Econ 302, Summer 2011

Final practice A. KEY

There are four parts, each worth 25 points. There are five bonus questions worth a total of 10 points, but they cannot raise your score above 100/100. Part I: Market structure Part II: Market interventions Part III: Consumer theory and production Part IV: Short answer Bonus In this practice, you will find all possible topics for Parts I-III and some examples for Part IV and Bonus. The specific questions asked in the exam may be different; and scores written next to each problem are rough estimates.

Part I. [25] Market structure

x. [20] **<u>Duopoly and collusion</u> – find the payoffs for a high-low game and put them in the game matrix**

There are two firms with identical per-unit costs of MC = 40 and no fixed costs.

Demand is given by $P_D = 400 - 3Q$.

a. Find the Cournot equilibrium quantities q_1^C and q_2^C and the Cournot equilibrium price P^C.

STEPS FOR COURNOT OUTCOME

① $MC_1 = MR_1$ AND $MC_2 = MR_2$

$\rightarrow q_1 = BR_1(q_2)$ AND $q_2 = BR_2(q_1)$

SOLVE 2 EQNS IN 2 UNKNOWNS $\rightarrow q_1^c, q_2^c$

② PLUG IN $Q^c = q_1^c + q_2^c \rightarrow P^c$

$$\boxed{\begin{aligned} q_1^c &= 40 \\ q_2^c &= 40 \\ P^c &= 160 \end{aligned}}$$

b. Find the firms' profits in the Cournot equilibrium Π_1^c and Π_2^c.

$$\Pi_1^C = P^C q_1^C - MC_1 q_1^C$$

SINCE MC_1 IS CONSTANT

$$= (P^C - MC_1)\, q_1^C$$

$$= (160 - 40)\, 40$$

$$\boxed{\Pi_1^C = 4800 \quad \Pi_2^C = 4800}$$

c. Suppose the firms collude by setting $q_1^m = \frac{1}{2}Q^M$ and $q_2^m = \frac{1}{2}Q^M$. Find these quantities and the price P^m.

MONOPOLY OUTCOME

① $MC = MR \rightarrow Q^m = 60$

② PLUG IN $Q^m \rightarrow P^m = 220$

$$\boxed{\begin{aligned} q_1^m &= 30 \\ q_2^m &= 30 \\ P^m &= 220 \end{aligned}}$$

d. What are the firms' profits Π_1^m and Π_2^m?

$$\Pi_1^m = 5400$$

$$\Pi_2^m = 5400$$

e. Suppose firm 1 follows the collusive agreement by setting output at half the monopoly output q_1^m, but firm 2 breaks the agreement by setting output at the Cournot level q_2^C. What is the price $P^{m,c}$ that results?

$q_1 = 30, q_2 = 40 \rightarrow Q = 70 \rightarrow \boxed{P^{m,c} = 190}$

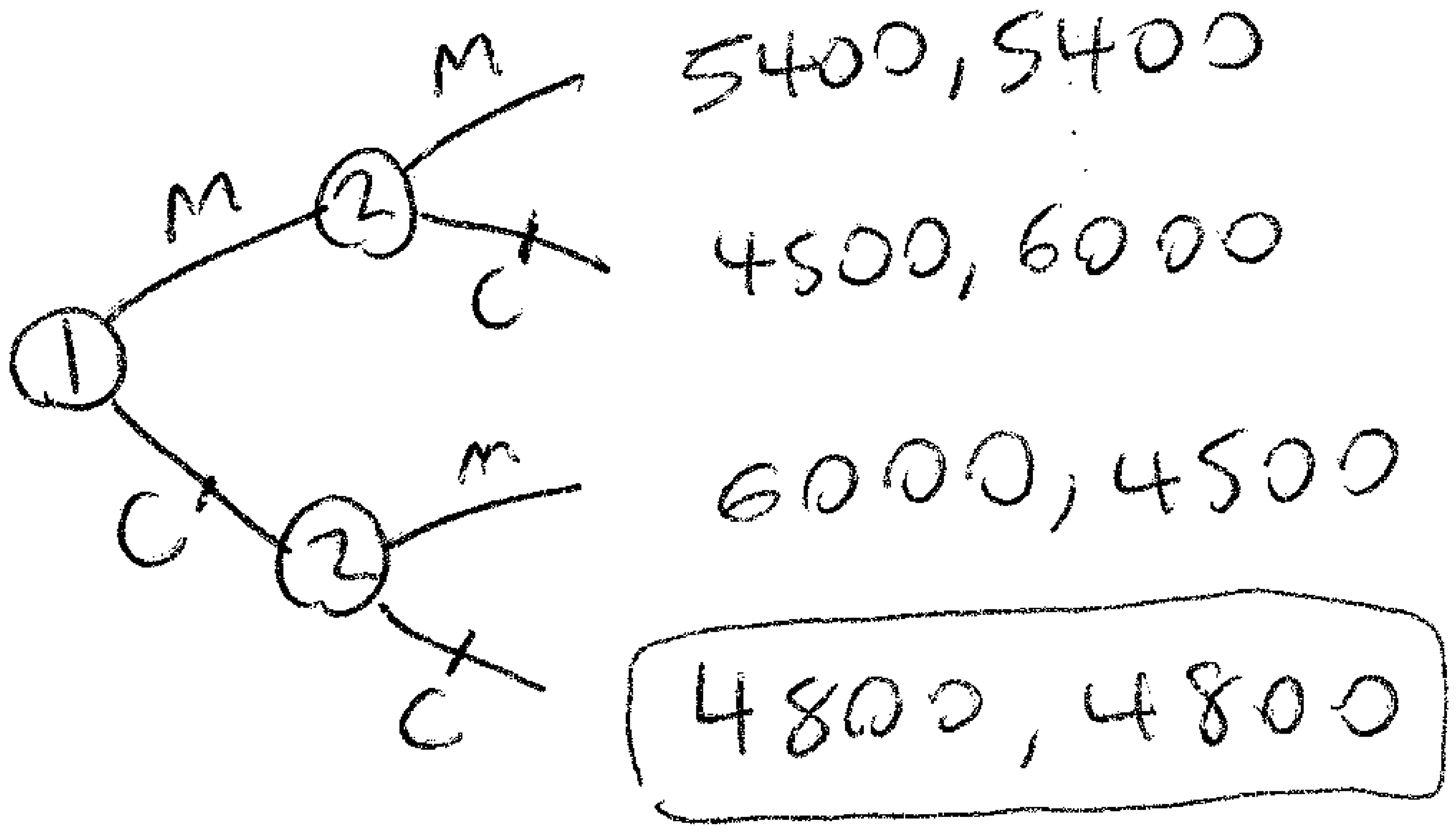
f. What are the firms' profits Π_1 and Π_2 in the case described in part e?

$\boxed{\begin{array}{l} \Pi_1 = 4500 \\ \Pi_2 = 6000 \end{array}}$

g. Enter the payoffs into a normal-form game matrix and circle the unique Nash Equilibrium outcome.

	m	c
m	5400, 5400	4500, 6000
c	6000, 4500	4800, 4800

h. Draw the extensive-form game if firm 1 moves first, and circle the unique Subgame-Perfect Nash Equilibrium.



x. [15] (WB16#1) **<u>Monopoly from production</u> – deriving C(q), choosing L^*, K^*, optimal P^M and Q^M, CS, PS, DWL, LI, ε**

A monopolist has production technology given by

$F(L, K) = L^{1/2}K^{1/2}$

$MP_L = ½\, K^{1/2}/L^{1/2}$

$MP_K = ½\, L^{1/2}/K^{1/2}$

Demand is given by P = 66 – 3Q and input prices are w = 9 for labor and r = 4 for capital.

a. Find the monopolist's cost function.

(A1) $MRTS = -\frac{w}{r}$ AND $q = \sqrt{LK}$

$\rightarrow L^*, K^*$ AS FNS. OF q

(A2) $C = wL^* + rK^*$

(B1) $wL^* = \frac{1}{2}C$ AND $rK^* = \frac{1}{2}C$

$\rightarrow L^*, K^*$ AS FNS OF C

(B2) PLUG BOTH INTO

$q = \sqrt{LK}$

AND SOLVE FOR C

$$\boxed{C = 12q}$$

b. Find the monopolist's optimal quantity and price Q^M and P^M.

(see p2)

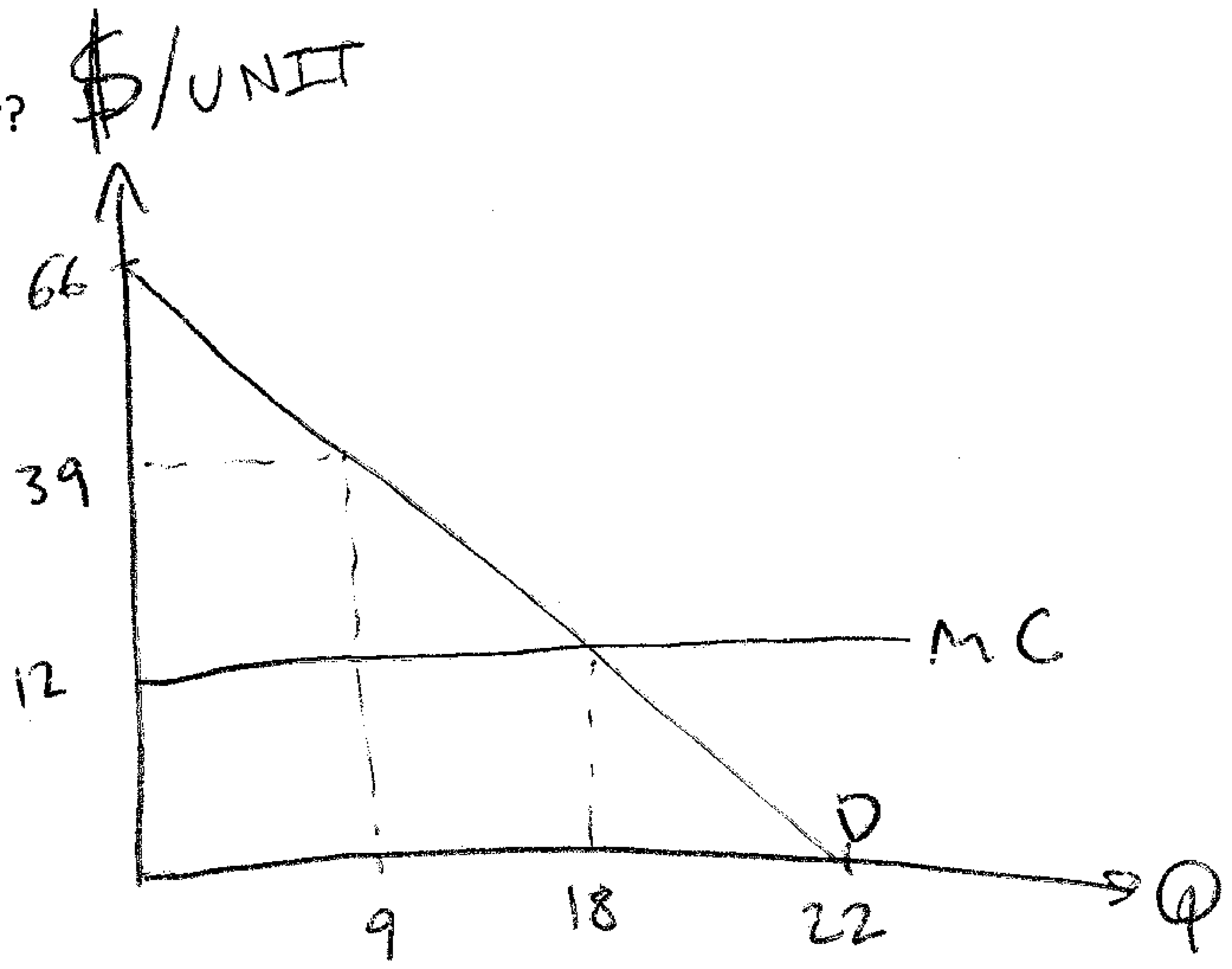
$$\boxed{Q^M = 9, \; P^M = 39}$$

c. How much labor and capital L^M and K^M will the monopolist buy to produce Q^M?

PLUG PART b INTO PART a

$$\boxed{L^* = 6, \; K^* = 13.5}$$

d. What is the Dead Weight Loss of this monopoly?



FIRST, FIND EFFICIENT OUTCOME

$P_D = MC \rightarrow Q^* = 18$

PLUGIN $Q^* \rightarrow P^* = 12$

GRAPH P_D, MC

$$\boxed{DWL^M = \tfrac{1}{2}(9)(27)}$$

e. What is the Lerner Index? What is the elasticity of Demand at Q^M?

$$LI^M = \frac{39-12}{39} = \boxed{9/13}$$

(A) $\varepsilon^M = \left(-\frac{1}{3}\right) \cdot \frac{39}{9}$

(B) $\varepsilon^M = \frac{-1}{LI}$ FOR MONOPOLY

$$\boxed{\varepsilon = -\frac{13}{9}}$$

x. [20] (WB19#3) **<u>Cournot duopoly vs monopoly</u> – Cournot equilibrium q_1^C, q_2^C and P^C; CS, PS, DWL, LI, ε**

Market (inverse) Demand is P_D=200-5Q and the two duopolists have constant marginal costs MC_1= 50 and MC_2= 50 and no fixed costs.

a. Find each firm's revenues, expressed as functions of their output choices q_1 and q_2.

$$R_1 = Pq_1 = (200 - 5q_1 - 5q_2)q_1$$

$$R_2 = Pq_2 = (200 - 5q_1 - 5q_2)q_2$$

b. Find the (Cournot) equilibrium P^C, q_1^C and q_2^C.

(see p1)

$$\boxed{\begin{array}{l} q_1^C = 10 \\ q_2^C = 10 \\ P^C = 100 \end{array}}$$

c. Find the Lerner Index in the Cournot Equilibrium.

$$LI^C = 1/2$$

d. Find what the outcome would be if the firms behaved competitively P* and Q*.

