## L. Input Markets

1. Show the loss in rent if a labor (input) market which used to be competitive becomes a monopsony. Do this using a graph in which the demand for labor curve is horizontal. Also, divide the loss in rent into deadweight loss and a transfer, an explain whom the transfer is from and whom the transfer is now going to.

2. Refer to Figure 1.

   (a) If the buyer of labor is a monopsonist, what will $w$ and $L$ be? Label these points $w_m$ and $L_m$ on Fig. 1.

   (b) If the buyer of labor is a monopsonist, shade in the region representing economic rent in Fig. 1; use vertical lines for shading.

   (c) If the labor market is competitive, what will $w$ and $L$ be? Label these points $w_c$ and $L_c$ in Fig. 1.

   (d) If the labor market is competitive, shade in the region representing economic rent in Fig. 1; use horizontal lines for shading.

   (e) Indicate in Fig. 1 the loss in economic rent which occurs when the labor market switches from being competitive to being monopsonistic. This loss can be split up into two parts: a deadweight loss and a transfer from workers to the firm. Show these two parts on the figure, and explain your answer a little.

3. Suppose a firm has a marginal revenue product curve for labor $L$ of

$$L = 10 - MRP_L\,.$$

   Let $w$ be the price of labor (the "wage rate"). Suppose the supply curve of labor which the firm faces is given by

$$L = 2w$$

   and the marginal expense of labor curve is given by

$$ME_L = L\,.$$

   Find the equilibrium amount of labor hired, the wage, and the rent accruing to labor. (Besides giving the three numerical answers, please draw a picture illustrating your solutions.)

4. Suppose the supply of labor curve has the form $p_L = Q_L$ where $Q_L$ is the quantity of labor and $p_L$ is the price of labor. Suppose the firm hiring the labor is competitive in its output market, where the price of the output is 2. Suppose the marginal product of labor is $6 - Q_L$.

   (a) If the firm acts competitively in the labor market, how much rent will workers receive?

   (b) If the firm acts as a monopsonist in the labor market, how much rent will workers receive? Note that the marginal expense curve is $ME = 2Q_L$.

5. Suppose a firm which is both a monopolist and a monopsonist uses only labor to produce output. Let $L$ be the amount of labor it hires, $w$ be the wage it must pay, $Q$ be the output it produces, and $P$ be the price of its output. Suppose it turns out that:

| $L$ | $w$ | $Q$ | $P$ |
|---|---|---|---|
| 1 | 2 | 10 | 20 |
| 2 | 4 | 18 | 14 |
| 3 | 6 | 20 | 13.1 |
| 4 | 8 | 21 | 13 |

   (Column 2 shows the upward-sloping labor supply curve; Column 3 shows the production function; and Column 4 shows the downward-sloping output demand curve.) How much labor will the firm use?

   Hint: One way to figure this out is to start by finding $TR$ and $MR$, $MP$, the product of $MR$ and $MP$, and $TE$ (total expense) and $ME$. If you do it this way, remember that $MR$ is the change in revenue divided by the change in output (not input). Another way is to start by finding $MRP$ (marginal revenue produce), $TE$, and $ME$.

6. A firm makes corn $Q_c$ from fertilizer $F$ according to the production function $Q_c = 2F$, so the marginal physical product of fertilizer is 2. (Ignore the fact that this does not satisfy the Law of Diminishing Returns–this makes the math easier.) This firm is a monopoly supplier of corn, and the demand curve for corn which it faces is given by $P_c = 10 - \frac{1}{2}Q_c$, so marginal revenue $MR = 10 - Q_c$. In addition, the firm is a monopsony buyer of fertilizer, and the supply curve for fertilizer which it faces is given by $P_F = \frac{1}{2}F$ (or $F = 2P_F$), so the

marginal expense of fertilizer to the firm is $ME_F = F$. Find the profit-maximizing pounds of fertilizer, bushels of corn, price of fertilizer, and price of corn.

7. A firm produces corn $Q$ using only fertilizer as an input. It is both a monopolist and a monopsonist. It faces a demand curve for corn of $p = 4 - Q$ (so $MR = 4 - 2Q$). The firm has a production function of $Q = 2F$ where $F$ is fertilizer (so $MP_F = 2$). It faces a supply curve for fertilizer of $F = p_F$ where $p_F$ is the price of fertilizer; this implies that $ME = 2F$.

   Find the optimum values of $F$ and output $Q$ for the firm, and calculate the firm's profit.

8. Suppose a firm makes corn $Q$ using fertilizer $F$ and water $W$. The price of water is \$2/gallon. The firm is a monopsonist in the fertilizer market; if the firm wishes to buy '$F$' pounds of fertilizer, the price of fertilizer will be \$3$F$/pound. (So for example if the firm wanted to buy 5 pounds of fertilizer, the price of fertilizer would be \$15/pound.)

   (a) If the firm wishes to buy '$F$' pounds of fertilizer, what is the algebraic expression for the total amount of money it will spend on buying fertilizer?

   (b) Sketch the supply curve of fertilizer.

   (c) Tell me everything you know about the marginal expense curve of fertilizer facing this firm. (You do not have to derive the algebraic expression for the marginal expense curve of fertilizer because that would require calculus.)

   (d) In this problem, the firm does not have isocost *lines*, it has isocost *curves*. Give the algebraic expression for one such curve. (You do not have to sketch this curve.)

9. Suppose a firm produces corn $Q$ from fertilizer $F$ according to the production function $Q = 2F$ (so the marginal product of fertilizer is 2). Suppose that the demand curve for corn is $P = 10 - Q$ where $P$ is the price of corn. (This implies, where relevant, that marginal revenue equals $10 - 2Q$.) Finally, suppose that the supply curve of fertilizer is given by $F = p_F$ where $p_F$ is the price of fertilizer. (This implies, where relevant, that marginal expense equals $2F$.)

   Consider the following four situations:

(a) The firm is competitive in both its input market and its output market.

(b) The firm is competitive in its input market and the firm is a monopolist in its output market.

(c) The firm is a monopsonist in its input market and the firm is competitive in its output market.

(d) The firm is a monopsonist in its input market and the firm is a monopolist in its output market.

What is the numerical value of the firm's profit in each of these situations? Also answer: Which situation gives the lowest profit and which situation gives the highest profit, and why? (Guess the answer to this second question if you weren't able to calculate the profits numerically in the previous question.)

