

Case	Incremental Cost per Unit Incurred to Point of Transfer	+ Opportunity Cost per Unit to the Supplying Division	=	Transfer Price	External Market Price
a	Rs. 1,900	+ Re. 0	=	Rs. 1,900	Rs. 2,000
b	Rs. 1,900	+ Rs. 145.0 (Rs. 2,90,000 ÷2,000)	=	Rs. 2,045.0	Rs. 2,000
c	Rs. 1,900	+ Re. 0	=	Rs. 1,900	Rs. 1,850

Comparing transfer price to external market price, the Tractor Division will maximize annual operating income of Eicher Corporation as a whole by purchasing from the Machining Division in case 'a' and by purchasing from the external supplier in cases 'b' and 'c'.

2. Eicher Corporation is a highly decentralized company. If no forced transfer were made, the Tractor Division would use an external supplier, a decision that would be in the best interests of the company as a whole in cases 'b' and 'c' of requirement 1 but not in case 'a'.

Suppose in case 'a', the Machining Division refuses to meet the price of Rs. 2,000. This decision means that company will be Rs. 2,00,000 worse off in the short-run. In case top management interferes and forces a transfer at Rs. 2,000, it would undermine the philosophy of decentralization. Much top management would not interfere because they would view the Rs. 2,00,000 as an inevitable cost of a suboptimal decision that can occur under decentralization. Any top management interference with lower-level decision making weakens decentralization. Of course, such interference may occasionally be necessary to prevent costly blunders. But recurring interference and constraints simply transform a decentralized company into a centralized company.

17. 1. Prevention Costs: Quality training

Appraisal costs: Product inspection and materials inspection

Internal failures costs: Scrap and rework

External failure costs: Warranty

2. Preceding year – Total quality costs: Rs. 2,000,000; percentage of sales: 20 percent

(Rs. 2,000,000 /Rs.10,000,000). Current year – Total quality costs: Rs. 15,45,000;

Percentage of sales: 15.45 percent (Rs. 15,45,000/1,00,00,000). Profit has increased by Rs. 4,55,000. If quality costs drop to 2.5 percent of sales, another Rs. 12,95,000 of profit improvement is possible (Rs. 1,545,000 – Rs. 250,000).

18. Formulation of L.P.P is

Let the number of units in F1 = x_1

And the number of units in F2 = x_2

$\therefore$ the cost function is $Z = x_1 + 1.5x_2$

		Food	stuff
		F1	F2
Vitamin	V1	1	1
	V2	100	10
	V3	10	100

The in-equation due to Vitamin V1 is $x_1 + x_2 \geq 1$ mg

And The in-equation due to Vitamin V1 is $100 x_1 + 10 x_2 \geq 50$

The in-equation due to Vitamin V1 is $10 x_1 + 100 x_2 \geq 10$

$x_1 \geq 0, x_2 \geq 0$

The required L.P.P. is

Minimize $Z = x_1 + 1.5x_2$

Subject to

$x_1 + x_2 \geq 1$

$100 x_1 + 10x_2 \geq 50$

$10 x_1 + 100x_2 \geq 10$

Now we solve the above L.P.P in graphical method.

We shall converse the in equation given in L.P.P as equation

$$x_1 + x_2 = 1 \quad \rightarrow 1$$

$$10 x_1 + x_2 = 5 \quad \rightarrow 2$$

$$x_1 + 10x_2 = 1 \quad \rightarrow (3)$$

Consider the line (1)

$$x_1 + x_2 = 1$$

When $x_2 = 0, x_1 = 1$

The line (1) cuts x_1 axis at (1,0)

When $x_1 = 0, x_2 = 1$, the line (1) cuts x_2 axis at (0,1)

Consider the line (2)

$$10x_1 + x_2 = 5$$

When $x_2 = 0, 10x_1 = 5$

$$x_1 = 5/10 = \frac{1}{2} = 0.5$$

The line (2) cuts x_1 axis at (0.5,0)

