Monopoly Numerical :

A firm faces the following average revenue (demand) curve

$$P = 120 - 0.02Q$$

$$MR = 120 - 0.04Q$$

where Q = weekly production and P is price per unit.
The firm's cost function is given by $C = 60Q + 25{,}000$.
Assume that the firm maximises profit.
What is the level of the production, price and total profit per week?

Solution: We are given, $AR = P = (120 - 0.02Q)$

We know $AR = TR/Q$

$\therefore TR = AR \times Q$

$TR = (120 - 0.02Q) \times Q$

$$\boxed{TR = 120Q - 0.02Q^2}$$

$$\boxed{MR = 120 - 0.04Q}$$

$$\boxed{TC = 60Q + 25000}$$

$$\rightarrow MC = \frac{\Delta TC}{\Delta Q} = 60\frac{\cancel{\Delta Q}}{\cancel{\Delta Q}} + 0$$

$$\boxed{MC = 60}$$

We have to find out
(i) Q that maximises π
(ii) (P) at this point
(iii) total profit π

(i) Profit maximisation requires, $\boxed{MR = MC}$

$$120 - 0.04Q = 60$$

$$\Rightarrow 0.04Q = 120 - 60$$

$$\Rightarrow Q = \underline{60}$$

$\Rightarrow 0.04Q = \ldots$

$\Rightarrow Q = \frac{60}{0.04}$

$\Rightarrow Q = \frac{60 \times \cancel{100}^{25}}{\cancel{4}}$

$\Rightarrow Q = 60 \times 25$

$\boxed{Q = 1500 \text{ units}}$

∴ Monopolist will produce $Q = 1500$ units to maximise profit and charge, $P = 120 - 0.02Q$

$P = 120 - 0.02 \times 1500$

$= 120 - 30.00$

$= 120 - 30$

$\boxed{P = ₹90}$

∴ Total profit of monopolist, $\pi = TR - TC$

$\pi = P \times Q - (60Q + 25{,}000)$

$\pi = (90 \times 1500) - (60 \times 1500 + 25{,}000)$

$= 135000 - (90000 + 25000)$

$= 135000 - 34000$

$\boxed{\text{Profit } \pi = ₹\ 1{,}01{,}000}$

$\begin{array}{r} 135000 \\ -34000 \\ \hline 101000 \end{array}$

REVISION: THEORY OF COST:

1. Accounting cost → actual cost plus depreciation cost of capital

2. Opportunity cost → cost associated with opportunities forgone when a firm's resources are not used at its best alternative.

3. Economic cost → cost of using economic resources in production.

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4. Sunk cost → expenditure that has been made and cannot be recovered.

Seven important cost curves in short-run:

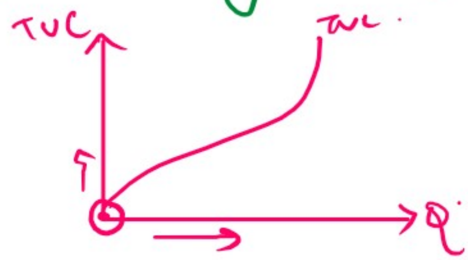
① Total variable cost (TVC) → cost that varies with output.

that is if output (Q) = 0 then TVC = 0

if output increases ⇒ TVC also increases

If output decreases ⇒ TVC also decreases.

→ it is upward sloping through the origin.



② Total fixed cost (TFC)

→ this cost doesnot vary with output.

It is fixed.

∴ TFC is horizontal.

③ Total cost of production (TC) → total cost incurred by the firm during production process.

ie it is the sum of TVC and TFC.

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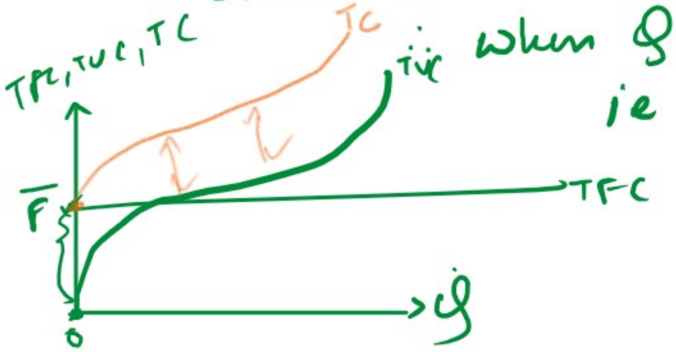
$\boxed{TC = TVC + TFC}$

