Final Examination

You have until 12:30pm to complete the exam, be certain to use your time wisely. For multiple choice questions, mark your answer on your scantron sheet. Choose only one answer for each multiple choice question; if more than one letter is chosen for a question it will be marked wrong. Write your answers for the short answer section directly on the exam. For the short answer questions, show your work clearly, place a box around final answers and be certain to label any graphs you draw. Final answers may be left as fractions. Non-graphing calculators may be used but they should not be necessary. Remember to put your name and ID number on both the exam (in the spaces provided below) and on the scantron sheet. Good luck!

Name: **ID Number:**   **Section:**

SECTION I: MULTIPLE CHOICE (60 points)

1. The minimum of a firm's average cost curve is at $20 and the minimum of the firm's average variable cost curve is at $10. If the firm is operating in a competitive market where the price is $15, then in the short run:

   (a) The firm will shut down.
   (b) The firm will earn positive profits.
   (c) The firm will have positive producer surplus.
   (d) The firm will be producing more than it would if the price were $20.

   > (c) The firm will produce because it can cover all of its variable costs and some of its fixed costs but it will lose money (since it can't cover all of the fixed costs). So in the short run, the firm produced with negative profits but positive producer surplus.

2. An industry has three firms in it. Firms A and B each have individual supply curves given by $S(p) = -10 + 2p$ and firm C has a supply curve given by $S(p) = 4p$. The industry supply curve will have a kink at a price of:

   (a) $5.
   (b) $10.
   (c) $.25.
   (d) $.25 and $5.

   > (a) Notice that firm C supplies at all postive prices. Supply from firms A and B goes to zero when the price hits $5. So there will be a kink in the industry supply curve at $5.

3. If a monopoly can use first degree price discrimination, the deadweight loss will be ____ than if the monopoly cannot price discriminate and profits will be ____ than if the monopoly cannot price discriminate. (You can assume the monopoly has constant marginal costs and the every consumer's demand curve is a downward sloping line.)

(a) Greater than, less than.
(b) Greatern than, greater than.
(c) Less than, less than.
(d) Less than, greater than.

(d) With first degree price discrimination, the monopoly can capture all of the consumer surplus. This means that the monopoly is earning the highest possible profits but is also producing at the efficient level of output implying zero deadweight loss.

4. A major difference between a competitive firm and a monopoly is that:

(a) Monopolies operate where marginal revenue equals marginal cost, competitive firms do not.
(b) Monopolies earn profits, competitive firms do not.
(c) Competitive firms operate where marginal revenue equals marginal cost, monopolies do not.
(d) Competitive firms operate where price equals marginal cost, monopolies do not.

(d) Both types of firms set their quantities where marginal revenue equal to marginal cost. However, monopolies then charge a higher price than their marginal cost. Both types of firms can earn positive profits (at least in the short run).

5. If a production technology exhibits increasing returns to scale, then producing 100 units of output will cost _____ as producing 50 units of output.

(a) Twice as much.
(b) More than twice as much.
(c) Less than twice as much.
(d) Not enough information.

(c) If the technology exhibits increasing returns to scale, then to double output we would use less than double the amount of inputs, implying that costs would less than double.

6. A firm's cost function is given by: $C(y) = 24y^2 + 8y + 16$. What is the firm's average fixed cost when it produces 10 units of output?

(a) $248.
(b) $249.60.
(c) $1.60.
(d) $488.

(c) The fixed costs for the firm are just $16. So average fixed costs are just $16 divided by the number of units of output.

7. If a person consuming goods x and y has standard, convex indifference curves, utility is maximized at the point where:

(a) The budget line is tangent to the indifference curve.
(b) The marginal utility of x is equal to the marginal utility of y.
(c) The money spent on x is equal to the money spent on y.

   (d) The quantity of x is equal to the quantity of y.

   (a) The person will maximize utility where the budget line is tangent to the indifference curve (or equivalently when the ratio of the prices is equal to the ratio of the marginal utilites).

8. There are two types of consumers for bagels, students and professors. Both students and professors stop consuming bagels when the price of bagels goes above $5. For every decrease in the price of bagels by a dollar, student demand goes up by five bagels while professor demand goes up by 10 bagels. If a monopolist has a constant marginal cost of $1 and can charge different prices to students and professors, which group will be charged a higher price?

