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**All questions must be answered on this test form!**

For each question you must show your work and (or) provide a clear argument.

Use the last two pages and the back of the form as scratch paper.

**Question 1** The profit of a firm before paying the manager's salary is  $\pi^b(e) = 80e - 0.1e^2$ , where  $e \geq 0$  is the manager's effort. If  $w$  is the manager's wage then the firm's profit after paying the wage is  $\pi^a(e, w) = 80e - 0.1e^2 - w$ . The manager chooses an effort level  $e \geq 0$  that maximizes his payoff  $w - e$ .

(a) Suppose the manager's wage is  $w = 40$  (independent of the manager's effort).

Then the

5 points

manager's effort is  $e =$                    , and the firm's profit  $\pi^a =$

(b) Now suppose the manager receives 10 percent of the firm's profit  $\pi^b$  as wage, i.e.,  $w = 0.1\pi^b$ , Then the

5 points

manager's effort is  $e =$                    .

the manager's total compensation is

**Question 2** A worker can choose to effort levels: High,  $e = 1$  and low,  $e = 0$ . Let  $w$  be the workers wage. Then utility is given by  $u(w, e) = w - 10e$ .

- (a) Suppose that the person's effort level can be observed by the supervisor. The worker receives a wage of  $w_l = 10$ , if he chooses the low effort level. Then, in order to induce the worker to choose the high effort level,  $w_h$  (the wage if he chooses  $e = 1$ ) must be at least  3 points

- (b) Now suppose that the supervisor must monitor the worker in order to determine the worker's effort. Suppose that the worker knows that if he shirks (chooses low effort) then he is found out with probability  $p$  and he is fired. If he is fired, he can immediately get a job at some other firm, where he gets a utility of 5. Otherwise, he receives a wage of  $w = 30$ . 3 points

*(The answer(s) may depend on  $p$ )*

- (c) Consider the same setup as in (b), except we now want to find the wage  $w$  that the firm must pay such that worker is indifferent between  $e = 0$  and  $e = 1$ , and we assume that  $p = 0.2$ . Then  3 points

*(This is the lowest wage that the firm can pay to get the high effort level)*

(d) Explain briefly how the results are affected if firing workers is difficult, i.e., if a worker who is found to be shirking can only be fired with a small probability. *2 points*

(e) Suppose again that workers can be fired. Explain briefly how the results are affected if the firm pays just the “market wage” and it is easy to find new jobs. *2 points*

**Question 3** Fill in the missing entries in the table below

*8 points*

Quantity of variable input	total output	marginal product of variable input	average product of variable input
0	0	—	—
1	<input type="text"/>	<input type="text"/>	60
2	100	<input type="text"/>	<input type="text"/>
3	<input type="text"/>	20	<input type="text"/>
4	132	<input type="text"/>	<input type="text"/>

**Question 4** Consider a firm that minimizes production costs.

- (a) The firm has a production function  $f(K, L) = \min\{K, L\}$ . Suppose that originally the price of  $K$  is  $r = 2$  and the price of  $L$  is  $w = 3$ . Then the price of  $K$  increases 100%. Determine by what percentage production costs increase. *4 points*

**The cost of producing  $Q$  units of output increases by \_\_\_\_\_ %.**

- (b) Now suppose that the firm uses two inputs,  $x_1, x_2$ , with prices  $w_1$  and  $w_2$ . The output is given by  $Q = x_1 + x_2$ . Suppose prices are originally,  $w_1 = w_2 = 2$ . Then the price of input 2 doubles. *4 points*

**The cost of producing  $Q$  units of output increases by \_\_\_\_\_ %.**

**Question 5** Consider a firm that minimizes production costs.

- (a) Suppose that there are two inputs: Input 1 is skilled and input 2 is unskilled labor. Suppose that if the firm decreases skilled labor by 1 unit, then it would have to increase unskilled labor by 4 units in order to keep output the same. The marginal product of unskilled labor is 40. Thus,

