example

$$Q = 2000 - 20P \Rightarrow P = \frac{-Q + 2000}{20}$$

$$C(Q) = 0.05Q^2 + 10000$$

$$MC = 0.1Q$$

$$TR = P \cdot Q$$

$$= \frac{Q - 2000}{20} \times Q$$

$$TR = \frac{-Q^2 + 2000Q}{20}$$

$$MR = \frac{-2Q + 2000}{20}$$

$$\boxed{MR = -\frac{Q}{10} + 100}$$

So at Equilibrium

$$MR = MC$$

$$\frac{Q}{10} - 100 = 0.1Q$$

$$-\frac{Q}{10} - 100 = \frac{Q}{10}$$

$$\frac{2Q}{10} = 100$$

$$\boxed{Q^* = 500}$$

and

$$P = \frac{-500 + 2000}{20}$$

$$P = \frac{1500}{20}$$

$$\boxed{P^* = 75}$$

Profit = TR − TC

$$= PQ - CQ$$

$$(P - AC)Q$$

$$= 75 - (0.05(500))$$

$$= 15{,}000.$$

mark up

$$= P - MC$$

$$= 75 - 0.1 \times 500$$

$$\boxed{\text{Markup} = 25}.$$

Profits

$$(P - AC)Q$$

$$PQ - (AC)Q$$

$$= PQ - \left(\frac{TC}{Q}\right)Q$$

$$= \boxed{TR - TC}$$

[P and AC − Profit
P and MC − Power (Mark up) strength analysis]

P = MC = zero strength
hence Perfect Comp. mkt

linear demand function (case)

$P = a - bQ$

$C(Q) = cQ$

$TR = P \cdot Q$

$= (a - bQ)Q$

$TR = aQ - bQ^2$

$\boxed{MR = a - 2bQ}$

$MC = c$

at $\boxed{MR = MC}$ – eqm

$a - 2bQ = c$

$-2bQ = c - a$

$\boxed{Q^* = \frac{a-c}{2b}}$

$P = a - \cancel{b}\left[\frac{a-c}{2\cancel{b}}\right]$

$P = \frac{2a - a + c}{2}$

$\boxed{P^* = \frac{a+c}{2}}$

and $AC = \frac{cQ}{Q}$

$\boxed{AC = c}$

for a linear demand function.

* Constant MC implies that we are having linear cost function $(AC = MC)$

So cost function cQ

not $C(Q) = \bar{c} + cQ$

$AC = \frac{\bar{c}}{Q} + c$ — so not equal to c (MC)

So cost function is cQ → fixed cost is zero.

* $MC = AVC \neq AC$ — fixed cost exist with cost function is linear

Constant elasticity demand function

$Q = a P^e$

$C(Q) = c Q$

(1) elasticity ?

$\eta = \left(\frac{dQ}{dP}\right) \frac{P}{Q}$

$\eta = e \cancel{a} P^{e-1} \times \frac{P}{\cancel{a} P^e}$

$\boxed{\eta = e}$

(2) P^*, Q^* - ?