EFFICIENT OUTCOME

(see PS)

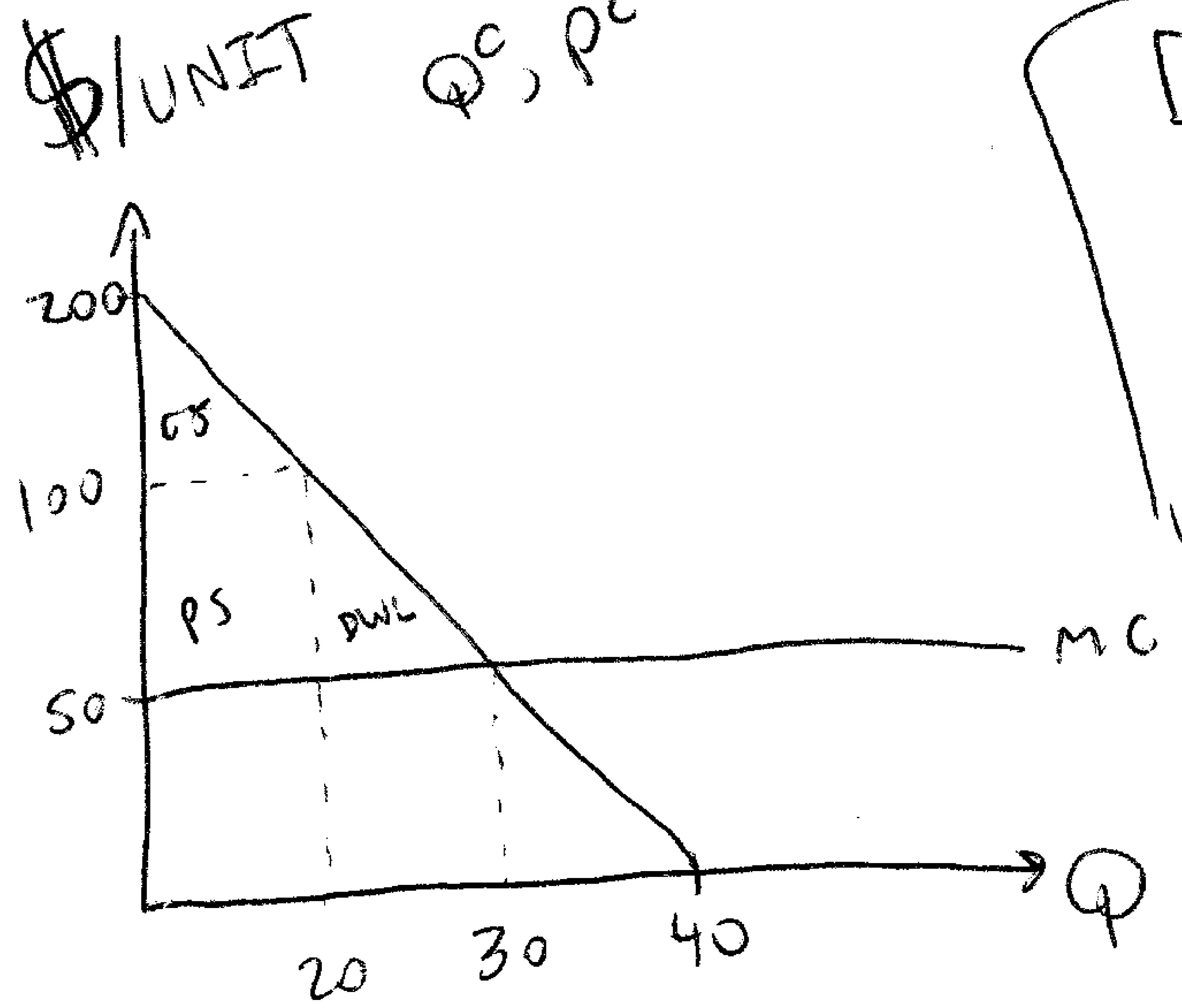
$$\boxed{\begin{aligned} Q^* &= 30 \\ P^* &= 50 \end{aligned}}$$

e. What is the Dead Weight Loss of the duopoly? What are the Consumer Surplus and Producer Surplus?

$$Q^c = q_1^c + q_2^c = 20$$

- GRAPH P_D, MC
- MARK INTERCEPTS
  Q^*, P^*
  Q^c, P^c

$$\boxed{\begin{aligned} DWL^c &= 250 \\ PS^c &= 1000 \\ CS^c &= 1000 \end{aligned}}$$



f. Find the market price and quantity if the firms merged into a monopoly P^M and Q^M.

MONOPOLY OUTCOME

(see p2)

$Q^m = 15$

$P^m = 125$

g. What would be the Dead Weight Loss of the monopoly? Also find the Consumer Surplus and Producer Surplus.

- GRAPH PO, MC
- MARK INTERCEPTS
  Q°, P°
  Q^m, P^m

$$\boxed{\begin{aligned} DWL^m &= 562.5 \\ CS^m &= 562.5 \\ PS &= 1125 \end{aligned}}$$

x. [10] **<u>Stackelberg vs Cournot duopoly</u> – Cournot equilibrium, Stackelberg equilibrium q_1^S, q_2^S and P^S, compare profits**

Two firms have identical marginal costs MC = 20 and no fixed costs. Demand is given by $P_D = 200 - 3Q$

a. Find the Stackelberg equilibrium when firm 1 chooses output first, q_1^S, q_2^S and P^S.

STACKELBERG OUTCOME

① $MC_2 = MR_2 \rightarrow q_2 = BR_2(q_1)$

② PLUG q_2 INTO P_D

FIND MR_1

③ $MC_1 = MR_1 \rightarrow q_1^S$

PLUGIN q_1^S TO ① $\rightarrow q_2^S$

④ PLUGIN $Q^S = q_1^S + q_2^S$ TO $P_D \rightarrow P^S$

$$\boxed{\begin{aligned} q_1^S &= 30 \\ q_2 &= 15 \\ P^S &= 65 \end{aligned}}$$

b. Find the firms' profits in the Stackelberg equilibrium.

$\pi_1^S = 1350$

$\pi_2^S = 675$

c. Find the Cournot equilibrium when the firms choose output at the same time, q_1^C, q_2^C and P^C.

COURNOT OUTCOME (SEE P1)

$$\boxed{\begin{aligned} q_1^C &= 20 \\ q_2^C &= 20 \\ P^C &= 80 \end{aligned}}$$

d. Find the firms' profits in the Cournot equilibrium.

$$\Pi_1^C = 1200$$
$$\Pi_2^C = 1200$$

x. [10] **Monopoly – optimal P^M and Q^M, CS, PS, DWL, LI, ε**

A monopolist has marginal cost MC = 2Q and no fixed costs. Demand is given by $P_D = 200 - 3Q$

a. Find the monopolist's optimal quantity and price Q^M and P^M.

MONOPOLY OUTCOME (SEE P2)

$$\boxed{\begin{array}{l} Q^M = 25 \\ P^M = 125 \end{array}}$$

b. What is the monopolist's marginal cost at Q^M?

50

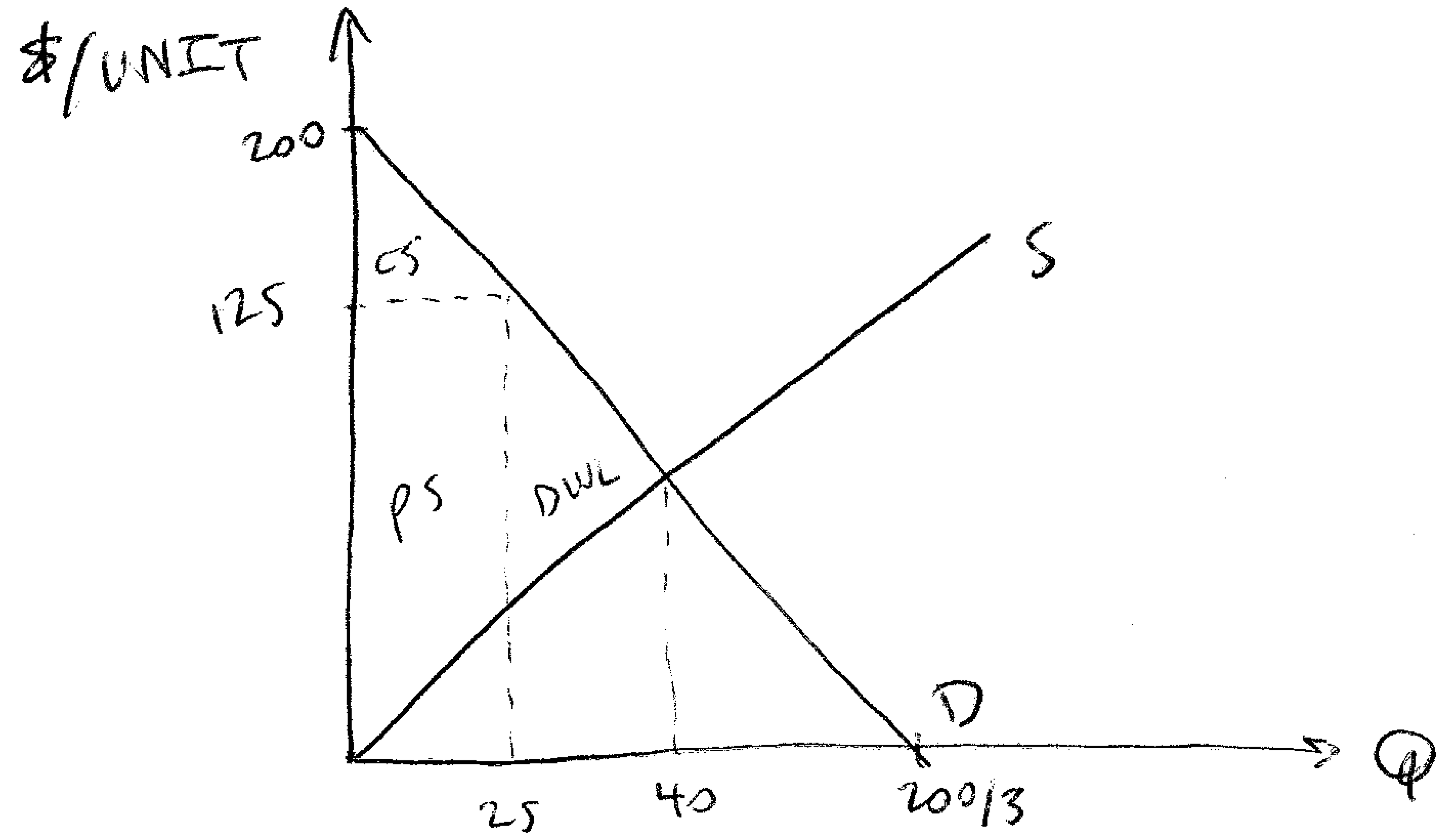
c. Find what the outcome would be if the monopolist behaved competitively P* and Q^*.

EFFICIENT OUTCOME

(SEE P5)

$$\boxed{Q^* = 40 \quad P^* = 80}$$

d. Graph Demand and Marginal Cost curves.



e. Find the Consumer Surplus, Producer Surplus and Dead Weight Loss under the monopoly.

$CS^m = 937.5$

$PS^m = 2500$

$DWL^m = 562.5$

x. [5] **Perfect competition**

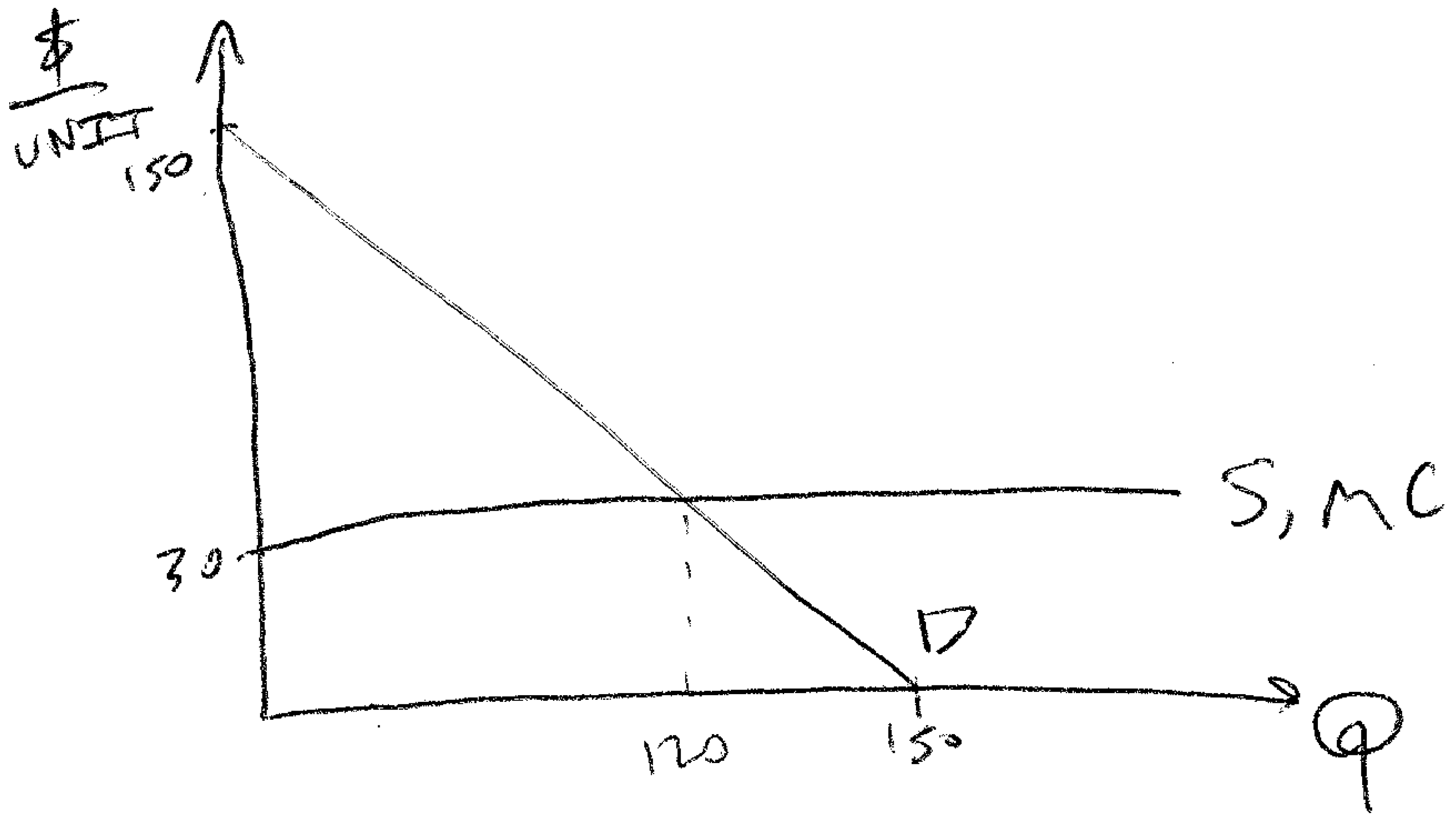
Competitive firms have identical costs, $C = 75 + 3q^2$, with marginal costs $MC = 6q$. Market (inverse) Demand is given by $Q = 150 - P$.

a. Find the firms' break-even price.

