4. A firm faces the following average revenue (demand) curve:

$$P = 120 - 0.02Q$$

where Q is weekly production and P is price, measured in cents per unit. The firm's cost function is given by $C = 60Q + 25{,}000$. Assume that the firm maximizes profits.

a. What is the level of production, price, and total profit per week?

b. If the government decides to levy a tax of 14 cents per unit on this product, what will be the new level of production, price, and profit?

(a) AR = $P = 120 - 0.02Q$

$TR = P \cdot Q = 120Q - 0.02Q^2$

$\Rightarrow MR = \frac{dTR}{dQ} = 120 - 0.04Q$

$TC = 60Q + 25{,}000$

$MC = \frac{dTC}{dQ} = 60$

Equilibrium in Monopoly,

$MR = MC$

$120 - 0.04Q = 60$

$\Rightarrow 60 = 0.04Q$

$\Rightarrow Q = 60/0.04 = 1500$ units

$AR = P = 120 - 0.02Q$

$P = 120 - 0.02(1500) = 90$ cents

Profit of the monopolist, $\pi = TR - TC$

$\pi = (1500 \times 90) - (60 \times 90 + 25000)$

$\pi = 200$ cents

(b) After tax 'T' per unit output.

$TR = PQ - TQ$

$P = 120 - 0.02Q$

$TR = 120Q - 0.02Q^2$

After tax:

$TR = 120Q - 0.02Q^2 - 14Q$

$MR = 120 - 0.04Q - 14$

$MR = 106 - 0.04Q$

$MC = 60$

In eqm'l: $MR = MC$

$\Rightarrow 106 - 0.04Q = 60$

$\Rightarrow 106 - 60 = 0.04Q$

$\Rightarrow Q = \frac{46}{0.04} = 1150$ units

$AR = P = 120 - 0.02Q$

$P = 120 - 0.02(1150)$

$P = 83$ cents

Profit of monopolist after tax,

$\pi = TR - TC$

$= (83 \times 1150) - [(60 \times 83) + 25000]$

$=$ Ans

Q The following table shows the demand curve facing a monopolist who produces at a constant marginal cost of $10.

MC = $10

Price	Quantity
18	0
16	4
14	8
12	12
10	16
8	20
6	24
4	28
2	32

$\Delta P = -2$, $\Delta Q = 4$

$b = \frac{\Delta P}{\Delta Q} = \frac{-2}{4} = -1/2$

Linear demand fn

$P = a - bQ$

$P = 18 - 1/2Q$

8	20
6	24
4	28
2	32
0	36

$P = 18 - \frac{1}{2}Q$ → AR

a. Calculate the firm's marginal revenue curve.

b. What are the firm's profit-maximizing output and price? What is its profit? (monopoly) (MR = MC)

c. What would the equilibrium price and quantity be in a competitive industry? ⇒ PC [P = MC]

d. What would the social gain be if this monopolist were forced to produce and price at the competitive equilibrium? Who would gain and lose as a result?

(c) $AR = P = 18 - \frac{1}{2}Q$

$\therefore TR = P \cdot Q = 18Q - \frac{1}{2}Q^2$

$MR = \frac{dTR}{dQ} = 18 - Q$

(b)

In equilibrium of Monopoly market:

$MR = MC$

$18 - Q = 10$

$\therefore Q = 18 - 10$

$Q^m = 8$ units

$\therefore AR: P = 18 - \frac{Q}{2} = 18 - \frac{8}{2} = 18 - 4 = \$14$ ← monopolist's price.

Since, $MC = \$10$

$\therefore TC = 10Q$

$\therefore$ Profit of a monopolist,

$\Pi = TR - TC$

$= P \cdot Q - TC$ [$\because TC = 10Q$]

$= (14 \times 8) - (10 \times 8)$

$\Pi = 112 - 80$

$\Pi = \$32$ ← monopolist's profit.

