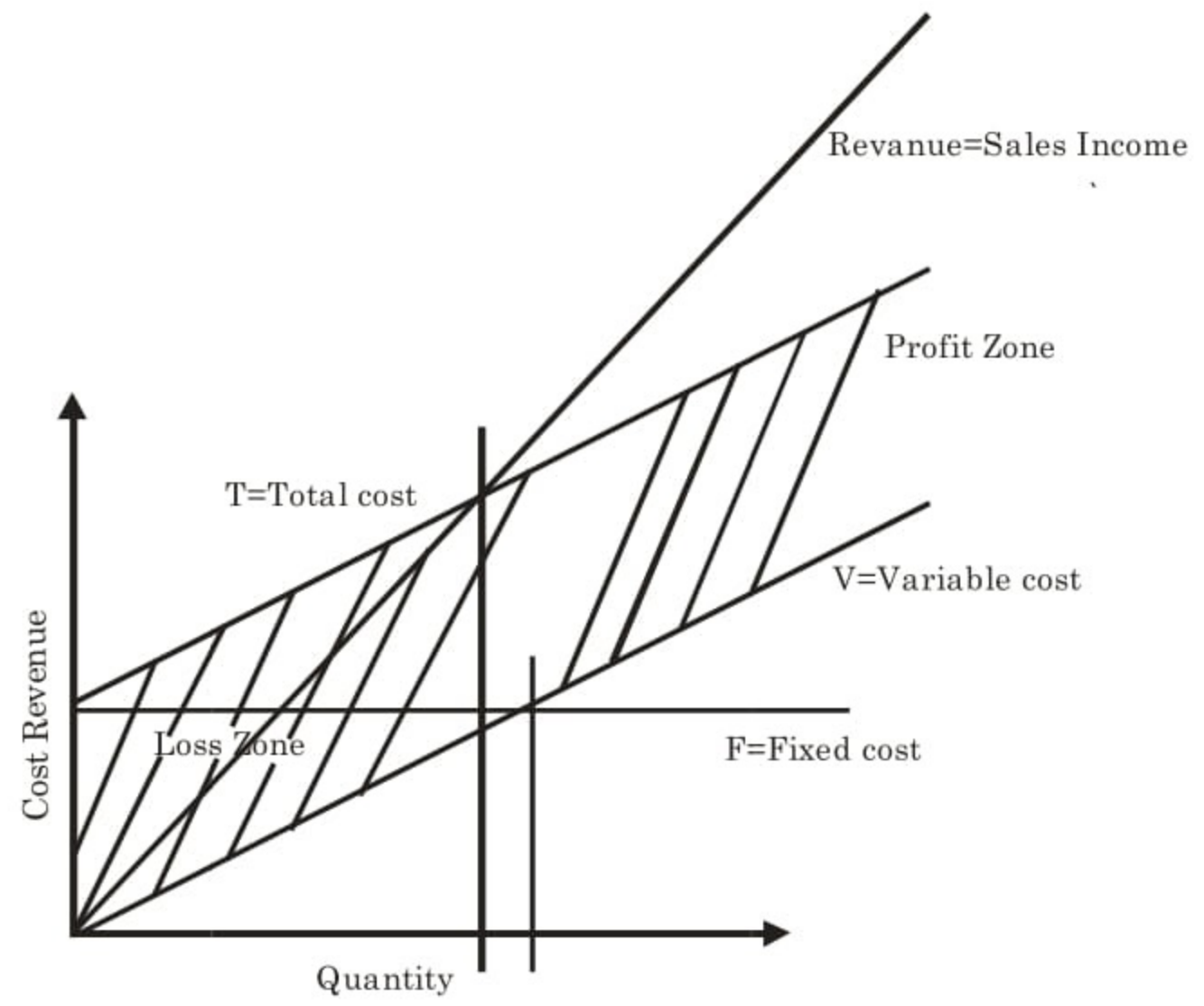# Break Even Analysis

A. It usually refers to the number of pieces for which a business neither makes a profit nor incurs a loss.

In other words, the selling price of the product is the total cost of production of the component.