① $MC = AC \rightarrow q^*$

② PLUG IN q^* TO $MC, AC \rightarrow \boxed{P^* = 30}$

b. Graph the Supply and Demand curves.



c. Find the equilibrium P^* and Q^*.

EFFICIENT OUTCOME (SEE PS)

$$\boxed{\begin{array}{l} P^* = 30 \\ Q^* = 120 \end{array}}$$

d. Calculate the Consumer Surplus.

$$\frac{1}{2}(120)(120)$$

x. [5] **Market power**

a. What does it mean for a firm to have market power?

IT CAN/DOES SET PRICE ABOVE MARGINAL COST

b. In imperfectly competitive markets, when consumers are ***more elastic***, do producers have more or less market power? Explain.

LESS, SINCE $LI = \frac{1}{|\varepsilon|}$

Part II. [25] Market interventions

x. [15] **Price restrictions from inverse Supply and Demand – effectiveness, shortage/surplus, CS, PS, DWL**

The US government is going to set a price floor of ***P^F = $400***. (Inverse) Demand and Supply are

$P_D = 300 + 2I - 4Q$ $= 600 - 4Q$ $P_D - P_S = 500 - 5Q$

$P_S = 100 + Q$

and income is $I = 150$.

a. Find the equilibrium ***before the price floor*** is used, P^* and Q^*.

$P_D - P_S = 0$ OR $P_S = P_D \rightarrow Q^*$

$Q^* = 100$ PLUGIN Q^* TO $P_S, P_D \rightarrow P^*$

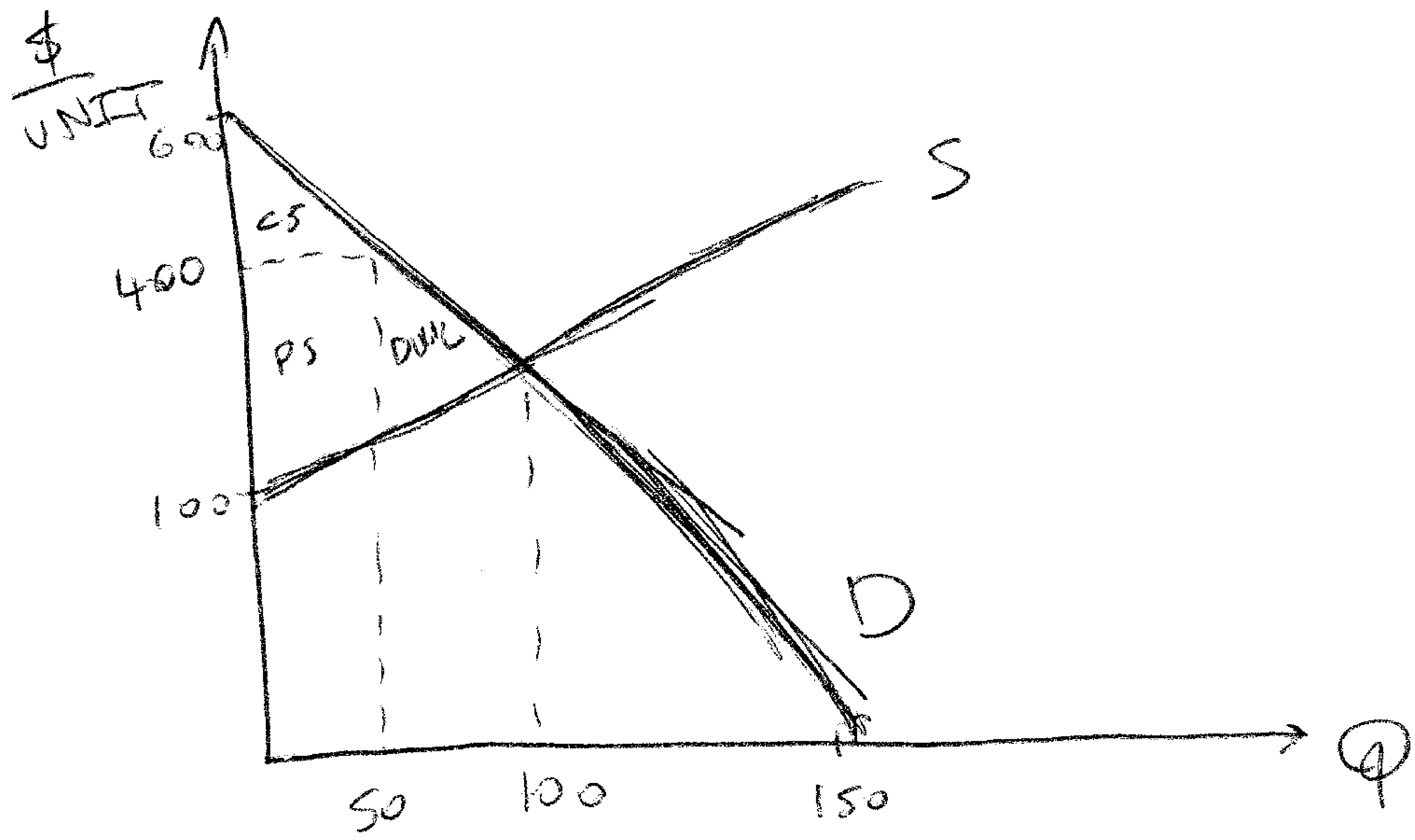
$P^* = 200$

b. How much is traded ***after the price floor*** is used?

$P^F = 400 > 200$ IS EFFECTIVE, LEADS TO A SURPLUS

$\rightarrow Q^T = Q_D \ldots 400 = 600 - 4Q \rightarrow Q^T = 50$

d. Make a Supply and Demand graph, indicating the Consumer Surplus, Producer Surplus and Dead Weight Loss ***after the price floor***.



e. Find an expression for the Demand curve, which gives the quantity demanded as a function of income I and the price P.

$$Q_D = 75 + \frac{1}{2}I - \frac{1}{4}P$$

f. ***Before the price floor***, is the good a necessity, a luxury or inferior?

$$\varepsilon = 3/14$$

g. ***After the price floor***, is the good a necessity, a luxury or inferior?

$$\varepsilon = 3/2$$

h. Do consumers or producers benefit from the price floor, or neither? (You may need to compute the CS and PS both before and after the price floor)

FIRST, NEED TO FIND $P_S = 100 + 50 = 150$

$PS^* = 5000$

$PS^F = 13,750$

$CS^* = 20,000$

$CS^F = 5000$

SUPPLIERS BETTER
CONSUMERS WORSE

x. [15] **<u>Per-unit tax from inverse Supply and Demand</u> – graphing, CS, PS, DWL, G, elasticities, incidence**

A per-unit tax of ***T = $40*** is going to be used in a market with (inverse) Demand and Supply curves given by...

$P_D = 300 - 7Q$

$P_S = 100 + Q$

a. Find the competitive equilibrium ***before the tax*** P^* and Q^*.

(SEE P 13)

$$\boxed{\begin{array}{l} Q^* = 25 \\ P^* = 125 \end{array}}$$

b. ***After the tax***, how much is...
... traded?
...paid by consumers?
...paid to suppliers?

$P_D - P_S = 40 \rightarrow Q^T$

PLUGIN $Q^T \rightarrow P_D^T, P_S^T$

$$\boxed{\begin{array}{l} Q^T = 20 \\ P_D^T = 160 \\ P_S^T = 120 \end{array}}$$

c. Find the Producer Surplus, Consumer Surplus, Government Revenue and Dead Weight Loss ***after the tax***.

• GRAPH P_D, MC
• MARK INTERCEPTS
#'S FOUND IN a&b
Q^*, P^*
Q^T, P^T_S, P^T_D

$CS^T = 1400$
$PS^T = 200$
$GR^T = 800$
$DWL^T = 100$

x. [10] (not on the test, but good practice) <u>**Market intervention for policy**</u>

The Demand and Supply for cigarettes are given by

$Q_D = 9000/P$ and

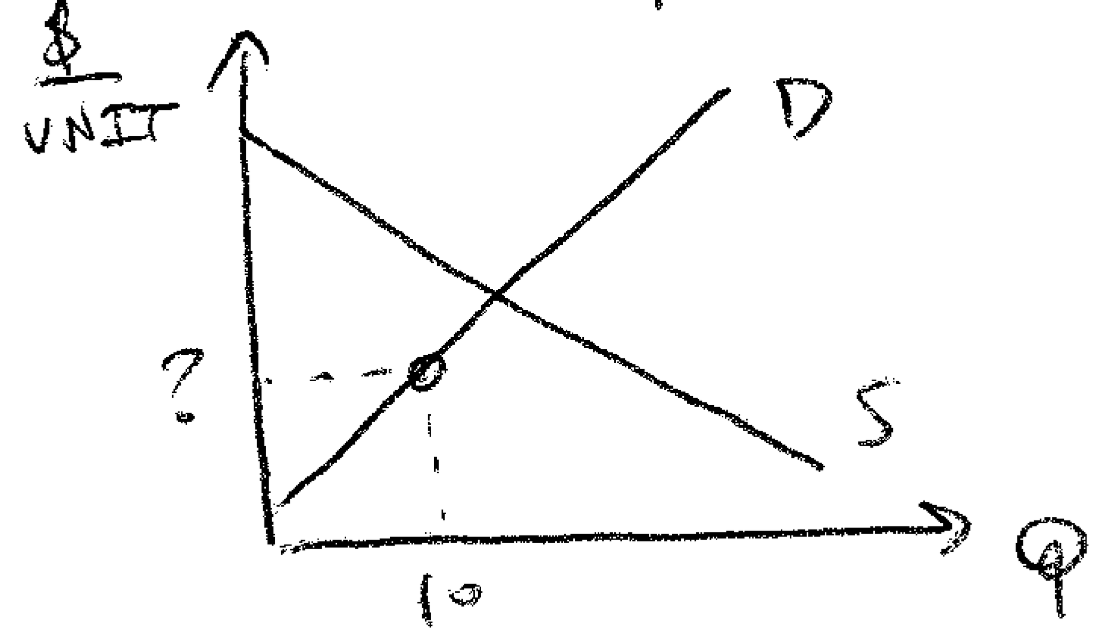
$Q_S = 10P$

where quantities are measured in millions of packs of cigarettes each week. The government wants to reduce consumption to Q = 10 million packs.

a. What price ceiling could the government set to reduce consumption to Q = 10?

PRICE CEILING → EFFECTIVE BELOW P^*
& $Q^T = Q_S$

$Q_S = 10$
$10P = 10$
$P^c = 1$



b. What price floor could the government set to reduce consumption to Q = 10?

$$Q_D = 10$$

$$\frac{9000}{P} = 10$$

$$\boxed{P^F = 900}$$

c. What per-unit tax could the government charge to suppliers to reduce consumption to Q = 10?

~~[illegible]~~

$$\boxed{899}$$

d. Consumers and producers are both worse off after the tax. Can the government fully compensate them with the revenues it collects? Explain.

NO, THERE'S A DWL

x. [5] **<u>Price restrictions</u> – shortage, surplus**

The Demand and Supply for soap are given by

$Q_D = 200 - 5P$ and

$Q_S = 5P$

a. Find the equilibrium.

- $Q_S = Q_D$ OR EQUIVALENTLY $Q_S - Q_D = 0 \rightarrow P^*$
- PLUGIN P^* TO $Q_S, Q_D \rightarrow Q^*$

$$\boxed{\begin{array}{c} P^* = 20 \\ Q^* = 100 \end{array}}$$

b. Find a price floor that causes a surplus.

$P^F = 30$ FOR EXAMPLE

c. How large is the surplus for the price floor you chose?

$Q_S - Q_D = 100$

150 50

d. At a price floor below the equilibrium price, is there a shortage or a surplus?

NEITHER

Part III. [25] Consumer theory and production.

x. [∞] **Income and Substitution Effects and Giffen goods**

If consumption of pasta falls when the price of pasta falls, ...

(A) ... it must be that pasta is a "bad."

(B) ... it must be that all other goods are necessities.

(C) ... it must be that consumption of pasta falls when income rises.