10. A firm produces corn output $Q_c$ from labor input $L$ according to the production function $Q_c = \frac{1}{2}L$. This means that the marginal product of labor is 1/2.

    The firm is a competitive buyer of labor. The labor supply $L^s$ is equal to $2w$ where $w$ is the wage rate. (This is equivalent to saying that the labor supply curve as a function of $L$ is $L/2$.) For simplicity, suppose this is the only buyer of labor in its area (even though it behaves competitively).

    The firm is a monopolist in the output (corn) market. The demand for corn is given by $P = 12 - \frac{1}{2}Q_c$ (so marginal revenue $MR = 12 - Q_c$).

    Find the equilibrium price of corn, amount of corn produced, wage rate, and quantity of labor hired.

11. A firm produces corn output $Q_c$ from labor input $L$ according to the production function $Q_c = \frac{1}{2}L$. This means that the marginal product of labor is $\frac{1}{2}$. The firm is a monopsony buyer of labor. The labor supply $L^s$ is equal to $2w$ where $w$ is the wage rate. (This is equivalent to saying that the labor supply curve as a function of $L$ is $L/2$.) The marginal expense is equal to $L$.

    The firm is competitive in the output (corn) market. The demand curve of corn is given by $P = 12 - 2Q_c$. For simplicity, suppose this is the only corn firm is existence (even though it behaves competitively).

    Find the equilibrium price of corn, amount of corn produced, wage rate, and quantity of labor hired.

12. A firm uses labor $L$ to produce corn $Q$. The firm is a monopolist in the corn market; it faces a demand for corn of the form $p = 12 - \frac{1}{2}Q$ (so marginal revenue $MR = 12 - Q$); $p$ is the price of corn. The firm is also a monopsonist in the labor market; it faces a supply for labor of the form $p_L = \frac{1}{2}L$ (so marginal expense $ME = L$); $p_L$ is the price of labor. The firm's production function is $Q = 2\sqrt{L}$ (so the marginal product of labor is $\frac{1}{\sqrt{L}}$). Find the following four numbers: the equilibrium price of corn, $p$; the equilibrium output of corn, $Q$; the equilibrium price of labor, $p_L$; and the equilibrium quantity of labor, $L$.

    - Hint 1: Write down the optimal condition of the firm in its input market.
    - Hint 2: The correct answer for $L$ is either 1 or 4 or 9 or 16 or 25 or 36 or 49.

13. This question concerns taxes.

    (a) Suppose an output market has a downward-sloping market demand curve and an upward-sloping industry supply curve, as usual. Suppose the government imposes a tax on this good. Show how the region of social surplus is divided into profit (which goes to firms), consumer surplus (which goes to consumers), and tax revenue (which goes to the government).

    (b) How could you determine whether a specific tax on a monopolist was borne mostly by consumers or mostly by the monopolist—or does a monopolist never bear the burden of a tax? To answer this question, show how price changes when the tax is imposed on the monopolist; then try to compare the amount of the price change to the amount of the tax, at least for your particular example.

    (c) How could you determine whether a specific tax on a monopsonist was borne mostly by input suppliers or mostly by the monopsonist—or does a monopsonist never bear the burden of a tax? To answer this question, show how price changes when the tax is imposed on the monopsonist; then try to compare the amount of the price change to the amount of the tax, at least for your particular example.

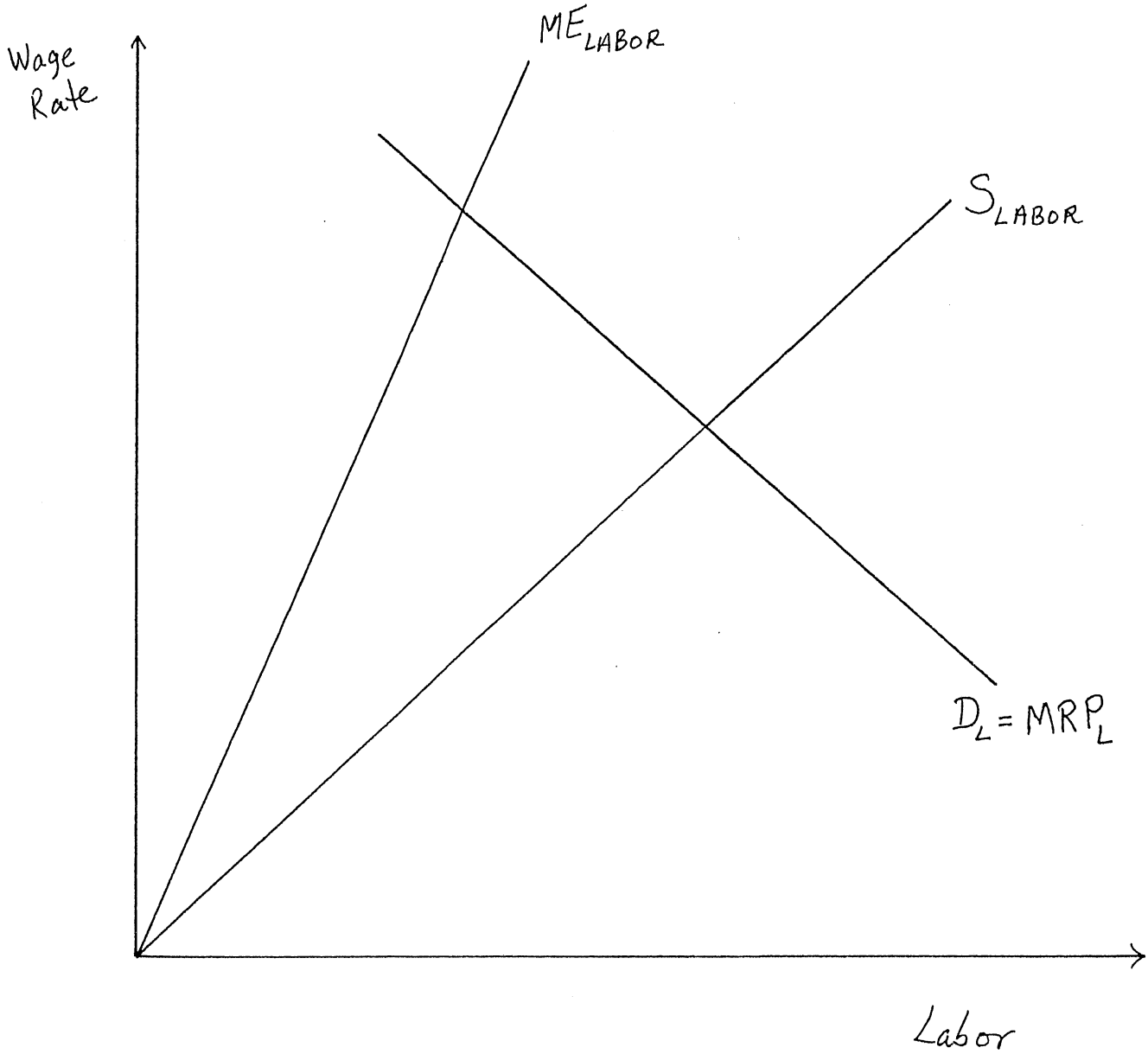
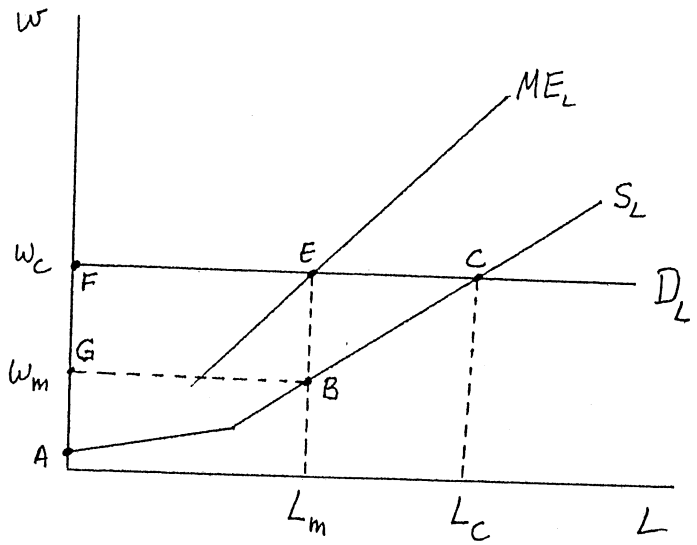