   (a) Professors.
   (b) Students.
   (c) They will be charged the same price.
   (d) Not enough information.

   (c) From the information in the problem, we can tell that the students have a demand curve given by $p = 5 - .2B$ while professors have a demand curve given by $p = 5 - .1B$. From these demand equations, we can get the marginal revenue functions for students and professors ($MR = 5 - .4B$ and $MR = 5 - .2B$ respectively). Setting these marginal revenue functions equal to the marginal cost of $1, we find that the number of bagels sold to students will be 10 and the price charged will be $3 while the number of bagels sold to professors will be 20 and the price charged will also be $3.

9. A firm's marginal cost curve will:

   (a) Always lie below its average cost curve.
   (b) Always lie above its average fixed cost curve.
   (c) Pass through the minimum of the average cost curve.
   (d) Always be upward sloping.

   (c) The marginal cost curve always passes through the minimums of the average variable cost curve and the average cost curve (if the curves have minimums). Often, the first portion of the marginal cost curve is downward sloping as firm's often experience some initial increasing returns to scale.

10. If a consumer's indifference curves for apples and oranges are straight lines, we can say for certain that:

   (a) The consumer prefers averages to extremes.
   (b) The consumer prefers extremes to averages.
   (c) The consumer will always consume the same ratio of apples to oranges.
   (d) The consumer's marginal rate of substitution is constant.

   (d) The slope of the indifference curve is equal to the marginal rate of substitution. So if the slope of the indifference curve is constant, the marginal rate of substitution will be constant.

11. Suppose that in the short run, a firm's average cost when producing 100 tables is $20 and the firms average cost of producing 200 tables is $30. Then we can say for certain that in the long run:

    (a) The average cost of producing 100 tables will be $20.
    (b) The average cost of producing 200 tables will be less than or equal to $30.
    (c) The average cost of producing 100 tables will be less than the average cost of producing 200 tables.
    (d) (b) and (c).

    (b) We know that in the long run, the costs of producing a given level of output will be less than or equal to the short run costs. We don't know if the average costs of producing different levels of output will be ordered the same way in the long run as in the short run (picture the a short run average cost curve that is tangent to the long run average cost curve, for many pairs of output the order of the short run aveage costs will be the opposite of the order of the long run average costs.)

12. Which of the following is true about a competitive firm's short run supply:

    (a) The firm will never produce at a quantity where the marginal cost curve is downward sloping.
    (b) The firm will never produce at a quantity where the average variable cost curve is downward sloping.
    (c) The firm will never produce at a quantity where the average cost curve is downward sloping.
    (d) (a) and (b).

    (d) If average variable cost is downward sloping, you are to the left of the minimum of the average variable cost curve. Firms only produce once the marginal cost curve passes through the minimum of the average variable cost curve, meaning firms only produce where the average variable cost curve is at a minimum or upward sloping. If a firm is producing where marginal cost is downward sloping, it could increases profits by producing more units (marginal costs would be lower for the next unit but marginal revenue would be the same as before).

13. Suppose that a firm uses butter and flour to produce biscuits. The slope of the firm's isocost curves will depend on:

    (a) The prices of butter and flour.
    (b) The price of bisuits.
    (c) The marginal product of butter and the marginal product of flour.
    (d) (a) and (b).

    (a) The slope of the iso-cost curves depends only on the relative prices of the inputs.

14. Suppose burritos are a normal, ordinary good. If the price of burritos decreases, then the income and substitution effects for burritos will:

    (a) Both be negative.
    (b) Both be positve.
    (c) Have opposite signs but the same magnitude.

(d) Have opposite signs and different magnitudes.

(b) For normal goods, demand goes up when income goes up. For ordinary goods, demand goes up when price goes down. So a decrease in price will lead to a positive income effect (because of the increase in effective income) and a positive substitution effect (because burritos get cheaper relative to other goods).

