Economics

(Micro-economics)

Chapter 3: PRODUCTION AND COSTS

PRODUCTION AND COSTS

Production Function

Production function is the relationship between physical input such as labour, capital and physical output of a good. It is expressed in the following form:

$q = f(x_1, x_2)$

It means by using x_1 amount of factor 1 and x_2 amount of factor 2, you will be able to produce q amount of good.

Fixed and variable factors

Factors of production are classified as fixed factors and variable factors. Fixed factors are those factors of the application which does not change with a change in output. Variable factors are those factors of the application which varies with a change in output.

Concept of period in production

The time period in which a firm makes changes in its production by changing only its variable factors but not its fixed factors is termed as short run. The time period in which a firm can change all the factors of production is termed as long run.

Concepts Related to Production

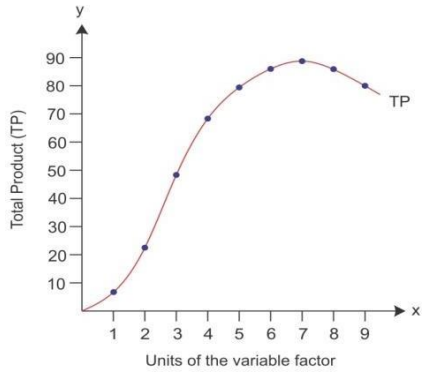
- Total Product (TP) is the sum total of each unit of the variable factor used in the process production. Average Product (AP) is the physical output per unit of the variable factor used in the process production.
- Marginal Product (MP) is the additional output attributed to an additional unit of the variable factor, while other factors remaining constant.

Relationship between MP and TP

Here the table and the diagram given below shows the relationship between MP and TP:

- Till the third unit of variable factor, MP increases from 4 to 28 units and the TP increases for every additional unit. So long as MP is increasing, TP is increasing at an increasing rate.
- But when MP starts diminishing at the 4th unit of variable factor input, the TP increases only at a decreasing rate
- When 7th unit was applied, MP is zero, there is no addition to TP and TP is at maximum level.
- When MP is negative, TP starts declining at the 8th unit. TP diminishes from 84 to 80 and the MP is negative 4 (-4).

Units of Fixed Factor	Units of Variable Factor	TP	MP
1	0	0	0
1	1	4	4
1	2	20	16
1	3	48	28
1	4	68	20
1	5	80	10
1	6	84	4
1	7	84	0
1	8	80	-4

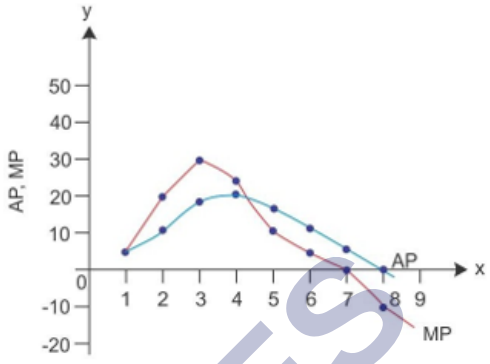


Relationship between AP and MP

Here the table and the diagram given below shows the following relationship between AP and MP:

- AP increases as long as MP is greater than AP. Till the point p, AP is at maximum.
- AP decreases when MP < AP. Beyond the point p, AP is at its top.
- AP is at its maximum when AP = MP.
- MP curve cuts AP from above at its maximum. MP may be zero or negative, but AP remains positive.

Units of Fixed Factor	Units of Variable Factor	AP	MP
1	0	0	0
1	1	4	4
1	2	10	16
1	3	16	28
1	4	17	20
1	5	16	10
1	6	14	4
1	7	12	0
1	8	1	-4



Returns to a Factor: Law of Variable Proportion

Law of variable proportion states that as more and more of the variable factor input is combined with the fixed factor input, eventually a point will be reached where the marginal product of the variable factor input starts declining.

Units of Fixed Factor	Units of Variable Factor	TP	MP	Stages
1	1	4	4	Increasing MP- Increasing returns to a factor
1	2	12	8	
1	3	24	12	
1	4	32	8	Diminishing MP- Diminishing returns to a factor
1	5	34	2	
1	6	34	0	
1	7	30	-4	
1	8	21	-9	Negative MP- Negative returns to a factor
1	9	10	-11	

Returns to Scale

If all factors are increased in the same proportion, the scale of production increases. It is a situation, where all factors are variable factors and are possible only in the long run. Returns to scale relates to the behaviour of total output as all factors are changed in same proportion. Three aspects of returns to scale are.