$MC = c$

$Q = a P^e$

$\frac{Q}{a} = P^e$

$\sqrt[e]{\frac{Q}{a}} = P \Rightarrow \left(\frac{Q}{a}\right)^{1/e}$

$TR = P.Q$

$= \cancel{\sqrt[e]{\frac{Q}{a}} \cdot Q} \left(\frac{Q}{a}\right)^{1/e} . Q$

$TR = \left(Q^{1/e+1}\right) \frac{1}{a^{1/e}}$

$MR = \frac{\frac{1}{e}+1 \left(Q^{1/e}\right)}{a^{1/e}}$

$\frac{\frac{1}{e}+1 \left[Q^{1/e}\right]}{a^{1/e}} = c$

$Q^{1/e} = \frac{c \cdot a^{1/e}}{\left(\frac{1}{e}+1\right)}$

$Q^{1/e} = \frac{e(c \cdot a^{1/e})}{(1+e)}$

$\boxed{Q^* = \left[\frac{e(c a^{1/e})}{1+e}\right]^e}$

$P = \left(\frac{\left[\frac{e(c.a^{1/e})}{1+e}\right]^e}{a}\right)^{1/e}$

$P = \frac{\frac{e(c \cdot a^{1/e})}{1+e}}{a^{1/e}}$

$P = \frac{e\, c(a^{1/e})}{(1+e)\, a^{1/e}}$

$\boxed{P^* = \frac{e\, c}{(1+e)}}$

for Monopoly firm we know, ①

$$MR = MC \quad \text{or} \quad MR = AR\left(1+\frac{1}{e}\right)$$

$$MR = P\left(1+\frac{1}{e}\right)$$

at profit maximisation condition

$$c = P\left(1+\frac{1}{e}\right)$$

$$c = P\left(\frac{e+1}{e}\right)$$

$$c \cdot e = P(e+1)$$

$$\boxed{P = \frac{e \cdot c}{(1+e)}}$$

$$\frac{dP}{dc} = \left(\frac{e}{1+e}\right)$$

ote)
for $e < -1$ is the case for profit maximisation (elastic sagment)
Because as inelasticity sagment MR goes negative

① $e = -2$

$$P = \frac{-2c}{(1-2)}$$

$$\boxed{P = 2c}$$

② $e = -1.5$

$$P = \frac{-1.5 \cdot c}{(1-1.5)}$$

$$P = \frac{+1.5}{+0.5} c$$

$$\boxed{P = 3c}$$

as elasticity increases towards −1, then divergence b/w P and MC is increasing? with elasticity ↑ing