(i) No. Profit no loss

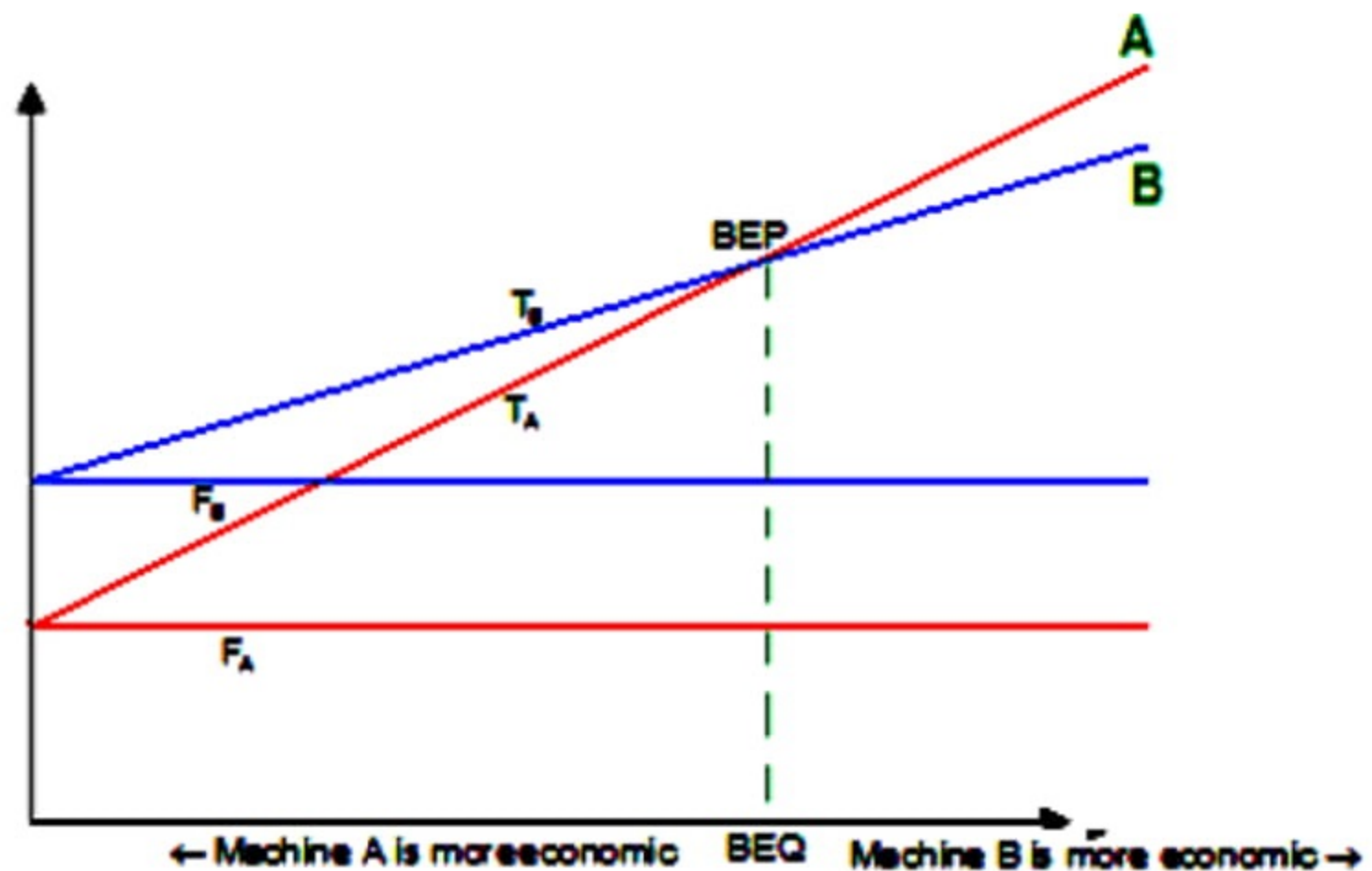Fixed cost + variable cost × Quantity = Selling price × Quantity

