

Unit-2Chapter-3MacroeconomicsPrice & Output Determination

A. Very short questions : for 1 mark

i. Define Firm and industry with suitable example.

⇒ Firm is an individual producing unit of the industry.

for example: Godstar and Shikhar are the firms of shoe industry. Industry is a group of firms producing similar or identical products. For example, a sugar factory represents a firm where as all sugar factories combinedly represents an industry.

ii. Distinguish between firm and industry.

Firm	Industry
1) Firm is an individual producing unit of industry.	1) Industry is a group of firms producing homogeneous products.
2) A firm is a price taker not maker. It should accept the price determined by the industry.	2) An industry determines price at the intersecting point of demand and supply curves.

iii.

⇒ State the meaning of equilibrium.
Equilibrium means a point of rest from which there is no tendency of movement. It means a point where market demand and supply are equal and the market is cleared as there is neither excess supply nor excess demand.

- i. In which situation firm attains its equilibrium according to TR-TC approach?
- ⇒ According to TR-TC approach, firm attains its equilibrium when the gap between TR and TC is maximum.
- v. What are the conditions to be satisfied for equilibrium of a firm under MR-MC approach?
- ⇒ The conditions for equilibrium of a firm under MR-MC approach are:
- 1) $MC = MR$
 - 2) MC must cut MR from below.

B. Short questions: For 5 marks

- i. Explain the equilibrium of firm under perfect competition market by using TR-TC approach?
- ⇒ The TR-TC approach is the traditional approach to determine the equilibrium of a firm. It uses the concept of total revenue (TR) and total cost (TC) to determine the profit maximizing output and equilibrium of a firm.

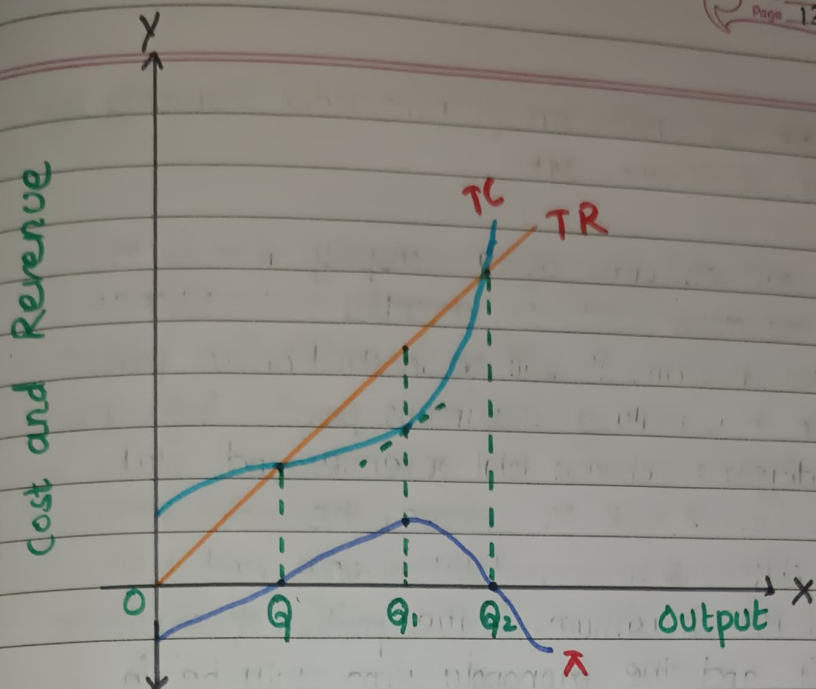
A perfect competition market is the market structure in which there are large number of sellers of a homogeneous product. Under perfect competition, a firm faces an inverse S-shape total cost (TC) curve and straight line total revenue (TR) curve.

Under TR-TC approach $\text{profit}(\pi) = TR - TC$. The firm is said to be in equilibrium when the gap between TR and TC is maximum.

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In the figure, output is measured on X-axis and cost and revenues are measured on Y-axis. TR is the total revenue curve and TC is the total cost curve. Given the total revenue and total cost curves, the firm is in equilibrium at Q_1 level of output production for which TR exceeds TC by the greatest amount. At output levels Q_0 and Q_2 , there is break even because at these output levels, TR and TC are equal.

The maximum level of output and profit is determined by drawing a tangent to the S-shaped total cost curve making parallel to the straight line TR. The vertical distances between TR and TC ~~become~~ measure the maximum level of profit per unit.

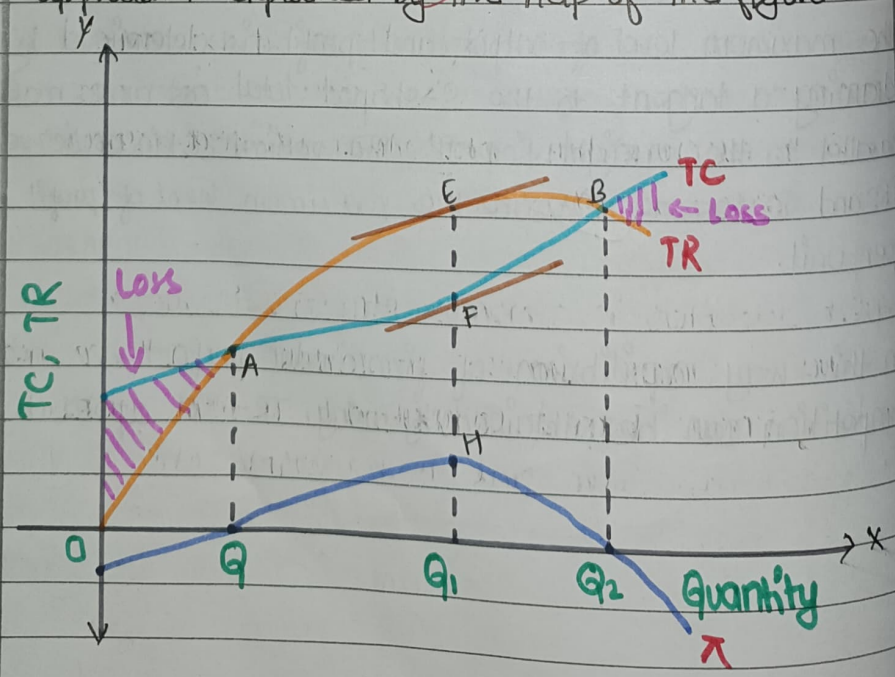
In this way, equilibrium of firm under perfect competition can be obtained by using TR-TC approach.

ii. Explain the equilibrium of firm under monopoly by using TR-TC approach.