Figure 1

Question 2's Fig. 1

# Answers

(1)




W: wage rate

L: amount of labor

$ME_L$: marginal expense of labor

For the competitive situation, $D_L = S_L$, so equilibrium is at $(L_c, W_c)$. Since rent is the area above the supply curve and below the price line, the rent under competition is given by the area ACF. In the monopsony situation, the firm sets marginal expense equal to demand (point E), determining $L_m$ and the market-clearing wage $W_m$. Rent is the area ABG.

Therefore, the area FCBG is the amount of rent which the workers (suppliers of the input) lose if they face a monopsonist. CBE is the deadweight loss; it used to be rent for the workers, but now it goes to no one because the monopsonist shrinks hiring. The area FEBG is a transfer from workers to the monopsonist, because while the $L_m$ workers are worth $D_L$ to the monopsonist (remember that $D_L$ is the MRP of labor, measuring how much labor is worth to the firm), the monopsonist only has to pay $W_m$ to them.

| | |
|---|---|
| $W_c, L_c$: 5pts | deadwt. loss: 5pts |
| comp. rent: 5pts | transfer: 5pts |
| ME curve: 5pts | |
| $W_m, L_m$: 5pts | |
| monopsony rent: 5pts | |

② a) You find $L_m$ from $ME_L = MRP_L$. For that $L_m$, you find $w_m$ by finding which $w$ will clear the market, which you get from $S_L$. See Fig. 1.

b) Rent is the area above the supply curve and below the input price line, as on Fig. 1.

c) Just set $S_L = D_L$.

[7 POINTS FOR EACH PART OF QUESTION 3.]

d) Same principle as (b).

e) The loss in (economic) rent is evidently the area $bc w_m w_c$ in Fig. 1. Area abc is the deadweight loss, since labor from $L_m$ to $L_c$ is not hired any more. The remaining area of loss, $w_c ac w_m$, is a transfer from workers to the firm because it used to accrue to workers but now forms part of the excess of each worker's $MRP_L$ over the wage he is paid.

