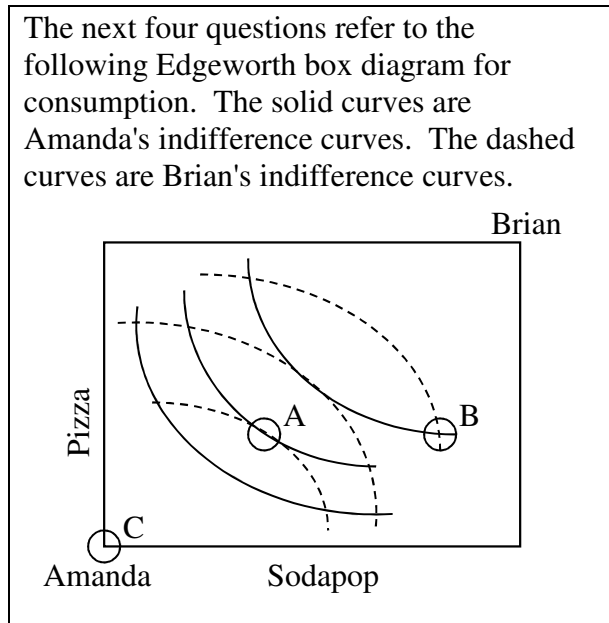


**EXAMINATION #4 VERSION B**  
**“General Equilibrium and Market Power”**  
**November 30, 2011**

**INSTRUCTIONS:** This exam is closed-book, closed-notes. Calculators are not permitted. Point values for each question are noted in brackets.

**I. MULTIPLE CHOICE:** Circle the one best answer to each question. Feel free to use margins for scratch work. [1 pt each—11 pts total]

The next four questions refer to the following Edgeworth box diagram for consumption. The solid curves are Amanda's indifference curves. The dashed curves are Brian's indifference curves.



- (1) From allocation B, *both* consumers can enjoy greater utility if
- Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
  - Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
  - Amanda gives Brian some pizza and some sodapop.
  - Brian gives Amanda some pizza and some sodapop.
  - No trade will allow both consumers to enjoy greater utility.

- (2) From allocation A, *both* consumers can enjoy greater utility if
- Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
  - Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
  - Amanda gives Brian some pizza and some sodapop.
  - Brian gives Amanda some pizza and some sodapop.
  - No trade will allow both consumers to enjoy greater utility.

- (3) Amanda and Brian have identical marginal rates of substitution in consumption at
- allocation A only.
  - allocation B only.
  - both allocations A and B.
  - neither allocation A nor B.

- (4) The contract curve for this Edgeworth box diagram does *not* pass through
- Allocation A.
  - Allocation B.
  - Allocation C.
  - The contract curve passes through *all three* allocations.
  - The contract curve does not pass through any of these three allocations.

(5) Which equation for average cost implies that the firm enjoys a natural monopoly?

- a.  $AC(q) = 0.001 q^2 + 0.02 q + 4$ .
- b.  $AC(q) = 7$ .
- c.  $AC(q) = 0.3 q$ .
- d.  $AC(q) = 2 - 0.02 q^{-1}$ .
- e.  $AC(q) = 4 + 100 q^{-1}$ .

(6) Suppose a monopolist faces the demand curve  $P = 50 Q^{-0.2}$ . The monopolist's marginal revenue function is

- a.  $MR(Q) = -10 Q^{-1.2}$ .
- b.  $MR(Q) = -8 Q^{-1.2}$ .
- c.  $MR(Q) = 50 Q^{-0.2}$ .
- d.  $MR(Q) = 50 Q^{0.8}$ .
- e.  $MR(Q) = 40 Q^{-0.2}$ .

(7) Monopoly causes economic inefficiency because

- a. monopoly prices are unfair.
- b. it is unfair for one firm to control the market.
- c. monopolists are usually wealthier than their customers.
- d. some consumers, willing to pay the marginal cost of the product, are not served.
- e. monopolists enjoy profits, called monopoly rents, even in the long run.

