Midterm 2

You have until 1:50pm 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 (no graphing calculators or phones can 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!

Name: **ID Number:**

1. (10 points) Recall that two features that contributed to the California electricity crisis were the cap on the rates that utility companies could charge residential customers for electricity and restrictions on the ability of utility companies to produce their own electricity, making them more reliant on the wholesale electricity market. Use a graph with kWh of electricity on the horizontal axis and price of electricity on the vertical axis to show how these two features would lead to a deadweight loss to society when the wholesale price of electricity rises above the rate utility companies are allowed to charge customers. You can assume that residential customers have a linear, downward sloping demand curve and in the wholesale electicity market, price is equal to the marginal cost. Be certain to clearly label all of the relevant features of your graph.

2. (25 points) During off-peak hours, the inverse demand function for electricity in Williamsburg is given by

$$p(K_o) = 100 - K_o \tag{1}$$

where K_o is the amount of electricity demanded by the off-peak customers in kWh. During peak hours, the demand is given by

$$p(K_p) = 100 - \frac{1}{2}K_p \tag{2}$$

where K_p is the amount of electricity demanded by the peak customers in kWh. Currently, the city has one power plant that can produce up to 100 kWh of electricity. The marginal costs of producing a kWh of electricity at the plant are constant and equal to \$25.

(a) Suppose that initially plant capacity cannot be changed and the city must charge a single price to customers of all types. What price would the city set in order to maximize total surplus? What is total surplus under this outcome?

(b) Now assume that the city can set different prices for peak and off-peak customers. What prices will the city set? Assume the city wants to both maximize total surplus and avoid any excess demand.

(c) Now suppose that the capacity of the plant can be expanded at a cost of \$15 per kWh of additional capacity. So the marginal cost of a unit of electricity beyond the current capacity is equal to the \$15 to expand capacity by a unit in addition to the \$25 in marginal costs from operating the plant. What would the new optimal capacity be? How much will total surplus increase as a result of this change in plant capacity? Assume that the city continues to set prices such that total surplus is maximized and can still charge different prices to peak and off-peak customers.

3. (10 points) Suppose that traditional rate of return regulation is being used to regulate a local telephone company. The local regulators are considering increasing the frequency of rate cases. Explain one reason why increasing the frequency of rate cases may increase consumer surplus in the short run. Also explain one reason why increasing the frequency of rate cases may decrease consumer surplus in the long run.

4. (30 points) The market for microchips is competitive and firms have no fixed costs and constant marginal costs of $50 per additional microchip. Demand for microchips in a single time period is given by the following equation:

$$D(p) = 500 - 5p \qquad (3)$$

Suppose that one firm is considering investing in developing a new method of manufacturing microchips that would lower marginal costs to $25.

(a) If the firm could only keep knowledge of the new method private for one period, how much would the firm be willing to invest in the new method of manufacturing?

(b) Now suppose that the firm can apply for a patent that is T periods long. Write down an expression that gives the maximum amount the firm is willing to invest in research and development, $I(T, r)$, as a function of the T and the interest rate r.

(c) To simplify things, assume that the interest rate is zero. Determine the optimal patent length from a regulator's perspective if the research and development costs required to develop the new method of manufacturing are equal to $150,000. Assume the regulator wants to maximize total surplus. Be certain to show all of your work.

(d) Suppose that the regulator has only rough estimates of the numbers used to calculate the optimal patent length and therefore might be off by one year in either direction. Which side would the regulator rather error on, making the patent length one year too long or making it one year too short? Be certain to justify your answer.

5. (25 points) The graph below shows the demand curve for internet service and the average cost and marginal cost curves for a single internet provider with the number of customers, N, on the horizontal axis. Use the graph to answer the questions below.
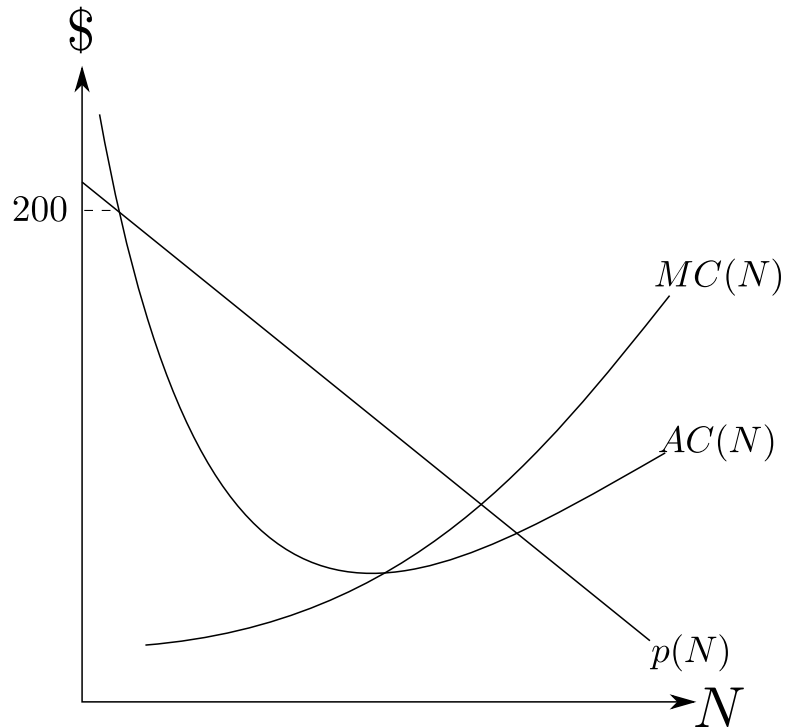
(a) On the graph, label the price the internet provider will charge and the number of customers it will serve if it acts as a monopolist.

(b) Suppose a second firm considers entering the industry. Will this firm enter and stay in the industry or will the original firm ultimately remain a natural monopoly? Use the graph and a written explanation to support your answer.

(c) Suppose that a regulator can give the original internet provider exclusive rights to operate in the city, preventing the second firm from attempting to enter. Explain one reason that the regulator might choose to block the entry of the second firm and one reason why the regulator might choose to allow entry of the second firm. Both reasons should relate to the regulator's goal of maximizing total surplus.

(d) The regulator decides to have a single firm provide service and chooses the firm by the following auction procedure. The regulator announces a price of $200 per customer and begins lowering the price by a dollar at a time. Firms remain in the auction as long as they are willing to provide service at the current price. When only one firm is left, that firm wins the right to be the internet provider for the city and must charge the last price announced in the auction and serve all customers who demand service at that price. Will this method of auctioning off a franchise lead to the socially efficient level

of internet service, an inefficiently low level of service, or an inefficiently high level of service? Be certain to fully explain your answer. You can assume that all of the firms have cost functions identical to the ones shown on the graph.