Final Exam - Solutions

You have until 8pm to complete the exam, be certain to use your time wisely. For multiple choice questions, mark your answer on your scantron sheet. Choose only the single best answer for each multiple choice question; if more than one letter is filled in for a question it will be marked wrong. For the short answer questions, write your answers directly on the exam. 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. Good luck!

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

SECTION I: MULTIPLE CHOICE (60 points)

1. If a firm's cost function exhibits increasing returns to scale:
   (a) Total costs will be lower as the level of output gets larger.
   (b) Average costs will be lower as the level of output gets larger.
   (c) Both (a) and (b).
   (d) Neither (a) nor (b).

   (b) Total costs will continue to rise as output goes up (you need to use more inputs overall) but average costs will fall (you need to use smaller increases in inputs for each additional unit of output).

2. If $AC(10) < AC(11)$, then (note: the numbers represent units of output):
   (a) $MC(10) < AC(10)$.
   (b) $MC(10) > AC(10)$.
   (c) $MC(10) = AC(10)$.
   (d) $MC(10) = MC(11)$.

   (b) If average cost is rising, it must be the case that marginal cost is greater than average cost (the costs from the next unit produced will pull up the average).

3. The slope of a consumer's budget line depends on:
   (a) The prices of the goods and income.
   (b) Income only.
   (c) The marginal utilities of the goods.
   (d) The relative prices of the goods.

   (d) Income will shift the budget line but not affect the slope. The slope depends only on the prices of the goods.

4. If two inputs are perfect substitutes in production, a profit-maximizing firm will:
   (a) Use them in fixed proportions.
   (b) Use only the input with the larger marginal product relative to its price.

(c) Use only the input with the smaller marginal product relative to its price.

(d) Use equal amounts of the inputs.

(b) If the inputs are perfect substitutes, then a firm can minimize costs and maximize profits by using only the input with a larger value for $\frac{MP_i}{p_i}$.

5. Which of the following statements is true?

(a) Profits for a competitive firm are positive in the long run.

(b) Profits for a monopoly are always negative at the socially efficient price and quantity.

(c) Profits for a monopoly are always positive at the socially efficient price and quantity.

(d) None of the above.

(d) In the long run, a competitive firm will earn zero profits. For a monopoly, whether profits are postive or negative at the socially efficient price and quantity depends on the monopolist's minimum efficient scale.

6. A monopolist will tend to earn higher profits under _____ than it would under _____.

(a) First degree price discrimination, third degree price discrimination.

(b) Third degree price discrimination, first degree price discrimination.

(c) Second degree price discrimination, first degree price discrimination.

(d) Both (b) and (c).

(a) Under first degree price discrimination, a monoplist can capture all of the total surplus (and will choose the quantity that maximizes total surplus). Second degree price discrimination and third degree price discrimination will typically lead to lower profits. Another way to think about this is that anything the monopolist could do under second or third degree price discrimination can be done under first degree price discrimination but the opposite is not true.

7. If two bundles are on the same indifference curve, they:

(a) Both give a consumer the same level of utility.

(b) Both cost the same amount.

(c) Are both in a consumer's budget set.

(d) Both have the same marginal utility for x and the same marginal utility for y.

(a) By definition, two bundles on the same indifference curve give the same utility. Costs of the bundles or marginal utilities of the two goods can vary along an indifference curve.

8. If a firm uses only capital and labor as inputs and the level of capital is fixed in the short run, the firm will choose a short run level of labor for which:

(a) The marginal product of labor is equal to the price of output divided by the wage.

(b) The marginal product of labor is equal to the wage divided by the price of output.

(c) The marginal product of labor is equal to the marginal product of capital.

(d) The marginal rate of substitution is equal to the ratio of the input prices.

(b) If the marginal product of labor is equal to the wage divided by the price of output, the firm has reached the level of labor at which the last worker just pays

for himself, moving beyond that would lower the marginal product of labor and lead to the last working costing more than the revenue he generates.

9. In a perfectly competitive industry where firms all have upward sloping marginal cost curves, the short run industry supply curve is _____ while the long run industry supply curve is _____.

    (a) A positively sloped line, horizontal line.
    (b) A negatively sloped line, horizontal line.
    (c) A positively sloped line, a positively sloped line.
    (d) A horizontal line, a positively sloped line.

    (a) The short run supply curve is simply the sum of all of the individual firm supply curves. Since the individual firm supply curves are upward sloping (since marginal cost is upward sloping) the industry supply curve will be upward sloping. In the long run, the price will always be equal to the minimum of the average cost curve, so the long run supply curve is a horizontal line at that price.

