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## Transfer Pricing

**Question12 Page No:- 294:-** A Company has two manufacturing divisions A and B Division A has a capacity of 96,000 hours per annum. It manufactures two products X and Y as per the following details:

|                                                              | X      | Y         |
|--------------------------------------------------------------|--------|-----------|
| Direct materials                                             | `300   | `60       |
| Variable Costs @ 80 per hour                                 | 320    | 80        |
| Selling price                                                | 800    | 160       |
| Maximum sales units                                          | 15,000 | Unlimited |
| <b>Division B produces Z whose particulars are as under:</b> |        |           |
|                                                              |        | `         |
| Imported component                                           |        | 800       |
| Direct materials                                             |        | 120       |
| Variable costs @ `40 per hour                                |        | 400       |
| Selling price                                                |        | 1450      |

The fixed overheads amount to ` 30 lacs and `5 lacs per annum for division A and B respectively. With a view to minimize the dependence on imported component, the company explored the possibility of the Division B using the product X as substitutes for imported component. This is possible provided Division B spends two machine hours entailing an additional expenditure of ` 80 per component on modification of the product X to fit in to the product Z. The production of Z in Division B is 5000 units per annum. Division B seeks a discount of ` 80 so that the transfer price of product X can be set at ` 720 each.

You are required to present division wise profitability and the profitability of the company as a whole on the basis of the following conditions:

- Division B imports its requirement of components.
- Division B uses 5000 units of substitute material product X, transferred from Division A at market price of ` 800 per unit.
- Division B uses 5000 units of substitute material product X, transferred from Division A at a transfer price of ` 720 per unit.

### Solution:-

|                           | Products |     |       |
|---------------------------|----------|-----|-------|
|                           | X        | Y   | Z     |
| Selling price per unit(`) | 800      | 160 | 1,450 |
| Less: Variable Costs: (`) | 620      | 140 | 1,320 |
| Contribution per unit(`)  | 180      | 20  | 130   |
| Hours required per unit   | 4        | 1   | -     |

|                                           |        |        |   |
|-------------------------------------------|--------|--------|---|
| Contribution per hour(`)                  | 45     | 20     | - |
| Demand in units                           | 15,000 | -      | - |
| Hours required to meet the units demanded | 60,000 | 36,000 |   |

(i) When division B imports its component requirements:

| Division A              |                 | Division B            |                 |
|-------------------------|-----------------|-----------------------|-----------------|
|                         | `               |                       | `               |
| <b>Contribution</b>     |                 | <b>Contribution</b>   | <b>6,50,000</b> |
| X- 15,000 units X ` 180 | 27,00,000       | (5,000 units X ` 130) |                 |
| Y- 36,000 units X ` 20  | 7,20,000        | Less: Fixed Costs     | 5,00,000        |
| Total Contribution      | 34,20,000       |                       |                 |
| Less: Fixed Costs       | 30,00,000       |                       |                 |
| <b>Profit</b>           | <b>4,20,000</b> | <b>Profit</b>         | <b>1,50,000</b> |

The profit of the company as a whole is ` 5,70,000

(ii) When division B buys 5,000 units of product X at ` 800 per unit:

| Division A              |                 | Division B                                 |                   |
|-------------------------|-----------------|--------------------------------------------|-------------------|
|                         | `               |                                            | `                 |
| Contribution            |                 | Sales revenue(5000 units X 1450)           | 72,50,000         |
| X- 20,000 units X ` 180 | 36,00,000       | Less: variable cost (5,000 units X ` 1320) | 66,00,000         |
| Y – 16,000 units X ` 20 | 3,20,000        | Less: additional cost (5000 units X ` 80)  | 4,00,000          |
| Total contribution      | 39,20,000       | Contribution                               | 2,50,000          |
| Less: Fixed costs       | 30,00,000       | Less: Fixed costs                          | 5,00,000          |
| <b>Profit</b>           | <b>9,20,000</b> | <b>Loss</b>                                | <b>(2,50,000)</b> |

Profit of the company as a whole in this case would be ` 6,70,000.

(iii) Division B gets a product X at a transfer price ` 720 from Division A.

| Profit of Division A                   |                  | Profit for Division B       | Product Z Cost per unit |
|----------------------------------------|------------------|-----------------------------|-------------------------|
| <b>Contribution</b>                    | `                |                             | `                       |
| X-15,000 units X ` 180                 | 27,00,000        | Variable Cost of material X | 720                     |
| X- 5,000 units X ` 100(for division B) | 5,00,000         | Direct materials            | 120                     |
| Y- 16,000 units X ` 20                 | <u>3,20,000</u>  | Variable overheads          | 400                     |
| Total Contribution                     | 35,20,000        | Additional Cost             | <u>80</u>               |
| Less: Fixed costs                      | <u>30,00,000</u> | Total Cost(A)               | 1320                    |
| Profit                                 | <u>5,20,000</u>  | Selling Price (B)           | <u>1450</u>             |
|                                        |                  | Contribution(per unit){ B-  | <u>130</u>              |

|  |  |                                         |                        |
|--|--|-----------------------------------------|------------------------|
|  |  | A}                                      |                        |
|  |  | Total Contribution(5,000 units X ` 130) | 6,50,000               |
|  |  | Less: Fixed Costs                       | <u>5,00,000</u>        |
|  |  | <b>Profit of Division B</b>             | <b><u>1,50,000</u></b> |

Total profit of the company as a whole is ` 6,70,000.

## **TRANSFER PRICE**

**Question21 Page No.- 300:-** A Company is organized on decentralized lines with each manufacturing operating as a separate profit centre. Each division manager has full authority on sale of divisions output to outsiders or to other divisions. Division AB manage single standardized product. Some output is sold externally and remaining is to division XY where it is a subassembly in the manufacture of the division P unit cost of division AB product and division XY is s follows:

|                                                  | Division AB(`) | Division X |
|--------------------------------------------------|----------------|------------|
| Transfer from division AB to XY                  | -              |            |
| Direct Material                                  | 42.00          |            |
| Direct Labour                                    | 6.00           | 35.00      |
| Direct Expenses Variable manufacturing Overheads | 3.00           | 4.50       |
| Manufacturing Overheads                          | 3.00           | --         |
| Selling and packing expenses                     | 3.00           | 18.00      |
| Manufacturing Overheads                          | 6.00           | 18.00      |
| Income selling & packing expenses                | 3.00           | 2.50       |
|                                                  | 24.00          | 120.00     |

Division AB sold 40,000 units annually at the standard price of ` . 45 in external market.

In addition to the external sales, 10,000 units are transferred annually to division XY at internal price of ` 42 per unit. Variable selling and packing expenses are not informed by supplying division for the internal transfer of the product. Division XY transports the transferred goods into more advance product. The manager of division to disagrees with the basis used to set the transfer price. He argues that transfer price should be made at variable cost since he claims that his division is taking output that division AB should be unable to sell at price ` 45.