- Increasing returns to scale happens when increase in output is proportionately greater than the increase in output in factor input, while the factor ratio remains constant.
- Constant returns to scale happens when increase in output is proportionately equal

to increase in factor input, while the factor ratio remains constant.

- Diminishing returns to scale happens when increase in output is proportionately lesser than the increase in factor input, while the factor ratio remaining constant.

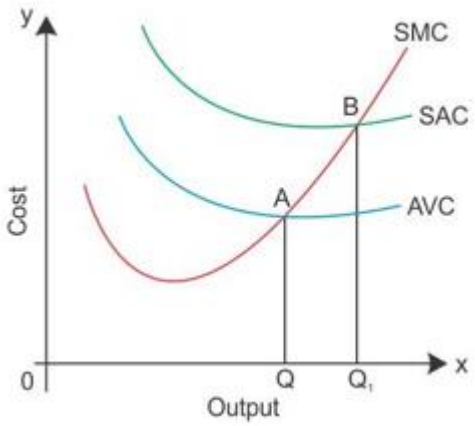
Cost Function

A cost function shows the functional relationship between cost and output. It gives the least cost combinations of inputs corresponding to various levels of output.

Short run cost

- **Short run costs:** are the cost during which some factors are fixed in supplies such as plant and machinery. These are divided into
- **Fixed costs:** Fixed costs are the sum total of expenditure incurred by the producer on the purchase or hiring of fixed factors of production. It does not change with change in quantity of output. It remains the same whether the output is zero or maximum.
- **Variable costs:** Variable costs are the expenditure incurred by the producer on the use of variable factors of production. It changes with change in quantity of output. Its cost is zero when output is zero.
- **Average costs:** Cost per unit of output produced is called an average cost i.e. AC=TC/Q. It is the sum total of average fixed cost (AFC) and average variable cost (AVC).
- **Average fixed** cost is the fixed cost per unit of output. AFC curve slopes downward to the right. It shows that AFC decreases as output increases. It is a rectangular hyperbola curve. It means that the product of AFC and output is equal to TFC which remains constant at all levels of output.
- TFC = AFC * Q
- **Average variable cost**: is the variable cost per unit of output. AVC curve is U-shaped. This is in accordance with the law of variable proportions. It falls so long as returns to a factor are increasing. It rises when returns to a factor are decreasing.
- **Marginal cost:** Marginal cost (MC) is the change in total cost when an additional unit of output is produced. It is also U-shaped curve in accordance with the law of variable proportions. Falling MC is in accordance with rising marginal product (MP), when there are increasing returns to a factor. Rising MC is in accordance with falling MP when there are diminishing returns to a factor.

Shapes of the short run cost curves



- MC curve should be shown cutting both AC and AVC at their lowest points.
- When AC falls, MC falls faster than AC. Then the MC remains below AC curve.
- When AC rises, MC rises faster than AC. Then the MC curve is above AC curve.
- As MC falls faster than AC, it reaches its lowest point earlier than AC. Then the MC starts increasing even when AC is declining.
- MC must cut AC from its lowest point.

Long run costs

In the long run, all the inputs are variable. Hence, there is no distinction between variable costs and fixed costs. All costs are variable cost in the long run. Shape of long run total cost (LTC) remains the same as short run total costs. Initially, LTC curve increases at a diminishing rate then it tends to increase at a constant rate and finally it rises at an increasing rate. This curve starts from the origin because all the costs are variable cost which varies with output. Therefore, when output is zero, the variable costs are also zero.

Long run average cost is defined as cost per unit of output. Long run marginal cost is the change in total cost per unit of change in output. The sum of all marginal costs up to certain output level gives the total cost at that particular level. Like short run average and marginal cost curves, long run average and marginal cost curves are also U-shaped.