10. If two identical firms compete with each other by choosing quantities, individual firm profits at the resulting equilibrium:

    (a) Will be equal to one half of the monopoly profits.
    (b) Will be zero.
    (c) Will be positive but less than one half of the monopoly profits.
    (d) Will be negative.

    (c) When two firms choose quantities, the equilibrium level of total output will be between the monopoly level and the efficient level. So total profits will be less than monopoly profits but still greater than zero.

11. If goods x and y are both ordinary goods and complements, an increase in the price of good x will:

    (a) Increase consumption of both goods.
    (b) Decrease consumption of both goods.
    (c) Increase consumption of x and decrease consumption of y.
    (d) Increase consumption of y and decrease consumption of x.

    (b) Consumption of x will go down since it is an ordinary good. Consumption of y will go down since x and y are complements.

12. Marginal revenue for a firm in a competitive industry:

    (a) Increases as the firm increases output.
    (b) Decreases as the firm increases output.
    (c) Remains constant as the firm increases output.
    (d) The answer depends on the firm's cost function.

    (c) A firm in a competitive industry is a price taker. So for each unit they sell, the marginal revenue is just equal to the market price.

13. Indifference curves are:

    (a) Always downward sloping.
    (b) Always upward sloping.
    (c) Downward sloping if one or both of the goods are 'bads'.
    (d) Downward sloping if both of the goods are 'bads'.

       (d) If both goods are good or if both goods are bad, the indifference curves will be downward sloping. If one good is good while the other is a bad, the indifference curves would be upward sloping.

14. Charging an annual membership fee for a CD club and then allowing members to buy as many CD's as they want at a low price per CD is an example of:

    (a) Third degree price discrimination.
    (b) Bundling.
    (c) A two-part tariff.
    (d) Second degree price discrimination.

       (c) A two-art tariff consistents of a flat fee and then a per unit price, with the consumer free to choose any quantity they want at that price.

15. In which of the following cases would a quantity tax not lead to deadweight loss?

    (a) When demand and supply are both unit elastic.
    (b) When the tax is set such that tax revenue is maximized.
    (c) When tax revenues are spent efficiently.
    (d) When the supply curve is perfectly inelastic.

       (d) When the supply curve is perfectly inelastice (a vertical line), introducing a quantity tax will not change the equilibrium quantity. Consequently, there is no deadweight loss.

16. A firm with no fixed costs in a competitive industry:

    (a) Will produce output at all positive prices.
    (b) Will produce at a level of output where marginal revenue equals marginal cost (if they decide to produce a positive amount of output).
    (c) Will have profits that are less than producer surplus.
    (d) Both (a) and (b).

       (b) If the firm is producing, they will choose the quantity at which marginal cost equals marginal revenue (market price in the case of a competitive industry). If the minimum of their average cost curve is greater than zero, there will be some prices at which the firm decides not to produce. The difference between profits and producer surplus is just fixed cost, so if fixed costs are zero profits will equal producer surplus.

17. On a graph with capital on the vertical axis and labor on the horizontal axis, the slope of an isocost line will be:

    (a) Steeper the larger the wage is.
    (b) Steeper the larger the rental rate of capital is.
    (c) Steeper the larger the marginal product of labor is.

(d) Steeper the larger the marginal product of capital is.

(a) The slope of the isocost line would just be $-\frac{w}{r}$. So the line gets steeper as w gets larger or as r gets smaller.

18. If two identical firms compete with each other by choosing prices, the equilibrium quantity (the combined output of both firms):

    (a) Will tend to be between the monopoly quantity and the efficient quantity.
    (b) Will be equal to the monopoly quantity.
    (c) Will be equal to the efficient quantity.
    (d) Will maximize total combined profits of the firms.

    (c) The firms will keep undercutting each other until price falls to marginal cost, which is the efficient outcome. Note that the firms wouldn't necessarily reach the efficient outcome if they had different cost functions.

19. If a firm's average cost curve is a horizontal line, a graph of total costs as a function of output will be (note: you can assume total costs are positive for positive quantities of output):

    (a) A vertical line.
    (b) A horizontal line.
    (c) A straight line but not horizontal.
    (d) Not enough information.

    (c) If the average cost curve is a horizontal line it means that average costs are constant. Total costs would be that constant times y.

20. If firms in a competitive industry are earning positive profits in the short run:

    (a) The number of firms will increase and the industry supply curve will get flatter.
    (b) The number of firms will increase and the industry supply curve will get steeper.
    (c) The number of firms will decrease and the industry supply curve will get flatter.
    (d) The number of firms will decrease and the industry supply curve will get steeper.

    (a) If positive profits are being made, firms will enter the industry. Adding additional firm supply curves to the industry supply will lead to a flatter industry supply curve.