⇒ The main objective of a monopoly firm is to get maximum profit. So, according to traditional theory of firm, it will be in equilibrium position when it is making maximum profits. Profit is the difference between total revenue and total cost. i.e. $\pi = TR - TC$. Hence, the point where the difference between total revenue and total cost is the maximum, is the position of maximum profit and the monopoly firm will be in equilibrium.

Under TR-TC approach, a firm is said to be in equilibrium when the gap between total revenue (TR) and total cost (TC) is the maximum i.e., the profit (π) is maximum.

The equilibrium condition of a firm under this approach is explained by the help of the figure:



In the figure, the total cost curve (TC) is U-shaped. In the figure, TR and TC are intersecting at two points. The first intersection point is at quantity Q, where the firm is in equilibrium. The second intersection point is at quantity Q2, where the firm is in equilibrium. Hence, these two points are the equilibrium points. Where there is a profit, the profit lies between the TR and TC curves. The equilibrium of a firm is determined by the tangency of the TR and TC curves. The gap between the TR and TC curves at quantity Q1 is the maximum profit. The curve (TC) is U-shaped and the output is Q1.

iii. How a firm determines its equilibrium under perfect competition?

⇒ The MR-AR approach is used to determine the equilibrium of a firm under perfect competition. The concept of Marginal Revenue (MR) and Marginal Cost (MC) is used to determine the equilibrium.

Perfect Competition: In perfect competition, there are many sellers and buyers of a homogeneous product. The demand curve is a horizontal line, and the marginal revenue curve is also a horizontal line. The U-shaped marginal cost curve determines the equilibrium quantity.

In the figure, TR is the total revenue curve; TC is the total cost curve; π is the profit curve. A cost-revenue situation of a hypothetical firm is shown in the figure. In the figure, total revenue curve TR and total cost curve TC are intersected at two points A and B where total revenue and total cost of a monopoly firm are equal. Hence, these points represent 'break-even' of the firm where there is neither profit nor loss. The monopoly profits lie between the output OQ_1 and OQ_2 . For the equilibrium of the firm, the slope of TR curve and TC curve should be equal and parallel which is shown by the tangents drawn at the point E and F. So, the gap between EF is the maximum which represents the maximum profit at OQ_3 level of output. The total profit curve (π) is the highest at point H where quantity of output is OQ_1 .

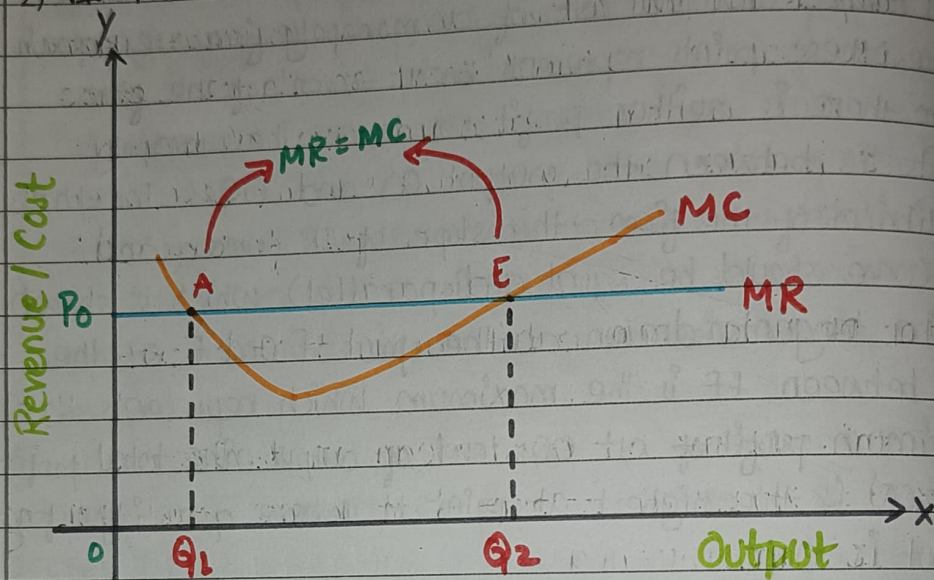
iii. How a firm attains the equilibrium under perfect competition according to MR-MC approach? Explain.

⇒ The MR-MC approach is the modern approach to determine the equilibrium of a firm. It uses the concept of Marginal Revenue (MR) and Marginal Cost (MC) to determine the profit maximizing output and equilibrium of a firm.

Perfect Competition is a market structure in which there are a large number of sellers of a homogeneous product. Under perfect competition, a firm faces U-shaped MC curve and a horizontal MR curve.

Under MR-MC approach, two conditions must be fulfilled simultaneously for the equilibrium of a firm. They are:

- 1) $MR = MC$
- 2) MR must cut MC from below.



In the figure, cost and revenue of the firm are measured on y-axis and output is measured on x-axis. In the figure, the first order condition is fulfilled at two points 'A' and 'E' because $MR = MC$ at both points.

However, point 'E' is the real equilibrium because at the point 'E' MR curve is cut by MC curve from below.

In this way, equilibrium can be obtained under perfect competition market by using MR-MC approach.

Describe market

⇒

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Describe the equilibrium of a firm under monopoly market according to MR-MC approach.

⇒

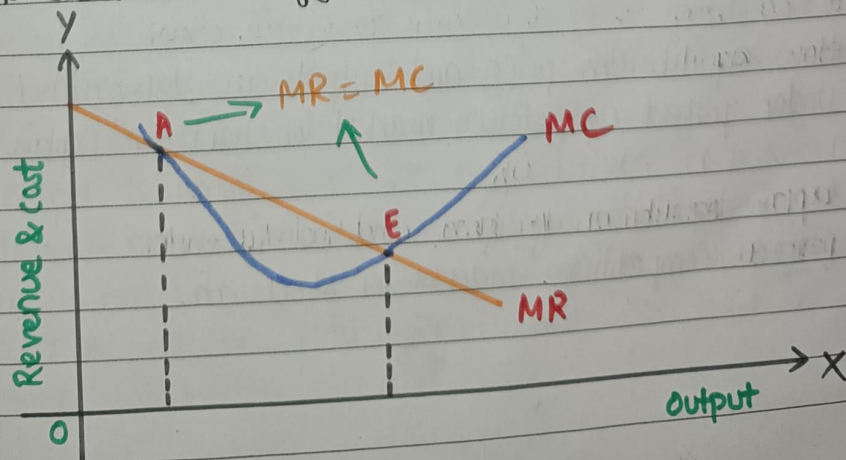
The MR-MC approach is the modern approach to explain the equilibrium of firm. This method is based on marginal concept rather than total concept. Therefore, it is also called marginal approach. In this method equilibrium of a firm is explained with the help of marginal revenue (MR) and marginal cost (MC). MR is the additional revenue obtained by the firm by selling one additional unit of output. MC is the additional cost of producing one additional unit of output.