Class : 11th Economics (Microeconomics)
Chapter-3 : Producer Behaviour & Supply

Measurment
$e_s = \frac{\%\text{ change in quantity supplied}}{\%\text{ change in price}}$

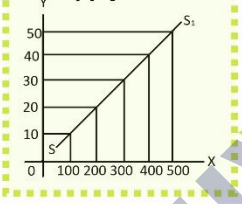
Forms
Perfect Elastic, es =∞,
Perfect Inelastic, es =0
Unitary Elastic, es =1
Relatively Elastic, es >1
Relatively Inelastic, es <1

Determinants
- Number of sellers,
- Prices of resources,
- Taxes and subsidies,
- Technology available,
- Prices of related products.

Supply Schedule
A method of sharing the different amounts of a certain product that a company would need to supply.

Meaning
A producer is said to be in equilibrium when he produces the level of output at which his profits are maximum.

Supply Curve



Price Elasticity of Supply

Different Products

Marginal Product
The change in output per unit of Change in the input when all other inputs are

Average Product
The output per unit of variable input.

Total Product
The Total output of a commodity produced.

Condition
- Marginal cost = Marginal Revenue.
- Marginal cost should cut the marginal revenue curve from below.

Meaning
A producer is said to be in equilibrium when he produces the level of output at which his profits are maximum.

Producer's Equilibrium

Producer Behaviour & Supply

Supply

Return to a Factor

Return to a factor relate to the short - period production function when one factor is varied keeping the other factor fixed in order to have more output.

Revenue

Relation Between TR and MR
- When TR rises, MR is positive,
- When TR is maximum, MR becomes Zero,
- When TR falls, MR becomes negative.

Relation Between AR and MR
- When MR > AR, AR rises,
- When MR = AR, AR is constant,
- When MR < AR, AR falls.

Types

Total Revenue
TR = P x Q

Average Revenue
$AR = \frac{TR}{Q} = \frac{P \times Q}{Q} = P$

Marginal Revenue
$MR = TR_n - TR_{n-1}$

Production Function

Short-run
The firms do not have enough time, to change in the factors of production, i.e., some remain constant

Long-run
The supply both the inputs, labour and capital is assumed to be elastic.

Short-run Coasts

Marginal Cost
- Cost of producing one extra unit.

$MC = TC_n - TC_{n-1}$

Total Cost
TC = TVC + TFC

Total Fixed Cost
Does not Very With Level of output, e.g., rent for budding.

Total Variable Cost
Change with level of output, e.g., cost of raw material.

Average Total Cost

Formula
$ATC = \frac{TC}{Q}$

Types

Average Fixed Cost
$AFC = \frac{TFC}{Q}$

Average Variable Cost
$AVC = \frac{TVC}{Q}$

Important Questions

Multiple Choice Questions-

1. In production function, production is a function of:

(a) Price

(b) Factors of Production

(c) Total Expenditure

(d) None of these

2. The basic reason of operating the Law of Diminishing Returns is:

(a) Scarcity of Factors

(b) Imperfect Substitution between Factors

(c) Both (a) and (b)

(d) None of the above

3. Which of the following explains the short-run production function ?

(a) Law of Demand

(b) Law of Variable Proportion

(c) Returns to Scale

(d) Elasticity of Demand

4. Long-run production function is related to:

(a) Law of Demand

(b) Law of Increasing Returns

(c) Laws of Returns to Scale

(d) Elasticity of Demand

5. In which stage of production a rational producer likes to operate in shot-run production ?

(a) First Stage

(b) Second Stage

(c) Third Stage

(d) None of these

6. Law of variable proportion explains three stages of production. In the first stage of production:

(a) Both MP and AP rise

(b) MP rises

(c) AP Falls

(d) MP is zero

7. At which time all the factors of production may be changed ?

(a) Short run

(b) Long run

(c) Very Long run

(d) All the three

8. Production function is expressed as:

(a) Qx = Px

(b) Qx = f(A, B, C, D)

(c) Qx = Dx

(d) None of these

9. Which factors among following we find in short-run production process ?

(a) Fixed Factors

(b) Variable Factors

(c) Both (a) and (b)