**The marginal product of skilled labor is** .

*3 points*

- (b) Again, suppose that there are two inputs, skilled and unskilled labor. Now, if the firm decreases skilled labor by 2 units, then it would have to increase unskilled labor by 7 units in order to keep output the same. Suppose that the wage of a skilled worker is 70,000. Then

**The wage of an unskilled worker is** .

*3 points*

- (c) Again, there are two inputs, skilled and unskilled labor. The wage of skilled workers is 50,000, that of unskilled workers is 20,000. The marginal product of an unskilled worker is 10. Thus,

**The marginal product of a skilled worker is** .

*3 points*

**Question 6** Suppose that there are 100 firms in a competitive market. Each firm's cost function is given by  $C(Q) = 10Q + 2Q^2$ . Demand is given by  $Q(P) = 2,000 - 20P$ .

(a) Then

Aggregate supply is  $Q_s(P) =$  .

The equilibrium price is  $P =$  .

*5 points*

(b) Now suppose that the government introduces a tax of 9 Dollars on the firm per unit of output that is produced. Thus, the firm's variable cost increases by  $9Q$ .

Then

The equilibrium price is  $P =$  .

The government's tax revenue is .

*5 points*

**Question 7** A firm has a cost function  $C(Q) = 2Q$ . The demand of a typical consumer is  $Q(P) = 10 - 2P$ .

- (a) Suppose the firm uses the optimal (i.e., profit maximizing) two-part pricing schedule, consisting of a fixed fee  $F$  and a price per unit,  $P$ . Then *5 points*

$F =$  \_\_\_\_\_ ,  $P =$  \_\_\_\_\_ .

The firm's profit (per consumer) is \_\_\_\_\_ .

- (b) The government introduces a tax of 2 Dollars on the firms per unit of output that is produced, i.e., the new cost function is  $C(Q) = 4Q$ . Then

$F =$  \_\_\_\_\_ ,  $P =$  \_\_\_\_\_ .

The firm's profit (per consumer) is \_\_\_\_\_ .

The tax revenue (per consumer) is \_\_\_\_\_ .

To determine the deadweight loss generated by the tax proceed as follows: Add the loss to the consumer (change in surplus) and the firm (change in profits) from the tax, and subtract to total tax revenue from this amount. Then

*7 points*

For each Dollar of taxes raised, the deadweight loss is \_\_\_\_\_ cents.

**Question 8** You are supposed to provide advise to each of 5 firms. The data provided by the firms is incomplete, and it could also be wrong. All of these firms are monopolists. In each case choose one of the five recommendations listed below: *10 points*

**No Change:** Do not change the current level of production.

**Increase:** Increase the level of output.

**Decrease:** Decrease the level of output.

**Shut Down:** Shut down production, i.e. choose  $Q = 0$ .

**Problem:** There is a problem with the data provided, i.e., some of the numbers must be incorrect.

Firm	P	MR	Rev.	Q	TC	MC	ATC	AVC	Recommendation
A	3.9	3.0		2,000	7,400	2.9		3.24	
B	5.9			10,000		5.9	4.74	4.24	
C		9	44,000	4,000		9	11.9	10.74	
D	35.9	37.9		5,000		37.9	35.9		
E	35		3,990	1,000	3,300		at min	23.94	

**Question 9** Suppose a firm has constant marginal cost 12. The firm can sell its product in two different countries,  $A$ , and  $B$ . The price elasticity of demand is  $-2$  in country  $A$ , and  $-1.5$  in country  $B$ . The firm charges a price per unit  $P_A$ , and  $P_B$ . Then *10 points*

$P_A =$ , $P_B =$ .
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Suppose the government of country  $A$  decides to buy the product in country  $B$  for the citizens of country  $A$  in order to make the product available at lower prices (in case  $P_B < P_A$ ). What will be the likely reaction of the firm?