Under this approach, a firm can maximize its profit by producing at that point where the following conditions are fulfilled.

1) $MC = MR$

2) MC curve cuts MR curve from below.

Under monopoly, firm can sell more only at lower prices. This makes AR and MR curves downward sloping. However, MC curve is U-shaped. The equilibrium condition of a firm under this approach is shown in the figure.



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In the figure, U-shaped marginal cost curve cuts marginal revenue curve (MR) at two points A and E where marginal revenue and marginal cost of the firm are equal. But the firm will not be in equilibrium at point A because it does not satisfy second condition. i.e. at point A, MC cuts MR from above. Between the point A and E, marginal cost is lower than marginal revenue. Therefore, it is profitable for the firm to expand output up to OQ_2 level of output.

At OQ_2 level of output, the firm will be in equilibrium because above two conditions are fulfilled. This is the point of maximum profit of the firm. Thus, the firm will go on expanding its output up to OQ_2 . but it is not profitable to produce more than OQ_2 level of output where MC is greater than MR.

In this way, the firm can maximize its profit at point E where $MC = MR$ and MC curve cuts MR curve from below. So, the firm can maximize its profit by producing OQ_2 level of output.

C. Long questions: For 8 marks

1. How equilibrium price and outputs are determined under perfect competition market in short run? Explain.

OR

Explain equilibrium of firm and industry under perfect competition market in short run.

- Perfect Competition is the market structure in which there are large number of buyers and sellers of homogeneous product. The features of perfect competition market are:
- 1) Large number of buyers and sellers.
 - 2) All the sellers are selling homogeneous product.
 - 3) There is free entry and exit of the firm.
 - 4) Perfect knowledge of market among buyers and sellers.
 - 5) There is perfect mobility of factors of production.
 - 6) Uniform price prevails all over the market.
 - 7) Profit maximization is the objective of firm.

Under perfect competition, a firm and industry are different. A firm is an individual producing unit whereas industry is a group of firm producing homogeneous products.

The conditions of equilibrium of a firm are:

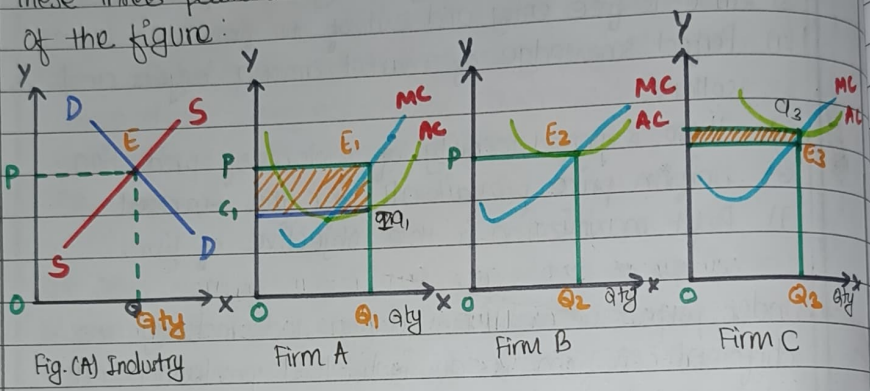
- 1) $MC = MR$
- 2) MC must cut MR from below.

The condition of equilibrium of an industry is Demand (D) = Supply (S).

Short-run is the short period of time in which some factors of production are variable and others are fixed. So, only the quantity of variable factors can be changed in order to change the quantity of output. Therefore, short-run equilibrium of a firm does not necessarily mean that firms are earning excess profit. Profit situation depends upon AR and AC at the level of equilibrium. So, there are three possibilities:

- 1) If $AR > AC$, the firm makes excess profit (i.e. $\pi > 0$)
- 2) If $AR = AC$, the firm makes normal profit (i.e. $\pi = 0$)
- 3) If $AR < AC$, the firm faces loss (i.e. $\pi < 0$)

These three possibilities can be explained by the help of the figure:



The figure shows short run equilibrium of firm and industry.

The firm A is earning supernormal profit. Its equilibrium point is OQ_1 . E_1O_1 represent average value and O_1Q_1 represents average cost. Since $AR > AC$, the firm is said to be earning supernormal profit.

The firm B is earning normal profit. OQ_2 is the equilibrium of the firm. E_2O_2 represents average revenue. Since $AR = AC$ and hence firm is said to be earning normal profit.

The firm C is suffering loss. OQ_3 is the equilibrium of the firm. Since $AR < AC$, the firm is said to be in loss.

Hence, In this way, equilibrium price and output are determined.

How equilibrium price is determined under monopoly market.

Explain equilibrium in monopoly market.

Monopoly is the sole seller of product.

- 1) Single Seller
- 2) No close substitutes
- 3) Barrier to entry
- 4) Imperfect competition
- 5) Imperfect information
- 6) Price discrimination
- 7) Profit maximization

Under monopoly, equilibrium price and output are determined.

- 1) $MR = MC$
- 2) MC must be upward sloping

Short run equilibrium of a firm is determined when the firm is earning normal profit.

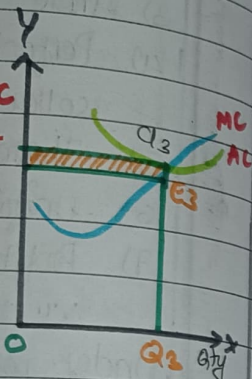
- 1) If $AR > AC$
- 2) If $AR = AC$
- 3) If $AR < AC$

(i.e. $\pi > 0$)

$\pi = 0$

(iii) $\pi < 0$

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How equilibrium price and outputs are determined under monopoly market in short run? Explain.

OR

Explain equilibrium of firm or industry under monopoly market.

Monopoly is the market structure in which there is single seller of product having no close substitutes. The features of monopoly market are:

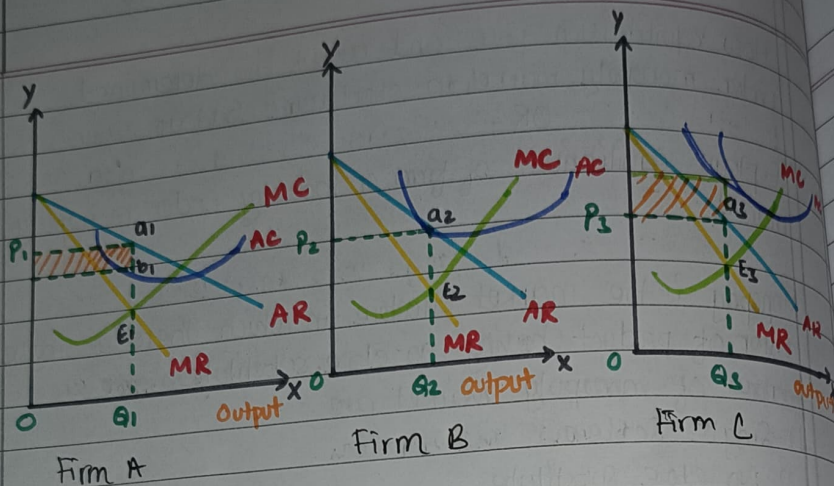
- 1) Single Seller
- 2) No close substitute
- 3) Barrier to entry and exit of the firm.
- 4) Imperfect mobility of factor of production.
- 5) Imperfect knowledge about the market.
- 6) Price Discrimination.
- 7) Profit maximization is the objective of the firm.