21. If the price of a normal, ordinary good goes up, the income and substitution effects for that good:

    (a) Will both be positive.
    (b) Will both be negative.
    (c) Will have opposite signs.
    (d) The answer depends on whether the other good is a complement or substitute.

    (b) Since the price went up, the substitution effect will be negative regardless of the type of good. Because x is a normal good, the effective drop in income will lead to a negative price effect.

22. Which of the following is true at any level of output y?

(a) Short run average costs are less than long run average costs.
(b) Short run average costs are greater than long run average costs.
(c) Short run average costs are less than or equal to long run average costs.
(d) Short run average costs are greater than or equal to long run average costs.

(d) If we happen to be at our optimal levels of inputs in the short run, short run average costs will equal long run average costs. However, if the level of any fixed inputs is not equal to the optimal level, short run average costs will be greater than long run average costs.

23. If a consumer has well-behaved indifference curves (the optimal bundle is at a point of tangency between the indifference curve and the budget line), then at the consumer's optimal bundle (x^*, y^*):

(a) A dollar spent on x will increase utility by the same amount as a dollar spent on y.
(b) The marginal utility of x is equal to the marginal utility of y.
(c) An increase in both x and y would lead to a decrease in utility.
(d) A movement along the budget line could lead to an increase in utility.

(a) The fact that the optimal bundle is at a point of tangency means that $\frac{MU_x}{p_x} = \frac{MU_x}{p_x}$, or a dollar spent on x increases utility by the same amount as a dollar spent on y.

24. Which of the following is true?

(a) The marginal cost curve intersects the average fixed cost curve at its minimum.
(b) The average variable cost curve intersects the average cost curve at its minimum.
(c) The average cost curve lies below the average variable cost curve.
(d) The marginal cost curve intersects the average variable cost curve at its minimum.

(d) The marginal cost curve intersects the average variable cost curve and the average cost curve at their minimums. The average fixed cost curve has no minimum, it continues to slope downward as output increases.

25. If the demand curve is downward sloping and the supply curve is upward sloping, a quantity tax will:

(a) Increase the price paid by consumers and decrease the price received by producers.
(b) Decrease consumer surplus and decrease producer surplus.
(c) Decrease consumer and producer surplus by an amount greater than the revenue generated by the tax.
(d) All of the above.

(d) The tax will decrease quantity, increase the consumer price and decrease the producer price leading to declines in consumer and producer surplus. The combined decline in consumer and producer surplus will be greater than the tax revenue by an amount equal to the deadweight loss.

<center>SECTION II: SHORT ANSWER (40 points)</center>

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. (18 points total) Suppose there is only one bookstore in town and it acts as a monopolist. The bookstore can get books from publishers at a price of $5 a book and can order as many or as few books as it wants at this price. The inverse market demand curve for books is given:

$$p(b) = 10 - \frac{1}{100}b \tag{1}$$

   (a) Derive an expression for the revenue of the bookstore in terms of the number of books sold (b) and an expression for the total costs of the bookstore as a function of the number of books sold (b). (4 points)

$$R(b) = b \cdot p(b)$$

$$R(b) = b(10 - \frac{1}{100}b)$$

$$R(b) = 10b - \frac{1}{100}b^2$$

   For the cost function, notice that the firm has constant marginal costs of $5 per book. So total costs will just be $5 times the number of books:

$$C(b) = 5b$$

   (b) If the bookstore is maximizing profits, what price will each charge per book, how many books will it sell and what will total profits be? (4 points)

   The bookstore is a monopolist, so it has marginal revenues given by:

$$MR(b) = \frac{dR(b)}{db} = 10 - \frac{1}{50}b$$

   The bookstore will sell the quantity of books at which marginal revenue is equal to marginal cost:

$$MR(b) = MC(b)$$

$$10 - \frac{1}{50}b = 5$$

$$5 = \frac{1}{50}b$$

$$b = 250$$

$$p(250) = 10 - \frac{1}{100}250 = 7.5$$

$$\pi = b \cdot (p - AC) = 250 \cdot (7.5 - 5) = 625$$

   So the bookstore will sell 250 books at a price of $7.50 per book and earn a profit of $625.

(c) What would be the socially efficient price and quantity of books sold? (3 points)

   The socially efficient price and quantity would be where the marginal cost curve intersects the demand curve:

$$MC(b) = p(b)$$

$$5 = 10 - \frac{1}{100}b$$

$$5 = \frac{1}{100}b$$

$$b = 500$$

$$p(500) = 10 - \frac{1}{100}500 = 5$$

   So the socially efficient quantity is 500 books at a price of $5 a book.