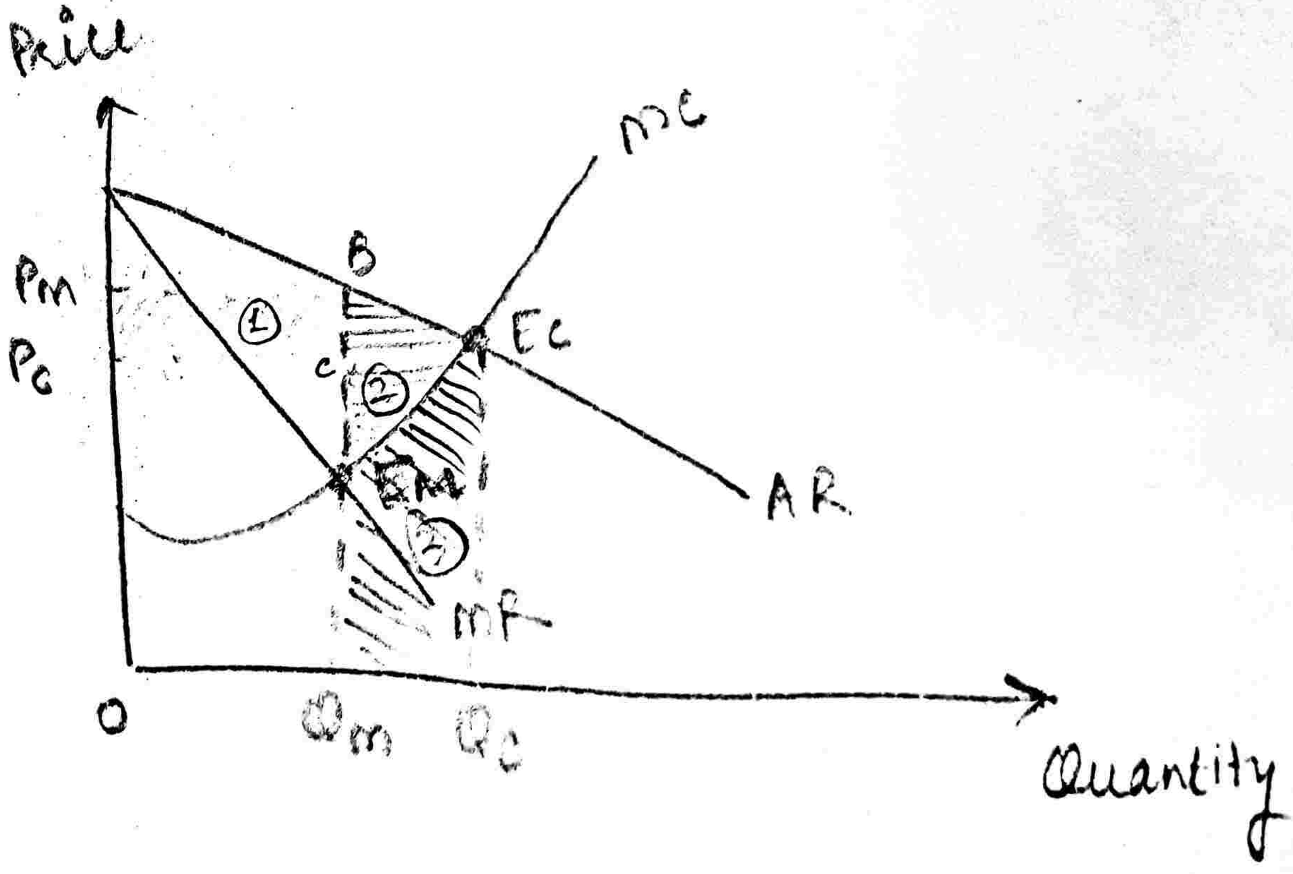
* $\boxed{e = -1}$

$P = \frac{-1C}{0}$

$\boxed{P = \infty}$

Monopoly and resource allocation

under Monopoly MR = MC < P, in this senerio market price doesnot convey accurate information abt cost of prodn, Hence consumers decision will no longer reflect true appourtunity cost of prodn and Resources will be misallocated



(3)

region 1

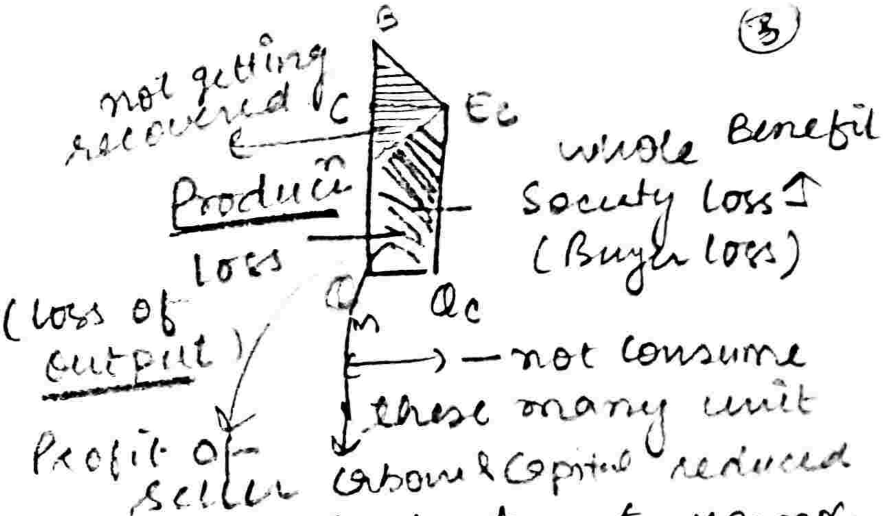
$P_M B C P_C$

region 2

$B E_c E_m$

region 3

$E_m E_c Q_c Q_m$



if the shift from competitive industry to monopoly then there is change in welfare