Under monopoly, there is no difference between firm and industry. The conditions for equilibrium of the firm and industry are:

- 1) $MR = MC$
- 2) MC must cut MR from below

Short run equilibrium of a firm does not mean that firm is earning supernormal profit. Whether the firm earns profit or not depends upon AR and AC. So there are three possibilities:

- 1) If $AR > AC$, the firm is earning super natural profit.
- 2) If $AR = AC$, the firm is earning normal profit.
- 3) If $AR < AC$, the firm is suffering loss.



Firm A is earning supernormal profit. The equilibrium of the firm is given by E_1 similarly. AR is given by $a_1 b_1$ and AC is $b_1 a_1$. Since $AR > AC$, the firm is earning super normal profit.

Firm B is earning normal profit. The equilibrium of the firm is E_2 . AR is given by $a_2 b_2$ and AC also $a_2 b_2$. Q_2 is the equilibrium quantity. Since $AR = AC$, the firm is earning normal profit.

Firm C is suffering loss. The equilibrium of the firm is E_3 . AR is given by $a_3 b_3$ and AC is given by $b_3 a_3$. Since $AR < AC$, the firm is suffering loss.

In this way, equilibrium price and output is determined under monopoly in short run.

Numericals

- 1) Suppose the cost function of a locality is $TC = 60 + 7Q^2$ and $P = 120 - 5Q$
- Compute TR, TC and profits units.
 - Graphically, find out the profit maximum profit.
 - Compute MR and MC function.

Solution

We have,

$$TC = 60 + 7Q^2$$

$$TR = P \times Q = 120Q - 5Q^2$$

a) Calculation of TR, TC

Output	TR = 120Q - 5Q ²
0	0
1	115
2	220
3	315
4	400
5	475
6	540
7	595
8	640
9	675
10	700

Numericals

- 1) Suppose the cost function of a tea shop in your locality is $TC = 60 + 7Q^2$ and demand function is $P = 120 - 5Q$

- Compute TR, TC and profits upto output level of 10 units.
- Graphically, find out the profit maximizing output and maximum profit.
- Compute MR and MC functions.

Solution

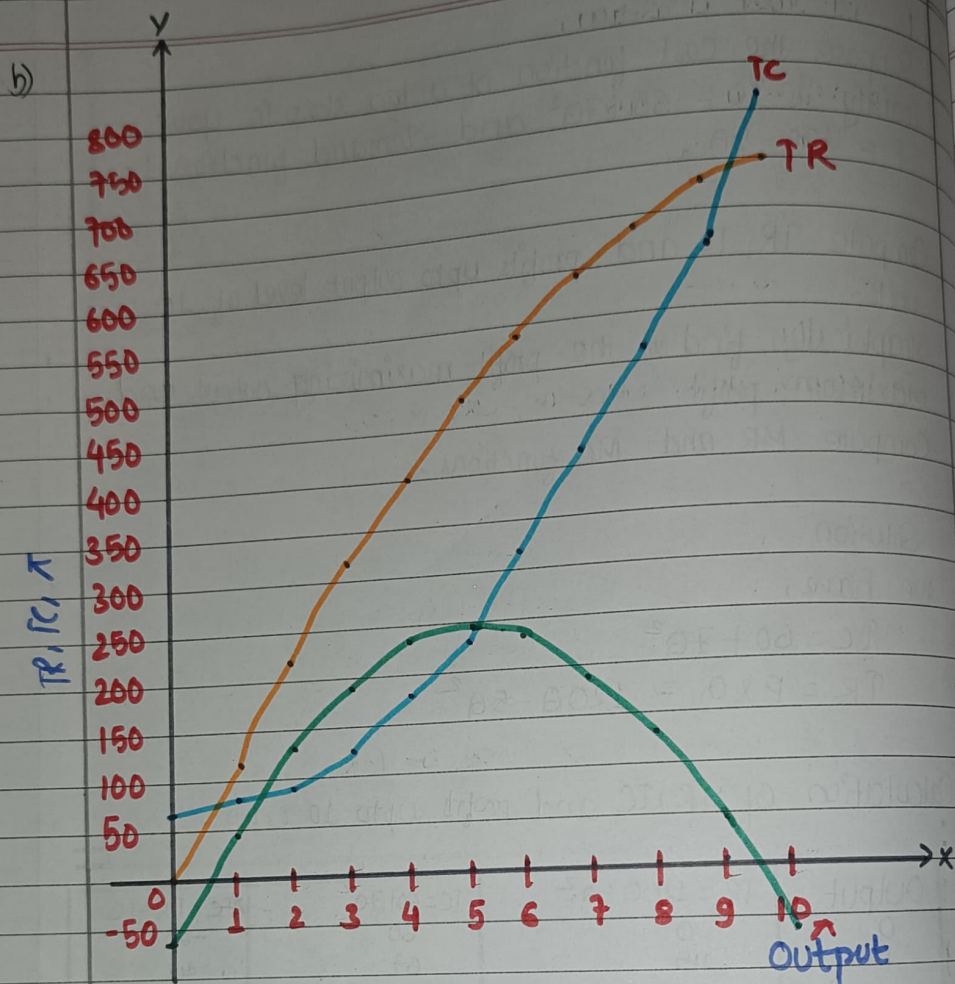
We have,

$$TC = 60 + 7Q^2$$

$$TR = P \times Q = 120Q - 5Q^2$$

- Calculation of TR, TC and profit upto 10 units.