(c) In a competitive market,

in equi: $P = MC$

$$18 - \frac{Q}{2} = 10$$

$$\Rightarrow 18 - 10 = \frac{Q}{2}$$

$$\Rightarrow 8 \times 2 = Q$$

$$\Rightarrow \boxed{Q^c = 16 \text{ units}}$$

$$\therefore P = 18 - \frac{Q}{2} = 18 - \frac{16}{2} = 18 - 8 = 10$$

$$\therefore \boxed{P^c = \$10}$$

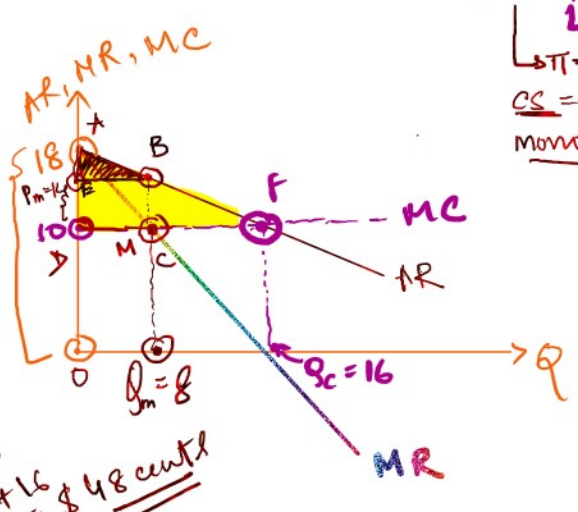
(d) Social cost of Monopoly

⇒ (Dead-weight Loss to society)

$AR = 18 - Q/2$

$MR = 18 - Q$

$MC = \$10$ (constant)



Monopolist

↳ MR = MC

↳ $\Pi = 32$

CS = area $\triangle ABE$

Monopolist's $\Pi = 32$

area EBCD = ED × DC

= (14 − 10) × (8)

= 4 × 8

= 32 units

PC: P = MC

PC: gain

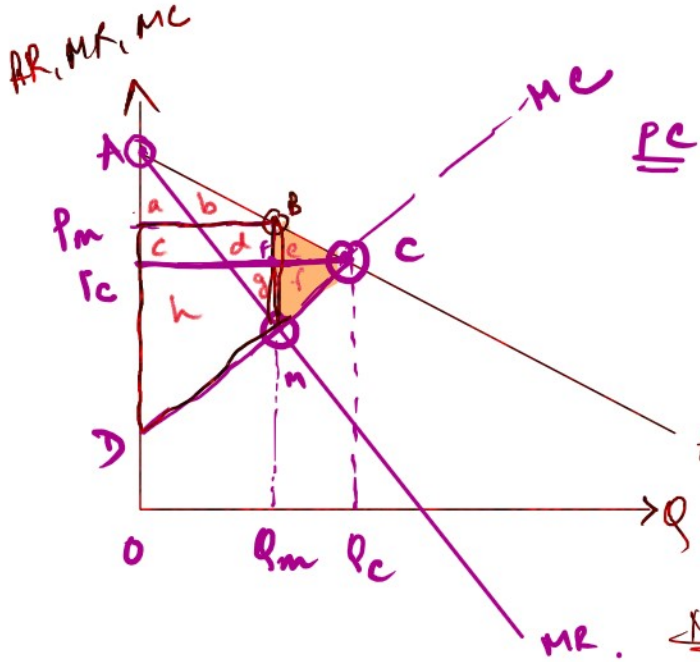
Monopolist (Π + area $\triangle BCF$

= area EBFD

= $32 + \frac{1}{2} \times 8 \times 8$

= $32 + \frac{1}{2} \times 64 \times 8$

$32 + 16 = \$48$ cents



DWL
$= \frac{1}{2} \times BM \times CF$
= ans

PC: CS = area $\Delta AP_c C$
$(a+b+c+d+e)$

PS = area $\Delta P_c BC$
$(h+g+f)$

SW_c = CS + PS
$= (a+b+c+d+e+g+f+h)$

Monopoly

CS = area ΔAP_mB
$(a+b)$

PS = area $P_m BMD$
$= (c+d+g+h)$

$SW_m = (a+b+c+d+g+h)$

Change in SW = $SW_m - SW_c$
$= -e-f$
(ans)

Dead weight loss

Change in social welfare as market moves from PC market to monopoly is area ΔBCM $[ie - (e+f)]$.

↑

Social cost of monopoly.