$$F + VQ = SQ$$

(ii) Fixed profit 'P'

$$F + VQ + P = SQ$$

B. Break-even point analysis is also used to make a choice between two machine tools to produce a given component.

The intersection of Total cost line of Machine A and Machine B is BEP.

At break even point

Total cost of machine A = Total cost of machine B

$$F_A + QV_A = F_B + QV_B$$

$$\therefore \quad Q = \frac{F_B - F_A}{V_A - V_B}$$

Here note if $F_A > F_B$ and $V_A < V_B$ or $F_A < F_B$ and $V_A > V_B$ only then Q will be positive.

But if Q comes out negative then, if
(i) $F_A = F_B$ but $V_A \neq V_B$: Whose Variable cost is less that one is economical.
(ii) $V_A = V_B$ but $F_A \neq F_B$: Whose Fixed cost is less that one is economical.
(iii) $F_A \neq F_B$ and $V_A \neq V_B$: Whose both Fixed and Variable cost is less that one is economical.

❖ The same type of analysis can also be used to decide whether an item should be manufactured or purchased and what capacity manufacturing the item would be more economical then purchasing it.

Contribution: Contribution is the measure of economic value that tells how much the sale of one unit of the product will contribute to cover fixed cost, with the remainder going to profit.
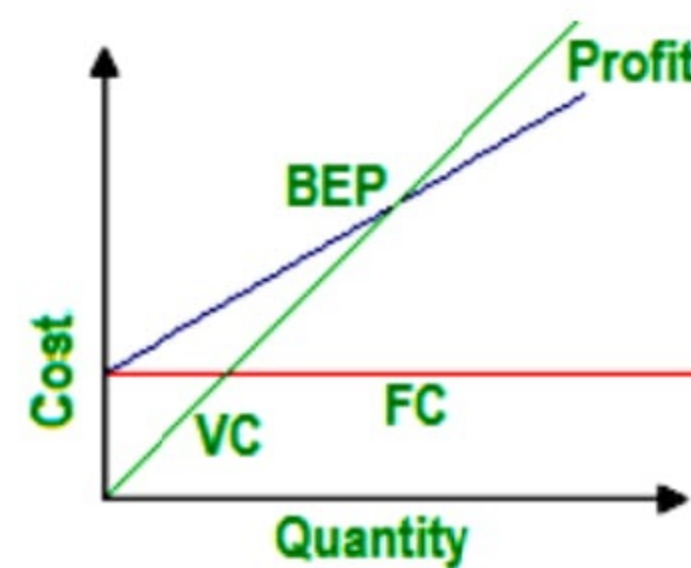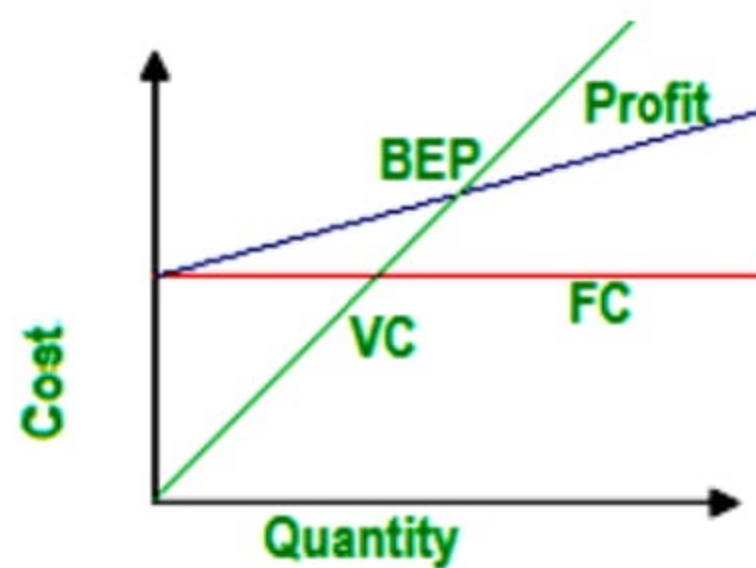
Contribution = Sales – total variable cost (Q.V.)
As Sales = $F + QV + P$