When $x_1 = 0$

$$10x_1 + x_2 = 5$$

$$x_2 = 5$$

The line (2) cuts x_2 axis at (0,5)

Consider the line 3

$$x_1 + 10x_2 = 1$$

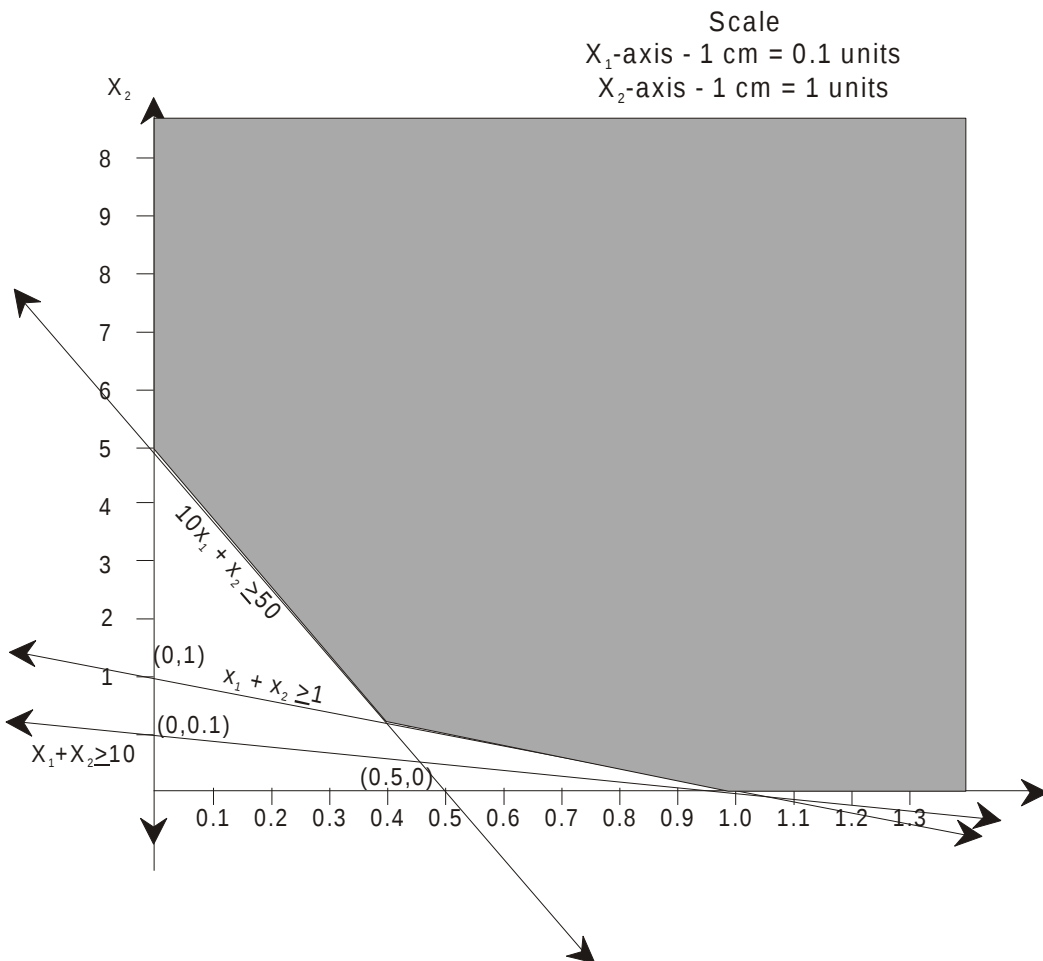
When $x_2 = 0$, $x_1 = 1$

The line (3) cuts x_1 axis at (1,0)

When $x_1 = 0$, $10x_2 = 1$

$$x_2 = 0.1$$

The line (3) cuts x_2 axis at (0,0.1)



From the graph the region QAB is called Solution Space

The point B = (0,5)

The point A = (1,0)