15. Suppose there is a monopoly selling to several different types of consumers. Consider the profits when the firm can use first degree price discrimination (π_{1st}), second degree price discrimination (π_{2nd}) and third degree price discrimination (π_{3rd}). Which ordering of these profits is correct:

    (a) $\pi_{1st} \geq \pi_{2nd} \geq \pi_{3rd}$
    (b) $\pi_{3rd} \geq \pi_{2nd} \geq \pi_{1st}$
    (c) $\pi_{1st} \geq \pi_{3rd} \geq \pi_{2nd}$
    (d) $\pi_{3rd} \geq \pi_{1st} \geq \pi_{3rd}$

    (a) Notice that when switching from third degree to second degree price discrimination, the monopoly can capture additional consumer surplus because it takes away the ability of the consumer to adjust quantity in response to price. So profits should be greater than or equal to what the monopoly made under third degree price discrimination. Anything the monopoly can do in second degree price discrimination, it can also do under first degree price discrimination, so profits under first degree price discrimination should be greater than or equal to profits under second degree price discrimination.

16. In a competitive industry with no barriers to entry or exit, the short run industry supply curve will typically be ____ and the long run industry supply curve will be ____.

    (a) Upward sloping, upward sloping.
    (b) Upward sloping, horizontal.
    (c) Downward sloping, horizontal.
    (d) Upward sloping, vertical.

    (b) In the short run, firms will produce more if the price is higher, so the industry supply curve is upward sloping. In the long run, the number of firms always adjusts to the point where profits for each firm are zero (so price is equal to the minimum of the average cost curve). So in the long run, price is always the same but the quantity supplied can vary by having different numbers of firms.

17. Suppose at its current level of production in a competitive industry, a firm's marginal costs are $40, its average variable costs are $50 and the market price is $40. We can say for certain that:

    (a) The firm is maximizing profits.
    (b) The firm is earning positive profits.
    (c) The firm is earning negative profits.
    (d) (a) and (c).

    (c) The firm is losing money since average variable costs are greater than the price. The firm would do better by shutting down.

18. If the government forced a monopoly to operate at the socially efficient quantity, what must be true?

    (a) The monopoly will be losing money.
    (b) The monopoly will be earning positive profits.
    (c) The monopoly's marginal cost curve will intersect the demand curve at the efficient quantity.
    (d) The monopoly's producer surplus will be negative.

    (c) Monopolies can still earn positive profits at the socially efficient quantity, they just typically earn higher profits at a lower quantity. What is definitely true about the socially efficient quantity is that it is quantity at which marginal cost intersects the demand curve.

19. If two goods are complements, then an increase in the price of one good will:

    (a) Decrease demand for the other good.
    (b) Increase demand for the other good.
    (c) Have no effect on demand for the other good.
    (d) Not enough information.

    (a) If the price of a complement goes up, then demand for both goods will go down.

20. For an industry with an upward sloping supply curve and a downward sloping demand curve, a quantity tax placed on consumers will:

    (a) Decrease consumer surplus and decrease producer surplus.
    (b) Generate deadweight loss.
    (c) Have the same effect as a quantity tax of the same amount placed on producers.
    (d) All of the above.

    (d) The tax will lead to a lower equilibrium quantity, a lower price received by producers and a higher price paid by consumers meaning that consumer surplus and producer surplus both decrease and a deadweight loss is generated.

21. Which of the following guarantees that a firm's producer surplus is equal to its profits?

    (a) The firm has no fixed costs.
    (b) If the firm's fixed costs are equal to its variable costs.
    (c) The price is above the firm's breakeven price.
    (d) The firm is producing a positive amount of output.

    (a) The difference between producer surplus and profits is just the fixed cost. So if fixed costs are zero, producer surplus will equal profits.

22. Which of the following is definitely true about a tax that generates a deadweight loss?

    (a) The tax decreases total surplus.
    (b) The decrease in consumer and producer surplus will be equal to the deadweight loss.
    (c) The decrease in consumer and producer surplus will be greater than the deadweight loss.
    (d) The decrease in consumer and producer surplus will be equal to the tax revenues.

(a) If the tax didn't decrease total surplus, there would be no deadweight loss. The size of the deadweight loss will be the decrease in consumer and producer surplus minus the tax revenue.