(D) ... it must be that the Income Effect for pasta is weak.

x. [10] **Consumer choice for Cobb-Douglas preferences**

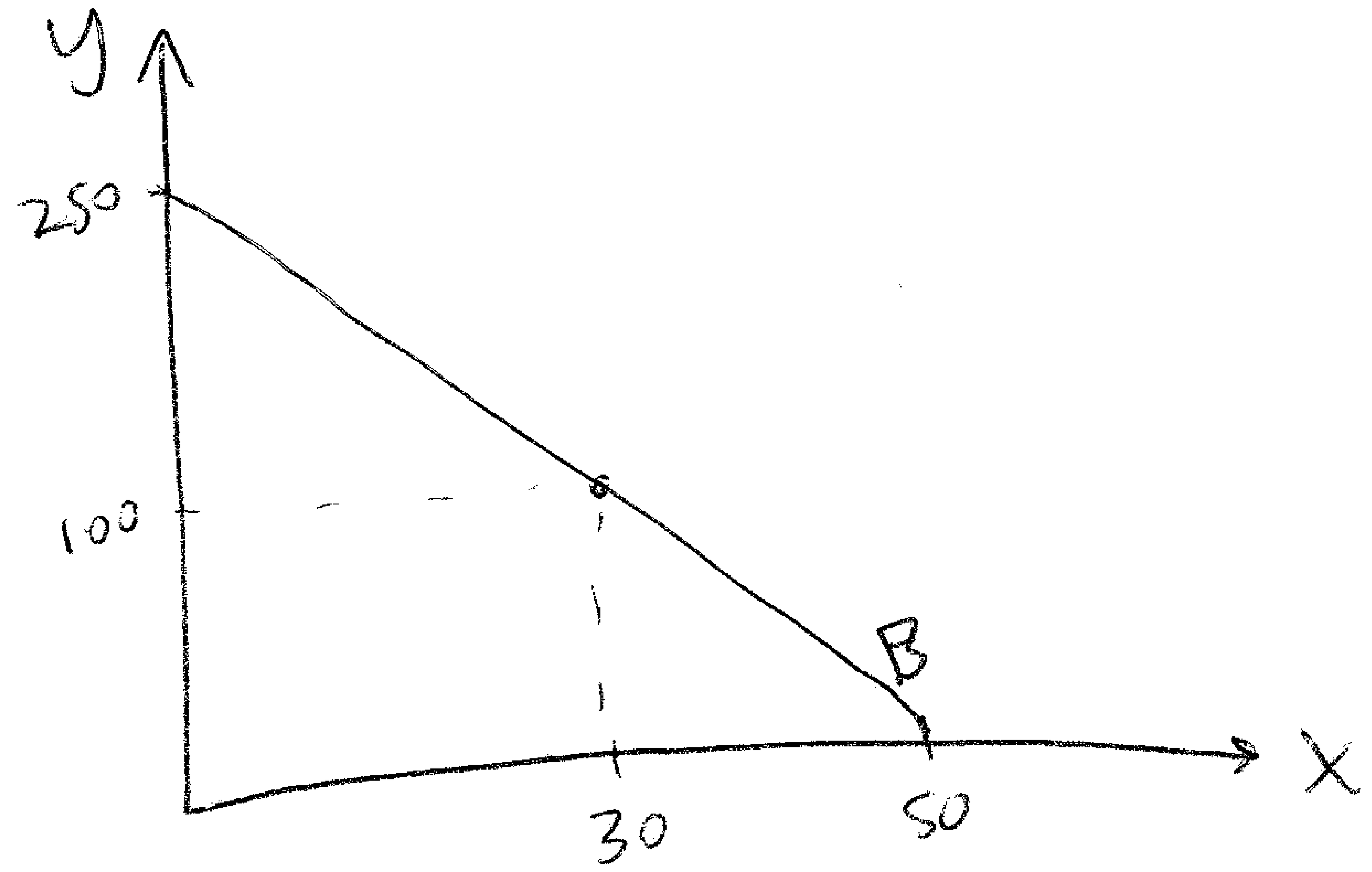
The consumer faces prices $P_X = 10$ and $P_Y = 2$, and has income I = 500 and preferences given by

$U = X^3Y^2$

$MU_X = 3X^2Y^2$

$MU_Y = 2X^3Y$

a. Graph the consumer's budget set, labeling axes and intercepts.



d. Find the consumer's optimal bundle X^* and Y^* and mark it on your graph.

$MRS = MRT$ & $P_x X + P_y Y = I$ | $P_x X = \frac{3}{5} I$ & $P_y Y = \frac{2}{5} I$

$\boxed{X^* = 30 \quad Y^* = 100}$

x. [10] **Price decomposition**

A consumer has income I = 600 to spend on goods X and Y. The price of Y is $P_Y = 4$. The price of X is initially $P_X = 100$, but it later decreases to $P_X' = 25$.

$U = X^{1/2}Y^{1/2}$

$MU_X = ½\, Y^{1/2}/X^{1/2}$

$MU_Y = ½\, X^{1/2}/Y^{1/2}$

a. How much does the consumer choose X^* and Y^* when $P_X = 10$?

(SEE PREVIOUS Q)

$\boxed{X^* = 3 \quad Y^* = 75}$

b. How much does the consumer choose X^{**} at the new price $P_X' = 25$?

(SEE PREVIOUS)

$X^{**} = 12$

c. How much money, M, would the consumer need to have to be just as well off after the price change?

① FIND u^*
FIND x^c, y^c AT NEW PRICES AS FNS. OF M
② SOLVE $u^* = (x^c)^{\frac{1}{2}}(y^c)^{\frac{1}{2}}$ FOR M

$\boxed{M = 300}$

$x^c = 6$

d. How much of the change in the consumer's choice is due to the Income Effect?

$\underbrace{3 \rightarrow 6}_{\text{SUB}} \rightarrow 12$

$\boxed{\text{INC} = 6}$

d. Is X normal or *inferior*? Explain by defining each term.

NORMAL - CONSUMPTION RISES WITH INCOME

INFERIOR - CONSUMPTION FALLS WITH I

x. [5] **Deriving Demand for Cobb-Douglas preferences.**

A consumer's utility function is $U = X^2Y$ with marginal utilities $MUx = 2XY$ and $MUy = X^2$. The consumer has $300 to spend. Derive expressions for the consumer's Demand for X and Y in terms of the prices P_X and P_Y.

(SEE p20)

$$\boxed{\begin{array}{l} X^* = 200/P_x \\ y^* = 100/P_y \end{array}}$$

x. [5] **Consumer choice with perfect substitutes preferences**

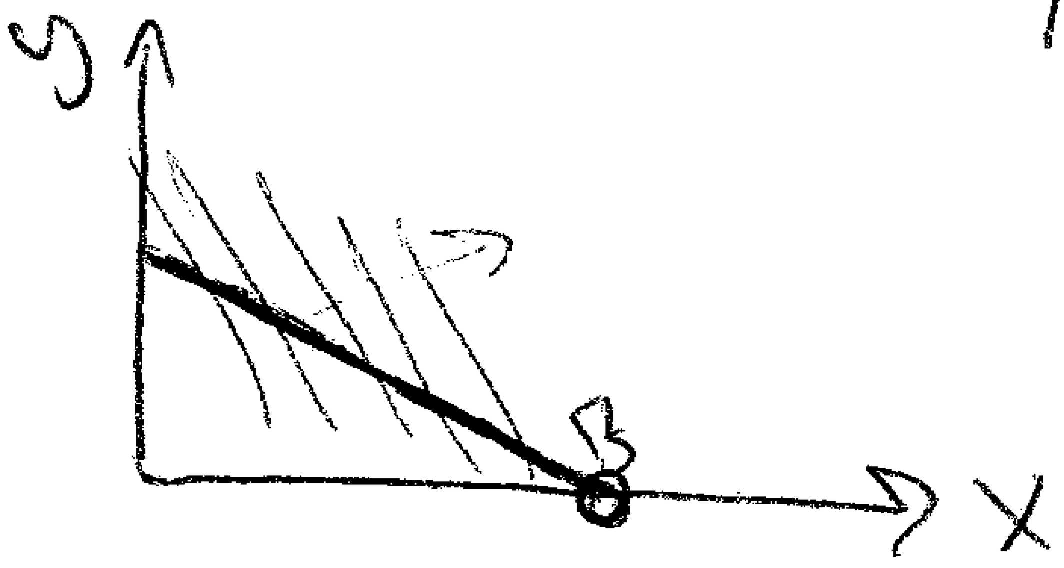
A consumer's utility function is $U = X+2Y$ with $MU_X = 1$ and $MU_Y = 2$.

a. True or False? These are perfect-complements preferences.

b. The prices are $P_X = 1$ and $P_Y = 3$. Derive expressions for the consumer's Demand for X and Y in terms of the consumer's income I.

(A) GRAPHICAL

$$\boxed{\begin{array}{l} X^* = I \\ y^* = 0 \end{array}}$$



$MRT = -\frac{1}{3}$

$MRS = -\frac{1}{2}$

(B) COST-BENEFIT (PER UNIT)

$\frac{MU_x}{P_x} = 1$

$\frac{MU_y}{P_y} = 2/3$

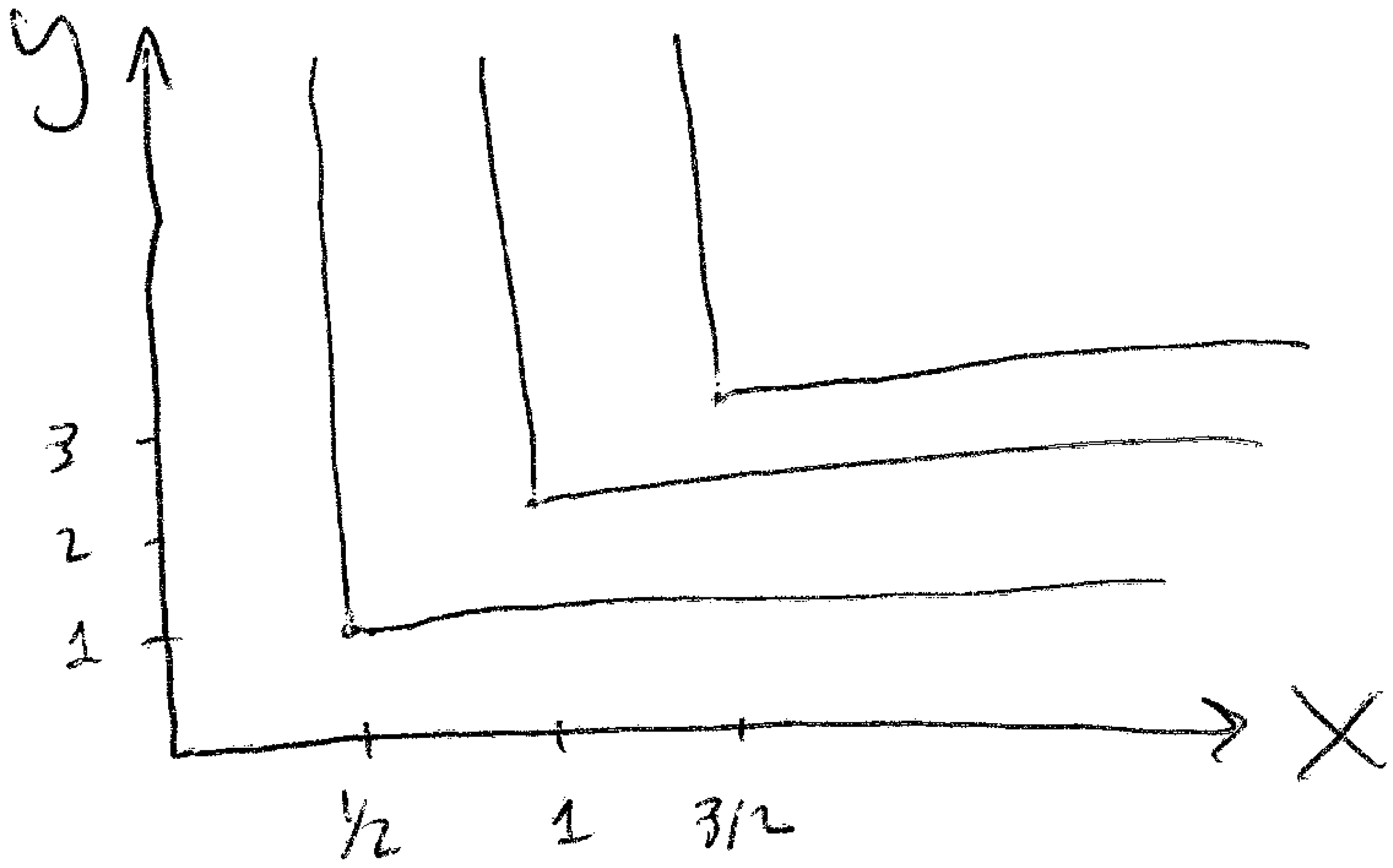
(C) ALL X OR ALL Y

- ALL X → $P_xX = I$ → $U = I$
- ALL y → $P_yY = I$ → $U = 2(I/3)$

x. [5] **Consumer choice with perfect complements preferences**

A consumer has preferences described by U = min{2X, Y} and income I = 95. Market prices are $P_X = 5$, $P_Y = 7$.

a. Graph three of the consumer's indifference curves.



b. How much will the consumer buy of X and Y?