We shall find Q

Q is the intersection of the eqn. (1) and (2)

$$(2)-(1) \rightarrow 9x_1 = 4$$

$$x_1 = 0.44$$

$$\therefore (1) \rightarrow 0.44 + x_2 = 1$$

$$x_2 = 0.56$$

$$\therefore \text{the point Q} = (0.44, 0.56)$$

$$\text{At A}(1,0), Z = 1$$

$$\text{At B}(0,5), Z = 0 + 1.5 \times 5 = 7.5$$

$$\text{At Q}(0.44, 0.56), Z = 0.44 + 1.5 \times 0.56 = 1.28$$

$$\therefore \text{Minimum } Z = 1 \text{ at } x_1 = 1, x_2 = 0$$

19. Last year's operating profits:

	Rs.
Sales	2,00,00,000
(Rs.20 × 10,00,000 bars)	
Less: Variable costs	1,25,00,000
(Rs.12.50 × 10,00,000 bars)	
Contribution margin	75,00,000
Less: Fixed cost	30,00,000
Operating profits	45,00,000

(i) Maximum amount that can be spent on Advertising

$$\text{Desired profits} = \text{Rs. } 45,00,000 \times 1.50 = \text{Rs. } 67,50,000$$

	Rs.
Contribution	1,50,00,000
(Rs. 7.50 × 20,00,000 bars)	
Less: Desired operating profits	67,50,000
	82,50,000
Less: Fixed Costs (other than incremental advertising)	30,00,000
Maximum amount that can be spent on advertising	52,50,000

(ii) (a) Determination of increase in selling price to maintain the same Break-even point

	Rs.
Variable cost increased to	15 / bar

Break-even point (units) last year	30,00,000
	Rs.20 – Rs.12.50
	4,00,000 bars
4,00,000 bars =	Rs.30,00,000
	S – Rs.15
S =	Rs.22.50

Selling price to increase by Rs.2.50 or by 12.5%

$$(\text{Rs. } 2.50 / \text{Rs. } 20) \times 100 = 12.5\%$$

(b) New price, if company wants to increase old contribution margin ratio by 50%

$$\text{Last year's contribution margin ratio} = \frac{\text{Rs. 7.50}}{20} = 37.50\%$$

New contribution margin ratio 56.25%

$$\therefore \text{Variable cost/ sales ratio} = 43.75\%$$

$$\text{Hence new selling price be} = \frac{\text{Rs.15}}{0.4375} = \text{Rs.34.2857}$$

- (iii) Computation of sales volume that would be needed at new price for the company to earn the same profit as last year

New selling price (Rs.)	25
New sales volume bars	8,00,000
Contribution (Rs.)	1,00,00,000
(Rs.25– 12.50) × 8,00,000 bars	
Less: Fixed cost (Rs.)	30,00,000
Operating profits (Rs.)	<u>70,00,000</u>

The decision seems to be good one as operating profits have increased from Rs.45 lakhs to Rs.70 lakhs.

$$\begin{aligned} \text{Desired sales quantity} &= \frac{\text{Rs. 30,00,000} + \text{Rs. 45,00,000}}{\text{Rs. 25} - \text{Rs. 2.50}} \\ &= 6,00,000 \text{ bars} \end{aligned}$$

- (iv) Computation of selling price that would be needed to achieve the goal of increasing profit by 50%

Variable cost / bar	Rs.15
Fixed cost increase due to advertising	from Rs. 30 lakhs to Rs. 80 lakhs
Sales volume	20,00,000 bars

Desired selling price needed to achieve profit goal of Rs.67,50,000

$$20,00,000 \text{ bars} = \frac{80 \text{ lakhs} + \text{Rs. 67.5 lakhs}}{S - \text{Rs.15}}$$

$$\therefore S = \text{Rs. 22.375}$$

Yes, sales manager plan seems feasible as price increase of $2.375/20 = 11.875\%$ is required to achieve desired profit goal but the caveat is

- Is market so big?
- Will competitors not follow aggressive strategy, when it hurts them?

21. (i) Classification of Aerodec's activities.