He also submitted a report of the relationship between selling price and demand to support of his disagreement. The report of customer demand at various selling prices for division AB and for division XY is as follows:

### **Division AB**

|                            |        |        |        |
|----------------------------|--------|--------|--------|
| Selling Price per unit(`.) | 30     | 45     | 60     |
| Demand (units)             | 60,000 | 40,000 | 20,000 |
| Division XY                |        |        |        |
| Selling price per unit(`.) | 120    | 135    | 150    |
| Demand (Units)             | 15,000 | 10,000 | 5,000  |

The Company has sufficient capacity to meet demand at various selling prices. Internal transfer demanded units will be decided by XY division.

**Required:-**

- (i) To Calculate divisional profitability and overall profitability of company if division AB transfer demanded units to XY at price of ₹42.
- (ii) To Calculate divisional profitability and overall profitability of company if division AB transfers demanded units to XY at variable cost.
- (iii) In place of internal transfers, AB division can sell 10,000 units of their product in new external market without effecting existing market, at price ₹32 per unit and XY division can purchase these units at the rate of ₹31 in open market. Calculate company's profit by following above strategies.

**Solution:-****(i) AB sells product at external market**

|                           |                 |                  |                 |
|---------------------------|-----------------|------------------|-----------------|
| Selling price(₹)          | 30              | 45               | 60              |
| Less variable cost        | 18              | 18               | 18              |
| Contribution(per unit)    | 12              | 27               | 42              |
| Demands(units)            | 60,000          | 40,000           | 20,000          |
| <b>Total Contribution</b> | <b>7,20,000</b> | <b>10,80,000</b> | <b>8,40,000</b> |

Optimal output is 40,000 units at a selling price of ₹45.

**AB transfer at ₹42 to XY division then contribution of XY**

|                                  |                 |                 |                 |
|----------------------------------|-----------------|-----------------|-----------------|
| Selling price(₹)                 | 120             | 135             | 150             |
| Less Variable cost V + TP(42+60) | 102             | 102             | 102             |
| Contribution (per unit)          | 18              | 33              | 48              |
| Demands(units)                   | 15,000          | 10,000          | 5,000           |
| <b>Total Contribution</b>        | <b>2,70,000</b> | <b>3,30,000</b> | <b>2,40,000</b> |

Manager will choose out put level 10,000 units at a selling price of ₹135.

Overall profit when transfer made at ₹42

|                                                            |             |
|------------------------------------------------------------|-------------|
| Division AB Contribution on 10,000 units $(42 - (18 - 3))$ | = 2,70,000  |
| Division XY contribution 10,000 $(135 - 102)$              | = 3,30,000  |
| Total Contribution                                         | = 6,00,000  |
| Division AB contribution from external market sale         | = 10,80,000 |
| Total profit                                               | = 16,80,000 |

**(ii) AB transfer at variable cost**

|                                |                 |                 |                 |
|--------------------------------|-----------------|-----------------|-----------------|
| Selling price(₹)               | 120             | 135             | 150             |
| Less variable Cost ( ₹15 + 60) | 75              | 75              | 75              |
| Contribution (per unit)        | 45              | 60              | 75              |
| Demands (units)                | 15,000          | 10,000          | 5,000           |
| <b>Total contribution</b>      | <b>6,75,000</b> | <b>6,00,000</b> | <b>3,75,000</b> |

Optimal is 15,000 units at the rate of 120 per unit.

If AB transfer at variable cost (Rs. ₹15 ) then no contribution will be generated by AB division.

|                                                                             |             |
|-----------------------------------------------------------------------------|-------------|
| XY division choose 15,000 units level gives contribution $15,000 \times 45$ | = 6,75,000  |
| Division AB contribution from external market sale                          | = 10,80,000 |
| Total contribution                                                          | = 17,55,000 |

- (iii) Contribution AB division by selling 10,000 units to new external market at ₹32 and XY division purchasing at ₹31.

|                                        |            |
|----------------------------------------|------------|
| Contribution $(32 - 18) \times 10,000$ | = 1,40,000 |
|----------------------------------------|------------|

|                                                    |                           |
|----------------------------------------------------|---------------------------|
| XY Contribution {135-{31+60}}                      | = 4,40,000                |
| Division AB contribution from external market sale | = <u>10,80,000</u>        |
| Total contribution                                 | = <u><b>16,60,000</b></u> |

## **TRANSFER PRICE**

**Question:-** A Company has two manufacturing divisions X and Y, X has a capacity of 96000 hours per annum. It manufactures two products “Gear and Engines as per the following details.

|                                     | <b>Gears</b> | <b>Engines</b> |
|-------------------------------------|--------------|----------------|
| Direct Materials                    | 240          | 64             |
| Variable Costs at 64hours           | 256          | 64             |
| Selling price in the outside market | 640          | 128            |

**Division “Y” procures “Wheels” as per the following details**

|                                     | <b>`/unit</b> |
|-------------------------------------|---------------|
| Imported components                 | 640           |
| Direct Materials                    | 96            |
| Variable Cost at ` 40 per hour      | 320           |
| Selling price in the outside market | 1,160         |

The fixed overheads for X and Y are ` 24 lakhs and ` lakhs respectively .With a view to minimizing dependence on the imported components, the company has explored a possibility of Division Y using product “Gears instead of the imported components. This is possible provided Division Y spends 2 machine hours entailing an additional expenditure of ` 64 per component on modification of product “Gears to fit into “wheels” . Production and sales of “Wheels” in Division Y is limited to 5000 units per annum.

- (1) What will be maximum transfer price per unit that Y will offer?
- (2) In each of the following independent situations state with supporting calculation, the minimum transfer price per unit that X will demand from Y, if 5000 units are required by Y.
- (3) In which of the above situations in (ii) will the Management step in and compel X to sell to Y in the interest of overall company’s profits?

Answer:- Y will pay only a maximum of ` (640 -64) = ` 576 so that its outside purchase cost is matched i.e. Maximum Transfer price by Y = 576 ` per unit.

|                             | <b>Gears</b>          | <b>Engines</b> |
|-----------------------------|-----------------------|----------------|
|                             | <b>(no. of units)</b> |                |
| Market demand is limited to | 20,0000               | 20,000         |
| Market demand is limited to | 15,000                | 10,000         |
| Market demand is limited to | 18,000                | 24,000         |

|                 | <b>Gears</b> | <b>Engines</b> | <b>Total</b> |
|-----------------|--------------|----------------|--------------|
| Hours per unit  | 4            | 1              |              |
| Hours available |              |                | 96,000       |

|                |        |        |  |
|----------------|--------|--------|--|
| Units possible | 24,000 |        |  |
|                | or     | 96,000 |  |

|                                      |                           |        |
|--------------------------------------|---------------------------|--------|
| Outside Demand                       | 20,000                    | 20,000 |
| Hours required                       | 80,000                    | 20,000 |
| Units required by Y                  | 5,000                     |        |
| Hours required                       | 20,000                    |        |
| Contribution per hour                | 36                        | 30     |
| Maximise sales so that hours=        | 80,000                    | 16,000 |
| Hours used for Y                     | 4,000                     | 16,000 |
| Contribution per units of Y required | 1,000                     | 4,000  |
| On units transferred to Y            | 30 X 16,000 + 36 X 4000   |        |
|                                      | = 480,000 + 1,44,000      |        |
|                                      | = 6,24,000                |        |
| <b>Contribution per units</b>        | = 6,24,000/5,000 = 124.80 |        |