(d) None of these

10. The cycle which increases first and after being constant starts to reduce is called :

(a) APP

(b) MPP

(c) TPP

(d) All of these

11. Which of the following is a saurce of production ?

(a) Land

(b) Labour

(c) Capital

(d) All of these

12. Law of variable proportion is related to :

(a) Both short-run and long run

(b) Long-run

(c) Short-run

(d) Very Long-run

13. An active factor of production is:

(a) Capital

(b) Labour

(c) Land

(d) None of these

14. If all the factors of production are increased by same proportion and as a result output increases by a greater proportion than it is called :

(a) Constant returns to scale

(b) Decreasing returns to scale

(c) All of these

(d) None of these

15. Which of the following is included in money cost ?

(a) Normal Profit

(b) Explicit Cost

(c) Implicit Cost

(d) All of these

Very Short :

1. 1 Does Total Physical Product increase only when Marginal Physical Product increases?

2. 2 What will be the marginal product when the total product is maximum?

3. 3 How is Total Physical Product derived from Marginal Physical Product?

4. 4 What do you mean by production?

5. 5 Increase in Total Physical Product indicates that there are increasing returns to a factor.

6. 6 Why Average Fixed Cost curve never touches “x” axis though lies very close to the x-axis?

7. 7 When TVC is zero at zero levels of output, what happens to TFC or why TFC is not zero at zero level od output?

8. 8 What is a change in quantity demanded?

Short Questions :

1. Evaluate the marginal product for the following.

Variable Factor Unit	0	1	2	3	4	5	6
Total Unit	0	5	13	23	28	28	24

2. Define cost concept. What are the different types of cost?

3. Explain the likely behaviour of total product under the stage of increasing return to a factor with the help of numerical example.

4. With the help of example distinguish between total fixed cost and total variable cost.

5. Draw average cost, average variable cost and marginal cost curves on a single diagram and explain their relations.

6. Draw average cost, average variable cost and average fixed cost curves on a single diagram and explain their relation.

7. Explain the relation between average revenue and marginal revenue when a firm can sell an additional unit or a good by lowering the price.

8. Explain how do the following determine price elasticity of supply:

(i) Nature of the good (ii) Time period.

9. Define marginal revenue. State the relation between marginal revenue and average revenue when a firm:

(i) is able to sell more quantity of output at the same price.

(ii) is able to sell more quantity of output only by lowering the price.

10. How do changes in MR affect TR?

Long Questions:

1. In the following table, identify the different phases of the law of variable proportions and explain them with the help of the table and a diagram.

Variable input (units)	1	2	3	4	5	6	7	8
Total product (units)	2	5	9	12	14	15	15	14

2. All the inputs used in production of a good are increased simultaneously and in the same proportion. What are its possible effects on Total Product? Explain with the help of a numerical example.
3. Explain the relation between Average Cost and Marginal Cost.
4. If price elasticity of supply of a commodity is 5. A producer supplies 500 units of this

product at a price of Rs. 5 per unit. How much quantity of this product will be supplied, at the price of Rs. 6 per unit?

Assertion Reason Question:

1. **Direction:** In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

   A. Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).

   B. Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

   C. Assertion (A) is true, but Reason (R) is false.

   D. Assertion (A) is false, but Reason (R) is true.

   Assertion (A): Increasing returns to a factor is a short run phenomenon.

   Reason (R): Greater application of the variable factor ensures fully utilization of the fixed factor.

2. **Direction:** In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

   A. Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).

   B. Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

   C. Assertion (A) is true, but Reason (R) is false.

   D. Assertion (A) is false, but Reason (R) is true.

   Assertion (A): Average product increases only when marginal product increases.

   Reason (R): AP increases so long as MP is greater than AP, whether MP is rising or falling.

MCQ Answers :

1. (b) Factors of Production
2. (c) Both (a) and (b)
3. (b) Law of Variable Proportion
4. (c) Laws of Returns to Scale
5. (b) Second Stage
6. (a) Both MP and AP rise
7. (b) Long run
8. (b) Qx = f(A, B, C, D)
9. (c) Both (a) and (b)
10. (d) All of these
11. (d) All of these
12. (c) Short-run
13. (b) Labour
14. (d) All of these
15. (d) All of these

Very Short Answers :

1. No, because Total Physical Product increases Marginal Physical Product decreases but remains positive.
2. Marginal Product will be zero when the total product is maximum.
3. Cumulative addition
4. Production is the method of producing or developing goods or services in large quantities with the help of various materials.
5. No, the total physical product also rises when the returns to a factor decrease.
6. The Average Fixed Cost curve never touches “x” axis though lies very close to the x-axis because Total Fixed Cost can never be zero.
7. When TVC is zero at zero levels of output, what happens to TFC or why TFC is not zero at zero levels of output because the fixed cost is to be acquired even at zero levels of output.
8. It is a change along a demand curve. The change is due to a change in price and quantity of a commodity. The two types of change in quantity demand are Extension in demand and Contraction in demand.