Therefore contribution = $F + P$

Since both sales and variable cost vary with output, contribution also vary with output.
At BEP, contribution = F

(A) (i) Capital-intensive industry
    (ii) High contribution
    (iii) High FC, Low VC

B) (i) Labour-intensive industry
    (ii) Low contribution
    (iii) Low FC; High VC

Case (A): Requires a large volume of output to reach break even, but once it has attained its profitability increases rapidly.
Case (B): Profitability after BEP increases slowly.

Case (A): When fixed costs are a large portion of total cost, small changes in volume or prices can result in significant changes in profit.
Case (B): When variable costs are high a reduction is variable cost may be more effective in generating profits than changes in the total volume or per-unit prices.

Margin of safety ratio (M/S) ratio

$$\left(\frac{M}{S}\right) \text{ratio} = \frac{\text{Margine of safety}}{\text{Present sale}}$$

Higher is the ratio, more sound of the economics of the firm. At BEP (M/S) = 0

Angle of incidence: θ

This is the angle between the lines of total cost and total revenue. Higher is the angle of incidence faster will be the attainment of considerable profit for given increase in production over BEP. Thus the higher value of θ make system more sensitive to changes near BEP.

Profit volume ratio:

$$\frac{\text{Sale} - \text{Variable cost}}{\text{Sale}}$$

Higher is the profit volume ratio, greater will be angle of incidence and vice-versa.

OBJECTIVE QUESTIONS (GATE, IES, IAS)

Previous 20-Years GATE Questions

GATE-1. A standard machine tool and an automatic machine tool are being compared for the production of a component. Following data refers to the two machines. **[GATE-2004]**

	Standard Machine Tool	Automatic Machine Tool
Setup time	30 min.	2 hours
Machining time per piece	22 min.	5 min
Machine rate	Rs.200 per hour	Rs.800 per hour

The breakeven production batch size above which the automatic machine tool will be economical to use, will be

(a) 4 (b) 5 (c) 24 (d) 225

GATE-2. A company produces two types of toys: *P* and *Q*. Production time of *Q* is twice that of *P* and the company has a maximum of 2000 time units per day. The supply of raw material is just sufficient to produce 1500 toys (of any type) per day. Toy type *Q* requires an electric switch which is available @ 600 pieces per day only. The company makes a profit of Rs. 3 and Rs. 5 on type *P* and *Q* respectively. For maximization of profits, the daily production quantities of *P* and *Q* toys should respectively be: **[GATE-2004]**

(a) 100, 500 (b) 500, 1000 (c) 800, 600 (d) 1000, 1000

GATE-3. A component can be produced by any of the four processes I, II, III and IV. Process I has a fixed cost of Rs. 20 and variable cost of Rs. 3 per piece. Process II has a fixed cost Rs. 50 and variable cost of Re. 1 per piece. Process III has a fixed cost of Rs. 40 and variable cost of Rs. 2 per piece. Process IV has a fixed cost of Rs. 10 and variable cost of Rs. 4 per piece. If the company wishes to produce 100 pieces of the component, from economic point of view it should choose

[GATE-2005]