23. Suppose a firm has three factories, A, B and C. Each factory has constant marginal costs and the marginal cost at factory A is less than the marginal cost at factory B which is less than the marginal cost at factory C ($MC_A < MC_B < MC_C$). Which of the following statements is definitely true if the firm is maximizing profits?

    (a) The firm will produce at all three factories.
    (b) The firm will produce more at factory B than at factory C.
    (c) The firm will not produce any units at factory C.
    (d) The level of production at factory B will depend on the market price of output.

    (c) If the marginal costs are constant at all three factories and lowest at factory A, then all production will occur at factory A no matter how many units are being produced or what the market price of output is.

24. If demand is perfectly inelastic, the the demand curve will be:

    (a) A vertical line.
    (b) A horizontal line.
    (c) A line with a slope of 1.
    (d) A line with a slope of -1.

    (a) If demand is perfectly inelastic, then the quantity demanded does not change at all when price changes. This implies a vertical demand curve.

25. In a competitive industry, the current price is $25 and marginal costs are greater than average costs for each firm at their current level of output. What would we expect to happen to the number of firms in the industry?

    (a) The number of firms will increase.
    (b) The number of firms will decrease.
    (c) The number of firms will stay the same.
    (d) The number of firms will incresae in the short run but decrease in the long run.

    (a) If marginal cost is currently greater than average cost, firms are earning positive profits. Seeing the positive profits, additional firms will enter the industry until there are enough firms to drive price down to the point where profits are zero.

SECTION II: SHORT ANSWER (40 points)

For this section, be certain to show your work and clearly label any graphs you draw. Give complete answers but keep them concise. Please place a box around final answers where appropriate.

1. (15 points total) Suppose that a firm's cost function for producing xylophones is given by $C(x) = 8x^2 + x + 2$, where x is the number of xylophones being produced. The market for xylophones is perfectly competitive.
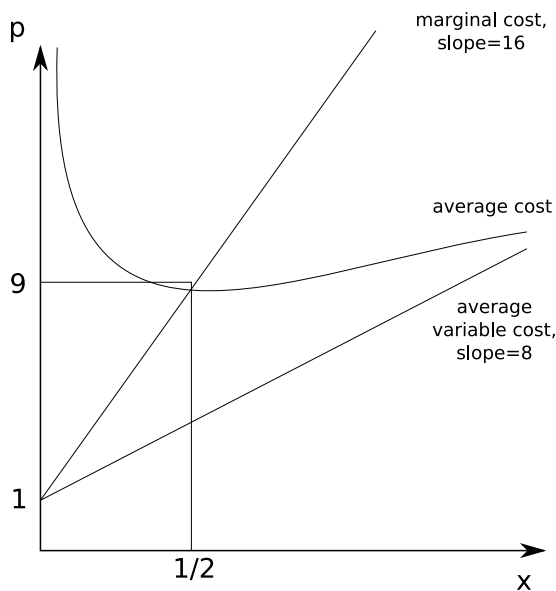
   (a) (5 points) Find expressions for the average cost, average variable cost and marginal cost functions for the firm in terms of the number of xylophones produced.

   $$AC(x) = \frac{C(x)}{x} = 8x + 1 + \frac{2}{x}$$

   $$AVC(x) = \frac{VC(x)}{x} = 8x + 1$$

   $$MC(x) = \frac{dC(x)}{dx} = 16x + 1$$

   (b) (5 points together with part (c)) Graph the functions you found in part (a). Be certain to label any minimums, including the value of x at which those minimums occur.

   (c) (see part (b) for points) Above what price does the firm earn positive profits?

   The firm will earn positive profits when the price is above the minimum of the average cost curve, which occurs at a price of \$9. To find this price, you can either directly solve for the minimum of the average cost curve by taking the derivative and setting it equal to zero or you can simply set the marginal cost equal to the average cost as follows:

   $$MC(x) = AC(x)$$

$$16x + 1 = 8x + 1 + \frac{2}{x}$$

$$x = \frac{1}{2}$$

$$AC(\frac{1}{2}) = 8 \cdot \frac{1}{2} + 1 + \frac{2}{\frac{1}{2}} = 9$$

(d) (5 points) In the long run, all firms in the industry have an average cost function given by $AC(x) = x^2 - 20x + 110$. The demand curve for the industry is given by $D(p) = 1020 - 2p$. Find the equilibrium price, output per firm and number of firms in the long run.