Minimum Transfer price per unit = contribution + variable Cost  
= 124.8 + 240 + 256  
= ` 620.80

(b)

|                                                                                                        | <b>Gears</b> | <b>Eng.</b> |
|--------------------------------------------------------------------------------------------------------|--------------|-------------|
| Market demand                                                                                          | 15,000       | 10,000      |
| Hours required per unit                                                                                | 4            | 1           |
| Hours required                                                                                         | 60,000       | 10,000      |
| Spare Capacity available =                                                                             |              | 26,000      |
| Units of Gears possible = 26,000 per unit=                                                             |              | 6,500       |
| Required for Transfer                                                                                  |              | 5,000       |
| Since spare capacity is used, minimum transfer price = variable cot of manufacturing = 240 + 256 = 496 |              |             |

X will agree to anything above ` 496 per unit.

(c) **Market Demand**

|                               |        |        |
|-------------------------------|--------|--------|
| Units                         | 18,000 | 24,000 |
| Hours per units               | 4      | 1      |
| Hours required                | 72,000 | 24,000 |
| Horus required for Y's demand |        | 20,000 |

This will ne need by sacrificing production of “ Engines”. Hence contribution per hours for transferred units must be at least.

Contribution Required on 5000 units = 20,000 X 30 = 6,00,000

Contribution Required per unit = 6,00,000/ 5,000 = 120 `.

Minimum Transfer Price = Contribution per unit + Variable cost

= 120 + 240 + 256

= ` 616 per unit

Gears and Engines earn a contribution. Variable Cost of in house manufacturing of imported Components = 240 + 256 + 64 = 560

Production outside = ` 640

` 80/- per unit is being paid for outside purchase.

Contribution lost per unit of facility X =  $80/4 = 20$  hours.

Since X is earning higher contribution per hours 36 & 30 for r each product, the management will not have to interfere in situation (a) & (c) where full production capacity is used for outside sales.

In (i) (b) Management need not interfere since it is a win-win situation. Departments can negotiate in the relevant range between 496 and 576.

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## TOTAL QUALITY MANAGEMENT

**Question:-** A Company makes a single product which sells at ` 800 per unit and whose variable cost of production is ` 500 per unit. Production and sales are 1000 units per months. Production is running to full capacity and there is market enough to absorb an additional 20% of output each month.

The Company has two options:

### Option1:-

Inspect finished goods at ` 10,000 per month. 4% of production is detached as defectives and scrapped at no value. There will be no warranty replacement, since every defect is detached. A small spare part which wears out due to defective material is required to be replaced at ` 2,000 per spare for every 20 units of scrap generated. The repair cost is not included in the manufacturing cost mentioned above.

### Option II:-

Shift the finished inspection at no extra cost to raw material inspection. ( Since defective raw materials are entitled to free replacement by the supplier.). take up machine set-up tuning and machine inspection at an additional cost of ` 8,000 per month, SOP that scrap of finished goods is completely eliminated. However, delivery of uninspected finished products may result in 1 % of the quantity sold to be replaced under free warranty due to minor variation in dimensions, which does not result in the wearing out of the spare as stated in option 1.

- (i) Using monthly figures relevant for decision making, advise which option is more beneficial to the company from a financial perspective.
- (ii) Identify the quality costs that can be classified as
  - (a) appraisal costs and
  - (b) External failure costs.

### Solution:-

|                                                      | Option I   |           | Option II  |  |
|------------------------------------------------------|------------|-----------|------------|--|
| Production                                           | 1000 units |           | 1000 units |  |
| Finished goods inspection                            | 10,000     | Appraisal | -          |  |
| Raw Material inspection                              | 20,000     | Appraisal | 10,000     |  |
| scrap 4 % = 40 units X<br>Variable cost per unit 500 |            |           |            |  |
| Contribution lost 300 X 40                           | 12,000     | Appraisal | -          |  |

|                                   |               |           |               |                         |
|-----------------------------------|---------------|-----------|---------------|-------------------------|
| Machine repair                    | 4000          | Appraisal | -             |                         |
| Machine set up                    |               |           | 8,000         |                         |
| Warranty replacement              |               |           |               |                         |
| 1% X 1000 = 10 unit               |               |           |               |                         |
| <b>Contribution lost 10 X 300</b> |               |           | <b>3,000</b>  | <b>External Failure</b> |
| Variable cost lost 10 X 500       |               |           | 5,000         | External Failure        |
| Quality Cost                      | <b>46,000</b> |           | <b>26,000</b> |                         |
| <b>Better Option II</b>           |               |           |               |                         |

### ***PRODUCT PROFFITABILITY(Activity Based Costing)***

**Question:-** Fairbilt Furniture Ltd. Manufactures three products: Tables, Chairs and Cabinets. The company is in the process of finalizing the plans for the coming year: hence the executives thought it would be prudent to have a look at the product-wise performance during the current year. The Following information is furnished:

|                                                                    | <b>Tables</b> | <b>Chairs</b> | <b>Cabinets</b> |
|--------------------------------------------------------------------|---------------|---------------|-----------------|
| Unit Selling price                                                 | 80            | 60            | 36              |
| Direct material                                                    | 28            | 24            | 16              |
| Direct labour                                                      | 20            | 12            | 12              |
| Factory Overheads:                                                 |               |               |                 |
| Variable                                                           | 8             | 6             | 4               |
| Fixed                                                              | 8             | 6             | 1.28            |
| <b>Cost of Production</b>                                          | <b>64</b>     | <b>48</b>     | <b>33.28</b>    |
| <b>Selling distribution &amp; General administration expenses:</b> |               |               |                 |
| Variable                                                           | 4             | 2             | 2               |
| Fixed                                                              | 4             | 6             | 1.52            |
| Unit Cost(I)                                                       | 72            | 56            | 36.80           |
| Unit Profit (loss) (II)                                            | 8             | 4             | (0.80)          |
| Sales volume ( units)                                              | 10,000        | 15,000        | 15,000          |
| <b>Profit (loss)</b>                                               | <b>80,000</b> | <b>60,000</b> | <b>(12,000)</b> |

For the coming period, the selling prices and the cost of three products are expected to remain unchanged. There will be an increase in the sales of tables by 1,000 units and the increase in sales of cabinets is expected to be 8,000 units. The sales of chairs will remain to be unchanged. Sufficient additional capacity exists to enable the increased demands to be met without incurring additional fixed costs. Some among the executives contend that it will be unwise to go for additional production and sale of cabinets, since it is already making losses at ` 0.80 per unit. The suggestion is that cabinets should be eliminated altogether. Do you agree? Substantiate with necessary analysis and determine the product wise and overall profits for the coming year.