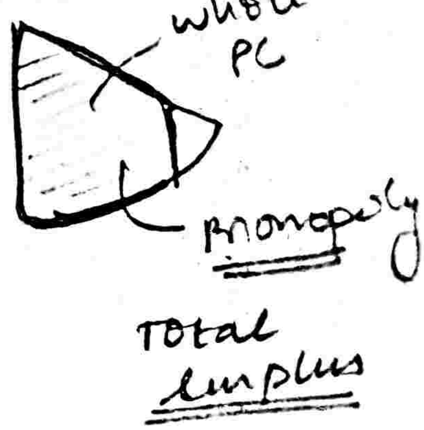
1) Consumer surplus reduces by region 1

2) Region 3 reflects value of inputs reallocated to production of other goods

3) Region 2 represents Dead weight loss, it has two components

(1) ΔBCE_c (loss in consumer surplus)

(2) ΔCE_cE_m (loss in producer surplus)



in example (1) P^* is 75 and cost is 50.

if a Buyer has willingness to pay which is equal to 60, then he will not able to Buy a good.

Here, willingness to pay is greater than MC hence transaction must takes place.
But due to Monopoly such transactions are prevented hence Monopoly Eq^m is not Pareto ~~equili~~ optimum. (Becaus of ω [P > MC)

Example
welfare loss and elasticity

$Q = P^e$. (Constant elasticity demand fn) Pr

$MC = AC = C$

1) Competitive Price expression
2) Monopoly " "

Equilibrium under Perfect competition

$P = MC$

$(Q)^{1/e} = C$

$\boxed{Q_c = C^e}$

Equilibrium under monopoly market

$MR = MC$

$TR = P \cdot Q$

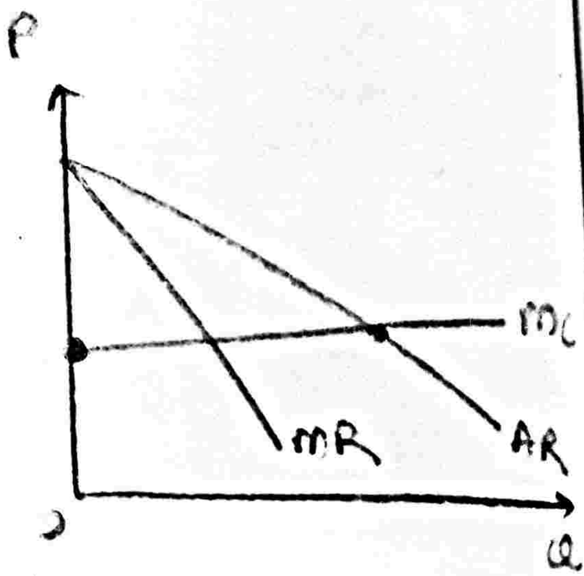
$= (Q)^{1/e} \cdot Q$

$TR = (Q)^{\frac{1+e}{e}}$

$MR = \frac{1+e}{e} Q^{\frac{1+e-e}{e}}$

$MR = \frac{1+e}{e} Q^{1/e}$

$MR = MC$



for Competitive market
→ Producer Surplus is zero (Profit of Producer is zero)
$P = MC$

in Perfect comp. in Short Terms - Profits - in long run zero profit or
SR - zero profit → LR " zero p.

$$\frac{1+e}{e} Q^{1/e} = c$$

$$Q^{1/e} = \frac{c \cdot e}{1+e}$$

$$\boxed{Q_M = \left(\frac{e \cdot c}{1+e}\right)^e}$$

$$P = Q^{1/e}$$

$$P_M = \left[\left(\frac{e \cdot c}{1+e}\right)^e\right]^{1/e}$$

$$\boxed{P_M = \frac{e \cdot c}{1+e}}$$

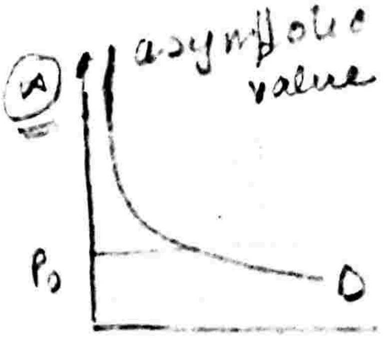
$$P_c = (c^e)^{1/e}$$

$$\boxed{P_c = c}$$

consumer surplus expression

consumer surplus at P_0 (general)