(a) Process I (b) Process II (c) Process III (d) Process IV

GATE-4. Two machines of the same production rate are available for use. On machine 1, the fixed cost is Rs. 100 and the variable cost is Rs. 2 per piece produced. The corresponding numbers for the machine 2 are Rs. 200 and Re. 1 respectively. For certain strategic reasons both the machines are to be used concurrently. The sale price of the first 300 units is Rs. 3.50 per unit and subsequently it is only Rs. 3.00. The breakeven production rate for each machine is: **[GATE-2003]**

(a) 75 (b) 100 (c) 150 (d) 600

IES-1. Last year, a manufacturer produced 15000 products which were sold for Rs. 300 each. At that volume, the fixed costs were Rs. 15.2 lacs and total variable costs were Rs. 21 lacs. The break even quantity of product would be: **[IES-2000]**
(a) 4000 (b) 7800 (c) 8400 (d) 9500

IES-2. Assertion (A): It is possible to have more than one break-even point in break even charts. **[IES-1999]**
Reason (R): All variable costs are directly variable with production.
(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is **not** the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

IES-3. On a lathe, the actual machining time required per work piece is 30 minutes. Two types of carbide tools are available, both having a tool life of 60 minutes. **[IES-1998]**
Type I : Brazed type of original cost Rs. 50/-.
Type II : Throwaway tip (square) of original cost Rs. 70/-
If the overall cost of grinding the cutting edge is Rs. 10/-, assuming all the costs are the same for both the types, for break even costs, the appropriate batch size would be:
(a) 2 pieces (b) 4 pieces (c) 6 pieces (d) 8 pieces

IES-4. Two alternative methods can produce a product first method has a fixed cost of Rs. 2000/- and variable cost of Rs. 20/- per piece. The second method has a fixed cost of Rs. 1500/- and a variable cost of Rs. 30/-. The break even quantity between the two alternatives is: **[IES-1996]**
(a) 25 (b) 50 (c) 75 (d) 100

IES-5. For a small scale industry, the fixed cost per month is Rs. 5000/-. The variable cost per product is Rs. 20/- and sales price is Rs. 30/- per piece. The break-even production per month will be: **[IES-1995]**
(a) 300 (b) 460 (c) 500 (d) 10000

IES-6. In the production of a product the fixed costs are Rs. 6,000/- and the variable cost is Rs. 10/- per product. If the sale price of the product is Rs. 12/-, the break even volume of products to be made will be: **[IES-2008]**
(a) 2000 (b) 3000 (c) 4000 (d) 6000

IES-7. Process I requires 20 units of fixed cost and 3 units of variable cost per piece, while Process II required 50 units of fixed cost and 1 unit of variable cost per piece. For a company producing 10 piece per day **[IES-1997]**
(a) Process I should be chosen (b) Process II should be chosen
(c) Either of the two processes could be chosen
(d) A combination of process I and process II should be chosen

IES-8. Match List-I (Methods) with List-II (Applications) and select the correct answer using the codes given below the lists: **[IES-1998]**
List-I   List-II

A. Break even analysis				**1.** To provide different facility at different locations					
B. Transportation problem				**2.** To take action from among the paths with uncertainty					
C. Assignment problem				**3.** To choose between different methods of manufacture					
D. Decision tree				**4.** To determine the location of the additional plant					

Codes:	**A**	**B**	**C**	**D**		**A**	**B**	**C**	**D**
(a)	4	3	1	2	(b)	3	4	1	2
(c)	3	4	2	1	(d)	4	3	2	1

IES-9. M/s. ABC & Co. is planning to use the most competitive manufacturing process to produce an ultramodern sports shoe. They can use a fully automatic robot-controlled plant with an investment of Rs. 100 million; alternately they can go in for a cellular manufacturing that has a fixed cost of Rs. 80 million. There is yet another choice of traditional manufacture that needs in investment of Rs. 75 million only. The fully automatic plant can turn out a shoe at a unit variable cost of Rs. 25 per unit, whereas the cellular and the job shop layout would lead to a variable cost of Rs. 40 and Rs. 50 respectively. The break even analysis shows that the break even quantities using automatic plant *vs* traditional plant are in the ratio of 1: 2. The per unit revenue used in the break even calculation is: **[IES-1997]**
(a) Rs. 75   (b) Rs. 87   (c) Rs. 57   (d) Rs. 55