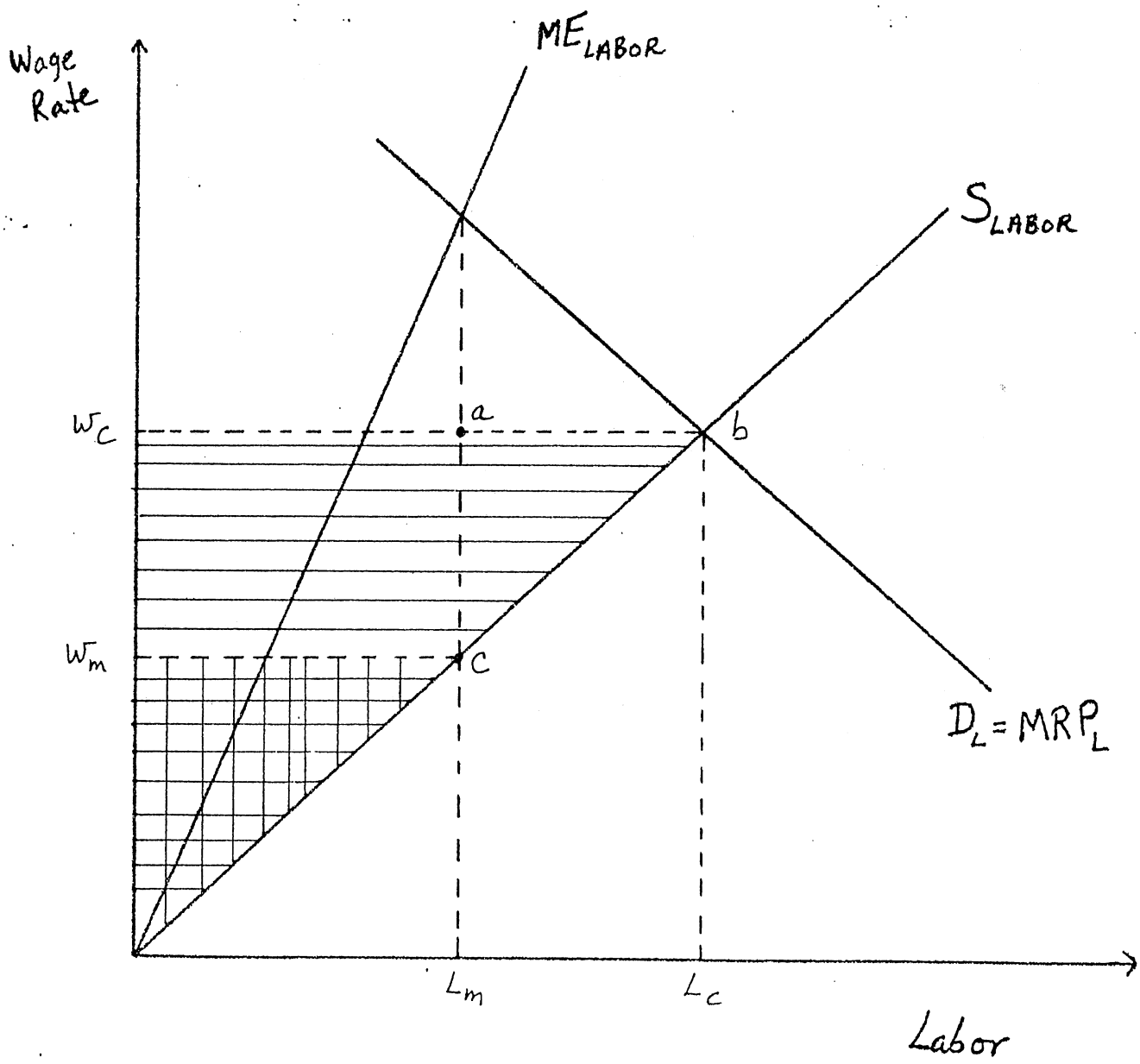
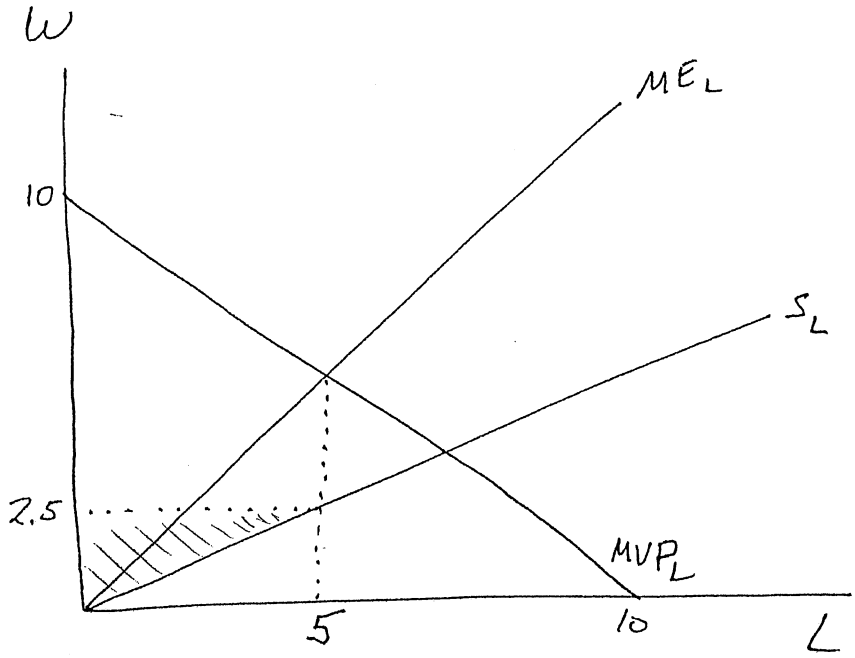



Figure 1

(3)




10 points (OK without the 2.5 and 5)

MVP curve: $L = 10 - MVP \Rightarrow$

4 pts → $MVP = 10 - L$

4pts → S curve: $L = 2w \Rightarrow w = \frac{1}{2}L$

4pts → ME curve: $w = ME = L$

4pts → In equilibrium, $MVP_L = ME_L$: $10 - L = L \Rightarrow L = 5$

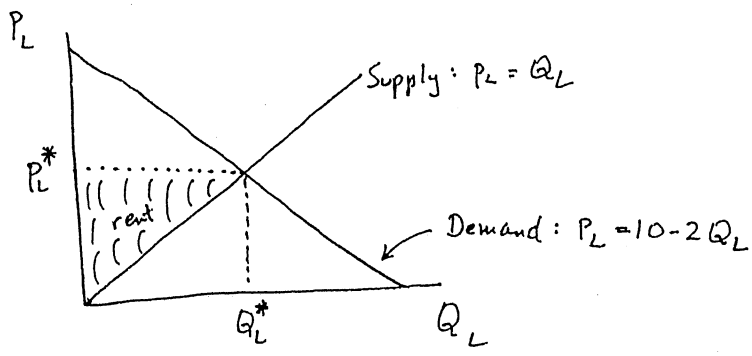
4pts → Then get market-clearing wage from the S curve: $w = \frac{1}{2}(5) = \$2.50$.

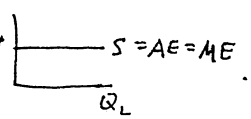
$$\text{rent} = \tfrac{1}{2}(5)(2\tfrac{1}{2}) = \tfrac{1}{2} \cdot 5 \cdot \tfrac{5}{2} = \tfrac{25}{4} = 6\tfrac{1}{4}$$

(4) a) Demand for labor = MRP = MR · MP (5pts)

$= 2(5 - Q_L) = 10 - 2Q_L$.

[Note: The exam had a misprint. The marginal product of labor was supposed to be $6 - Q_L$, which gives simpler arithmetic.]




$(Q_L^*, P_L^*)$ is the competitive equilibrium. The reason is that if the firm takes $P_L^*$ as given — as it does because it is competitive in the labor market — then it sees its supply curve as being flat at $P_L^*$, like this: 

So it sets ME = MRP, and since ME is flat at $P_L^*$, it chooses to hire $Q_L^*$ workers when the price is $P_L^*$ (which is the answer we wanted).

