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## Final Exam

You have until 5pm to complete the exam, be certain to use your time wisely. Answer all questions directly on the exam. You must show all of your work to receive full credit. Non-graphing calculators may be used. You may leave answers as fractions. Unless a problem says otherwise, you can assume that firms can produce fractions of units and charge non-integer prices (so a firm could produce 82.4 units and sell at a price of \$5.325 per unit). Remember to put your name on the exam. Good luck!

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**Name:**

**ID Number:**

1. (10 points) There is one electric company providing power to a small town. The town is trying to determine how to best regulate the electric company.
  - (a) Why might it be efficient to allow the electric company to have a natural monopoly rather than having multiple companies providing electricity to the town? Be certain to fully explain your answer.
  - (b) Suppose that the local government can observe all of the electric company's costs. The government decides to regulate the prices the electric company charges with traditional rate-of-return regulation. Prices are set such that the electric company can cover its costs and receive a 5% return on its investments. Prices are adjusted frequently by the government to maintain the 5% return. Explain why adjusting the prices less frequently might lead to more efficient outcomes.

2. (15 points) There is a local factory that currently has no pollution controls at all and emits 500 units of pollution from its smokestacks. The factory can reduce the amount of pollution it emits by installing smokestack scrubbers. The more the firm spends on these scrubbers, the greater the reduction in pollution. The firm's marginal costs of reducing pollution by one more unit are given by the following marginal cost function:

$$MC(R) = \frac{1}{10}R \quad (1)$$

where  $R$  is the total reduction in pollution. Each unit of pollution produces \$10 of harm to the community.

- (a) Suppose the local government decides to use fines to get to the factory to reduce pollution. The firm must pay an amount  $F$  per unit of pollution. If the government sets the fine at \$20 per unit of pollution, how much will the firm spend on reducing pollution and how many units of pollution will the firm still produce?
- (b) Is a fine of \$20 efficient? If so, explain way. If not, calculate the deadweight loss generated by setting  $F$  at \$20 rather than its socially efficient level.
- (c) Suppose that the government was choosing between using a fine and a standard (specifying the exact amount of pollution the factory can produce) to achieve the efficient level of pollution. Which of these two approaches would the firm prefer? Fully explain your answer. Assume that both the fine and the standard would be set correctly to achieve the efficient level of pollution.

3. (15 points) There are two gas stations in town. Both gas stations have no fixed costs and constant marginal costs equal to \$1 per gallon of gasoline sold. Demand for gasoline in the town is given by the following demand function:

$$D(p) = 100 - 50p \quad (2)$$

where  $D(p)$  is the number of gallons of gasoline demanded at a price of  $p$  per gallon. In the absence of any collusion, the two gas stations compete by posting prices. The gas station posting the lower price gets all of the demand. If they post the same price, they split demand evenly.

- (a) Suppose that the two firms decide to collude, agreeing on a price that they will both charge and then splitting demand evenly between them. What price will they charge and what will the profits per firm be?
- (b) Explain why the outcome in part (a) is inefficient, using specific numbers if possible.
- (c) The government decides to make this act of collusion illegal. If the firms get caught colluding, they will have to pay a fine equal to  $F$  and forfeit any profits they earned through collusion. The government can spend money on monitoring to increase the probability of catching the firms colluding. The probability of catching the firms as a function of  $M$ , the amount of money spent on monitoring, is:

$$p(M) = \frac{1}{1 + (\frac{1}{2})^M} \quad (3)$$

Write down an expression giving an individual firm's expected profits from colluding as a function of  $M$  and  $F$ .

- (d) At the government's current choice of  $M$  and  $F$ , both  $M$  and  $F$  are positive but no firms are being caught despite collusion taking place. How would you recommend the government adjust  $M$  and  $F$ ? Be certain to fully explain your answer.

4. (10 points) Suppose that there are two firms polluting the local water supply. A regulator decides to control pollution by issuing permits to the firms. The permits a firm holds determine the amount of pollution the firm can produce. If a firm has  $n$  permits, it is allowed to produce no more than  $n$  units of pollution.
- (a) Explain why letting the firms trade permits should lead to a more efficient outcome than not allowing the firms to trade permits.
  - (b) Explain why allowing firms to trade permits is not a sufficient condition for ensuring that the efficient level of pollution reductions takes place.