Output	$TR = 120Q - 5Q^2$	$TC = 60 + 7Q^2$	$\pi = TR - TC$
0	0	60	-60
1	115	67	48
2	220	88	132
3	315	123	192
4	400	172	228
5	475	235	240
6	540	312	228
7	595	403	192
8	640	508	132
9	675	627	48
10	700	766	-60



Hence, the profit maximizing output is 5 units and maximum profit is 240.

c) By definition,

$$MR = \frac{dTR}{dQ} = \frac{d(120Q - 5Q^2)}{dQ}$$

$$= 120 - 10Q$$

$$\therefore MR \text{ function} = 120 - 10Q$$

$$MC = \frac{dTC}{dQ} = \frac{d(-60 + 7Q^2)}{dQ} = 14Q$$

$$\therefore MC \text{ function} = 14Q$$

d) For first order condition

$$MR = MC$$

$$\Rightarrow 120 - 10Q = 14Q$$

$$\Rightarrow 120 = 24Q$$

$$\Rightarrow \frac{120}{24} = Q$$

$$\therefore Q = 5$$

For second

$$\frac{d(MC)}{dQ}$$

$$= \frac{d(14Q)}{dQ}$$

$$\Rightarrow 14$$

Clearly, slope is positive
So, the profit is

2. If the given by following:

Output
TC

a) Using best
b) Find

Solution

$$Q =$$

$$\Rightarrow P$$

$$\Rightarrow TR$$

d) For first order condition,

$$MR = MC$$

$$\Rightarrow 120 - 10Q = 14Q$$

$$\Rightarrow 120 = 24Q$$

$$\Rightarrow \frac{120}{24} = Q$$

$$\therefore Q = 5 \text{ units}$$

For second order condition, (at $Q = 5$)

$$\frac{d(MC)}{dQ}$$

$$= \frac{d(14Q)}{dQ}$$

$$\Rightarrow 14$$

$$\frac{d(MR)}{dQ}$$

$$= \frac{d(120 - 10Q)}{dQ}$$

$$= -10$$

Clearly, slope of $MC >$ slope of MR .

So, the profit maximizing output = 5

2. If the demand function facing a pure monopolist is given by $Q = 12 - P$, Use the cost schedule to answer the following:

Output	0	1	2	3	4	5
TC	10	17	18	21	30	48

- a) Using TR and TC approach, find the monopolist's best level of output.
- b) Find the profit maximizing output geometrically.

Solution

$$Q = 12 - P$$

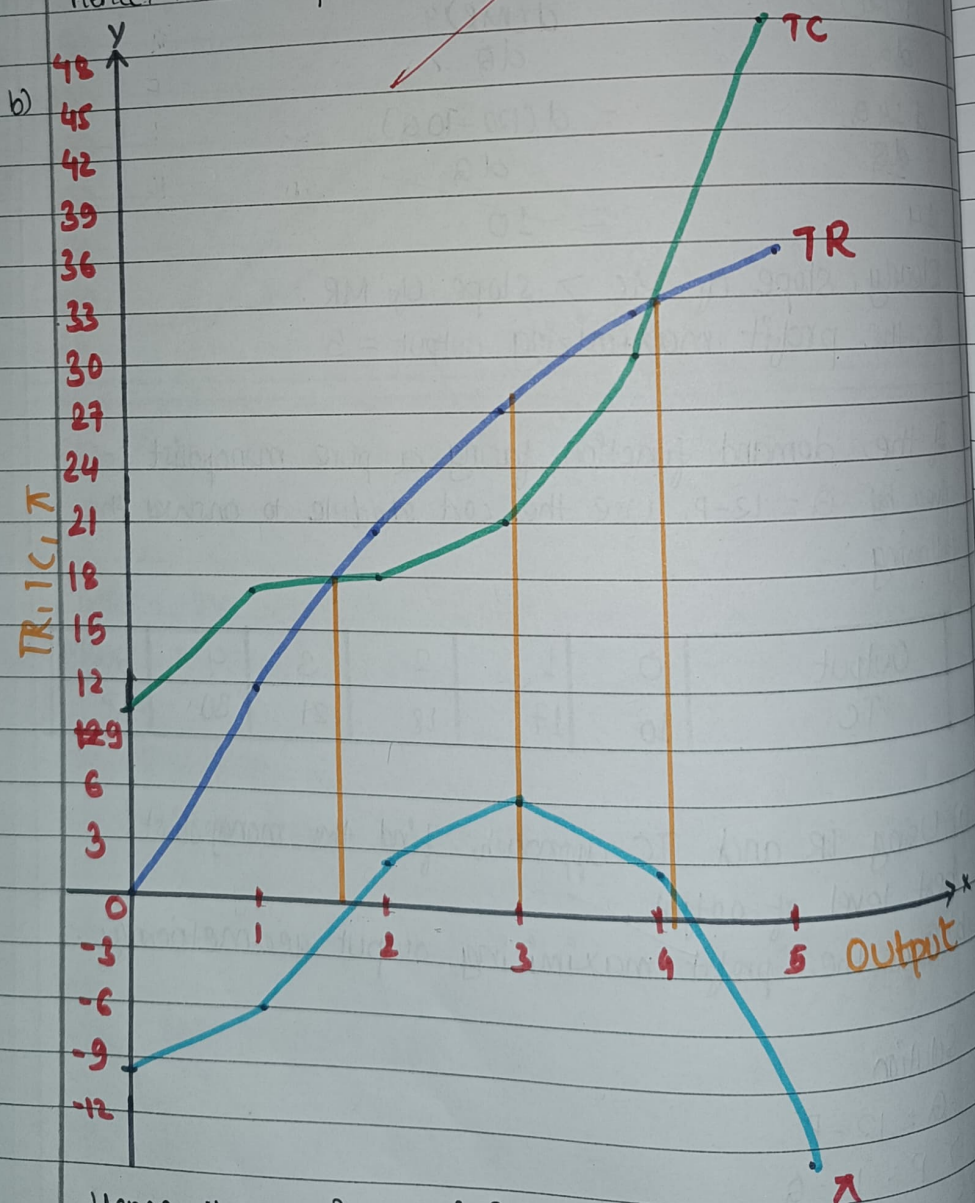
$$\Rightarrow P = 12 - Q$$

$$\Rightarrow TR = 12Q - Q^2$$

Calculation of monopolist's best level of output.

Output	Price	TR = P x Q	TC	Profit = TR - TC
0	12	0	10	-10
1	11	11	17	-6
2	10	20	18	2
3	9	27	21	6
4	8	32	30	-2
5	7	35	48	-13

Hence, the monopolist's best level of output is 3.



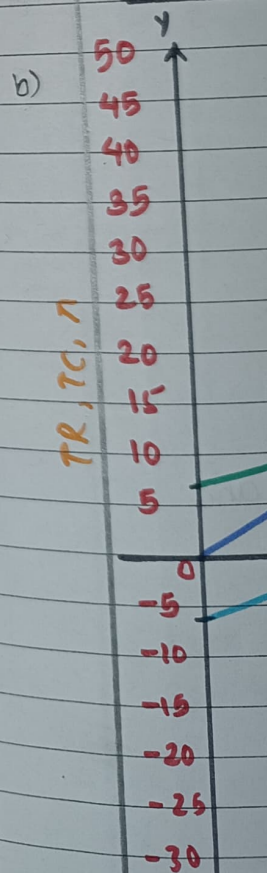
Hence, the profit maximizing output is 3 units.