Setting D = S $\Rightarrow$ $P_L = Q_L$ and $P_L = 10 - 2Q_L$

5 pts in total

$Q_L = 10 - 2Q_L$

$3Q_L = 10$

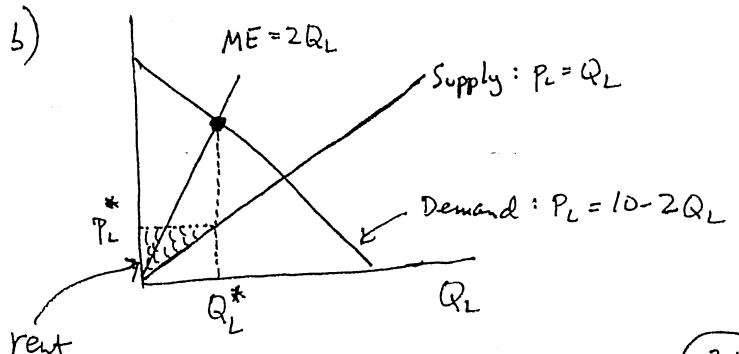
$Q_L^* = \frac{10}{3} = 3\frac{1}{3}$ ← (3pts)

$P_L^* = 3\frac{1}{3}$ ← (3pts)

(3pts)

rent $= \frac{1}{2}$ base · height $= \frac{1}{2} Q_L^* P_L^* = \frac{1}{2} \cdot \frac{10}{3} \cdot \frac{10}{3} = \frac{50}{9} = 5\frac{5}{9}$.

b)




ME = MRP

$2Q_L = 10 - 2Q_L$ } (5 pts in total)

$4Q_L = 10$

$Q_L^* = \frac{10}{4} = \frac{5}{2} = 2\frac{1}{2}$ ← (3pts)

(3pts) → $P_L^* = 2\frac{1}{2}$ from the supply curve →

3 pts

rent $= \frac{1}{2}$ base $\cdot$ height $= \frac{1}{2} Q_L^* p_L^* = \frac{1}{2} \cdot \frac{5}{2} \cdot \frac{5}{2} = \frac{25}{8} = 3\frac{1}{8}$.

So rent drops from $5\frac{5}{9}$ to $3\frac{1}{8}$ when workers have to face a monopsonist.

| L | W | Q | P | TR | ΔTR | ΔQ | MR = $\frac{\Delta TR}{\Delta Q}$ | MPP = $\frac{\Delta Q}{\Delta L}$ | MRP (MR · MPP) | TE | ME |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 10 | 20 | 200 | | | | | | | |
| | | | | | | | | | | 2 | |
| 2 | 4 | 18 | 14 | 252 | 52 | 8 | $6\frac{1}{2}$ | 8 | 52 | 8 | 6 |
| 3 | 6 | 20 | 13.1 | 262 | 10 | 2 | 5 | 2 | 10 | 18 | 10 |
| 4 | 8 | 21 | 13 | 273 | 11 | 1 | 11 | 1 | 11 | 32 | 14 |

TE and TR: 2 pts. total

Compare these two columns:

hire 3 workers

conclusion: 8 pts

Remark: one can also get MRP directly from MRP = $\frac{\Delta TR}{\Delta L}$. In this example, $\Delta L = 1$, which is why the ΔTR column is just like the MRP column.

⑥

For grading: if MR and MPP are missing, count MRP as 15 pts.

(6) $ME_F = MRP_F$. Since $MRP_F = MP_F \cdot MR_C$ [ $MRP_F = \frac{\Delta TR}{\Delta F}$, $MP_F = \frac{\Delta Q}{\Delta F}$ (Q: corn!), $MR_C = \frac{\Delta TR}{\Delta Q}$ ], one has (TR: corn!)

(7 pts)

(8 pts) $\rightarrow ME_F = MP_F \cdot MR_C$

(3 pts) $\rightarrow F = 2 \cdot (10 - Q)$. But from the production function, $Q = 2F$. Hence

(7 pts) $\rightarrow F = 2(10 - 2F)$

$F = 20 - 4F$

$5F = 20$

(2 pts) $\rightarrow$ $\boxed{F = 4.}$ Then $Q = 2F$, so $\boxed{Q = 8.}$ (2 pts)

From the supply curve for fertilizer, $P_F = \frac{1}{2}F$, so $\boxed{P_F = 2.}$ (3 pts) From the demand curve for corn, $P = 10 - \frac{1}{2}Q = 10 - \frac{1}{2}(8)$, so $\boxed{P_C = 6}$. (3 pts) For another way to do this, see over →

## Another Way to work Question 6

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TC}{\Delta F}\,\frac{\Delta F}{\Delta Q} = ME_F \div MPP_F = F \div 2$$

($\Delta Q$: corn)

$$MR = 10 - Q = 10 - 2F$$

$$MR = MC \Rightarrow \quad 10 - 2F = F/2$$

$$20 - 4F = F$$

$20 = 5F \Rightarrow F = 4$, as before. The other answers follow exactly as before.

(7)

$P = 4 - Q$

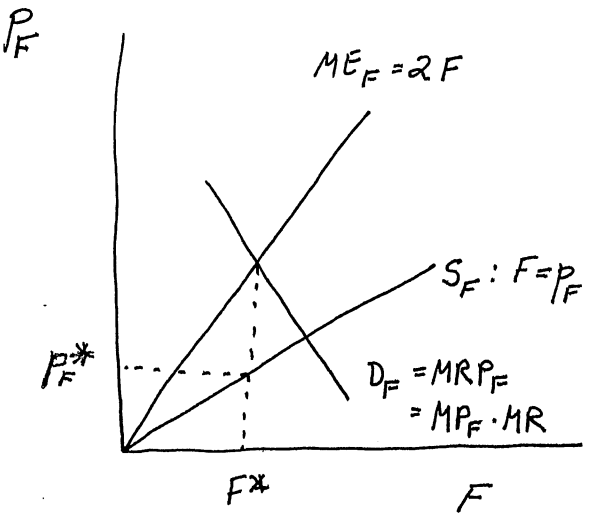
$MR = 4 - 2Q$

$Q = 2F$

$MP_F = 2$

$S_F : F = P_F$

$ME_F = 2F$




$D_F = MP_F \cdot MR = 2(4 - 2Q) = 8 - 4Q$

$= 8 - 4(2F)$ from the production function

$= 8 - 8F.$

We find $F^*$ by setting $D_F$ equal to $ME_F$, so

$8 - 8F = 2F$

$8 = 10F \Rightarrow \underline{F^* = 0.8.}$

Then $P_F$ comes from the supply curve : $P_F = F = 0.8$ so $\underline{P_F^* = 0.8.}$

Output $Q = 2F = 2(0.8) = \underline{1.6.}$

$TC = P_F^* F^* = 0.8 \cdot 0.8 = 0.64$

To get TR : $Q = 1.6$ from above ; $P = 4 - Q = 4 - 1.6 = 2.4.$

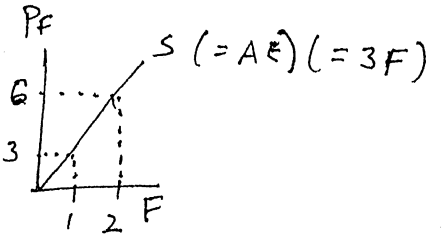
so $TR = P \cdot Q = (2.4)(1.6) = 3.84.$

Hence $\pi = TR - TC = 3.84 - 0.64 = \underline{3.2.}$

(8) a) price × quantity = $3F \cdot F = 3F^2$. This is "total expense" (of F).