IES-10. Process X has fixed cost of Rs. 40,000 and variable cost of Rs. 9 per unit whereas process Y has fixed cost of Rs.16, 000 and variable cost of Rs. 24 per unit. At what production quantity, the total cost of X and Y are equal? **[IES-2004]**
(a) 1200 units   (b) 1600 units   (c) 2000 units   (d) 2400 units

IES-11. Which one of the following information combinations has lowest break-even point? **[IES-2004]**

Fixed cost (in Rs.)	Variable cost / unit (in Rs.)	Revenue/units (in Rs.)
(a) 30,000	10	40
(b) 40,000	15	40
(c) 50,000	20	40
(d) 60,000	30	40

IES-12. The indirect cost of a plant is Rs 4,00,000 per year. The direct cost is Rs 20 per product. If the average revenue per product is Rs 60, the break-even point is: **[IES-2003]**
(a) 10000 products   (b) 20000 products
(c) 40000 products   (d) 60000 products

IES-13. If the fixed cost of the assets for a given period doubles, then how much will the break-even quantity become? **[IES-2007]**
(a) Half the original value   (b) Same as the original value
(c) Twice the original value   (d) Four times the original value

IES-14. Process X has a fixed cost of Rs 40,000 per month and a variable cost of Rs 9 per unit. Process Y has a fixed cost of Rs 16,000 per month and a variable cost of Rs 24 per unit. At which value, total costs of processes X and Y will be equal? **[IES-2009]**

	(a) 800	(b) 1200	(c) 1600	(d) 2000

IES-15. Consider the following statements: [IES-2009]
The break-even point increases
1. If the fixed cost per unit increases
2. If the variable cost per unit decreases
3. If the selling price per unit decreases
Which of the above statements is/are correct?
(a) 1 only   (b) 1 and 2   (c) 2 and 3   (d) 1 and 3

IES-16. If the total investment is Rs. 5,00,000 for a target production, the income for the current year is Rs. 3,00,000 and total operating cost is Rs. 1,00,000; what is the economic yield?   [IES-2006]
(a) 10%   (b) 30%   (c) 20%   (d) 40%

IES-17. Based on the given graph, the economic range of batch sizes to be preferred for general purpose machine (OP), NC machine (NC) and special purpose machine (SP) will be:
Codes:

	GP	NC	SP
(a)	2	5	4
(b)	1	4	5
(c)	3	2	4
(d)	1	4	2
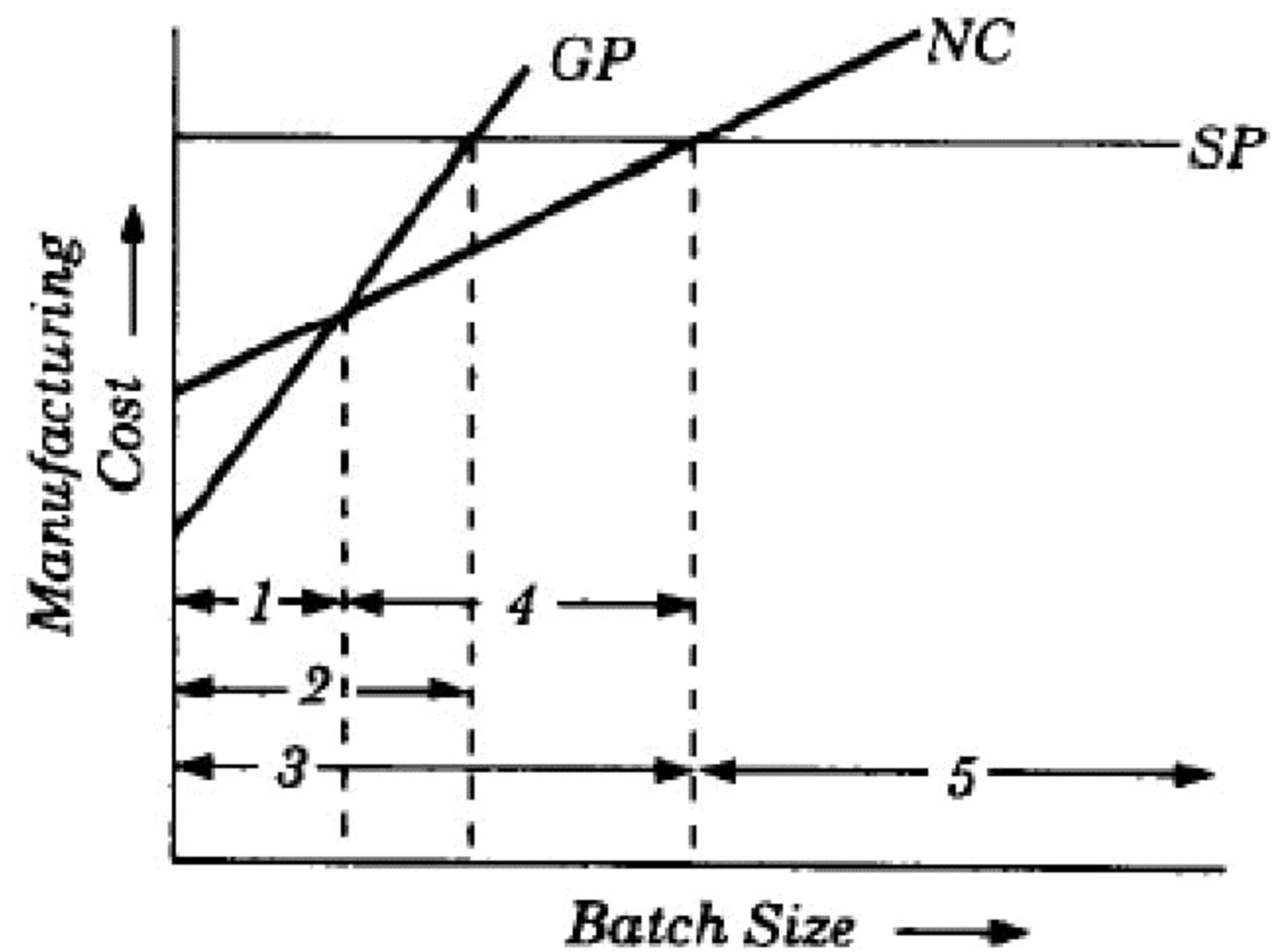
[IES-1997]

IES-18. Assertion (A): A larger margin of safety in break-even analysis is helpful for management decision.   [IES-1997]
Reason (R): If the margin of safety is large, it would indicate that there will be profit even when there is a serious drop in production.
(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is **not** the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

IES-19. Match List-I (Element of cost) with List-II (Nature of cost) and select the correct answer using the codes given below the lists: [IES-1994]