3. You are given schedule.

- Find the p
- Plot TR, T
- what is th

a)

Quantity
0
1
2
3
4
5
6



c) Hence, output

of output.

Profit = TR - TC
-10
-6
2
6
<u>2</u>
-13

is 3

TC

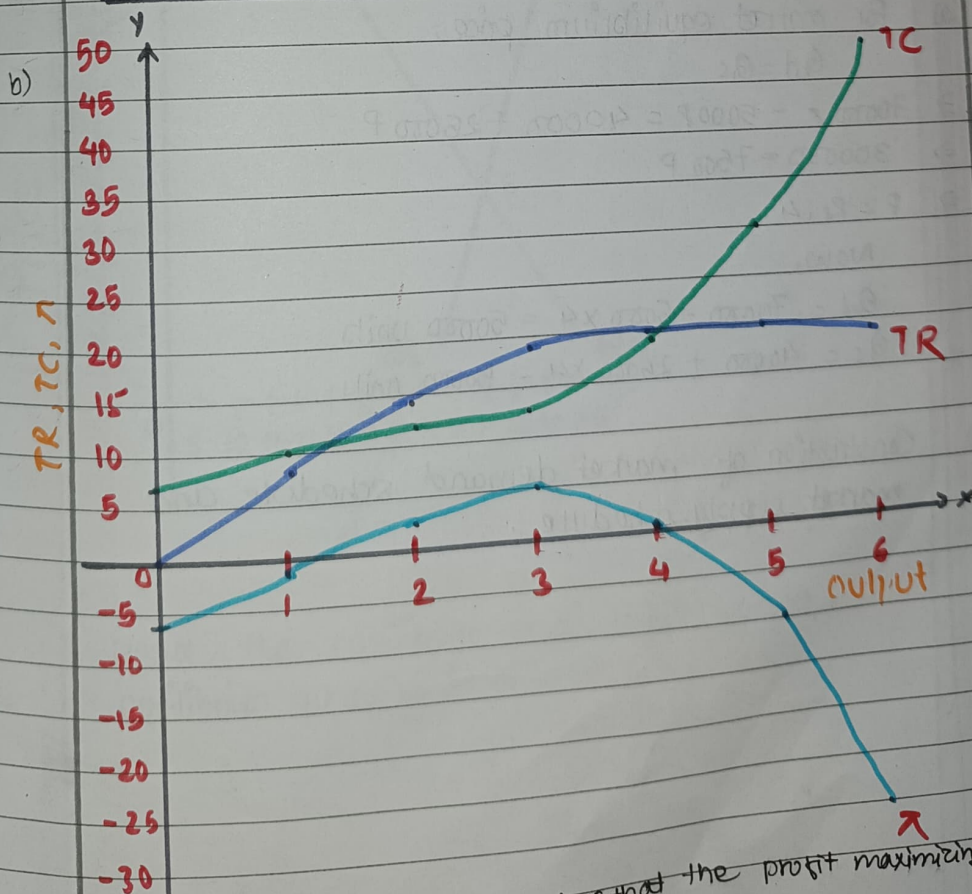
TR

Output

3. You are given the following revenue and cost schedule.

- Find the profit at each level of output.
- Plot TR, TC and profit in a figure.
- What is the profit maximizing level of output?

Quantity (Q)	Price (P)	TR	TC	$\pi = TR - TC$
0	9	0	6	-6
1	8	8	10	-2
2	7	14	12	2
3	6	18	13	5
4	5	20	19	1
5	4	20	30	-10
6	3	18	48	-30



c) Hence, from the figure, it is clear that the profit maximizing output is 3 units.

5. Suppose that the market demand in a perfectly competitive industry is given by:
 $Q_d = 70000 - 5000P$ and market supply function is $Q_s = 40000 + 2500P$. Find.

- the market equilibrium price.
- the market demand schedule and market supply schedule for price from \$1 to \$9.
- Draw the market demand curve and market supply curve to show equilibrium price and quantity.

Solution

$$Q_d = 70000 - 5000P$$

$$Q_s = 40000 + 2500P$$

- For market equilibrium price,

$$Q_d = Q_s$$

$$\Rightarrow 70000 - 5000P = 40000 + 2500P$$

$$\Rightarrow 30000 = 7500P$$

$$\Rightarrow P = \text{Rs. } 4$$

Now,

$$Q_d = 70000 - 5000 \times 4 = 50000 \text{ units}$$

$$Q_s = 40000 + 2500 \times 4 = 50000 \text{ units}$$

- Construction of market demand schedule and market supply schedule.

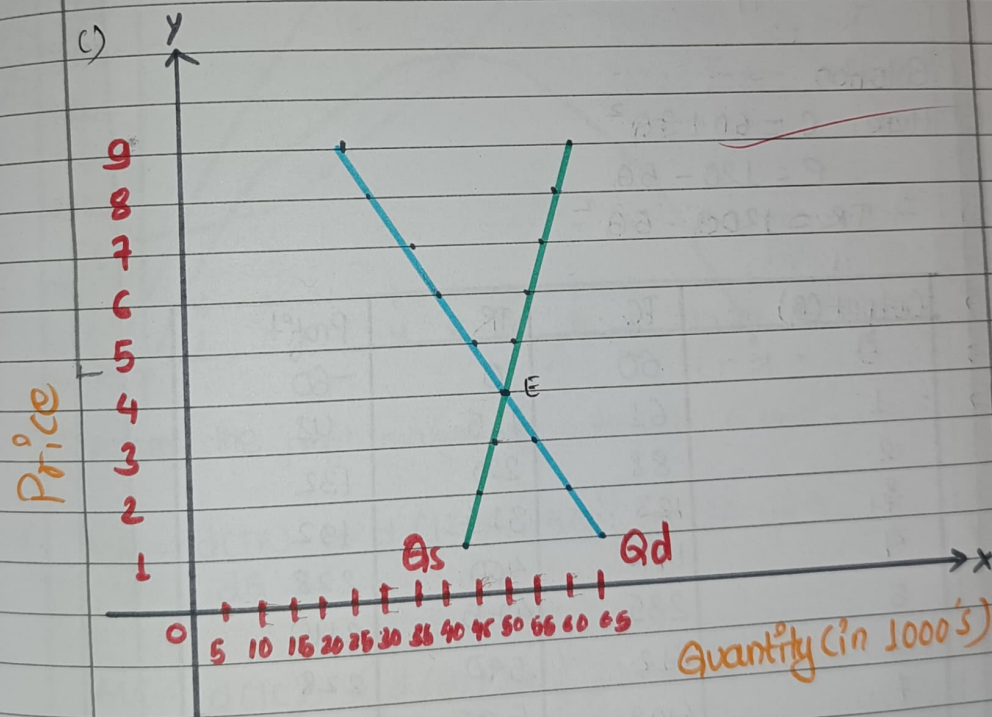
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Price (₹)	Q _d	Q _s
1	65000	42500
2	60000	45000
3	55000	47500
4	50000	50000
5	45000	52500
6	40000	55000
7	35000	57500
8	30000	60000
9	25000	62500



Hence, the equilibrium price is 50000 and equilibrium quantity is 40 units.