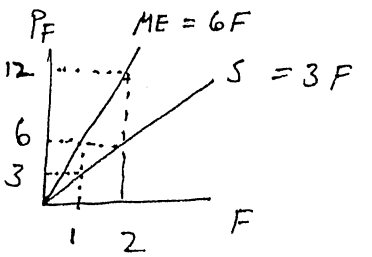
b) supply = average expense = $\frac{\text{total expense}}{\text{input}} = \frac{3F^2}{F} = 3F$.

Or you can realize directly from the problem that the supply curve has to be 3F.




c) Since AE is rising, ME has to be above it.

Optional: $ME = \frac{d\,TE}{dF} = \frac{d}{dF}(3F^2) = 6F$. (Like Problem 2b of Part 1 says, when the supply curve in an input market is linear, the associated ME curve has the same intercept but twice the slope.)




| | pts |
|---|---|
| a) | 10 |
| b) | 8 |
| c) | 6 |
| d) | 10 |

d) total cost $C = P_W W + P_F F$

$= 2W + (3F)(F) = 2W + 3F^2$

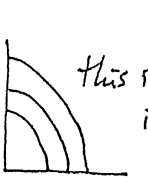
$C - 2W = 3F^2$

$\frac{1}{3}(C - 2W) = F^2$

$\sqrt{\frac{1}{3}(C-2W)} = F$ ← it's also OK if you solved for W instead of for F

↑ a constant, the total cost of this isocost curve

Optional:



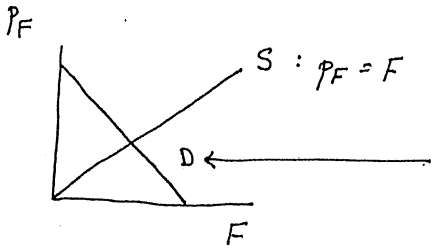

this is what the isocost curves look like

(9)

$Q = 2F$ $\quad MP_F = 2$

D for corn $P = 10 - Q$ $\quad [MR = 10 - 2Q$ if monopolist$]$

S of fertilizer $F = P_F$ $\quad [ME = 2F$ if monopsonist$]$

a) 


$= MRP_F = MR_Q \cdot MP_F$

$= (10 - Q) \cdot (2)$ ← $MR = P$ since firm is competitive in corn market

$= 20 - 2Q = 20 - 2(2F)$ from production function

$= 20 - 4F.$

$D_F = S_F \Rightarrow 20 - 4F = F \Rightarrow 20 = 5F \Rightarrow \underline{F = 4 \text{ lbs}}.$

Then $P_F = F = \$4/\text{lb}$, $Q = 2F = \underline{8 \text{ bu}}$. Price of Corn $P = 10 - 8 = \$2/\text{bu}$.

So Total Cost 'TC' $= P_F \cdot F = (\$4/\text{lb}) \cdot (4 \text{ lbs}) = \$16$,

Total Revenue 'TR' $= P_{corn} \cdot Q_{corn} = PQ = (\$2/\text{bu})(8 \text{ bu}) = \$16$,

$\pi = TR - TC = \$16 - \$16 = \boxed{\$0.}$

b) Same as part (a) except $MRP_F = MR_Q \cdot MP_F$

$= (10 - 2Q) \cdot (2)$ ← since firm is a monopolist

$= 20 - 4Q = 20 - 4(2F) = 20 - 8F.$

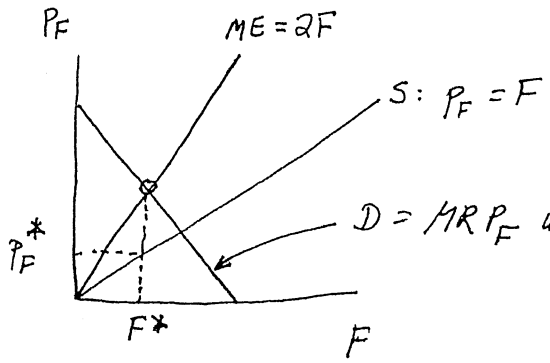
$D_F = S_F \Rightarrow 20 - 8F = F \Rightarrow 20 = 9F \Rightarrow F = \frac{20}{9}$ lbs, $P_F = F = \$\frac{20}{9}$/lb.

Then $Q = 2F = \frac{40}{9}$ bu., $p = 10 - Q = 10 - \frac{40}{9} = \frac{90-40}{9} = \$\frac{50}{9}$/bu.

$TR = pQ = \frac{50}{9} \cdot \frac{40}{9} = \frac{2000}{81}$, $TC = P_F F = \frac{20}{9} \cdot \frac{20}{9} = \frac{400}{81}$,

and $\pi = TR - TC = \frac{2000-400}{81} = \boxed{\$\frac{1600}{81} = \$19\frac{61}{81}}$.

c)




D = $MRP_F$ which is the same as in part (a), namely 20 - 4F.

A monopsonist sets $ME_F = MRP_F \Leftrightarrow 20 - 4F = 2F \Rightarrow 20 = 6F \Rightarrow$

$F = \frac{20}{6} = \frac{10}{3}$ lbs., $P_F = F = \$\frac{10}{3}$/lb. Then $Q = 2F = \frac{20}{3}$ bu.,

$p = 10 - Q = 10 - \frac{20}{3} = \frac{30}{3} - \frac{20}{3} = \$\frac{10}{3}$/bu.

$TR = pQ = \frac{10}{3} \cdot \frac{20}{3} = \$\frac{200}{9}$, $TC = P_F F = \frac{10}{3} \cdot \frac{10}{3} = \frac{100}{9}$, and

$\pi = TR - TC = \frac{200}{9} - \frac{100}{9} = \boxed{\$\frac{100}{9} = \$11\frac{1}{9}}$.

d) Same as part (c) except the $MRP_F$ is as in part (b) since the firm is a monopolist: $MRP_F = 20 - 8F$.