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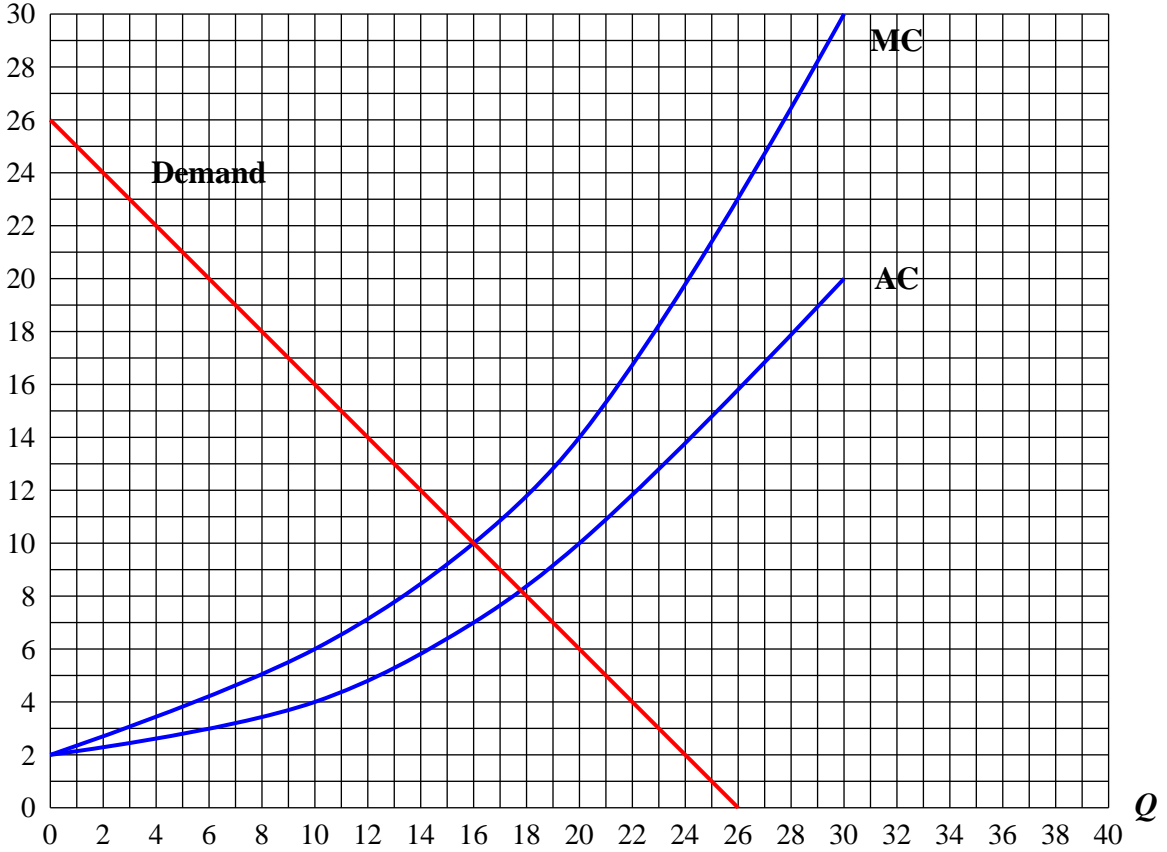
Does the government of country  $B$  have an incentive to disallow such purchases?

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**Question 10** The demand curve for a firm's product and the firms' average cost function are depicted below.

10 points

**P, Cost**



If the firm must behave competitively, i.e., must choose price equals to marginal costs, then

10 points

$P =$  \_\_\_\_\_ ,  $Q =$  \_\_\_\_\_ . Firm profits are \_\_\_\_\_ .

If the firm is a monopolist and charges a price per unit then

$P =$  \_\_\_\_\_ ,  $Q =$  \_\_\_\_\_ . Firm profits are \_\_\_\_\_ .

The net-loss to the consumers (i.e., change in consumer surplus) from a monopoly market versus a competitive market is \_\_\_\_\_ . Thus, the efficiency

loss of monopoly is \_\_\_\_\_ .

*Not graded: Use as Scratch Paper*

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