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GROUP 6

1.a

$y = x^3 - 5x^2 + 7x - 5$

$y' = 3x^2 - 10x + 7$

$3x^2 - 10x + 7 = 0$ to find critical points

$(3x - 7)(x - 1) = 0$

$x = \frac{7}{3}, 1$

$\oplus \quad | \quad \ominus \quad | \quad \oplus$

$\quad\quad 1 \quad\quad\quad \frac{7}{3}$

→ substitutes into first derivative

Domain where y is increasing : $(-\infty, 1) \cup (\frac{7}{3}, \infty)$

1.b Domain of $y = (-\infty, \infty)$

no, it is not concave for all domain since the turning point suggest that there is convexity.

$y'' = 6x - 10$

$= 6(\frac{7}{3}) - 10 = 4$

$\therefore$ convex at $\frac{7}{3}$

Question 2

a.) $MP_L = \frac{\Delta Q}{\Delta L} = 12L - 3L^2$ #

$AP_L = \frac{Q(L)}{L} = \frac{6L^2 - L^3}{L} = \frac{\cancel{L}(6L - L^2)}{\cancel{L}} = 6L - L^2$ #

B.) $\frac{d\,AP}{dL} = 6 - 2L \implies 6 - 2L = 0$

$6 = 2L$

$L = 3$ #

$\frac{d^2 AP}{dL^2} = -2 < 0$; globally concave function

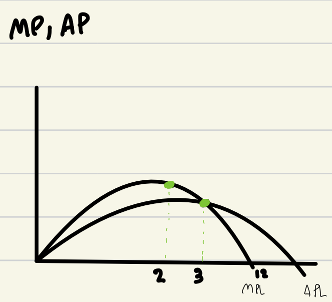
maximum point

C.) $MP_L = \frac{\Delta Q}{\Delta L} = 12L - 3L^2$

Maximum Point

$12L - 3L^2 = 0$

$L(12 - 3L) = 0 \rightarrow L = \cancel{0}, 4$



$\frac{d\,MPL}{dL} = 12L - 3L^2 = 12 - 6L$

$12 - 6L = 0$

$12 = 6L$

$2 = L$

Sub L in $6L^2 - L^3$; $Q = 32$

D.) $2P = 100 - Q$

$P = 50 - 0.5Q$

Revenue $= P(Q) \cdot (Q)$

$= 50 - 0.5Q \cdot Q$

$= 50Q - 0.5Q^2$

$MRP = \frac{dR}{dQ} = 50 - Q$ #

3.)

a.) Monopoly : $R(Q) = P(Q) \cdot Q$

$$= \left(40 + \frac{105}{Q} - \frac{3}{2}Q^2\right) \cdot Q$$

$$= 40Q + 105 - \frac{3}{2}Q^3$$

level of revenue - maximizing output : $MR = 0$

$$-\frac{9}{2}Q^2 + 40 = 0$$

$$Q^4 = \frac{4\sqrt{5}}{3} \approx 3 \ \#$$

elasticity of demand at the level of output : $\varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \frac{dQ}{dP} \cdot \frac{P}{Q}$

$$P = 40 + \frac{105}{Q} - \frac{3}{2}Q^2$$

$$\frac{dP}{dQ} = -105Q^{-2} - 3Q$$

$$= \frac{-105}{Q^2} - 3Q$$

$$Q = 3 \ ; \ \frac{dP}{dQ} = \frac{-62}{3}$$

$$Q = 3 \ ; \ \frac{P}{Q} = \left(40 + \frac{105}{Q} - \frac{3}{2}Q^2\right) \div Q$$

$$= \frac{40}{Q} + \frac{105}{Q2} - \frac{3}{2}Q$$

$$= \frac{40}{3} + \frac{105}{9} - \frac{3}{2}(3) = \frac{41}{2}$$

$$\Rightarrow \varepsilon = \frac{\% \Delta Q}{\% \Delta P} = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

$$= \frac{1}{-62/3} \cdot \frac{41}{2}$$

$$= \frac{-123}{124} \ \#$$

3b.)

$$\pi(Q) = R(Q) - C(Q)$$

$P(Q) \cdot Q - C(Q)$

$$= \left(40Q + 105 - \frac{3}{2}Q^3\right) - \left(6Q^3 - 81Q^2 - 175Q + 10\right)$$

3.c) $\pi(Q) = R(Q) - C(Q)$

$$= (100Q + 105 - \frac{3}{2}Q^3) - (6Q^3 - 81Q^2 - 175Q + 10)$$

$$= 40Q + 105 - \frac{3}{2}Q^3 - 6Q^3 + 81Q^2 + 175Q - 10$$

$$= \frac{-15}{2}Q^3 + 81Q^2 + 215Q + 95$$

F.O.C. $\frac{d\pi}{dQ} = \frac{-45}{2}Q^2 + 162Q + 215$

$\lambda = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$; $Q = \frac{-162 \pm \sqrt{162^2 - 4(-\frac{45}{2})(215)}}{2(-\frac{45}{2})}$

$$= \frac{-162 \pm 213.528}{-45}$$

$= 8.345$, $-\cancel{1.145}$

S.O.C. $\frac{d^2\pi}{dQ^2} = -45Q + 162$

Check : $Q^* = 8.345$; $-45(8.345) + 162 = -213.53 < 0$

concave

$\therefore$ 8.345 is the profit-maximizing output.