A monopsonist sets $ME_F = MRP_F \Leftrightarrow 2F = 20 - 8F \Rightarrow 10F = 20 \Rightarrow$

$F = \underline{2\text{ lb.}}$, $P_F = F = \underline{\$2/\text{lb.}}$, $Q = 2F = \underline{4\text{ lb.}}$, $p = 10 - Q = 10 - 4 = \underline{\$6/\text{lb.}}$. Then $TR = pQ = 6 \cdot 4 = \$24$, $TC = P_F F = 2 \cdot 2 = \$4$, and $\pi = TR - TC = \$24 - \$4 = \boxed{\$20.}$

So profit is the least when the firm has the least market power (part a), and profit is the most when the firm has the most market power (part b, where it has market power in both its input and its output markets). When it has power in one of its markets but not the other, its profit is in between the two extremes of \$0 and \$20.

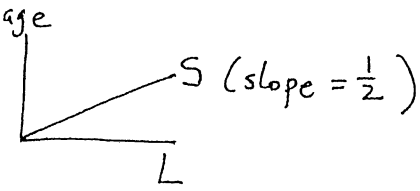
Optional: in this problem, monopolizing the output market increases the firm's profit much more than monopsonizing the input market.

Grading: 2pts. each for profit on a, b, c, d.
Minus one for a relatively minor economic error; minus zero for algebraic goofs (unless they are very serious).
Minus zero if incorrect explanation of high/low profits was due to incorrect numerical calculation of profit (since points should have already been deducted for that).
Minus one if incorrect explanation of high/low profits with correct numerical calculations of profit.
Plus 2 everything wrong except explanation of high/low profits.

(10)

$Q_c = \frac{1}{2} L \qquad MP_L = \frac{1}{2}$

$L^S = 2w$ or




monopolist ; demand $P = 12 - \frac{1}{2} Q_c$

$MR = 12 - Q_c$.

2pts → Set $ME = MRP$ (marginal expense = marginal revenue product).

$ME$ = wage rate since the firm is competitive in the labor market. The wage rate $= \frac{1}{2} L$.

$MRP = MR \cdot MP_L$

$= (12 - Q_c) \cdot \frac{1}{2}$.

2pts for the equation in $L$ and $Q_c$ or something similar → Hence $ME = MRP \Rightarrow \frac{1}{2} L = \frac{1}{2} (12 - Q_c)$. From $Q_c = \frac{1}{2} L$ above,

$Q_c = \frac{1}{2} (12 - Q_c)$

$2 Q_c = 12 - Q_c$

$3 Q_c = 12$

1pt for answers → $\underline{Q_c = 4}$.

Then $L = 2 Q_c = 8$, $w = \frac{1}{2} L = 4$, and $p = 12 - \frac{1}{2}(4) = 10$.

(11) $Q_c = \frac{1}{2}L$, $MP_L = \frac{1}{2}$ corn: $P = 12 - 2Q_c$

$L^S = 2w$, $ME = L$

Optimality in the labor market requires

$ME_L = MRP$ ← (10pts)

$L$

$= MR \cdot MP_L$ ← (6pts)

(6pts)

$= P \cdot MP_L$ since the firm is competitive in the output market

$= P \cdot (\frac{1}{2})$.

Note on grading: Out of these 22 points, if student only has $ME = P \cdot MP$, give 20 points; " " " " $ME = MR \cdot MP$, give 16 points

So $L = \frac{1}{2}P$

$2L = P = 12 - 2Q_c$ from the demand curve for corn

$2(2Q_c) = 12 - 2Q_c$ since $Q_c = \frac{1}{2}L$ (the production function)

(3pts for the substitution)

$6Q_c = 12$

$\boxed{Q_c = 2}$ ← (3pts)

(2pts)

Then $L = 2Q_c \Rightarrow \boxed{L = 4}$ from the production function

(2pts)

$P = 12 - 2Q_c = 12 - 2(2) \Rightarrow \boxed{P = 8}$ from the demand curve for corn

$w = \frac{1}{2}L \Rightarrow \boxed{w = 2}$ from the labor supply curve.

(3pts)

(12) $MRP = MR \cdot MP = (12 - Q)\left(\frac{1}{\sqrt{L}}\right) = (12 - 2\sqrt{L})\left(\frac{1}{\sqrt{L}}\right)$ because $Q = 2\sqrt{L}$ from the production function

(4pts) (4pts)

$ME = L$

$MRP = ME \Rightarrow \frac{12 - 2\sqrt{L}}{\sqrt{L}} = L$ (5pts) (4pts)

$12 - 2\sqrt{L} = L\sqrt{L}$

$12 = L\sqrt{L} + 2\sqrt{L}$

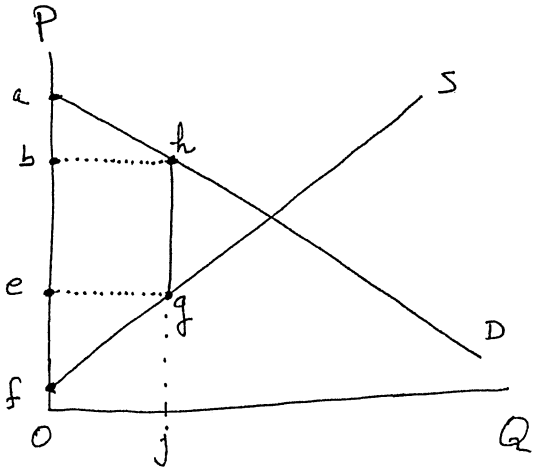
$12 = (L+2)\sqrt{L}$. By inspection (or checking the list given in Hint 2), this is satisfied by $\boxed{L = 4}$, because the RHS is $(4+2)\sqrt{4} = 6 \cdot 2 = 12$. (5pts)

Then $P_L = \frac{1}{2}L = \frac{1}{2}(4) = 2$ (4pts)

$Q = 2\sqrt{L} = 2\sqrt{4} = 4$ (3pts)

$P = 12 - \frac{1}{2}Q = 12 - 2 = 10$. (4pts)

(13) a)




Distance hg is the amount of the tax.

Distance Oj = eg is the quantity produced and sold.

4pts → Tax revenues are hg times eg, which is the rectangle bhge.

4pts → Consumer surplus is abh (above the price line, below the D curve).