Short Answers:

1.

Marginal Product	0	5	8	10	5	0	-4

2. The spending experienced on different inputs is known as the cost.

Types of cost:-

Money Cost- Total money spent by a company for manufacturing goods.

Explicit Cost & Implicit Cost- Payment made to an outsider are explicit and cost of self-supplied inputs are implicit cost.

Real Cost- All hard work, discomforts, sacrifices involved in manufacturing a product is called real cost.

Opportunity Cost- This the cost for the next best alternative foregone.

Short Run Cost- Fixed cost- Fixed factors cost

Variable Cost– Variable factor cost

3. Increasing return to a factor is the first phase of the Law of return to a factor. When more and more units of a variable factor is combined with fixed factor up to a certain level total physical product increases with increasing rate.

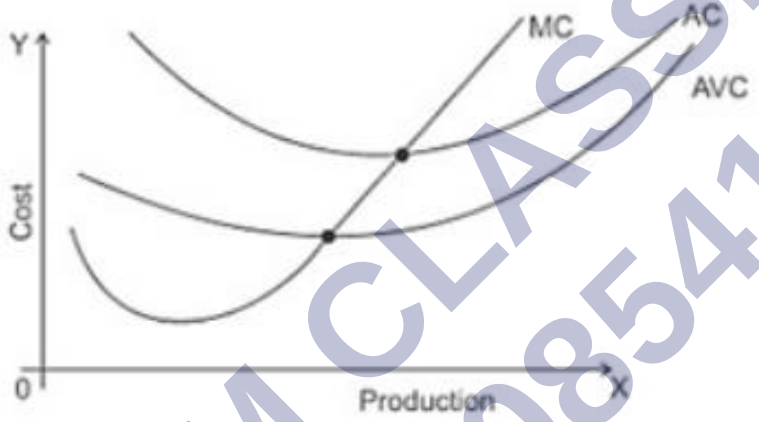
Machine	Unit of labour	Total physical product
1	1	10
1	2	24
1	3	42

4.

Basis	Fixed cost	Variable cost
Definition	Fixed cost is referred to as the cost that does not register a change with an increase or decrease in the quantity of goods produced by a firm.	Variable cost is referred to as the type of cost that will show variations as per the changes in the levels of production.
Nature of cost	It is time-dependent and changes after a certain period of time.	It is volume-dependent and changes based on the volume produced.
How are they incurred?	Fixed costs are incurred irrespective of any units produced.	Variable costs are incurred as and when any units are produced.

Does it change with the number of units?	Fixed cost decreases with an increase in the number of units produced.	Variable cost remains the same irrespective of the number of units produced.
Impact on profit	Higher production results in reducing the costs and increasing the profits.	There is no impact on profit with the level of production.
Examples	Rent, salaries, and property taxes	Labour cost, cost of raw materials, and sales commissions

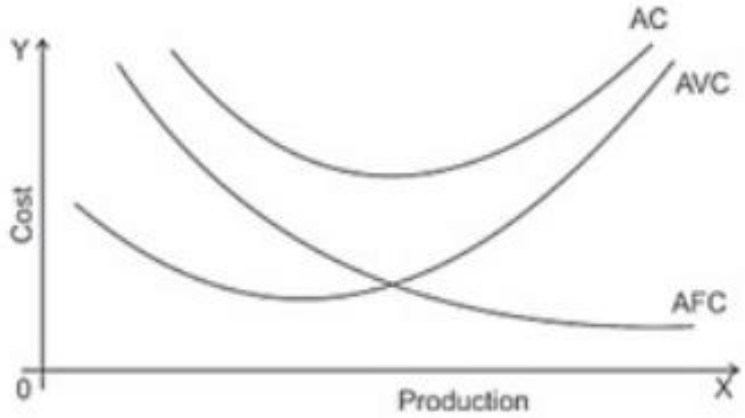
5.