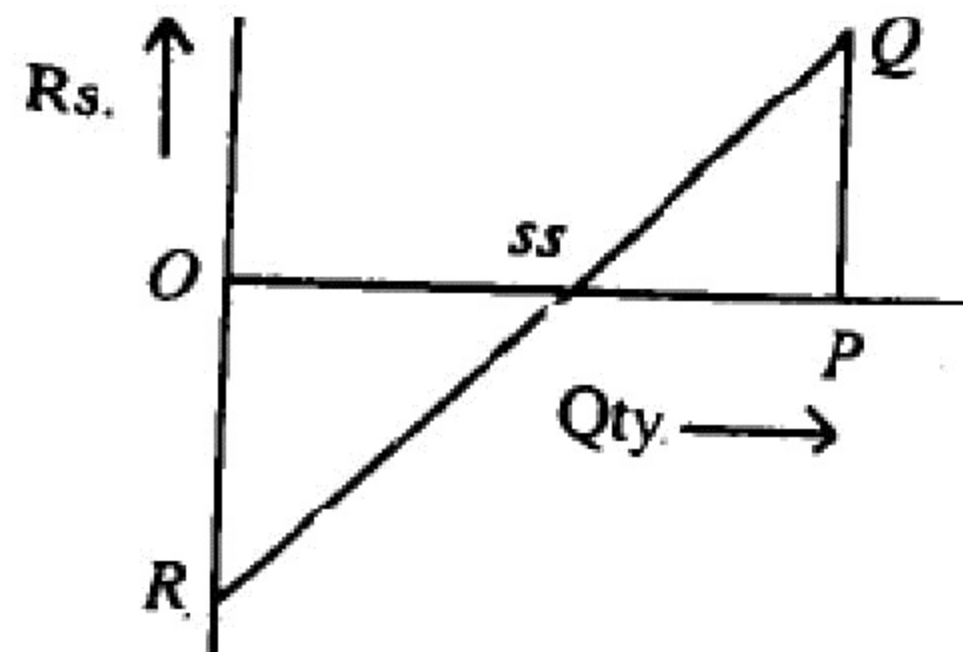| List-I		List-II	
A.	Interest on capital	1.	Variable
B.	Direct labour	2.	Semi-variable
C.	Water and electricity	3.	Fixed

Codes:	A	B	C		A	B	C
(a)	3	1	2	(b)	2	1	3
(c)	3	2	1	(d)	2	3	1

IAS-1. Fixed investments for manufacturing a product in a particular year is Rs. 80,000/- The estimated sales for this period is 2, 00,000/-. The variable cost per unit for this product is Rs. 4/-. If each unit is sold at Rs.20/-, then the break even point would be: **[IAS-1994]**
(a) 4,000   (b) 5,000   (c) 10,000   (d) 20,000

IAS-2. The fixed costs for a year is Rs. 8 lakhs, variable cost per unit is Rs. 40/- and the selling price of each unit is Rs. 200/-. If the annual estimated sales is Rs. 20,00,000/-, then the break-even volume is:
[IAS-1997]

(a) 2000   (b) 3000   (c) 3333   (d) 5000

IAS-3. Match List-I (Symbols) with List-II (Meaning) and select the correct answer using the codes given below the Lists; related to P/V chart on Break-Even Analysis as shown in the above figure:

List-I	List-II	[IAS-2002]
A. OR	1. Profit	
B. PQ	2. Break-Even Point	
C. SS	3. Profit/Volume Ratio	
D. RQ	4. Cost for new design	
	5. Fixed cost	

Codes:	A	B	C	D		A	B	C	D
(a)	5	4	2	3	(b)	2	1	3	5
(c)	5	1	2	3	(d)	2	4	3	5

IAS-4. If Break-even point = Total fixed cost $\div \left(1 - \dfrac{\text{Variable cost per unit}}{X}\right)$,
then X is the **[IAS-2000]**
(a) Overheads   (b) Price per unit
(c) Direct cost   (d) Materials cost

IAS-5. A company sells 14,000 units of its product. It has a variable cost of Rs. 15 per unit. **[IAS-1999]**
Fixed cost is Rs. 47,000 and the required profit is Rs. 23,000
Per unit product price (in Rs.) will be:
(a) 60   (b) 40   (c) 30   (d) 20

IAS-6. Two jigs are under consideration for a drilling operation to make a particular part. Jig A costs Rs. 800 and has operating cost of Rs. 0.10 per part. Jig B costs Rs. 1200 and has operating cost of Rs. 0.08 per part. The quantity of parts to be manufactured at which either jig will prove equally costly is: **[IAS-1998]**
(a) 8000   (b) 15000   (c) 20000   (d) 23000