Activity Cost Pool	Type of Activity
Labour related	Unit level
Machine setups	Batch level
Parts Administration	Product level
Production orders	Batch level
Material receipts	Batch level
General factory	Facility level

(ii) (a) Computation of the Pre-determined overhead rate.

$$\begin{aligned} \text{Pre-determined overhead rate} &= \frac{\text{Estimated total manufacturing overhead}}{\text{Estimated total direct labour – hours (DLHs)}} \\ &= \frac{\text{Rs. 8,00,000}}{50,000 \text{ DLHs}} = \text{Rs. 16 per DLH} \end{aligned}$$

(b) Computation of unit product cost

	Deluxe	Tourist
	Rs.	Rs.
Direct materials	25	17
Direct labour	60	48
Manufacturing overhead applied:		
Deluxe: 5 DLHs x Rs. 16 per DLH	80	
Tourist: 4 DLHs x Rs. 16 per DLH		64
Unit product cost	<u>165</u>	<u>129</u>

(iii) (a) Computation of the Activity Rate.

Activity	Estimated overhead Cost Rs. (i)	Total Expected Activity (ii)	Activity Rate Rs. (i) / (ii)
Labour related	80,000	50,000 DLHs	1.60 per DLH
Machine setups	150,000	5,000 setups	30.00 per setup
Parts administration	1,60,000	80 parts	2,000.00 per part
Production orders	70,000	400 orders	175.00 per order
Material receipts	90,000	750 receipts	120.00 per receipt
General factory	250,000	40,000 MHs	6.25 per machine hour

(b) Computation of overhead cost that would be assigned to a unit of each product.

Activities and Activity Rates	Deluxe		Tourist	
	Expected Activity	Amount Rs.	Expected Activity	Amount Rs.
Labour related at Rs. 1.60 per DLH	10,000	16,000	40,000	64,000
Machine setups, at Rs. 30 per setup	3,000	90,000	2,000	60,000
Parts administration, at Rs. 2,000 per part	50	100,000	30	60,000
Production orders, at Rs. 175 per order	100	17,500	300	52,500
Material receipts, at Rs. 120 per receipt	150	18,000	600	72,000
General factory, at Rs. 6.25 per MH	12,000	<u>75,000</u>	28,000	<u>175,000</u>
Total overhead cost assigned (i)		<u>3,16,500</u>		<u>4,83,500</u>
Number of units produced (ii)	2,000		10,000	
Overhead cost per unit, (i) / (ii)		158.25		48.35

(c) Computation of unit product of each product (under ABC)

	Deluxe	Tourist
	Rs.	Rs.
Direct Materials	25.00	17.00
Direct labour	60.00	48.00
Manufacturing overhead (see above)	158.25	48.35
Unit product cost	243.25	113.35

Under activity-based costing, the unit product cost of the Deluxe deck chair is much greater than the cost computed under traditional costing in (2) (b) above, and the unit product cost of the Tourist deck chair is much less. Using volume (direct labour-hours), in (2) (b), as a basis for applying overhead cost to products has resulted in too little overhead cost being applied to the Deluxe deck chair (the low-volume product) and too much overhead cost being applied to the Tourist deck chair (the high volume product).

22. (a) Statement showing the total cost for each products (if all overhead costs are absorbed on a machine hour basis)

Product	A	B	C	D
Output in units: (i)	240	200	160	240
Cost per unit				
Direct material	80	100	60	120
Direct labour	56	42	28	42
Overheads	80	60	40	60
(Refer to working note 1)				
Total cost per unit: (ii)	216	202	128	222
Total cost per product (i) × (ii)	51,840	40,400	20,480	53,280

- (b) Statement showing total costs for each product by using Activity Based Costing