In the long run, firms will operate at the minimum of their average cost curve, earning zero profits. So finding the minimum of the average cost curve will tell us the equilibrium price and output per firm:

$$0 = \frac{dAC(x)}{dx} = 2x - 20$$

$$x = 10$$

$$AC(10) = 10^2 - 20 \cdot 10 + 110 = 10$$

So the equilibrium price will be \$10. At that price, demand is 1000 xylophones. With each firm producing 10 xylophones, the total number of firms must be 100.

2. (15 points total) A monopolist in the market for good x has the following cost function: $C(x) = 20x + 100$. The inverse demand function for good x is given by: $p(x) = 1520 - \frac{3}{2}x$.

(a) (3 points) Find an expression for the marginal revenue for the firm in terms of x.

$$R(x) = p(x) \cdot x = \left(1520 - \frac{3}{2}x\right) \cdot x = 1520x - \frac{3}{2}x^2$$

$$MR(x) = \frac{dR(x)}{dx} = 1520 - 3x$$

(b) (4 points) Find the the quantity sold by the monopoly and the price charged.

The monopolist will set marginal revenue equal to marginal cost to determine quantity and then plug this quantity into the demand function to determine price:

$$MR(x) = MC(x)$$

$$1520 - 3x = 20$$

$$x = 500$$

$$p = 1520 - \frac{3}{2}500 = 770$$

So the quantity will be 500 units and the price will be $770.

(c) (4 points) Find the socially efficient quantity.

The socially efficient quantity will be where the marginal cost curve hits the demand curve:

$$MC(x) = p(x)$$

$$20 = 1520 - \frac{3}{2}x$$

$$x = 1000$$

(d) (4 points) Calculate the deadweight loss in the monopoly outcome compared to the socially efficient outcome.

The deadweight loss will be the area under the demand curve above the marginal cost curve between the monopoly quantity and the efficient quantity:

$$DWL = \frac{1}{2}(p(x_m) - p(x_{eff}))(x_{eff} - x_m)$$

$$DWL = \frac{1}{2}(770 - 20)(1000 - 500) = 187500$$

3. (10 points total) A firm is operating in the perfectly competitive market for widgets. The firm has two different factories, A and B, and must decide how to split its production between the two factories when the market price for widgets is \$160. The cost functions for the two factories are:

$$C_A(w_A) = 10w_A^2 \tag{1}$$

$$C_B(w_B) = 40w_B^2 \tag{2}$$

(a) (5 points) What percentage of widgets produced by the firm are made at factory A?
   The firm will set the marginal costs of the two factories equal:

$$MC_A(w_A) = MC_B(w_B)$$

$$20w_A = 80w_B$$

$$\frac{1}{4}w_A = w_B$$

To get the percentage of total widgets produced at factory A, we use the above result along with the fact that the total number of widgets is just equal to w_A plus w_B:

$$w_A + w_B = w_{total}$$

$$w_A + \frac{1}{4}w_A = w_{total}$$

$$w_A = \frac{4}{5}w_{total}$$

So four fifths, or 80%, of the widgets are produced at factory A.

(b) (5 points) Given that the market price for a widget is \$160, how many widgets total does the firm produce?
   We know that the firm will produce where price is equal to marginal cost. Given what we found in the previous part, we can write down a cost function for the firm in terms of the total number of widgets produced:

$$C(w_{total}) = C_A(\frac{4}{5}w_{total}) + C_B(\frac{1}{5}w_{total})$$

$$C(w_{total}) = 10\left(\frac{4}{5}w\right)^2 + 40\left(\frac{1}{5}w\right)^2$$

$$C(w_{total}) = 8w^2$$

Now we can get the marginal cost function for the firm and set it equal to the price:

$$MC(w_{total}) = \frac{dC(w_{total})}{dw_{total}} = 16w_{total}$$

$$p = MC(w_{total})$$

$$160 = 16w_{total}$$

$$w_{total} = 10$$

So the firm will produce a total of 10 widgets.