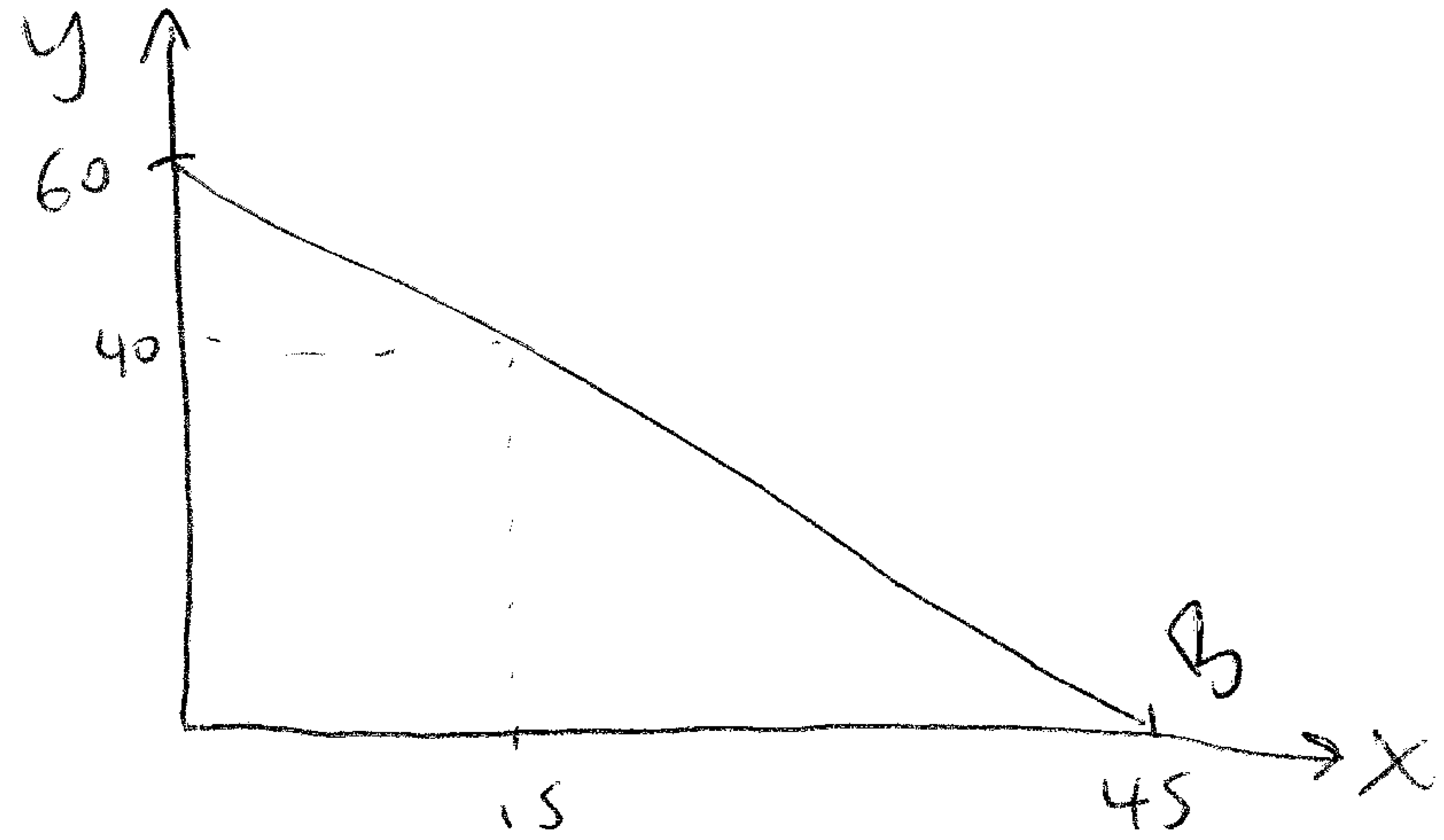
$2X = Y$ & $P_X X + P_Y Y = I$

$$\boxed{\begin{aligned} X^* &= 5 \\ Y^* &= 10 \end{aligned}}$$

x. [5] **<u>Budgets</u> – graphing, identifying the MRT, whether or not a bundle is affordable, how much is bought when $z is spent**

A consumer has I = 180 to spend on X any Y. The prices are $P_X = 4$ and $P_Y = 3$.

a. Graph the consumer's budget set, labeling axes and intercepts.



b. If the consumer spends 60 on X and 120 on Y, how much X and Y are bought?

$X = 15$, $y = 40$

c. On your graph, mark the bundle found in part b.

d. Is the bundle X = 20, Y = 20 affordable?

YES

x. [5] **<u>Increasing, decreasing or constant returns-to-scale</u>**

A firm's production function is given by $F(L,K) = L^{1/2}K^{3/4}$. Are there increasing, decreasing or constant returns to scale? Show your work.

$F(2L,2K) = (2L)^{\frac{1}{2}}(2K)^{\frac{3}{4}} = 2^{\frac{1}{2}+3/4} F(L,K) > 2F(L,K)$

$\boxed{\text{IRS}}$

x. [5] **Cobb-Douglas technology – deriving costs**

A firm has technology given by

$F(L, K) = L^{1/2}K^{1/2}$

$MP_L = ½\, K^{1/2}/L^{1/2}$

$MP_K = ½\, L^{1/2}/K^{1/2}$

The prices of inputs are w = 25 for labor and r = 16 for capital.

a. How do we know that there are Decreasing Marginal Returns to Labor?

MP_L IS DECREASING IN L

b. Find the firm's cost function.

(SEE P4)

$C = 40q$

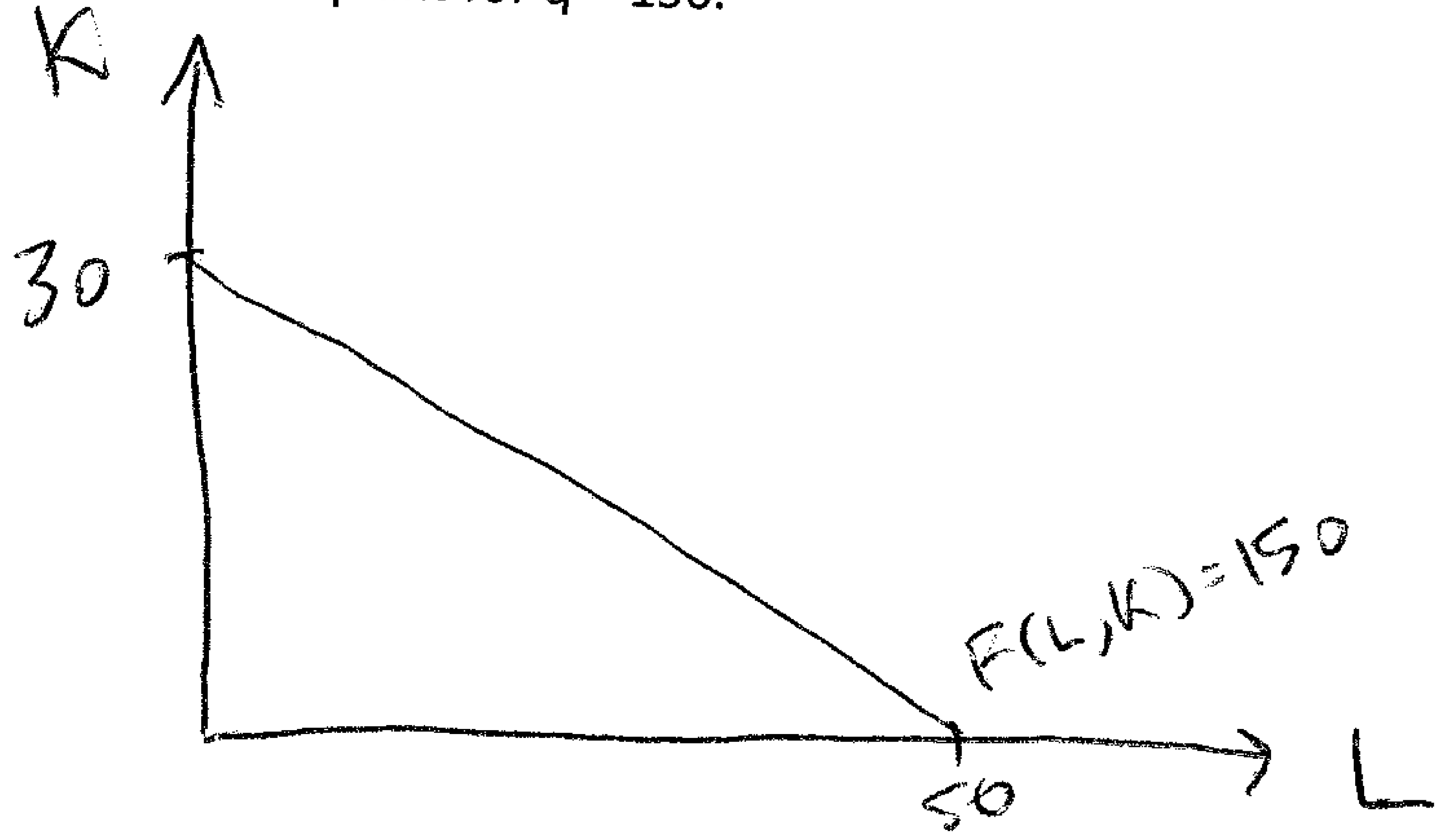
x. [5] **Perfect substitutes technology – graphing the isoquant, deriving costs**

A firm has technology given by

$F(L, K) = 3L + 5K$, $MP_L = 3$, $MP_K = 5$

The prices of inputs are $w = 25$ for labor and $r = 16$ for capital.

a. Draw the isoquant for $q = 150$.

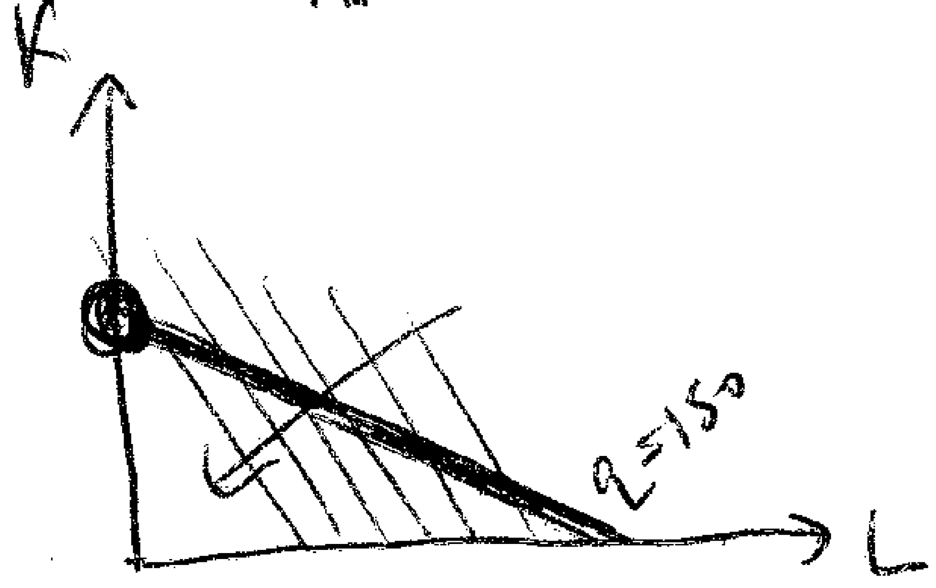


b. How much L and K should the firm purchase to produce $q = 150$ units of output?

(A) GRAPHICAL

$MRTS = -3/5$

$-w/r = -25/16$



(B) (PER UNIT) COST-BENEFIT

$\frac{MP_L}{w} = \frac{3}{25}$

$\frac{MP_K}{r} = 5/16$

(C) ALL L OR ALL K

- ALL L

$150 = 3L \rightarrow L' = 50$, $K' = 0$

$C = 25(50)$

- ALL K

$150 = 5K \rightarrow K' = 30$, $L' = 0$

$C = 16(30)$

$\boxed{L^* = 0, K^* = 30}$

c. What is the cost of the input bundle that you found in b?

$C = 16(30) = \boxed{480}$

x. [5] **Fixed-proportions technology – graphing the isoquant, deriving costs**

A firm's technology is described by the production function

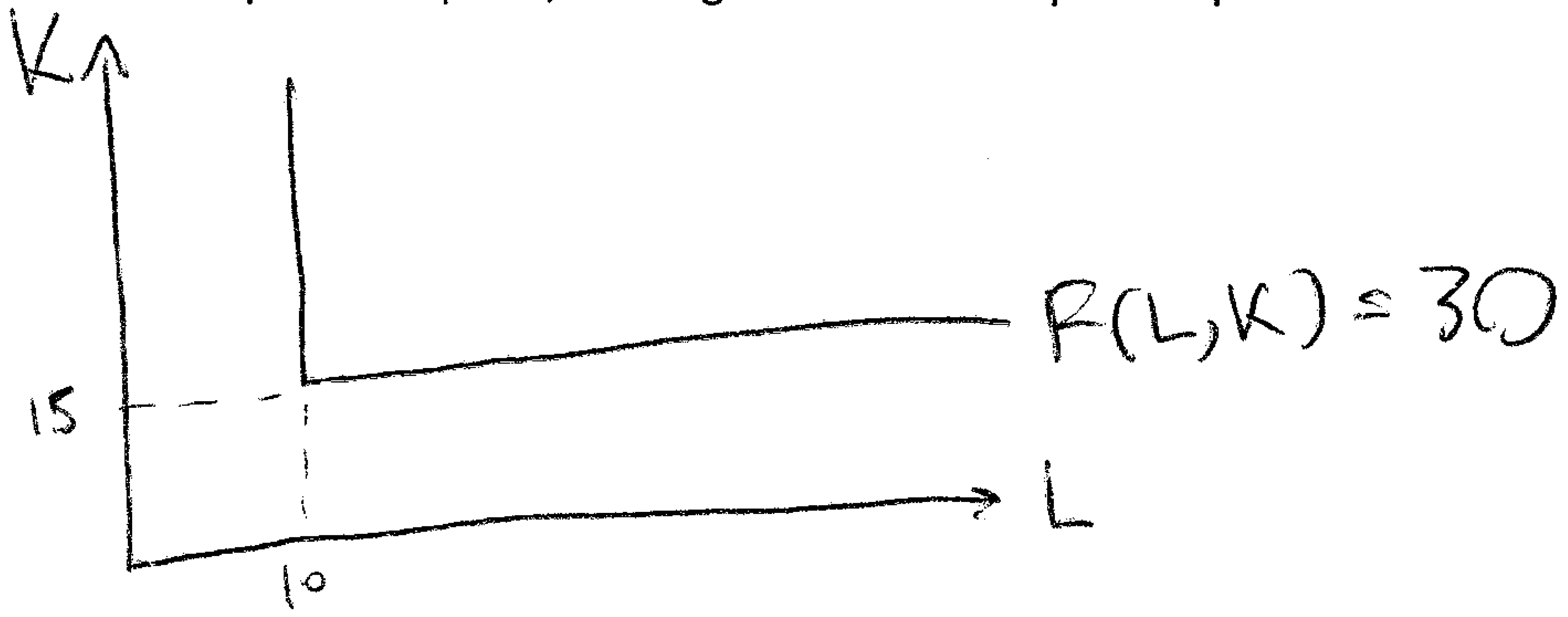
$F(L,K) = \min\{3L,2K\}$

The wage is $w = 6$ and the rental rate is $r = 10$.

a. What kind of technology does the firm have?

FIXED-PROPORTIONS

b. Graph the firm's isoquant for $q = 30$, labeling the axes and important points.



c. Derive the firm's cost function C(q), which gives the cost for any output goal q.