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c) Suppose the cost and demand functions of coffee are:

$$C = 60 + 7Q^2 \text{ and } P = 120 - 5Q$$

- Compute TR, TC and profit upto output level 10 units.
- Graphically, find out the profit and profit maximizing output.
- Compute MR, MC and plot them for output level 10 units.
- Show the equilibrium of firm in graph using marginal approach.

Solution

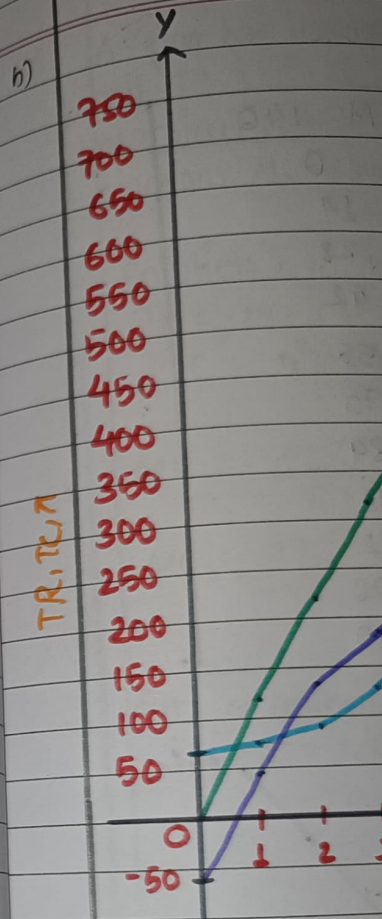
$$\text{Here, } C = 60 + 7Q^2$$

$$P = 120 - 5Q$$

$$TR = 120Q - 5Q^2$$

a)

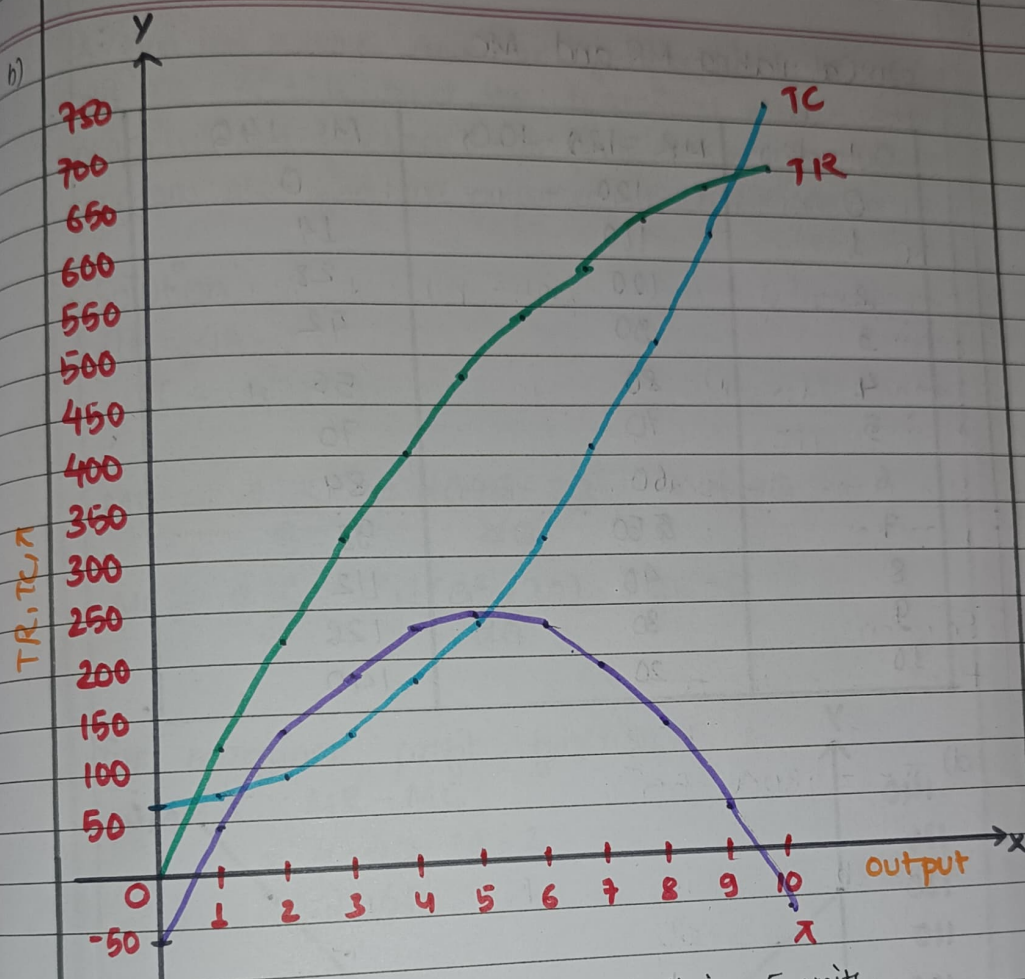
Output (Q)	TC	TR	Profit
0	60	0	-60
1	67	115	48
2	88	220	132
3	123	315	192
4	172	400	228
5	235	475	240
6	312	540	228
7	403	595	192
8	508	640	132
9	627	675	48
10	760	700	-60