Relation of AC, AVC and MC

1. MC interects to AC and AVC at their minimum level
2. AC and AVC decreases before the interection by MC, but remain greater than MC.
3. AC and AVC starts to increase after the itersection by MC, and becomes less than MC.
4. As output increases, AC and AVC tends to be closer but the difference between AC and AVC can never be zero.

6.



1. AC is the vertical summation of AVC and AFC

2. The difference between AC and AVC falls as output increases but the difference of AC and AFC increases.

3. As output increases AC and AVC tends to be closer but their curves do not interect each other because AFC always remains more than zero.

7.

1. AR and MR both decreases.

2. MR decrease at the rate of twice than AR.

3. MR become zero and negative but AR can never be zero.

8.

1. Nature of Commodity - Elasticity of industrial goods is more than that of agricultural goods. Similarly supply of durable goods e.g. table is more elastic than that of perishable goods e.g. vegetables.

2. Time Period- Generally elasticity of supply is more in the long period than in shorter period of time. The reason is that in the long period, all adjustments to the changed price can be made easily and supply of commodity can be varied accordingly

9. Marginal revenue is the addition to total revenue from producing one more unit of output.

1. MR = AR at all levels of the output. (In case of perfect competitive market)

2. MR will be less than AR at all levels of the output. (In case of monopoly and monopolistic market)

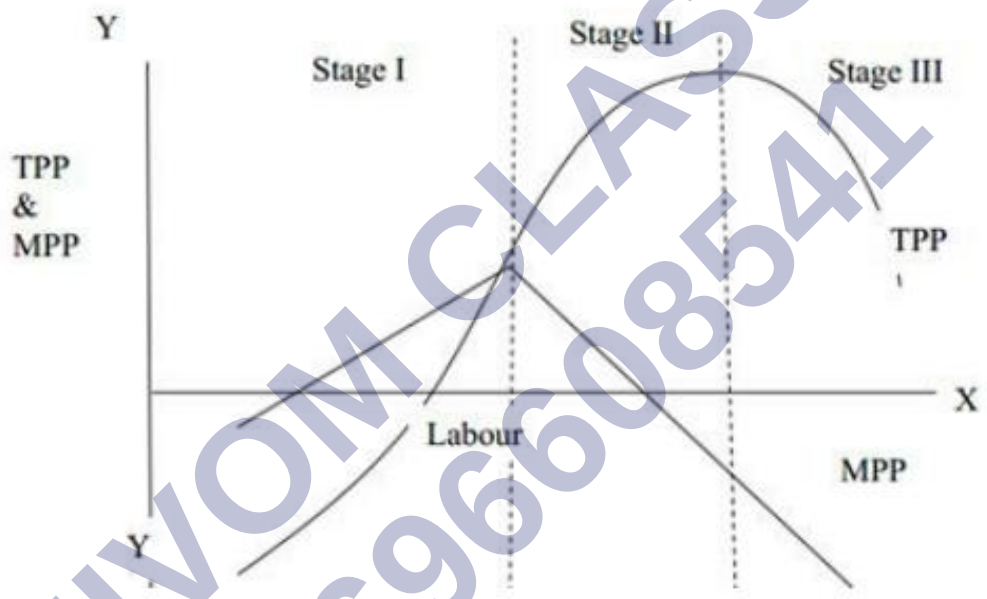
10.

1. If MR increases, TR increases at increasing rate.
2. If MR is constant, TR increases at constant rate.
3. If MR falls, TR increases at diminishing rate.

Long Answers:

1. Law of Variable Proportion states that if we go on using more and more units of a variable factor along with a fixed factor, the total output initially increases at an increasing rate, after that it increases at diminishing rate and finally it declines. It can be explained through the following three stages:

Units of labour	TPP	MPP	Stages of Produc tion
1	2	2	Stage I
2	5	3	
3	9	4	
4	12	3	Stage II
5	14	2	
6	15	1	
7	15	0	Stage III



Stage 1:

- TPP increases at an increasing rate.
- MP increases and reaches at its maximum at the end of the stage.
- This is also called stage of increasing returns.