D) The equilibrium of both the price and the output will remain constant. The only change will be the decrease in the profit.

4a)

$\pi = P \cdot q - STC = Pq - 0.5q^2 - 10q - 5$

FOC $\frac{d\pi}{dq} = P - q - 10 = 0$

$q = P - 10$

SOC $\frac{d^2\pi}{dq^2} = -1 < 0$

π is global concave
q is max profit

$q^* = P - 10$

$STC = 0.5q^2 + 10q + 5$

$SVC = 0.5q^2 + 10q$ $\qquad SFC = 5$

$AVC = \frac{SVC}{q} = \frac{0.5q^2 + 10q}{q} = 0.5q - 10$

$\min(AVC);\ q = 0$
$AVC > 0$

$q^s = q^* = \begin{cases} P - 10, & P > 10 \\ 0, & P \leq 10 \end{cases}$

$n = 100$

$\sum_{i=1}^{n} q_i^s(P) = q^s = 100(P - 10)$

$= 100P - 1000$

$q^s = \begin{cases} 100P - 1000, & P > 10 \\ 0, & P \leq 10 \end{cases}$

4b.

$Qd \begin{cases} 1100 - 50P, & P < 22 \\ 0, & P \geq 22 \end{cases}$

$q^s_{market} \begin{cases} 100P - 1000, & P > 10 \\ 0, & P \leq 10 \end{cases}$

$1100 - 50P = 100P - 1000$

$2100 = 150P$

$P^* = 14$

$Qd = 1100 - 50(14)$

$Q^* = 400$

$400/100$ for each firm

$\pi = (14)(4) - 0.5(4^2) - 10(4) - 5$

$= 3$

4C.

tax = €3

$P^s + t = P^d$ and $P^d - t = P^s$

$1100 - 50P^d = Q^d$

$P^d = \frac{1100 - Q^d}{50}$

$100P - 1000 = Q^s$

$P^s = \frac{Q + 1000}{100}$

$P^d - t = P^s$

$P^d - 3 = P^s$

$$\frac{1100 - Q^d}{50} - 3 = \frac{Q^s + 1000}{100}$$

$$\frac{1100 - Q^d - 150}{50} = \frac{Q^s + 1000}{100}$$

$45000 = 150Q^*$

$Q^* = 300$

after tax $P^s = \frac{300 + 1000}{100} = 13$

$P^d = P^s + t = 13 + 3$

$= 16$

4d.

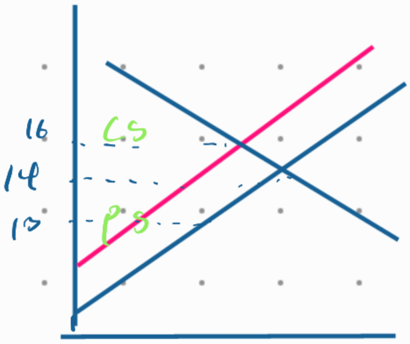
	B/f tax		A/f tax
Q	400		300
pd	14	+2	16
ps	14	−1	13
Tax	0		900

Tax revenue = 3 × 300
= 900

producer pay : (16−14) 300 = 600 → 66.6%
Consumer pay : (14−13) 300 = 300 33.3%

Burden
Producer : $\frac{600}{300}$ = \$2 /unit
Consumer : $\frac{300}{300}$ = \$1 /unit

4e.



A/F tax $\frac{1}{2}(3)(300) = 450$

B/F tax $= \frac{1}{2}(4)(400) = 800$

Δ Producer surplus $= -350$

profit a/f tax $= PQ - STC$

$= (13)(3) - (0.5)(3)^2 - (10)3 - 5$

$= -0.5$

profit for industry with 100 identical firms

$= -0.5 \cdot 100$

$= -50$

profit before tax $= (14)(4) - 0.5(4)^2 - 10(4) - 5$

$= 3$

profit with 100 firms

$= 3 \cdot 100 = 300$

Δx = profit a/f − profit b/f

$= -50 - 300$

$= -350$