Since TFC is ≠ 0 even when $Q = 0$

when $Q = 0 \Rightarrow TC \neq 0$

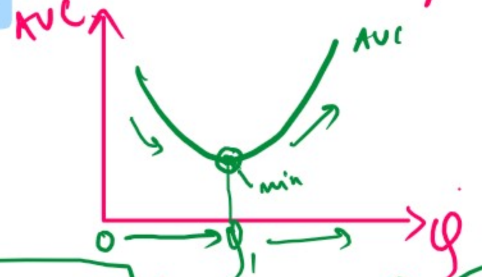
ie $Q = 0 \Rightarrow TC = 0 + TFC$

$\boxed{TC = TFC}$, as shown in diagram



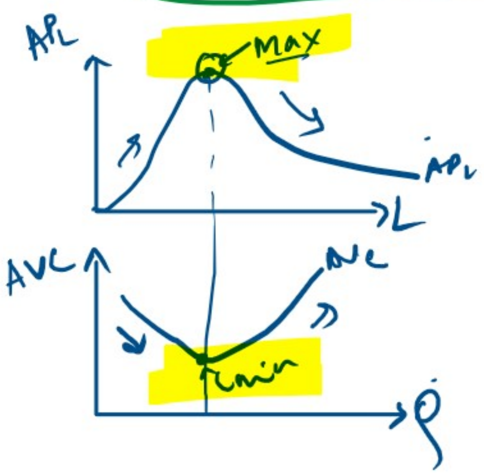
(4) Average variable cost $(AVC) = \frac{TVC}{Q}$ (variable cost per unit of production)

AVC is U-shaped $\Rightarrow$ with increase in production 'Q' $\Rightarrow$ AVC first decreases then reaches min and then increases. as shown in diagram.



Note: AVC is the mirror/reflection of AP_L $\rightarrow$ Avg productivity of Labour

$AP_L = Q/L$ $\rightarrow$ inverted-U-shape



L ← variable ← w

$AVC = \frac{TVC}{Q} = \frac{w \times L}{Q}$

$AVC = \frac{w}{Q/L} \Rightarrow AVC = \frac{w}{AP_L}$

w is const

$\therefore$ $\boxed{AVC \propto 1/AP_L}$ (inverse relation).

(5) Average fixed cost (AFC)

(TFC) (Tot fixed cost)

$\therefore$ $AVC = \frac{1}{APL}$ (inverse relation).

(5) Average fixed cost (AFC)

$$\downarrow AFC = \frac{TFC}{Q \uparrow}\downarrow$$ (Tot fixed cost per unit of output)

as Q increases and TFC is always const, so the per unit fixed cost decreases.

and AFC is a ==rectangular hyperbola.==

(6) Average cost (AC) = $\frac{TC}{Q}$ (total cost per unit of Q).

$$\therefore AC = \frac{(TVC + TFC)}{Q} = \frac{TVC}{Q} + \frac{TFC}{Q}$$

$$\boxed{AC = AVC + AFC}$$

AC: U-shaped. AVC: ↓ U-shape. AFC: ↓ →

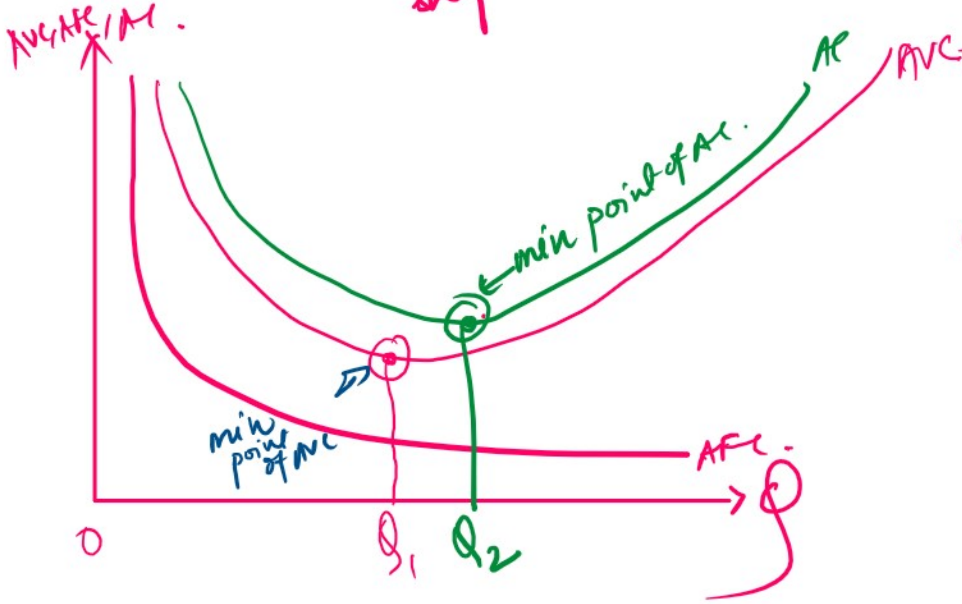
AC is a U-shaped curve.

initially with ↑se in Q both AVC and AFC is falling ⇒ AC is falling

at a particular output Q_1 ⇒ AVC is min & AFC is falling ⇒ AC continues to fall

at further Q_2 ⇒ AC reaches min after AVC.