Product	A	B	C	D
No. of units (i)	240	200	160	240
Direct material	19,200	20,000	9,600	28,800
Direct labour	13,440	8,400	4,480	10,080
Overheads				
Machine department cost	7702.15	4813.85	2567.38	5776.62
	(240 units × 8 hours × 4.11)	(200 units × 6 hours × 4.11)	(160 units × 4 hours × 4.11)	(240 units × 6 hours × 4.11)
Set up costs	3,000	2,500	2,000	3,000
	(240/20 × Rs.250)	(200/20 × Rs.250)	(160/20 × Rs.250)	(240/20 × Rs.250)
Stores receiving	1,800	1,800	1,800	1,800
	(20 × Rs.90)	(20 × Rs.90)	(20 × Rs.90)	(20 × Rs.90)

Inspection / quality control	1,200	1,000	800	1,200
	(240/20 × Rs.100)	(200/20 × Rs.100)	(160/20 × Rs.100)	(240/20 × Rs.100)
Output handling & despatch	2,640	2,200	1,760	2,640
(Refer to working note 2)	(240/10 × Rs.110)	(200/10 × Rs.110)	(160/10 × Rs.110)	(240/10 × Rs.110)
Total cost (ii)	48982.15	40713.85	23007.38	53296.62
Cost per unit (i) / ii)	204.09	203.57	143.80	222.07

Working Note:

1. Computation of machine hour rate

Product	A	B	C	D	Total
Output in units	240	200	160	240	
Machine hours (per unit)	8	6	4	6	
Total machine hours	1,920	1,200	640	1,440	5,200

$$\begin{aligned}
 \text{Machine hour rate} &= \frac{\text{Total overheads}}{\text{Total machines hours}} \\
 &= \frac{\text{Rs. 52,000}}{5,200 \text{ hours}} \\
 &= \text{Rs.10 per hour}
 \end{aligned}$$

2. Computation of overhead rate

Costs	(Rs.)	Cost driver	Cost driver transaction	Cost per unit
	(a)		(b)	(c)= (a)/(b)
Machine department cost	20,860	Machine hours	5,200 hours	4.011538
Set up costs	10,500	No. of production runs	42*	250
Stores receiving	7,200	Requisition raised	80 (20 × 4)	90
Inspection / quality control	4,200	No. of production runs	42*	100
Output handling & despatch	<u>9,240</u>	Orders executed	84**	110
	<u>52,000</u>			

* No. of production runs = Total output / units per production run
= 840/20
= 42

$$\begin{aligned}
 ** \quad \text{No. of orders executed} &= \text{Total output / units per order} \\
 &= 840 / 10 \\
 &= 84
 \end{aligned}$$

(c) Computation of product cost per unit [computed in part (a) + (b)]

	A	B	C	D
Cost per unit (a) (Rs.)	216	202	128	222
Cost per unit (b) (Rs.)	204.09	203.57	143.80	222.07
Difference (Rs.)	(11.91)	1.57	15.80	(06.07)

Product A and D are over costed with the traditional system and Product B & C are under-costed.

23. (a) The four types of products quality cost are:

- (i) Prevention costs: These are the costs incurred in preventing the production of products that do not conform to specification. They include quality of preventing maintenance, quality planning and training & extra costs of acquiring higher quality raw materials.
- (ii) Appraisal costs: These are the costs incurred to ensure that materials and products meet quality conformance standard. They include the cost of inspecting purchased parts, work in process and finished goods, quality audits & field tests.
- (iii) Internal failure cost: These are the costs associated with materials and products that fail to meet quality standards. They include costs incurred before the product is despatched to customer, such as the cost of scrap, repair, down line caused by defects.
- (iv) External failure costs: These are the costs incurred when inferior products are delivered to customer. They include the costs of handling customer complaints, repairs of returned products & the costs arising from a damaged company reputation

(b) Total Quality Management:

Traditional focus was primarily on the financial performance of an organisation. Now days it is crucial for organisation to monitor performance in many non financial areas as well. For many companies, quality is at the forefront of the area in which non financial performance is critically important. Monitoring product quality coupled with measuring and reporting quality costs helps companies program of total quality management (TQM). TQM refers to the broad set of management and control processes designed to focus the entire organisation and all of its employees on providing products or services that do the best possible job of satisfying the customers.

Refer to Chapter 12 of Institute Cost Management Book for answer of six C_s of T.Q.M.