Stage 2:

- TPP increase but at diminishing rate.
- MPP starts decline but remains positive.
- This stage comes to an end when TPP is maximum and MPP is zero.

Stage 3:

- TP starts decline.
- MP becomes negative.
- This is also called stage of decreasing/negative returns.

2. The behaviour of total output in the long run time period is technically termed as Returns to Scale.

There are three possibilities:

1. Increasing Returns to Scale (IRS):- It occurs when a given proportionate increase in all factor inputs (in some constant ratio) causes proportionately greater increase in output.

For example: Suppose there are only two inputs, labour (L) and Capital (K). Suppose 1K + IL produce 100 units and 2K + 2Lproduce 250 units. Input rises by 100% while the output rises by 150%.

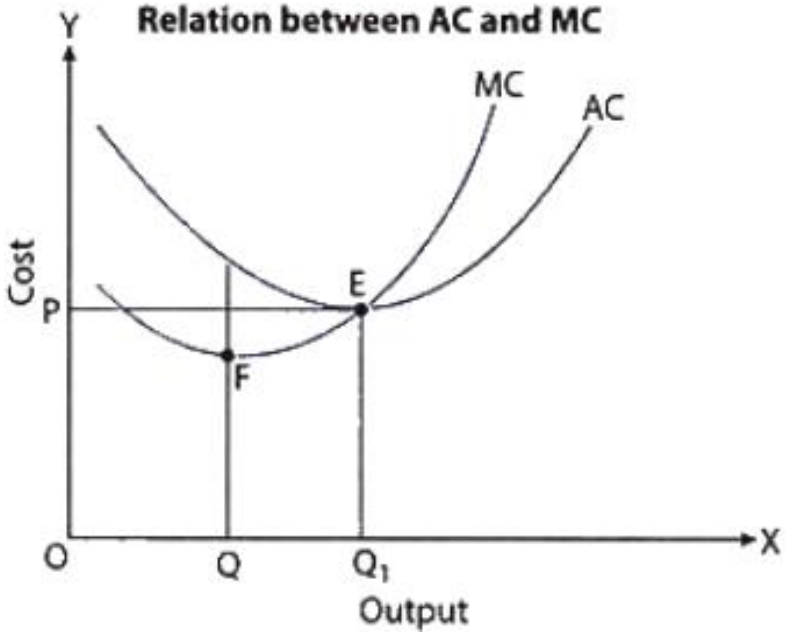
2. Constant Returns to Scale (CRS):- It occurs when a given proportionate increase in all factor inputs causes proportionately equal increase in output. At this stage, economies of scale are counter balanced by diseconomies of scale. For example, suppose 1K+1L produce 100 units and 2K+2L produce 200 units, both inputs and TP rise in the same proportion.

3. Diminishing Returns to Scale (DRS):- It occurs when a given proportionate increase in all factor inputs causes proportionately lesser increase in output.

For example, Suppose 1K+1L produce 100 units and 2K+2L produce 190 units, inputs rise by 100% while the output rise by 90%

3. Answer: The relation between Average Cost and Marginal Cost

- When Average Cost decreases, Marginal Cost declines faster than the Average Cost. So, that Marginal Cost curve remains lower than the Average Cost curve. This means Average Cost > Marginal Cost.
- When Average Cost increases, Marginal Cost rises faster than the Average Cost. So, that MC curve is above the Average Cost curve
- Marginal Cost curve intersects Average Cost curve from its lowest point. When the average curve is minimum then Marginal Cost=Average Cost.



4. es = 5

P	Q	Δq	=	x-500
5	500	Δp	=	1
6	x	P	=	5
		Q	=	500

$$e = \frac{\Delta q}{\Delta p} \times \frac{p}{q}$$

$$5 = \frac{X - 500}{1} \times \frac{5}{500}$$

$$5 = \frac{X - 500}{100}$$

$5 \times 100 = x - 500$

$500 = x - 500$

$500 + 500 = x$

$x = 1000$ (units)

Assertion Reason Answer:

1. B. Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

2. C. Assertion (A) is true, but Reason (R) is false.