**Solution;- Fairbilt Furniture Ltd,**

#### **Statement showing product Wise Contribution and Total profit**

|                     | <b>Tables</b>   |              | <b>Chairs</b>   |              | <b>Cabinets</b> |              | <b>Total</b> |
|---------------------|-----------------|--------------|-----------------|--------------|-----------------|--------------|--------------|
|                     | <b>Per unit</b> | <b>Total</b> | <b>Per unit</b> | <b>Total</b> | <b>Per unit</b> | <b>Total</b> |              |
| <b>Sales volume</b> |                 | 10,000       |                 | 15,000       |                 | 15,000       |              |

|                                                                    |    |         |    |         |    |         |           |
|--------------------------------------------------------------------|----|---------|----|---------|----|---------|-----------|
| (units)                                                            |    |         |    |         |    |         |           |
| <b>Selling Price (₹)</b>                                           | 80 | 800,000 | 60 | 900,000 | 36 | 540,000 | 22,40,000 |
| <b>Direct Material</b>                                             | 28 | 280,000 | 24 | 360,000 | 16 | 240,000 | 880,000   |
|                                                                    |    |         |    |         |    |         |           |
| <b>Direct Labour</b>                                               | 20 | 200,000 | 12 | 180,000 | 12 | 180,000 | 560,000   |
| <b>Variable factory overheads</b>                                  | 8  | 80,000  | 6  | 90,000  | 4  | 60,000  | 230,000   |
| <b>Variable Selling distribution &amp; Administration overhead</b> | 4  | 40,000  | 2  | 30,000  | 2  | 30,000  | 100,000   |
| <b>Total variable cost</b>                                         | 60 | 600,000 | 44 | 660,000 | 34 | 510,000 | 1,770,000 |
| <b>Contribution</b>                                                | 20 | 200,000 | 16 | 240,000 | 2  | 30,000  | 470,000   |
| <b>Fixed factory overheads</b>                                     |    | 80,000  |    | 90,000  |    | 19,200  | 189,200   |
| <b>Fixed selling distribution and administration overheads</b>     |    | 40,000  |    | 90,000  |    | 22,800  | 152,800   |
| <b>Total fixed overheads</b>                                       |    |         |    |         |    |         | 342,000   |
| <b>Total Profit</b>                                                |    |         |    |         |    |         | 128,000   |

The above analysis shows the cabinets make a contribution of ₹ 2 per unit. The loss sustained in the previous year is because of the falling sales volume sales volume below breakeven level.

### **FAIRBILT Furniture Ltd.**

#### **Budgeted Performance for the Coming Year**

|                        | <b>Tables</b> | <b>Chairs</b> | <b>Cabinets</b> |
|------------------------|---------------|---------------|-----------------|
| Unit Contribution (₹)  | 20            | 16            | 2               |
| Sales volume (units)   | 11,000        | 15,000        | 23,000          |
| Total Contribution (₹) | 220,000       | 240,000       | 40,000          |
| Less: Fixed Cost (₹)   | 120,000       | 180,000       | 42,000          |
| Profit (₹)             | 100,000       | 60,000        | 4,000           |

The Company makes a total profit of ₹ 164,000 if all the products are continued . However , if the production of cabinets is discontinued, there will be an adverse effect on the overall profit of the company. This is because cabinets also contribute toward meeting the fixed costs of the company.

## **TRANSFER PRICING**

**Question24 Page No.302:-** AB Ltd. has two divisions A & Division B. A produces components two units of which is required for one unit of final product produced by division B. Division A has a capacity to produce 20,000 units and entire quantity is supplied to Division B @ ₹ 200 per unit. Variable Cost of component at Division A is ₹ 190 and fixed cost is ₹ 20 per unit. For

final product of Division B, per unit variable cost(excluding component) is ₹ 700, Fixed cost ₹ 200 and Selling price is ₹ 1500.

Division A has placed an proposal for increasing the transfer price to ₹ 220 i.e. their market price. Division A's facility can be rented out @ ₹ 3.00 lakh annually. Division A argument is that instead of making loss on transfer, facilities can be rented out.

Division B's argument is that it can buy the same component from outside market@ ₹ 210.

Division A has given another proposal to augment its capacity to 40,000 units with an investment of ₹ 15 lakh so that it can sell 20,000 units to external market and transfer 20,000 units to Division B at ₹ 210 per unit. Fixed cost for Division A will go up by ₹ 1.00 lakhs.

You have evaluate the following and give your views:

- Division A Facilities rented out and Division B buys components @ ₹ 210 from outside market.
- Division A sells components to outside@ ₹ 220 and Division B buys components @ ₹ 210 from market.
- Proposal of enhancement of capacity of Division A to 40,000 units. (**Assume capital cost @ 12%**)

## Solution:-

### Present position on transfer of component at ₹ 200.

|                       | Rupees     |            | ₹ lakhs |
|-----------------------|------------|------------|---------|
|                       | Division A | Division B | AB Ltd  |
| Contribution per unit | 10         | 400        | 42.00   |
| Fixed cost per unit   | 20         | 200        | 24.00   |
| Profit per unit       | -10        | 200        |         |
| Profit                | -2,00,000  | 20,00,000  | 18.00   |

### (a) Renting out Division A's facility and Div B procures components @ ₹ 210.

|                        | A Division | B division | AB Ltd       |
|------------------------|------------|------------|--------------|
|                        | (₹)        | (₹)        | (₹ lakhs)    |
| No. of units           |            | 10,000     |              |
| Variable cost per unit |            | 1120       |              |
| Contribution per unit  |            | 380        |              |
| Total Contribution     |            | 38,00,000  | 38.00        |
| Fixed Cost             |            | 20,00,000  | 20.00        |
| Profit                 |            | 28,00,000  | 18.00        |
| Income from Rent       | 3,00,000   |            | 3.00         |
| <b>Total Profit</b>    |            |            | <b>21.00</b> |

### (b) Division A sells components at @ 220.00 and Div B procures it @ ₹ 210.

|                        | A division | B division | AB Ltd    |
|------------------------|------------|------------|-----------|
|                        | (₹)        | (₹)        | (₹ Lakhs) |
| No. of units           | 20,000     | 10,000     |           |
| Variable Cost per unit | 190        | 11,20      |           |

|                       |                 |                  |              |
|-----------------------|-----------------|------------------|--------------|
| Contribution per unit | 30              | 380              |              |
| Total Contribution    | 6,00,000        | 38,00,000        | 44.00        |
| Fixed cost            | 4,00,000        | 20,00,000        | 24.00        |
| <b>Profit</b>         | <b>2,00,000</b> | <b>18,00,000</b> | <b>20.00</b> |

( c) Enhancement of capacity of division A sells components at @ 220.00 and Div B Procures it @ ` 210

|                        | <b>A Division</b> |                 | <b>B division</b> | <b>AB Ltd</b> |
|------------------------|-------------------|-----------------|-------------------|---------------|
|                        | (`)               | (`)             | (`)               | (` Lakh)      |
|                        | <b>Sale</b>       | <b>Transfer</b> |                   |               |
| No. of units           | 20,000            | 20,000          |                   |               |
| Variable Cost per unit | 190               | 190             | 1120              |               |
| Contribution per unit  | 30                | 20              | 380               |               |
| Total Contribution     | 6,00,000          | 4,00,000        | 38,00,000         | 48.00         |
| Fixed cost             | 4,00,000          | 1,00,000        | 20,00,000         | 25.00         |
| Cost of Capital        |                   | 1,80,000        |                   |               |
| <b>Profit</b>          | <b>2,00,000</b>   | <b>1,20,000</b> | <b>18,00,000</b>  | <b>21.20</b>  |

**Question 14.** Tropicana Ltd. has decided to increase the size of its store. If wants information about the profitability to individual product lines: orange Juice Apple Juice and Mango Juice.