$$CS = \int_{P_0}^{\infty} Q(P) \cdot dP$$



$$= \int_{P_0}^{\infty} P^e \, dP$$

$$\boxed{CS = \left[\frac{P^{e+1}}{e+1}\right]_{P_0}^{\infty}}$$

$$CS = \left[\underbrace{\frac{\infty^{e+1}}{e+1}}_{0} - \frac{P_0^{e+1}}{e+1}\right]$$

— as price increase q approches to zero

$$\boxed{CS = -\left(\frac{P_0^{e+1}}{e+1}\right)}$$

Consumer surplus in Perfect comp. market

$P_0 = P_C = C$ $\quad\quad CS = -\left[\frac{P_C^{e+1}}{e+1}\right]$

$$\boxed{CS = -\left[\frac{c^{e+1}}{e+1}\right]}$$

consumer Surplus in monopoly.

$P_0 = P_M = \frac{e \cdot c}{1+e}$

$$\boxed{CS = -\left[\frac{\left[\frac{e \cdot c}{1+e}\right]^{e+1}}{e+1}\right]}$$

* depending upon elasticity the CS is depending, Because monopoly produces in region where $e<-1$ (elastic demand) then the (−) sign is offsetted.

Ratio of CSM to CS_c

$$\frac{CSM}{CS_{PC}} = \frac{\left(\frac{ec}{1+e}\right)^{e+1} / (1+e)}{\frac{c^{e+1}}{(e+1)}}$$

$$= \frac{\left(\frac{ec}{1+e}\right)^{e+1} \times \cancel{(e+1)}}{\cancel{(1+e)} \cdot c^{e+1}}$$

$$\frac{CSM}{CS_{PC}} = \left[\frac{\frac{ec}{1+e}}{c}\right]^{e+1} = \left(\frac{e}{1+e}\right)^{e+1}$$

Expected sign of the $\frac{CS_m}{CS_{PC}}$.

(less than 1)

Because $CS_M < CS_C$

consider $e = -2$

$$\frac{CS_m}{CS_c} = \left(\frac{-2}{1-2}\right)^{-2+1}$$

$$= \left(\frac{-2}{-1}\right)^{-1}$$

$$\frac{CS_m}{CS_c} = \frac{1}{2} = 0.5$$

$e = -1.5$

$$\left(\frac{-1.5}{1-1.5}\right)^{-1.5+1}$$

$$= \left(\frac{-1.5}{-0.5}\right)^{-0.5}$$

$$\frac{CS_m}{CS_c} = \left(\frac{1}{3}\right)^{0.5} = 0.57$$

as elasticity approachs -1 the ratio increases.

Monopoly Profit

$\boxed{AC = MC = c}$

$$\text{monopoly profit} = TR - TC$$

$$= P_m Q_m - c\,Q_m$$

$$= \left(\frac{ec}{1+e}\right) Q_m - c\,Q_m$$

$$= \left(\frac{ec}{1+e} - c\right) Q_m$$

$$= \left(\frac{ec - c - ec}{1+e}\right) Q_m$$

$$= \left(\frac{-c}{1+e}\right) Q_m$$

$$= \left(\frac{-c}{1+e}\right) P_m^{e}$$ – according to demand function

$$= \left(\frac{-c}{1+e}\right)\left(\frac{ec}{1+e}\right)^{e} = -\left(\frac{c}{1+e}\right)^{e+1} \cdot e^{e}$$

$$\frac{\text{Profit of Monopoly}}{\text{Competitive mkt Consumer Surplus}} = \frac{-\left(\frac{c}{1+e}\right)^{1+e} \times e^{e}}{-\left(\frac{c^{e+1}}{e+1}\right)}$$

$$= \frac{\frac{c^{e+1}}{(1+e)^{1+e}} \times e^{e}}{\left(\frac{c^{e+1}}{e+1}\right)}$$