after Q_2 ⇒ further increase in AVC & decrease in AFC ⇒ AC is increasing



(7) Marginal Cost (MC) = $\frac{\text{change in TC}}{\text{change in Q}}$

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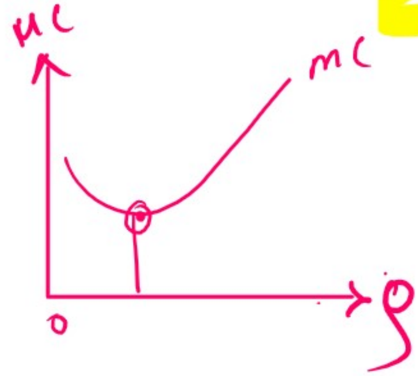
$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta(TVC + TFC)}{\Delta Q} = \frac{\Delta TVC}{\Delta Q} + \overset{0}{\frac{\Delta TFC}{\Delta Q}}$$

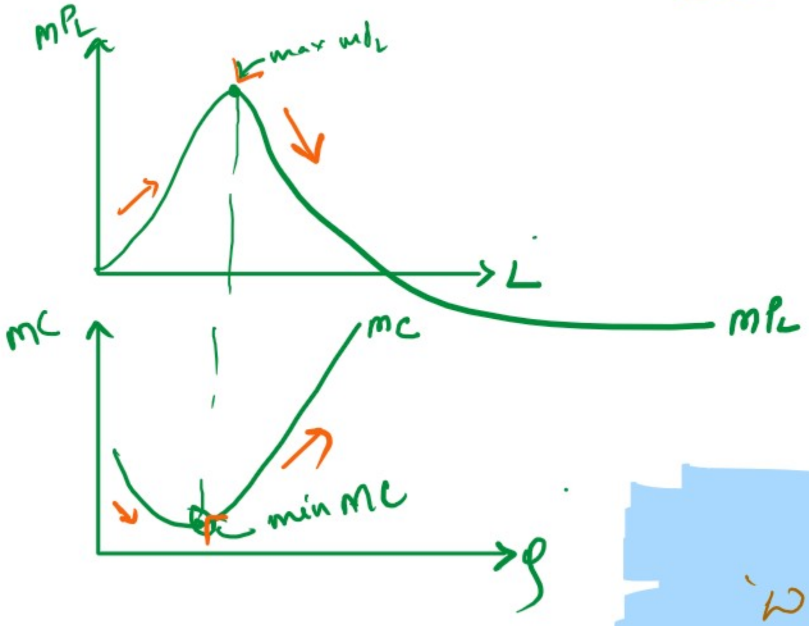


$$\therefore \boxed{MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q}}$$

meaning is that → change in TC is only due to change in TVC.
TFC do not effect the change.

⇒ **MC curve is U-shaped.**

MC is the reflection of MP_L (marginal product) = $\frac{\Delta Q}{\Delta L}$.



$MC = \frac{\Delta TC}{\Delta Q}$

$MC = \frac{\Delta TVC}{\Delta Q}$ } $TVC = w \times L$

$MC = \frac{\Delta(wL)}{\Delta Q} = w\frac{\Delta L}{\Delta Q}$

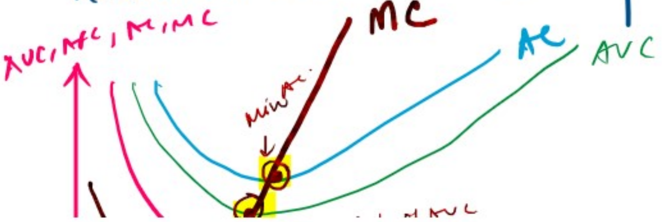
$mc = \frac{w}{\Delta Q/\Delta L}$

$\therefore MC = \frac{w}{MP_L}$

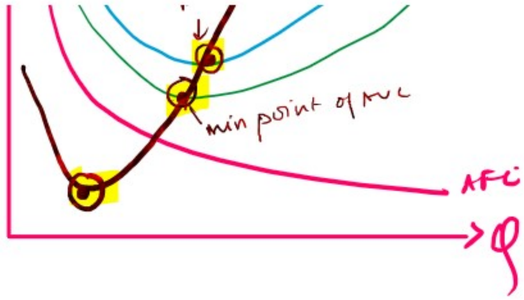
'w' is const → $mc \propto 1/MP_L$.

∴ There is inverse relation between mc and MP_L

Relation between Average Cost Curve and Marginal cost curves:



1. when AC/AVC are falling
→ mc is below.



1. When AC/AVC falling

⇒ MC is below.

ie $MC < AC/AVC$.

2. When AC/AVC at minimum

⇒ MC cuts AC/AVC

ie $MC = AVC$ & $MC = AC$

3. When AC/AVC rising.

⇒ MC is above AC/AVC

ie $MC > AVC/AC$.