**Tropicana Ltd provides the following data for each product line:**

|                                  | <b>Orange Juice</b> | <b>Apple Juice</b> | <b>Mango Juice</b> |
|----------------------------------|---------------------|--------------------|--------------------|
| Revenues                         | ` 3,17,400          | ` 8,40,240         | ` 4,83,960         |
| Cost of goods sold               | ` 2,40,000          | ` 6,00,000         | ` 3,60,000         |
| Cost of bottles returned         | ` 4,800             | ` 0                | ` 0                |
| Number of purchase orders placed | 144                 | 336                | 144                |
| Number of deliveries received    | 120                 | 876                | 264                |
| Hours of shelf-sticking time     | 216                 | 2,160              | 1,080              |
| Items sold                       | 50,400              | 4,41,600           | 1,22,400           |

**Tropicana Ltd also provides the following information for 2008.**

|   | <b>Activity<br/>(1)</b> | <b>Description of Activity<br/>(2)</b> | <b>Total costs<br/>(3)</b> | <b>Cost-Allocation<br/>Base</b> |
|---|-------------------------|----------------------------------------|----------------------------|---------------------------------|
| 1 | Bottle returns          | Returning of bottles to store          | Empty                      | Direct tracing to soft-         |
| 2 | Ordering                | Placing of orders for purchases        | ` 62,400                   | drink line                      |
| 3 | Delivery                | Physical delivery and receipts of      | ` 1,00,800                 | 624 purchase orders             |
| 4 | Shelf stocking          | merchandise                            |                            | 1,260 deliveries                |
| 5 | Customer support        | Stocking of merchandise on store       | ` 69,120                   | 3,456 hours of shelf-           |
|   | <b>Total</b>            | shelves and ongoing restocking         | ` 1,22,880                 | stocking time                   |
|   |                         | Assistance provided to customers,      |                            | 6,14,400 items sold             |
|   |                         | including checkout and bagging         |                            |                                 |

|  |  |  |                  |  |
|--|--|--|------------------|--|
|  |  |  | <b>` 3,60,00</b> |  |
|--|--|--|------------------|--|

### **Required**

**(A)** Tropicana Ltd currently allocates store support costs (at costs other than cost of goods sold) to products lines on the basis of cost of goods sold of each product line. Calculate the operating income and operating income as a percentage of revenues of each product line.

**(B)** If Tropicana Ltd allocates store support costs (all costs other than cost of goods sold) to product lines using an ABC system, calculate the operating income and operating income as a percentage of revenues for each product line.

**Answer:-** a. The following table shows the operating income and operating and operating income as a percentage of revenues for each product line. All store support costs (all costs other than cost of goods sold) are allocated to product lines using cost of goods sold of each product line as the cost allocated base. Total store support costs equal `3,60,000 (Cost of bottles returned, `4,800 + Cost of purchase orders, `62,400 + cost of deliveries `1,00,800 + Cost of self stocking ` 69,120 + Cost of customer support , ` 1,22,880). The allocation rate for store support costs = `3,60,000 ÷ `12,00,000 = 30% of cost of goods sold. To allocate support costs to each product line. Tropicana multiplies the cost of goods sold of each product line by 0.30.

|                                                                   | <b>Orange juice</b> | <b>Apple juice</b> | <b>Mango juice</b> | <b>Total</b> |
|-------------------------------------------------------------------|---------------------|--------------------|--------------------|--------------|
| Revenues                                                          | `3,17,400           | `8,40,240          | `4,83,960          | `16,41,600   |
| Cost of goods sold                                                | 2,40,000            | 6,00,000           | 3,60,000           | 12,00,000    |
| Store support cost<br>(`2,40,000: `6,00,000;<br>`3,60,000) X 0.30 | 72,000              | 180,000            | 1,08,000           | 3,60,000     |
| Total Cost                                                        | 3,12,000            | 7,80,000           | 4,68,000           | 15,60,000    |
| Operating income                                                  | `5,400              | ` 60,240           | ` 15,960           | `81,600      |
| Operating income /<br>Revenues                                    | 1.70%               | 7.17%              | 3.30%              | 4.97%        |

(c) Under An ABC system, Tropicana Ltd identifies bottle return costs as a direct cost because these costs can be traced to the soft drink product line. Tropicana Ltd then calculates cost allocation rates for each activity area. The activity rates are as follows:-

| <b>Activity</b> | <b>Cost Hierarchy</b> | <b>Total Costs</b> | <b>Quantity of cost Allocation Base</b> | <b>Overhead Allocation Rate</b> |
|-----------------|-----------------------|--------------------|-----------------------------------------|---------------------------------|
| Ordering        | Batch level           | `62,480            | 624 purchase orders                     | `100 per purchase order         |

|                  |                   |           |                            |                        |
|------------------|-------------------|-----------|----------------------------|------------------------|
| Delivery         | Batch-level       | `1,00,800 | 1,260 deliveries           | ` 80 per delivery      |
| Shelf stocking   | Output unit-level | `69,120   | 3,456 shelf stocking-hours | ` 20 per stocking hour |
| Customer support | Output unit-level | `1,22,880 | 6,14,400 items sold        | ` 0.20 per item sold   |

Store support costs for each product line by activity are obtained by multiplying the total quantity of the cost allocation base for each product line by the activity cost rate. Operating income and operating income as a percentage of revenues for each product line are as follows:-

|                                                                       | <b>Orange juice</b> | <b>Apple juice</b> | <b>Mango juice</b> | <b>Total</b> |
|-----------------------------------------------------------------------|---------------------|--------------------|--------------------|--------------|
| Revenues                                                              | `3,17,400           | `8,40,240          | `4,83,960          | `16,41,600   |
| Cost of goods sold                                                    | 2,40,000            | 6,00,000           | 3,60,000           | 12,00,000    |
| Bottle-return costs                                                   | 4,800               | 0                  | 0                  | 4,800        |
| Ordering costs(144; 336; 144)<br>Purchase orders X ` 100              | 14,400              | 33,600             | 14,400             | 62,400       |
| Delivery costs (120; 876; 264) deliveries X ` 80                      | 9,600               | 70,080             | 21,120             | 1,00,800     |
| Shelf-stocking costs (216,2160; 1080)<br>Stocking hours X `20         | 4,320               | 43,200             | 21,600             | 69,120       |
| Customer support costs (50,400 4,41,600; 1,22,400) items sold X `0.20 | 10,080              | 88,320             | 24,480             | 1,22,880     |
| Total Costs                                                           | 2,83,200            | 8,35,200           | 4,41,600           | 15,60,000    |
| Operating income                                                      | `34,200             | `5,040             | `42,360            | `81,600      |
| Operating income / Revenues                                           | 10.78%              | 0.60%              | 8.75%              | 4.97%        |

© Managers believe the ABC system is more credible than the simple costing system. The ABC system disitnguishe4s the different types of activities at Tropicana Ltd. more precisely. It also tracks more accurately how individual product lines use resources.