$3L = 2K$ & $q = \min\{3L, 2K\}$

OR EQUIVALENTLY

$q = 3L = 2K$

$\boxed{C = 7q}$

Part IV. [25] Short answer

x. [5] **Supply-and-Demand: calculating equilibrium – complement or substitute, normal or inferior, elasticities, find P^* and Q^***

$Q_D = 500 - 4I - 3P^G - 6P$

$Q_S = 100$

Income is I = 25 and the price of a related good is $P^G = 20$.

a. Find the equilibrium.

(SEE P17)

$$\boxed{\begin{matrix} P^* = 40 \\ Q^* = 100 \end{matrix}}$$

b. Find the income elasticity at the equilibrium.

$\varepsilon_I = -1$

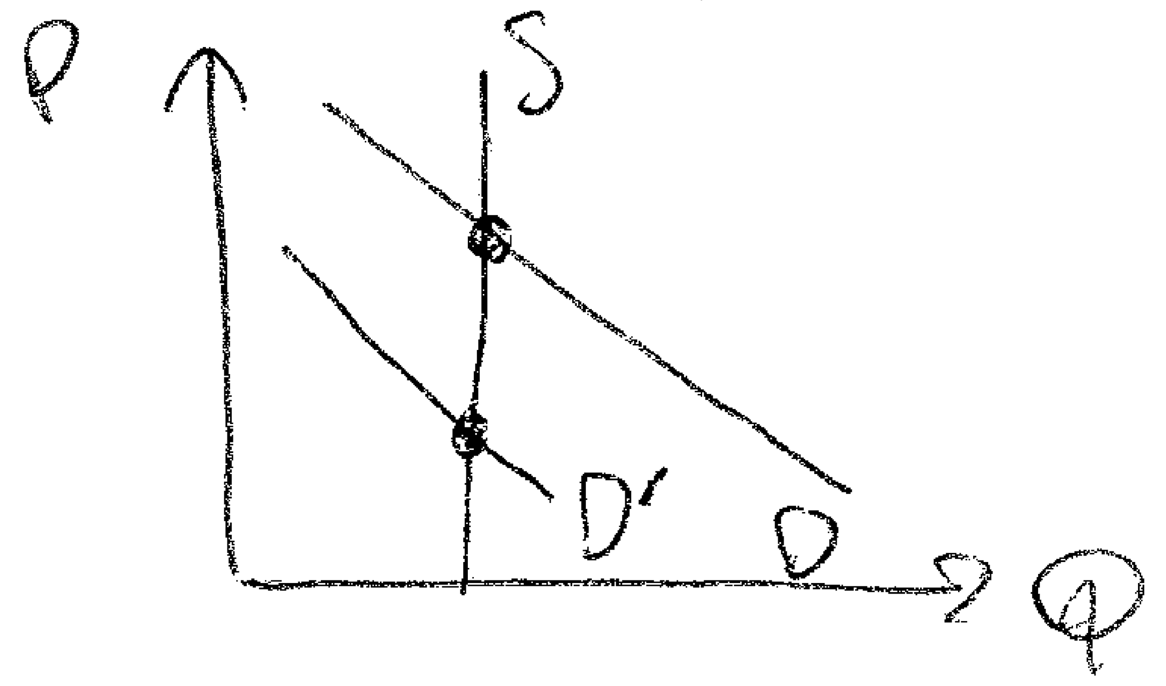
c. Is the good ~~normal~~ or inferior? Also, is it a luxury, a necessity or neither?

~~UNIT ELASTIC~~

d. Is the ***other good*** a complement or a substitute?

x. [5] **Supply-and-Demand basics: perfectly inelastic/elastic Supply/Demand, related goods, two shifts**

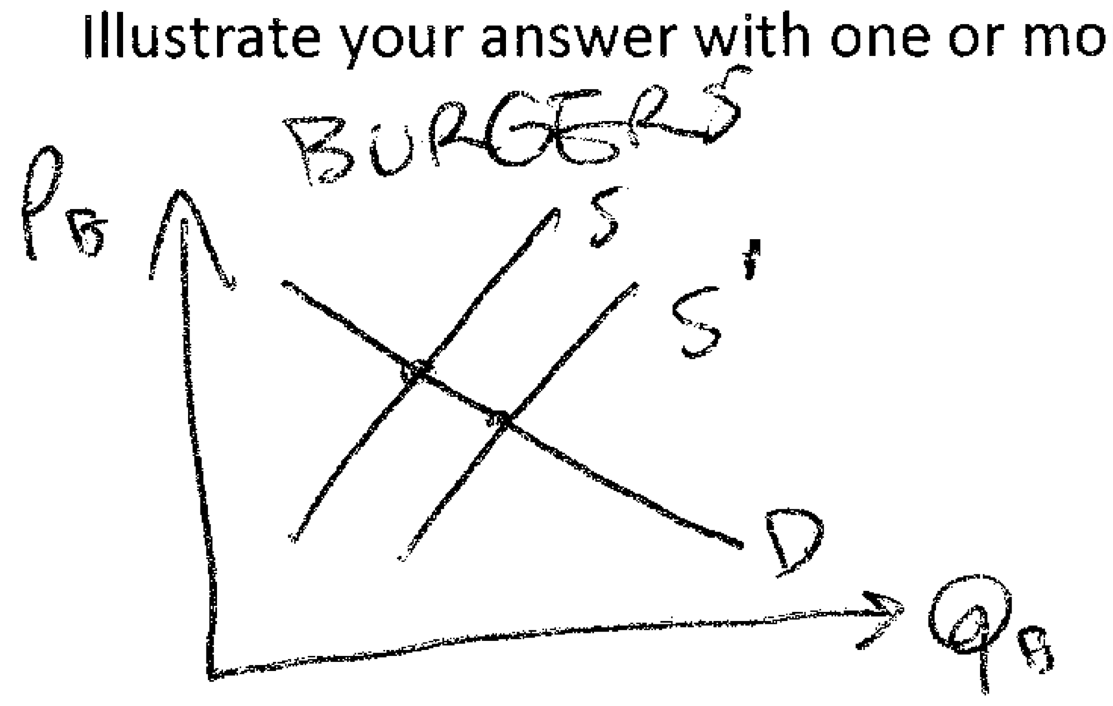
a. The Supply of tickets to the World Cup finals is ***perfectly inelastic.*** What happens to the equilibrium price and quantity if a substitute becomes cheaper (for example, if the game is streamed live online for free)? Illustrate your answer with a graph.



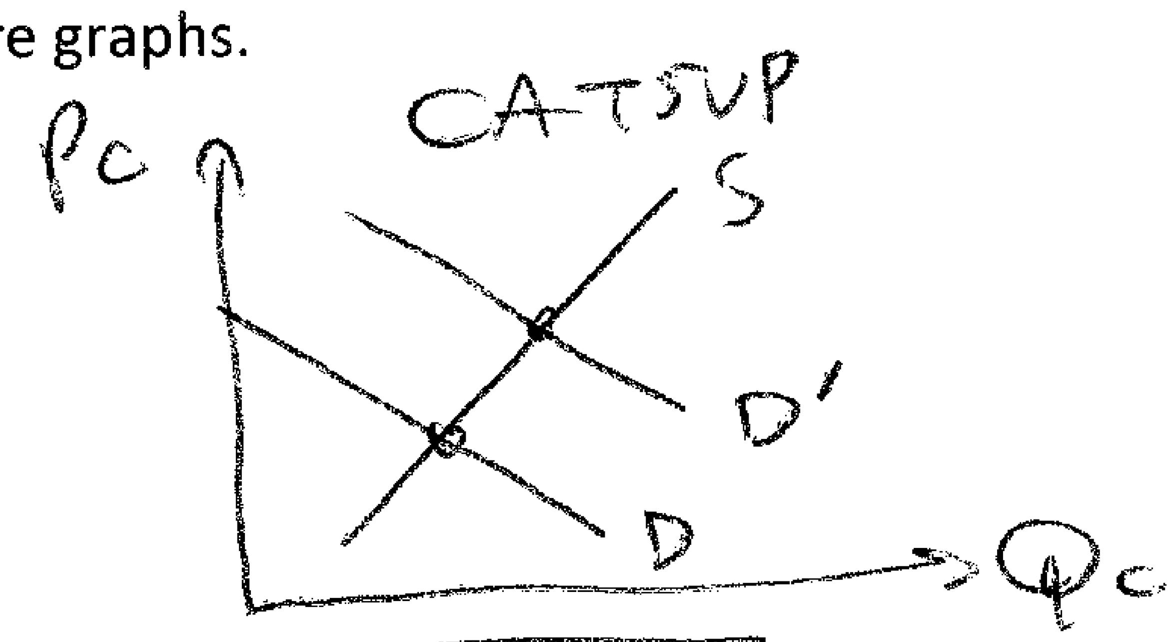
P* FALLS

Q* DOES NOT CHANGE

b. Hamburgers and catsup are complements. The price of beef – an input for hamburgers – falls. What happens to the equilibrium price and quantity in the market for catsup? Illustrate your answer with one or more graphs.



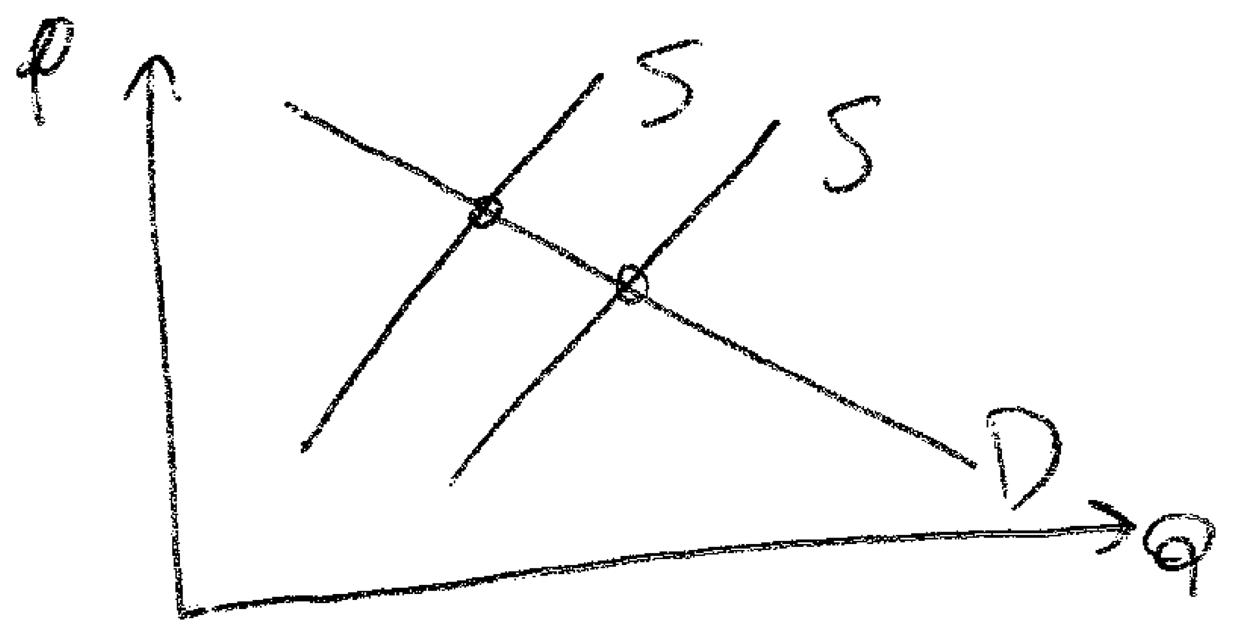
$P_B^* \downarrow$



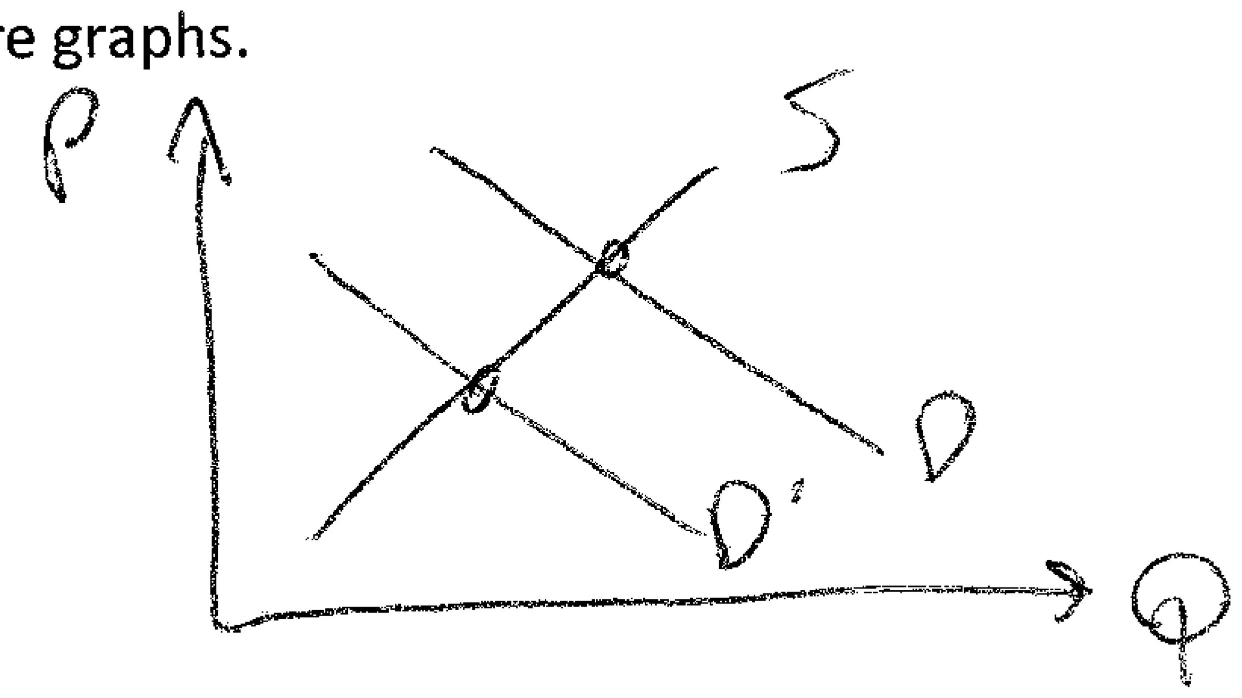
$P_C^* \uparrow$

$Q_C^* \uparrow$

c. There is an improvement in technology at the same time as a reduction in the number of consumers. What combined effect do these changes have on the equilibrium price and quantity? Explain using one or more graphs.