Hence, the profit

$$MR = \frac{d(TR)}{dQ}$$

$$MC = \frac{d(TC)}{dQ}$$



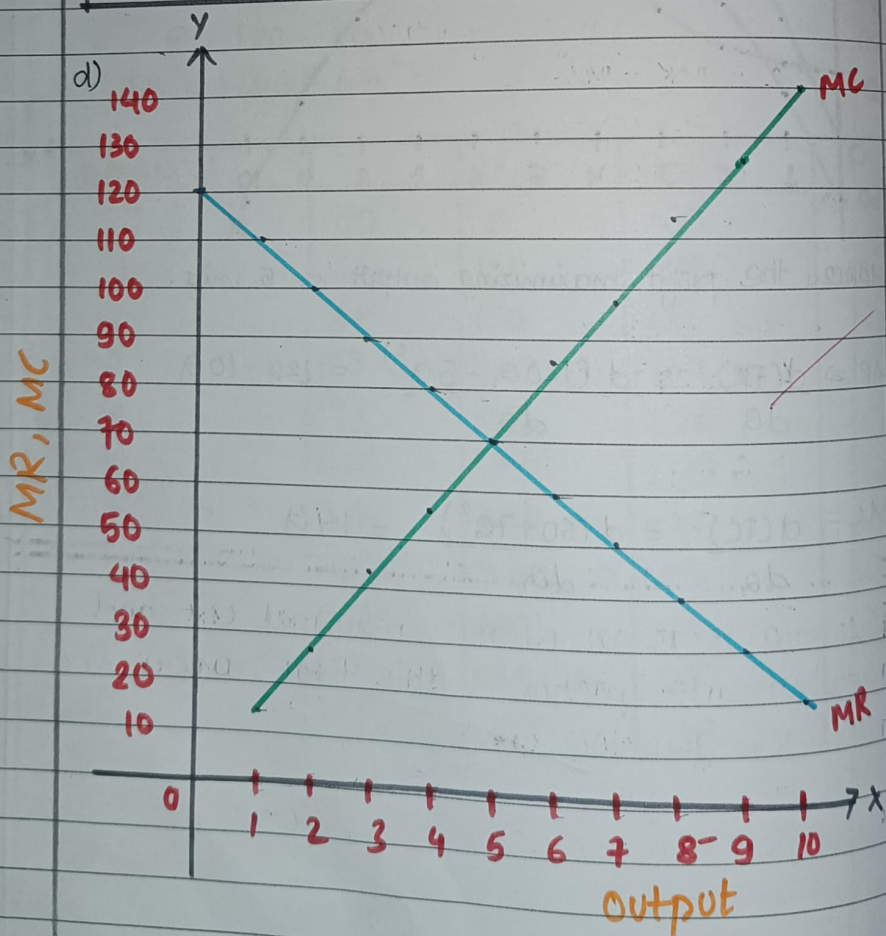
Hence, the profit maximizing output is 5 units.

$$MR = \frac{d(TR)}{dQ} = \frac{d(120Q - 5Q^2)}{dQ} = 120 - 10Q$$

$$MC = \frac{d(TC)}{dQ} = \frac{d(60 + 7Q^2)}{dQ} = 14Q$$

c) Calculating MR and MC

Output	MR = 120 - 10Q	MC = 14Q
0	120	0
1	110	14
2	100	28
3	90	42
4	80	56
5	70	70
6	60	84
7	50	98
8	40	112
9	30	126
10	20	140



7) A firm has revenue and $TC = Q^2 + 2Q$ marginal cost function. Also find

Solution

$$TR = 4Q - 2Q^2$$

$$TC = Q^2 + 2Q$$

$$MR = \frac{dTR}{dQ}$$

$$MC = \frac{dTC}{dQ}$$

For marginal

$$M\pi = MR$$

$$= 4 - 4Q$$

$$= 2 - 2Q$$

When $MR =$

$$4 - 4Q =$$

$$\Rightarrow 4 - 2 = 2Q$$

$$\therefore Q = 1$$

8) Find the marginal profit total cost

$$TR = 100Q - 2Q^2$$

14Q

- 7) A firm has revenue and cost functions as: $TR = 4Q - 2Q^2$ and $TC = Q^2 + 2Q$. Find the marginal revenue and marginal cost functions. Also, find the marginal profit function. Also find the output at which $MR = MC$.

Solution

$$TR = 4Q - 2Q^2$$

$$TC = Q^2 + 2Q$$

$$MR = \frac{dTR}{dQ} = \frac{d(4Q - 2Q^2)}{dQ} = 4 - 4Q$$

$$MC = \frac{dTC}{dQ} = \frac{d(Q^2 + 2Q)}{dQ} = 2Q + 2$$

For marginal profit function,

$$M\pi = MR - MC$$

$$= 4 - 4Q - 2Q - 2$$

$$= 2 - 6Q$$

When $MR = MC$,

$$4 - 4Q = 2Q + 2$$

$$\Rightarrow 4 - 2 = 2Q + 4Q$$

$$\therefore Q = \frac{1}{3}$$

- 8) Find the marginal revenue, marginal cost and marginal profit function if the total revenue and total cost function are:

$$TR = 100Q - 20Q^2 \text{ and } TC = 60Q - 10Q^2$$

Solution

$$MR = \frac{dTR}{dQ} = \frac{d(100Q - 20Q^2)}{dQ} = 100 - 40Q$$

$$MC = \frac{dTC}{dQ} = \frac{d(60Q - 10Q^2)}{dQ} = 60 - 20Q$$

$$MA = MR - MC$$

$$= 100 - 40Q - 60 + 20Q$$

$$= 40 - 20Q$$

10) You are given the following revenue and cost function:

$$TR = 100Q - 2Q^2 \text{ and } TC = 15 + 0.5Q + 0.4Q^2$$

a) The marginal revenue and marginal cost function.

b) Output at which $MR = MC$

c) Amount of profit.

Solution

$$a) MR = \frac{dTR}{dQ} = \frac{d(100Q - 2Q^2)}{dQ} = 100 - 4Q$$

$$MC = \frac{d\pi}{dQ} = \frac{d(15 + 0.5Q + 0.4Q^2)}{dQ} = 0.5 + 0.8Q$$

b) For $MR = MC$,

$$100 - 4Q = 0.5 + 0.8Q$$

$$\Rightarrow 100 - 0.5 = 0.8Q + 4.8Q$$

$$\Rightarrow Q = \frac{99.5}{4.8}$$

$$\therefore Q = 20.72$$

c) At 20.7

$$\pi = 100 \times 20.7 - 2 \times 20.7^2 - 15 - 0.5 \times 20.7 - 0.4 \times 20.7^2$$

$$= 1016.28$$

- 4) A perfectly competitive firm has the following total cost function. How much will firm produce if the product in the market is Rs 16 per unit?

Total output	Total cost (TC)	Marginal cost (MC)
0	20	—
1	30	10
2	42	12
3	55	13
4	69	14
5	84	15
6	100	16
7	117	17

Firm's equilibrium is given by,

$$MR = MC$$

$$\Rightarrow P = MC \quad [\because P = AR = MR \text{ under perfect competition}]$$

$$\Rightarrow 16 = 16$$

$$\text{at output} = 6$$

Hence, the firm will produce 6 units.