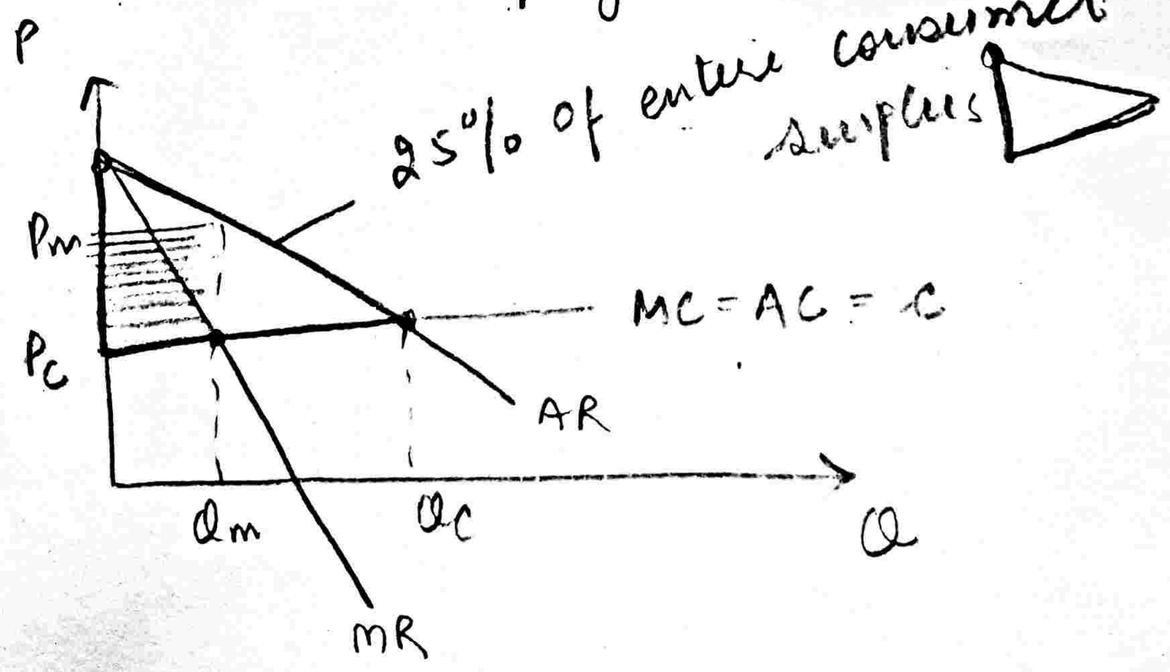
$$= \frac{e^{e}(e+1)}{(1+e)^{1+e}}$$

$$\frac{\pi_m}{CS_c} = \frac{e^{e}}{(1+e)^{e}} = \left(\frac{e}{1+e}\right)^{e}$$

so $\boxed{\frac{\pi_m}{CS_c} = \left(\frac{e}{1+e}\right)^{e}}$

$e = -2$

$\boxed{\frac{\pi_m}{CS_c} = \frac{1}{4}}$ i.e $1/4^{th}$ of consumer surplus enjoyed under Perfect Comp. is transfers to Monopoly profit.



(2) $e = -1.5$

$$\frac{\pi_m}{CS_c} = \left(\frac{-1.5}{1-1.5}\right)^{-1.5}$$

$$= \left(\frac{1.5}{0.5}\right)^{-1.5}$$

$$= \left(\frac{1}{3}\right)^{1.5}$$

$$= (0.33)^{1.5}$$

$$\boxed{\frac{\pi_m}{CS_s} = 0.1924}$$

$$\boxed{e \uparrow \Rightarrow \frac{\pi_m}{CS_c} \downarrow}$$