Rankings of relative profitability- of the three product lines under the simple costing system and under the ABC system are:

| Simple Costing System |       | ABC System       |        |
|-----------------------|-------|------------------|--------|
| 1:- Fresh Produce     | 7.17% | 1. Soft drinks   | 10.78% |
| 2:- Packaged food     | 3.30% | 2. Packaged food | 8.75%  |
| 3:- Soft drinks       | 1.70% | 3. Fresh produce | 0.60%  |

The percentage of revenues, cost of goods sold, and activity costs for each product line are as follows:-

|                           | Orange Juice | Apple Juice | Mango Juice |
|---------------------------|--------------|-------------|-------------|
| <b>Revenues</b>           | 19.34%       | 51.18%      | 29.49%      |
| <b>Cost of goods sold</b> | 20.00        | 50.00       | 30.00       |
| <b>Bottle returns</b>     | 100.00       | 0           | 0           |
| <b>Activity areas:</b>    |              |             |             |
| <b>Ordering</b>           | 23.08        | 53.84       | 2308        |
| <b>Delivery</b>           | 9.53         | 69.52       | 20.95       |
| <b>Shelf-stocking</b>     | 6.25         | 62.50       | 31.25       |
| <b>Customer support</b>   | 8.20         | 71.88       | 19.92       |

Developments in the Business Environment Activity Based Cost Management.

**Question 16 page no:-59:-** ALPHA Limited specialises in the distribution of pharmaceutical products. It buys from the pharmaceutical companies and resells to each of the three different markets.

1. General Supermarket Chains
2. Drugstore Chains
3. Chemist Shops

The following data for the month of April, 2009 in respect of ALPHA Limited has been reported:

|                                         | General Supermarket Chains | Drugstore Chains | Chemist Shops |
|-----------------------------------------|----------------------------|------------------|---------------|
| Average revenue per delivery            | ` 84,975                   | ` 28,875         | ` 5,445       |
| Average cost of goods sold per delivery | ` . 82,500                 | ` 27,500         | ` 4,950       |
| Number of deliveries                    | ` 330                      | ` 825            | ` 2,750       |

In the past, ALPHA Limited has used gross margin percentage to evaluate the relative profitability of its distribution channels.

The company plans to use activity based costing or analyzing the profitability of its

distribution channels.

The Activity analysis of ALPHA Limited is as under:

| Activity Area                      | Cost Driver                                |
|------------------------------------|--------------------------------------------|
| Customer purchase order processing | Purchase orders by customers               |
| Line item ordering                 | Line-items per purchase order              |
| Store delivery                     | Store deliveries                           |
| Cartons dispatched to stores       | Cartons dispatched to a store per delivery |
| Shelf-stocking at customer store   | Hours of shelf-stocking                    |

The April, 2009 operating costs (other than cost of goods sold) of ALPHA Limited are ` 8,27,970.

These operating costs are assigned to five activity areas. The cost in each area and the quantity of the cost allocation basis used in that area for April, 2009 are as follows:

| Activity Area                      | Total costs in April, 2009<br>(`) |                        |
|------------------------------------|-----------------------------------|------------------------|
| Customer purchase order processing | 2,20,000                          | 5,500 orders           |
| Line item ordering                 | 1,75,560                          | 58,520 line items      |
| Store delivery                     | 1,95,250                          | 3,905 store deliveries |
| Cartons dispatched to store        | 2,09,000                          | 2,09,000 cartons       |
| Shelf-stocking at customer store   | 28,160                            | 1,760                  |

Other data for April, 2009 include the following:

|                                                              | General Supermarket Chains | Drugstore Chains | Chemist Shops |
|--------------------------------------------------------------|----------------------------|------------------|---------------|
| Total number of orders                                       | 385                        | 990              | 4,125         |
| Average number of line items per order                       | 14                         | 12               | 10            |
| Total number of store deliveries                             | 330                        | 825              | 2,750         |
| Average number of cartons shipped per store delivery         | 300                        | 80               | 16            |
| Average number of hours of shelf-stocking per store delivery | 3                          | 0.6              | 0.1           |

**Required**

(1) Compute for April 2009 gross margin percentage for each of its three distribution channels and compute

ALPHA Limited's operating income.

(2) Compute the April 2009 rate per unit of the cost-allocation base for each of the five activity areas.

(3) Compute the operating income of each distribution channel in April, 2009 using the activity based costing information. Comment on the results. What new insights are available with the activity based cost information?

(4) Describe four challenges one would face in assigning the total April 2009 operating costs of ₹ 8,27,970 to five activity areas.

**Solution:-**

|                              | <b>General Super Market Chains</b> | <b>Drugstore Chains</b> | <b>Chemist Shops</b>     | <b>Total</b>       |
|------------------------------|------------------------------------|-------------------------|--------------------------|--------------------|
| <b>Revenues: (₹)</b>         | <b>2,80,41,750</b>                 | <b>2,38,21,875</b>      | <b>1,49,73,750</b>       | <b>6,68,37,375</b> |
|                              | <b>(330X ₹ 84,975)</b>             | <b>(825 X ₹ 28,875)</b> | <b>(2,750 X ₹ 5,445)</b> |                    |
| <b>Less: Cost of Goods</b>   | <b>2,72,25,000</b>                 | <b>2,26,87,500</b>      | <b>1,36,12,500</b>       | <b>635,25,000</b>  |
| <b>Sold : (₹)</b>            | <b>(330 X ₹ 82,500)</b>            | <b>(825 X ₹ 27,500)</b> | <b>(2,750 X ₹ 4,950)</b> |                    |
| <b>Gross Margin: (₹)</b>     | <b>8,16,750</b>                    | <b>11,34,375</b>        | <b>13,61,250</b>         | <b>33,12,375</b>   |
| <b>Less: Other</b>           |                                    |                         |                          |                    |
| <b>Operating Costs: (₹)</b>  |                                    |                         |                          | <b>8,27,970</b>    |
| <b>Operating Income: (₹)</b> |                                    |                         |                          | <b>24,84,405</b>   |
| <b>Gross Margin</b>          | <b>2.91%</b>                       | <b>4.76%</b>            | <b>9.09%</b>             | <b>4.96%</b>       |
| <b>Operating income</b>      |                                    |                         |                          | <b>3.72</b>        |