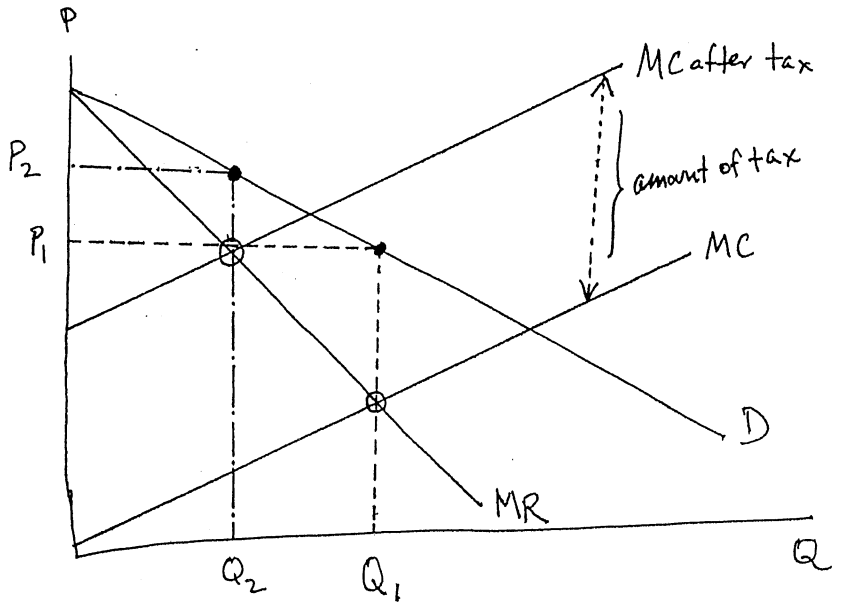
4pts → Producer surplus (profit) is egf (below the price line, above the S curve).

The price line is bh if firms send the checks to the government and it is eg if consumers send the checks to the government.

Partial credit for hg and Oj as the quantity

The entire region of social surplus is ahgf.

b)



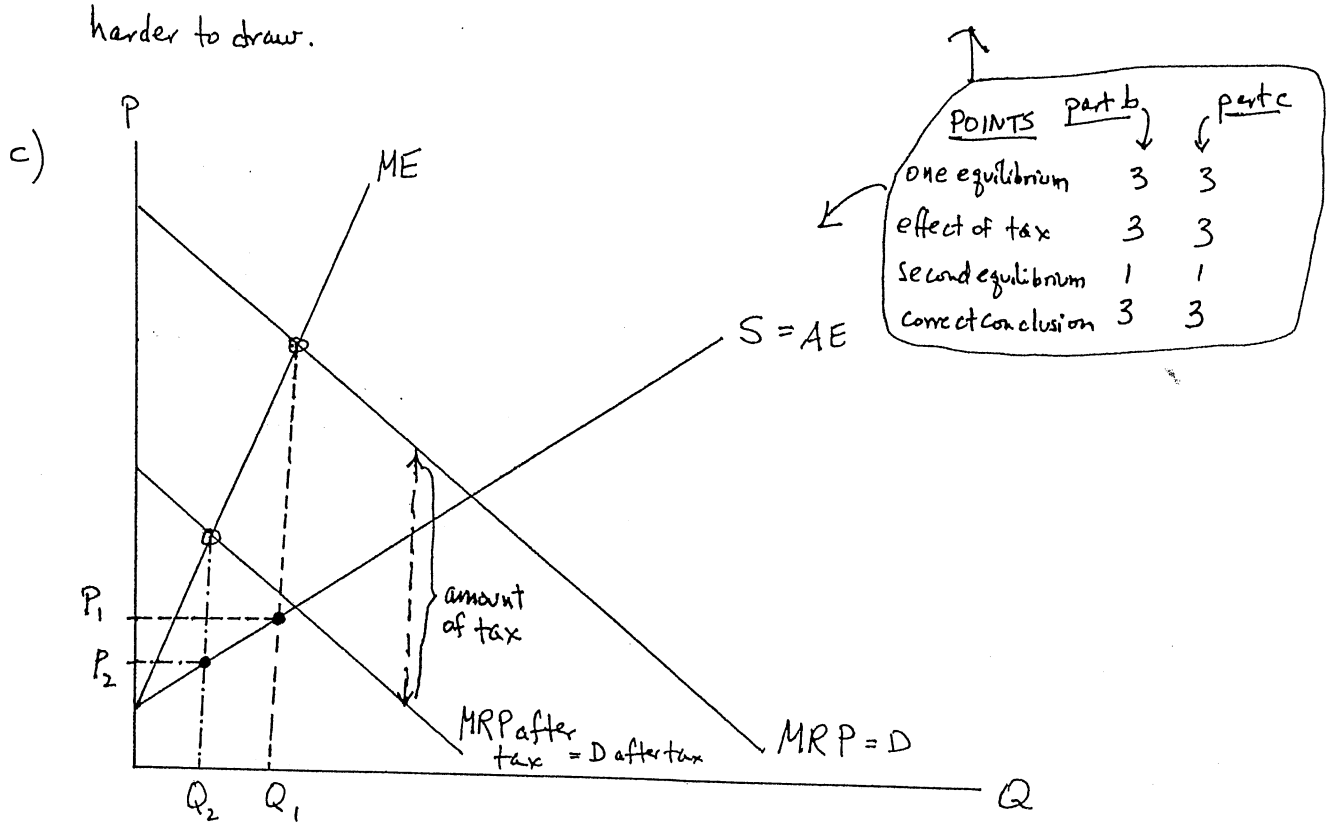

Here I suppose the tax is imposed on the firms. MC (marginal cost) shifts up by the amount of the tax. Monopoly equilibrium price and quantity shift from $(P_1, Q_1)$ to $(P_2, Q_2)$. The consumers' burden is the amount by which price rises, so it is $P_1P_2$. You can see that this is less than the amount of the tax, so the firm pays part —

Note: $P_1$ is not the height where MR crosses "MC after tax." It is just a coincidence that in this diagram, $P_1$ is close to that height.

of the tax and the consumers pay part of it. However, making a direct comparison on the graph of how much each party pays is not easy.

There is another correct way to answer this question, by supposing that the tax is imposed on consumers rather than on the firms, but this is harder to draw.

c)




Here I suppose the tax is imposed on the input purchaser, so the demand curve shifts down. (Again, there is another correct way to answer this question, by supposing that the tax is imposed on the input supplier.) The original monopsony equilibrium is $(P_1, Q_1)$ and the after-tax monopsony equilibrium is $(P_2, Q_2)$. The monopsonist does not pay the whole tax because he gets a price break: price falls from $P_1$ to $P_2$. However, even though input suppliers bear this $P_1P_2$ portion of the tax, the rest of the tax is borne by the monopsonist. It is not easy to graphically split up the amount of tax into portions paid by the monopsonist and by the input supplier.