$P^* \downarrow Q^* \uparrow$



$P^* \downarrow Q^* \downarrow$

$P^* \downarrow$ Q INDETERMINATE

x. [5] **Games: find all NE of a 2x2/normal-form game**

		Player 2 L	Player 2 R
Player 1	U	1, 3	0, 2
Player 1	D	0, 2	3, 0

a. Find all Nash Equilibria of the game above.

(U, L)

		Player 2 L	Player 2 R
Player 1	U	1, 3	0, 2
Player 1	D	0, 2	3, 3

b. Find all Nash Equilibria of the game above.

(U, L), (D, R)

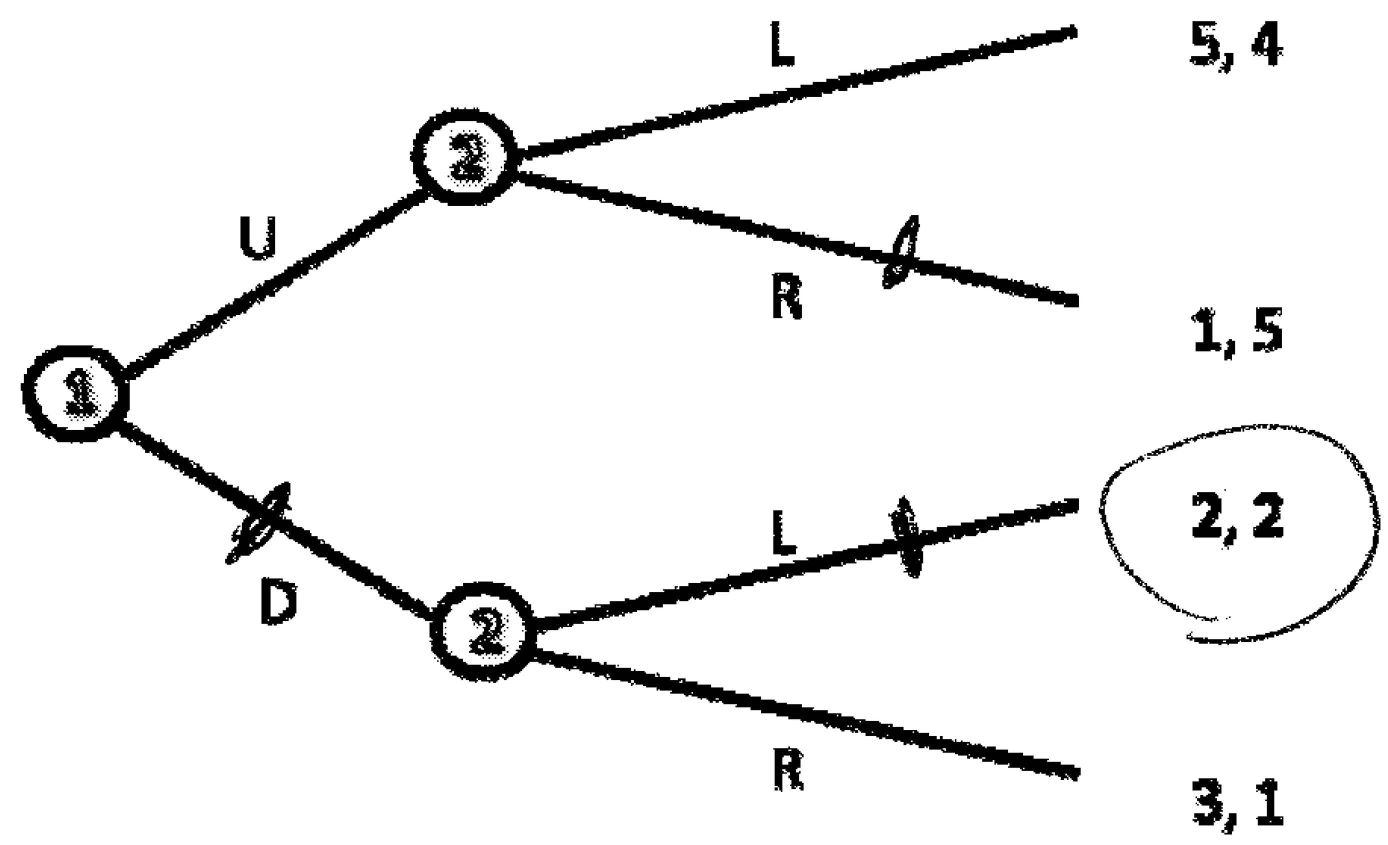
$(\frac{1}{2}U \oplus \frac{1}{2}D), (\frac{3}{4}L \oplus \frac{1}{4}R)$

c. Are any of the pure strategy Nash Equilibria found above inefficient? Which, if any?

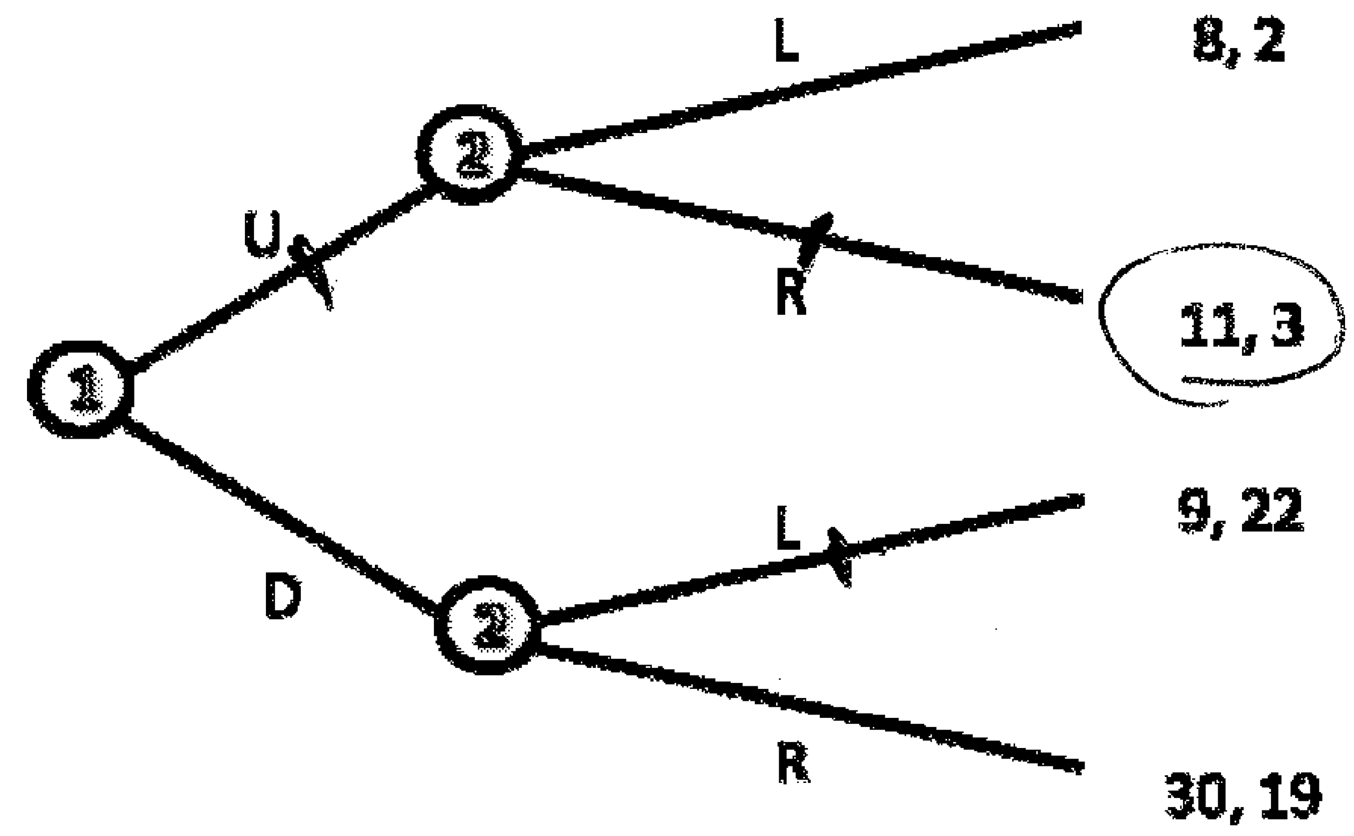
(U, L) IS PARETO DOMINATED BY (D, R) AND HENCE NOT EFFICIENT

OR (D, R) IS A PARETO IMPROVEMENT ON (U, L)

x. [5] **Games: find the SPNE outcome of an extensive-form game**



a. Find the unique Subgame-Perfect Nash Equilibrium outcome of the game above and circle it.



b. Find the unique Subgame-Perfect Nash Equilibrium outcome of the game above and circle it.

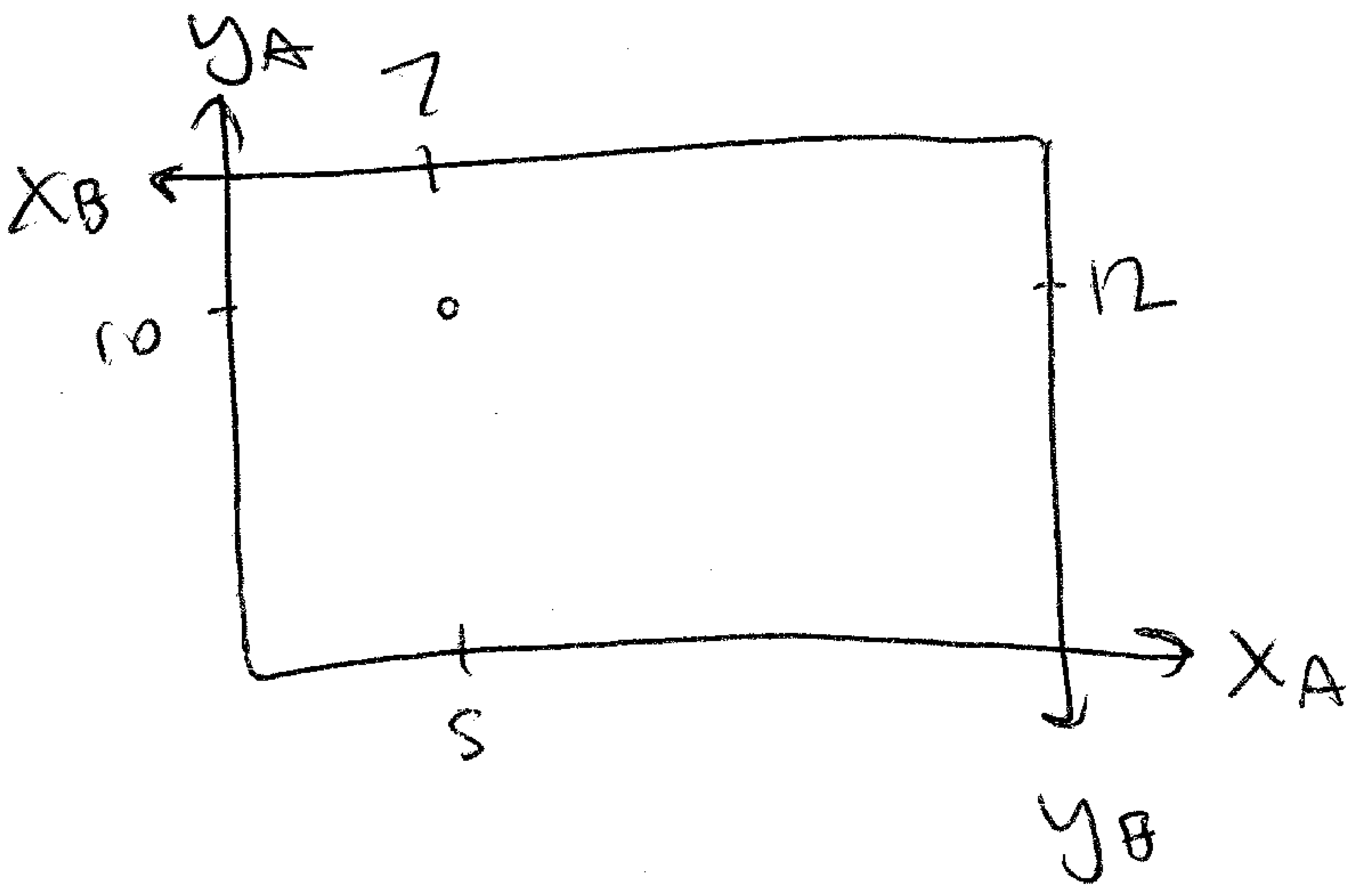
c. For each of the cases above, is there another outcome that is a Pareto improvement?

YES, FOR a, (U, L) PARETO DOMINATES
FOR b, (D, R) " "

x. [5] **Edgeworth box/Pure exchange: graphing**

Consumer A has endowment $X_A^0 = 5$ and $Y_A^0 = 10$; and consumer B has endowment $X_B^0 = 7$, $Y_A^0 = 12$.