**(ii) Computation of rate per unit of the Cost allocation base for each of the five activity areas for April 2009**

|                                       | <b>(₹)</b>         |
|---------------------------------------|--------------------|
| Customer purchase order processing    | 40/ order          |
| Line item ordering                    |                    |
| (₹ 1,75,560/ 58,520 line items)       | 3/ line item order |
| Store delivery                        | 50/ delivery       |
| (₹ 1,95,250 / 3,905 store deliveries) |                    |
| Cartons dispatched                    | 1/ dispatch        |
| (₹ 2,09,000/ 2,09,000 dispatches)     |                    |
| Shelf stocking at customer store (₹)  | 16/hour            |
| (₹ 28,160 / 1,760 hours)              |                    |

**(iv) Operating income Statement of each distribution channel  
In April -2009(Using the Activity based Costing information)**

|                                    | <b>General super<br/>Market chains</b> | <b>Drugstore<br/>Chains</b> | <b>Chemist<br/>Shops</b> |
|------------------------------------|----------------------------------------|-----------------------------|--------------------------|
| Gross margin (₹) : (a)             | 8,16,750                               | 11,34,375                   | 13,61,260                |
| Operating cost (₹) : (B)           | 1,62,910                               | 1,90,410                    | 4,74,650                 |
| Operating income (₹) : (A –B)      | 6,53,840                               | 9,43,965                    | 8,86,600                 |
| Operating income ( in %)           | 2.33                                   | 3.96                        | 5.96                     |
| Operating income/Revenue) X<br>100 |                                        |                             |                          |

Comments and new insights: The activity based cost information highlights, how the Chemist shops' uses a larger amount of ALPHA Ltd's resources per, revenue than do the other two distribution channels. Ratio of operating costs to revenues across these markets is :

|                                   |       |
|-----------------------------------|-------|
| General Supermarket chains        | 0.58% |
| (₹ 1,62,910/ ₹ 2,80,00,750) X 100 |       |
| Drug Store Chains                 |       |
| (₹ 1,90,410/ ₹ 2,38,21,875) X 100 | 0.80% |
| Chemist shops                     |       |
| (₹ 4,74,650/ ₹ 1,49,73,750) X 100 | 3.17% |

#### **Working Note:-**

#### **Computation of operating cost of each distribution channel:**

|                                               | <b>General super market<br/>chains `</b>           | <b>Drugstore Chains `</b>                        | <b>Chemist shops `</b>                            |
|-----------------------------------------------|----------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| <b>Customer purchase<br/>order processing</b> | 15,400<br>(` 40 X 385 orders)                      | 39,600<br>(` 40 X990 orders)                     | 1,65,000<br>(` 40 X 4125 orders)                  |
| <b>Line item ordering</b>                     | 16,170<br>(` 3 X 14 X 385)                         | 35,640<br>(` 3 X12 X 990)                        | 1,23,750<br>(` 3 X 10 X 4125)                     |
| <b>Store delivery</b>                         | 16,500<br>(` 50 X 330 deliveries)                  | 41,250<br>(` 50 X 825 deliveries)                | 1,37,500<br>(` 50 X 2750 deliveries)              |
| <b>Cartons dispatched</b>                     | 99,000<br>(` 1 X 300 cartoons X<br>300 deliveries) | 66,000<br>(` 1 X 80 Cartons X<br>825 deliveries) | 44,000<br>(` 1 X 16 cartons X<br>2750 deliveries) |
| <b>Shelf Stocking</b>                         | 15,840<br>(` 16 X 330 deliveries X 3<br>Av. Hrs)   | 7920<br>(` 16 X 825 deliveries X<br>0.6 Av. Hrs) | 4400<br>(` 16 X 2750 deliveries<br>X 0.1 Av. Hrs) |
| <b>Operating Cost</b>                         | 1,62,910                                           | 1,90,410                                         | 4,74,650                                          |

## **STANDARD COSTING**

**Question 72 page no. 254:-** ABC Limited manufactures three types of product namely Product1, Product2 and Product 3.The production process requires a single input raw

material, a single type of direct labour and a single energy input, electricity. Overheads are shared by all three products. Budgeted details of the three products are shown below:-

|                                | Product 1 | Product 2 | Product 3 |
|--------------------------------|-----------|-----------|-----------|
| Labour hours per unit          | 0.20      | 0.25      | 0.40      |
| Material Kg per unit           | 1.0       | 1.1       | 1.3       |
| Kilowatt hours per unit(KW hr) | 0.5       | 0.6       | 0.8       |
| Budgeted sales in units        | 10,000    | 6,000     | 2,000     |
| Forecasted price (₹)           | 15        | 20        | 40        |

The committed fixed overheads are expected to cost ₹ 80,000 per period and the unit costs for the input resources are as follows:-

|          |                       |
|----------|-----------------------|
| Labour   | ₹ 20 per hour         |
| Material | ₹ 4 per unit          |
| Energy   | ₹ 6 per kilowatt hour |

The actual financial results for ABC Limited for the concerned budgeted period are shown below:

|                    |          |            |            |
|--------------------|----------|------------|------------|
| Sales              |          |            | ₹ 3,85,000 |
|                    | Labour   | ₹ 1,09,452 |            |
|                    | Material | 96,448     |            |
|                    | energy   | 61,671     |            |
| Variable Costs     |          |            | 2,67,571   |
| Committed overhead |          |            | 84,000     |
| Profits            |          |            | ₹ 33,429   |

Additional information regarding inputs and output during the concerned period are provided to you below:

| Outputs   |          |       | Inputs    |             |         |
|-----------|----------|-------|-----------|-------------|---------|
|           | Quantity | Price |           | Quantity    | Price   |
| Product 1 | 12,000   | ₹ 16  | Labour    | 5,212 hours | ₹ 21.00 |
| Product 2 | 5,500    | 22    | Materials | 21,920 Kg   | 4.40    |
| Product 3 | 1,800    | 40    | energy    | 10,633 Kwhr | 5.80    |

With the help of the above information you are required to calculate the standard margin (Contribution) and subsequently compute the following variances in order to reconcile Budgeted Profits with the Actual profits:

- Sales – Activity Variance
- Price – Recovery variance
- Productivity variance.