(d) Calculate the deadweight loss associated with the monopoly outcome. (3 points)

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

$$DWL = \frac{1}{2}(7.5 - 5)(500 - 250) = 312.5$$

(e) Explain one alternative pricing strategy the bookstore could use to earn even higher profits than what you found in part (b). Your answer should be specific to the information given in the problem, you cannot assume that there are different types of customers or other types of products not mentioned in the problem. (Note: You do not need to calculate exact numbers but you do need to fully describe the pricing strategy and explain why it would generate greater profits. You may include a graph if it helps illustrate your explanation.) (4 points)

   With the information given in the problem, it isn't clear that the bookstore would be able to use second or third degree price discrimination. We do have enough information to see that the bookstore could use either first degree price discrimination or a two-part tarriff. If the bookstore opted to use first degree price discrimination, it could make an all or nothing offer to the consumers of 500 books at a total price equal to the entire area under the demand curve. This would allow the bookstore to capture all of the consumer surplus. If the bookstore opted for a two-part tarriff, it would set the price of a book equal to $5 and then charge the consumers a flat fee equal to the consumer surplus at a price of $5 and quantity of 500 books. Either of these approaches would lead to significantly larger profits for the bookstore.

2. (10 points total) A firm in a perfectly competitive industry uses ten identical factories to produce a total amount of output y. The cost function for an individual factory i is given by:

$$C_i(y_i) = 10y_i^2 \tag{2}$$

(a) Suppose that the factory wants to produce 20 total units of output. How many units of output will the firm produce at each factory and what will the firm's total costs be? (3 points)

The firm will divide output among the factories such that the marginal costs at each factory are equal. Since the factories all have the same cost function, marginal costs will only be equal if the same amount of output is produced at each factory. So each factory produced one tenth of the total output, in this case that would mean two units at each factory. Total costs will be:

$$C(20) = 10 \cdot C_i(2)$$

$$C(20) = 10 \cdot 10 \cdot 2^2$$

$$C(20) = 400$$

(b) Derive an expression for the firm's total costs as a function of the total amount of output produced, y. (4 points)

$$C(y) = 10 \cdot C_i(\frac{1}{10}y)$$

$$C(y) = 10 \cdot 10(\frac{y}{10})^2$$

$$C(y) = y^2$$

(c) If the market price is \$40, how many units will the firm produce and what will the firm's profits be? (3 points)

Based on this cost function, the firm's marginal cost function is:

$$MC(y) = \frac{dC(y)}{dy} = 2y$$

The firm will choose its output level by setting price equal to marginal cost:

$$p = MC(y)$$

$$40 = 2y$$

$$y = 20$$

Profits are:

$$\pi = p \cdot y - C(y)$$

$$\pi = 40 \cdot 20 - 20^2 = 400$$

3. (12 points total) A fast food restaurant operates in a competitive industry and has the total costs for producing hamburgers given by:

$$C(h) = h^3 - 10h^2 + 35h \tag{3}$$

where h is the total number of hamburgers produced.

(a) Derive expressions for average costs as a function of h and marginal costs as a function of h. (3 points)

$$AC(h) = \frac{C(h)}{h} = h^2 - 10h + 35$$

$$MC(h) = \frac{dC(h)}{dh} = 3h^2 - 20h + 35$$

(b) What is the lowest price at which the restaurant will still produce a positive quantity of hamburgers? (3 points)

Since there are no fixed costs, the restaurant will never produce at a price below the minimum of the average cost curve. We can find the quantity of hamburgers at which average costs reach their minimum by setting marginal cost equal to average cost:

$$AC(h) = MC(h)$$
$$h^2 - 10h + 35 = 3h^2 - 20h + 35$$
$$2h^2 = 10h$$
$$h = 5$$
$$AC(5) = 5^2 - 10 \cdot 5 + 35 = 10$$

So the lowest price at which the restaurant will produce a positive quantity of hamburgers is $10.

(c) Will the restaurant ever produce at quantity at which profits are negative? Why or why not? (3 points)

The firm will never produce at a quantity at which profits are negative. Notice that there are no fixed costs for the firm (all terms in the cost function include h). So if the firm shuts down, profits would be zero. Therefore if the firm were earning negative profits, it would make more sense to shut down and earn zero profits.

(d) Suppose market demand for hamburgers is given by:

$$D(p) = 2000 - 50p \tag{4}$$

If all other fast food restaurants have the same cost function, what will the total number of restaurants be in the long run? (3 points)

In the long run, profits for each firm should be zero. This occurs if the price is equal to the minimum of the average cost curve. We already found this price in part (b), it is $10. At a price of $10, total demand for hamburgers is 1500. Each restaurant produces 5 (we found this number in part (b)), so there will be a total of $\frac{1500}{5}$ or 300 restaurants in the long run.