5. (15 points) The demand for lawnmowers ( $L$ ) is given by the following inverse demand function:

$$p(L) = 100 - \frac{1}{10}L \quad (4)$$

A firm's marginal cost of producing an additional lawnmower is \$20. Every extra lawnmower in use produces both air and noise pollution. The marginal costs of these forms of pollution to society get worse as the number of lawnmowers increases. The marginal costs of the pollution to the community are given by the following function:

$$MC_{\text{poll}} = \frac{1}{10}L \quad (5)$$

where  $L$  is the total number of lawnmowers in use.

- (a) In the absence of any government regulation, how many lawnmowers will be sold and what will the total cost of pollution to the community be from those lawnmowers? Assume that the market for lawnmowers is competitive.
- (b) What is the socially efficient number of lawnmowers?
- (c) If a regulator wanted to use a quantity tax to achieve the efficient number of lawnmowers, what should the size of the quantity tax be? Assume that the quantity tax is placed on producers.

6. (10 points) Currently, the patent length for a new drug is 20 years. If the patent length were increased to 30 years, explain what you would expect to happen to:
- (a) Levels of research and development in the pharmaceutical industry
  - (b) Consumer surplus in the pharmaceutical market

Be certain to discuss all of the effects on these quantities, not just the net effect. So if consumer surplus increases for one reason but decreases for another, discuss both reasons even if the effects cancel each other out.

7. (15 points) Suppose that two internet providers, firm  $A$  and firm  $B$ , are bidding to win an exclusive franchise to provide internet access to Williamsburg. Bidding works in the following way. The government announces a high price per customer. If both firms are willing to provide service at that price, the government lowers the price by \$1 and once again sees if both firms will provide service at that price. This continues until one firm drops out. The remaining firm wins the franchise. The lowest price at which both firms would provide service is the price that the winning firm must charge. The firm must meet whatever the customer demand is at that price.

Firm  $A$  has high fixed costs for its proposed infrastructure but then low marginal costs of adding additional customers. Firm  $B$  has lower fixed costs ( $FC_B < FC_A$ ) but higher marginal costs than firm  $A$  ( $MC_A < MC_B$ ). Both firms have constant marginal costs. The demand curve for internet service is linear and downward sloping. On a graph with price on the vertical axis and number of internet customers on the horizontal axis, show the following (be certain to clearly label everything on the graph):

- (a) The average cost and marginal cost curves for both firms
- (b) The demand curve
- (c) The price and quantity of internet service that will result from the bidding process
- (d) The efficient quantity of internet service
- (e) The deadweight loss generated by being at the price and quantity resulting from the bidding process

8. (10 points) Below are essay questions related to the group projects. Choose one and only one question to answer. You may not choose a question related to the topic that you presented.
- (a) Explain two different ways that higher auto safety standards could be achieved, only one of which should be related to direct regulation of the industry by the government. Which of these two ways would you expect to lead to the most efficient outcome? Be certain to fully explain your answer.
  - (b) Why might granting exclusive franchise rights to a cable television provider lead to inefficient outcomes compared to allowing free entry of firms into the cable television market? Your answer should cover inefficiencies generated by the franchise bidding process itself and by the level of service provided after that bidding process has been completed.
  - (c) Suppose that Williamsburg introduced a living wage law, setting a minimum local wage based on the poverty line. Discuss how the introduction of this law would affect the efficiency and equity of the local labor market.
  - (d) Provide one argument for and one argument against Dominion Virginia Power being allowed to charge fees to customers who install solar power systems.
  - (e) Provide an argument for whether Google should or should not be allowed to keep its search results algorithm secret. Your argument should focus on economic efficiency.
  - (f) Suppose that a lobbyist for the online gambling industry makes the following claim:  
*“People choose to gamble online because it increases their utility; they wouldn’t make bets if it didn’t provide them with some benefit. Restricting their ability to gamble would therefore lead to an inefficient outcome.”*  
Do you agree or disagree with this statement? Be certain to fully explain your answer.
  - (g) In class we discussed the reasons for blocking mergers that lead to a firm controlling too large a share of a market and for preventing collusion among firms. Given these reasons, why does the government allow sports teams to effectively collude with one another?