**Solution:-**

## Computation of Standard Margin

|                            |          | Product 1   | Product 2   | Product 3    |
|----------------------------|----------|-------------|-------------|--------------|
| <b>Selling Price</b>       |          | ` 15.00     | ` 20.00     | ` 40.00      |
|                            | Labour   | ` 4.00      | ` 5.00      | ` 8.00       |
|                            | Material | 4.00        | 4.40        | 5.20         |
|                            | Energy   | 3.00        | 3.60        | 4.80         |
| <b>Variable Costs</b>      |          | ` 11.00     | ` 13.00     | ` 18.00      |
| <b>Contribution Margin</b> |          | <b>4.00</b> | <b>7.00</b> | <b>22.00</b> |

|                                    |                                                                      |
|------------------------------------|----------------------------------------------------------------------|
| <b>(a) Sales Activity Variance</b> | = (Actual output – Budgeted output) X Standard margin                |
|                                    | = (12,000 – 10,000) X 4 + (5,500 – 6,000) X 7 + (1,800 – 2,000) X 22 |
|                                    | = ` 100 Favorable                                                    |

**(b) Price – Recovery variance = sales Price Variance – Input Cost Variance**

Where,

**Sales Price variance** = ( Actual price –Budgeted price) X Actual sales volume

**Input cost variance** = ( Actual unit cost of input –Standard unit cost o input) X Actual inputs consumed.

**Sales Price Variance** = [ (16 – 15) X 12,000 + (22 – 20 ) X 5500 + (40 – 40 ) X 1800]  
= ` 23,000 Favorable

**Input Cost Variance**

|                               | Actual Unit costs | Budgeted Unit costs         | Difference | Actual Inputs | Input Cost Variances |
|-------------------------------|-------------------|-----------------------------|------------|---------------|----------------------|
| Labour                        | 21.00             | 20                          | 1          | 5,212 hr.     | ` 5,212              |
| Materials                     | 4.40              | 4                           | 0.40       | 21,920 Kg     | 8,768                |
| Energy (Kw hr)                | 5.80              | 6                           | 0.20       | 10,633 kw hr  | (2,127)              |
| Committed overhead            | 84000             | 80,000                      | 4,000      |               | 4,000                |
| Input Cost Variance           |                   |                             |            |               | ` 15,853             |
| Hence Price Recovery Variance |                   | = ` 23,000 - ` 15,853       |            |               |                      |
|                               |                   | <b>= ` 7,147 Favorable.</b> |            |               |                      |

## ( c) Productivity Variance

Productivity variance = { std. Consumption @ actual –Actual Consumption ) X Std Price

Standard Consumption

@ actual output

|          | Product 1 | Product 2 | Product 3 | Total  | Actual             | Difference | Std          | Usage           |
|----------|-----------|-----------|-----------|--------|--------------------|------------|--------------|-----------------|
|          |           |           |           |        | <b>Consumption</b> |            | <b>Price</b> | <b>Variance</b> |
| Labour   | 2,400     | 1,375     | 720       | 4,495  | 5,212              | 717        | `20          | `14,340         |
| Material | 12,000    | 6,050     | 2,340     | 20,390 | 21,920             | 1,530      | 4            | 6,120           |

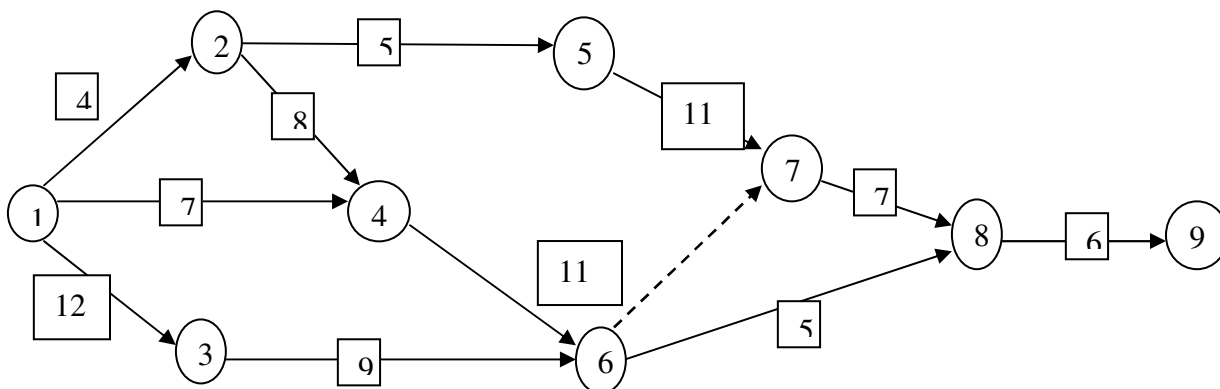
|                              |       |       |       |        |        |      |   |                 |
|------------------------------|-------|-------|-------|--------|--------|------|---|-----------------|
| Energy                       | 6,000 | 3,300 | 1,440 | 10,740 | 10,633 | -107 | 6 | (642)           |
| <b>Productivity Variance</b> |       |       |       |        |        |      |   | <b>` 19,818</b> |

**Question:- The number of days of total float (TF) earliest start times (EST) and duration in days are given for some of the following activities.**

| Activity | TF | EST | Duration |
|----------|----|-----|----------|
| 1 - 2    | 0  | 0   |          |
| 1 - 3    | 0  |     |          |
| 1 - 4    | 5  |     |          |
| 2 - 4    | 0  | 4   |          |
| 2 - 5    | 1  |     | 5        |
| 3 - 6    | 2  | 12  |          |
| 4 - 6    | 0  | 12  |          |
| 5 - 7    | 3  |     |          |
| 6 - 7    |    | 23  |          |
| 6 - 8    | 2  |     |          |
| 7 - 8    | 0  | 23  |          |
| 8 - 9    |    | 30  | 6        |

- (1) Draw the network
- (2) List the paths with their corresponding durations and state when the project can be completed.

Solution:-



**Network Diagram : 6 -7 dummy**

6 – 8-9 and 7-8-9

1-2-5-7 and 1-2-4-6

1-4-6 and 1-3-6

| Activity | Duration | Early start | Late start | Late finish | Total Float |
|----------|----------|-------------|------------|-------------|-------------|
| 1 - 2    | 4        | 0           | 0          | 4           | 0           |
| 1 - 3    | 12       | 0           | 2          | 14          | 0           |

|       |    |    |    |    |   |
|-------|----|----|----|----|---|
| 1 – 4 | 7  | 0  | 5  | 12 | 5 |
| 2 – 4 | 8  | 4  | 4  | 12 | 0 |
| 2 – 5 | 5  | 4  | 8  | 13 | 1 |
| 3 – 6 | 9  | 12 | 14 | 23 | 2 |
| 4 – 6 | 11 | 12 | 12 | 23 | 0 |
| 5 – 7 | 11 | 9  | 12 | 23 | 3 |
| 6 – 7 | 0  | 23 | 23 | 23 | 0 |
| 6 – 8 | 5  | 23 | 25 | 30 | 2 |
| 7 – 8 | 7  | 23 | 23 | 30 | 0 |
| 8 – 9 | 6  | 30 | 30 | 36 | 0 |

| Path                      | Duration |
|---------------------------|----------|
| 1 – 2 – 5 – 7 – 8 – 9     | 32       |
| 1 – 2 – 4 – 6 – 7 – 8 – 9 | 36       |
| 1 – 2 – 4 – 6 – 8 – 9     | 34       |
| 1 – 4 – 6 – 7 – 8 – 9     | 31       |
| 1 – 4 – 6 – 8 – 9         | 29       |
| 1 – 3 – 6 – 7 – 8 – 9     | 34       |
| 1 – 3 – 6 – 8 – 9         | 32       |

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