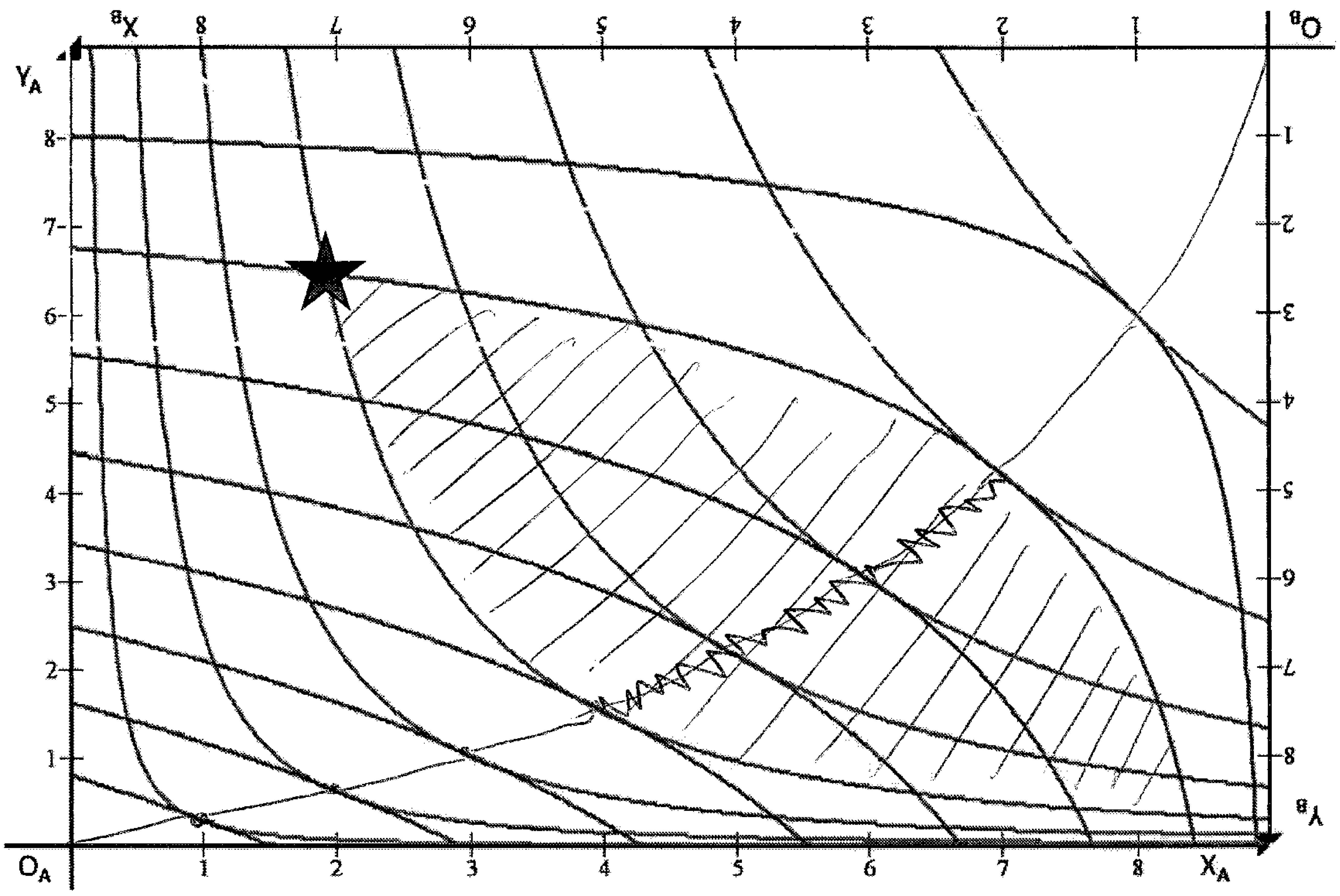
a. Draw the Edgeworth box, labeling the four axes.



b. Mark the endowment point, labeling the four quantities.

x. [5] **Edgeworth box/Pure exchange: concepts**

The Edgeworth box for two consumers is given below, along with several of their indifference curves. The endowment point is marked with a star.



a. Sketch the contract curve, representing all efficient allocations.

b. Shade in the allocations that are Pareto improvements on the endowment, representing trades the consumers are both willing to make.

c. Sketch the core, representing the Pareto improvements that are also efficient.

x. [5] **Edgeworth box/Pure exchange: equilibrium**

Ann and Bob have preferences and endowments given by

U_A	=	X^2Y	U_B	=	XY
MU_{AX}	=	$2XY$	MU_{XB}	=	Y
MU_{AY}	=	X^2	MU_{YB}	=	X
X_A^0	=	70	X_B^0	=	70
Y_A^0	=	70	Y_B^0	=	70

a. Find the Marginal Rates of Substitution for each consumer at the endowment allocation, MRS_A and MRS_B.

$MRS_A = -2$

$MRS_B = -1$

b. Is the endowment allocation efficient? Explain.

NO, SLOPES DON'T MATCH

c. Find the pure exchange equilibrium price P_X, and quantities X^*_A, Y^*_A, X^*_B and Y^*_B (the price of Y is fixed at $P_Y = 1$).

$P_X = \frac{7}{5}$

$X_A = 80$

$Y_A = 56$

$X_B = 60$

$Y_B = 94$

① FIND DEMANDS (SEE P20) $\rightarrow D_x = X_A + X_B$, $D_y = Y_A + Y_B$

② FIND SUPPLIES

$S_y = Y_A^0 + Y_B^0$

$S_x = X_A^0 + X_B^0$

③ SET $S_y = D_y$ OR $S_x = D_x$ $\rightarrow P_x^*$

④ PLUGIN P_x TO ① FOR THE REST

x. [5] **General equilibrium in two markets**

Solve for the general equilibrium. Your answer should consist of four numbers: price and quantity for good 1 and good 2.

$Q_{D1} = 10 - 3P_1 + P_2$
$Q_{D2} = 6 - 4P_2 + P_1$
$Q_{S1} = -3 + 4P_1$
$Q_{S2} = -2 + 6P_2$

① $Q_{S1} = Q_{D1}$ & $Q_{S2} = Q_{D2}$
SOLVE TWO EQNS IN TWO UNKNOWNS → P_1^*, P_2^*
② PLUGIN P_1^*, P_2^* TO Q FORMULAS → Q_1^*, Q_2^*

$$\boxed{\begin{array}{l} P_1^* = 2,\ P_2^* = 1 \\ Q_1^* = 5,\ Q_2^* = 4 \end{array}}$$

x. [5] (not on test, but good practice) **Pareto efficiency**

Suppose Ann and Bob have endowments and preferences over goods X and Y given by

$U_A = XY$, $MU_{XA} = Y$, $MU_{YA} = X$ $\qquad X_A^0 = 0$, $Y_A^0 = 8$
$U_B = X+Y$, $MU_{XB} = 1$, $MU_{YB} = 1$ $\qquad X_B^0 = 10$, $Y_B^0 = 2$

a. State a reallocation of the goods that is a Pareto improvement over the endowment. There is more than one right answer.

A (0,0) $\qquad u_A = 0 \geq 0 = u_A^0$
B (10,10) $\qquad u_B = 20 > 12 = u_B^0$ ✓

b. Show that giving Ann and Bob each 5 units of each good is efficient.

$MRS_A = -1$
$MRS_B = -1$

x. [5] **Short-run costs and production for Cobb-Douglas**

A firm has technology given by

$F(L, K) = L^{1/3}K^{2/3}$

$MP_L = (1/3)\ K^{2/3}/L^{2/3}$

$MP_K = (2/3)\ L^{1/3}/K^{1/3}$

The prices of inputs are w = 32 for labor and w = 25 for capital.

Find the firm's short-run cost function if the firm's capital is fixed at K = 4.

PLUGIN K TO $q = F(L, K)$
SOLVE FOR L
PLUG K & L INTO C

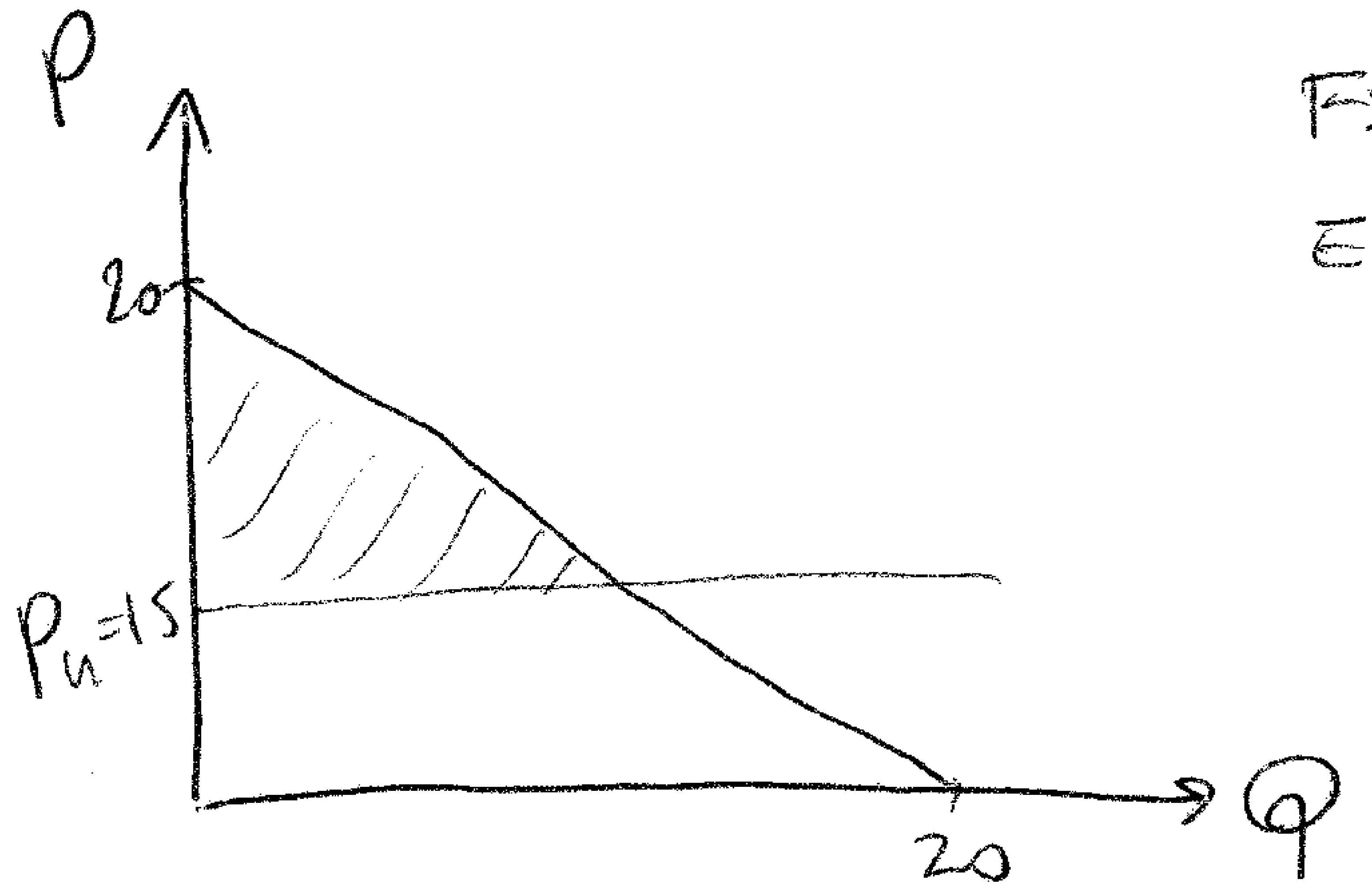
$$\boxed{C = 2q^3 + 100}$$

Bx. [2] **Optimal two-part tariffs**

Ann's Demand function for sandwiches from a campus cafeteria is

$Q_D = 20\text{-}P$

The cafeteria has set a price of P = 15 per sandwich, and wants to charge Ann an access fee to get into the cafeteria. What fee P_A should it charge Ann to maximize its revenue?



FIND Q_u
EXTRACT SURPLUS
$P_A^* = CS$

$\boxed{12.5}$

Bx. [2] **Monopoly pricing in two markets – optimal P_1^M, P_1^M, q_1^M and q_2^M.**

A monopolist is selling a good it two markets and has marginal cost MC = $2(Q_1 + Q_2)$. (Inverse) Demand in the two markets is given by

$P_1 = 100 - Q_1$

$P_2 = 190 - 3Q_2$

What prices should the monopolist charge in the two markets to maximize profits?

① $MC = MR_1$ & $MC = MR_2$

$\rightarrow Q_1^m = 15, Q_2^m = 20$

② PLUG IN Q_1^m, Q_2^m TO P_1, P_2

$$\boxed{\begin{array}{l} P_1^m = 85 \\ P_2^m = 130 \end{array}}$$

Bonus. [10]

There will be 5 two-point questions. Some examples of the sort of question you might see...

Bx. [2] **Interpreting ICC graphs**

Bx. [2] **Define (something)**

Bx. [2] **Show that (something about monopoly and elasticity)**

Bx. [2] **Assumptions on preferences, and when they are violated**

Bx. [2] **State the two welfare theorems for pure exchange economies**

Bx. [5] **Increasing, decreasing or constant returns-to-scale with exotic technology**

A firm's production function is given by $F(L,K) = L^{1/2}K^{3/4} + 3K$. Are there increasing, decreasing or constant returns to scale? Show your work.

Bx. [2] **Cobb-Douglas technology with non-½ exponents – deriving costs**

A firm's technology is given by

$F(L, K) = L^{2/3}K^{1/3}$

$MP_L = (2/3)\ K^{1/3}/L^{1/3}$

$MP_K = (1/3)\ L^{2/3}/K^{2/3}$

And the input prices are $w = 16$, $r = 1$.

Find the firm's cost function.

$C = 12q$

Bx. [2] **Short-run costs and production for perfect substitutes or fixed-proportions**

A firm has a production function F(L, K) = 5L + 4K and a fixed amount K = 10 of capital in the short run. Input prices are w = 2 for labor and r = 5 for capital. Find the firm's short-run cost function.

HINT: ONLY BUY LABOR IF NEEDED

Bx. [2] **Deriving Demand for perfect substitutes or perfect complements preferences**

A consumer has a utility function U = min{5X, 4Y} and income I = 1000. Find the consumer's demand for X and Y, expressed in terms of the prices of X and Y.

$$y^* = \frac{1000}{\frac{4}{5}P_x + P_y}$$

$$X^* = \frac{1000}{P_x + \frac{5}{4}P_y}$$

WHAT ABOUT PERF. SUBS?

Bx. [2] **Exotic budgets**

A consumer has income I = 100. The price of good X is $P_X = 5$. The price of good Y is $P_Y = 5$ if the consumer buys fewer than 10 units, but it is $P_Y' = 2$ LOWERED TO ~~if the consumer buys more than~~ FOR UNITS BEYOND THE FIRST 10 units. Graph the consumer's budget set, labeling any important points.

	x	y
ALL X	20	0
ALL y	0	35
	10	10

10@5 + 25@2