(8) Suppose an industry is served by just two firms: Firm A and Firm B. If Firm A *decreases* its output while Firm B leaves its output unchanged, then Firm B's profit will

- a. remain unchanged.
- b. decrease.
- c. increase.
- d. Cannot be determined from information given.

(9) Suppose all the firms in an industry reach an agreement to raise the product price above the competitive level and thereby maximize the sum of their profits. Then each firm has an incentive to cheat on the agreement by individually

- a. producing less output than its quota as specified in the agreement.
- b. increasing its price even further.
- c. decreasing its price.
- d. all of the above.

(10) Suppose consumers do not view breakfast cereal brands as perfect substitutes. For example, some consumers prefer Cheerios while others prefer Kellogg's Corn Flakes. Then breakfast cereals are said to be

- a. differentiated products.
- b. normal products.
- c. efficient products.
- d. elastic products.
- e. complementary products.

(11) Suppose an industry is characterized by *monopolistic competition*. Then in the long run, price equals

- a. the elasticity of demand.
- b. average profit.
- c. marginal cost.
- d. average cost.
- e. marginal revenue.

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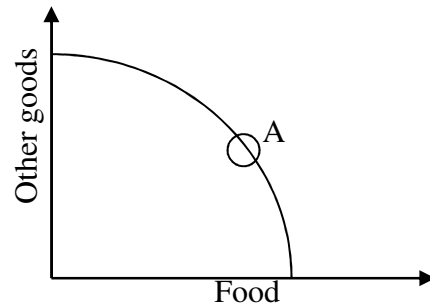
**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins and graphs for scratch work. Work carefully—partial credit is not normally given for questions in this section.

(1) [Cost minimization across firms: 6 pts] Suppose Firm A and Firm B must together produce a total of 50 units of output at *minimum total cost*. Firm A's total cost function is given by  $TC_A = 2q_A + (q_A^2/8)$ , where  $q_A$  denotes Firm A's output level. Firm B's total cost function is given by  $TC_B = 7q_B + (q_B^2/4)$ , where  $q_B$  denotes Firm B's output level.

- What output level  $q_A$  should be produced by Firm A?
- What output level  $q_B$  should be produced by Firm B?
- Suppose Firm A and Firm B are competitive firms, taking price as given. What market price would motivate Firm A and Firm B to produce these output levels?

units
units
\$

(2) [General equilibrium: 10 pts] Consider the graph at right of an economy's production-possibility curve. Assume this economy is in general competitive equilibrium at point A, where the slope of the production-possibility curve is  $-3$ .



- Suppose this country wants to produce 24 more units of other goods. To do so, must the country *increase* or *decrease* production of food?
- By how much?
- What is this country's opportunity cost of a single unit of *food*?
- Consider the consumer's budget line with food on the horizontal axis and other goods on the vertical axis. What must be the slope of every consumer's budget line in this economy?
- If the price of other goods is \$5 per unit, then what must be the price of food?

units of food
units of other goods
\$

(3) [Marginal revenue: 6 pts] Suppose a coffee vendor with market power is now selling 20 cups of coffee per hour at a price of \$2.50. If she cuts the price to \$2.40, she can sell one more cup of coffee per hour (that is, a total of 21 cups of coffee per hour).

- a. Compute the vendor's marginal revenue for the 21<sup>st</sup> cup of coffee.

\$
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Suppose the marginal cost of making a cup of coffee is \$1.00 per cup, and suppose the vendor does lower her price to \$2.40 to sell 21 cups per hour.

- b. Will the vendor's hourly profit *increase* or *decrease*?
- c. By how much?

\$

(4) [Monopoly price discrimination: 4 pts] Suppose the producer of the Madrigal Concert believes that the price elasticity of demand for tickets by adults is  $-2$ , and the elasticity of demand by children is  $-5$ . Assume the concert has a marginal cost of \$20 per ticket.

- a. Compute the concert's profit-maximizing ticket price for adults.
- b. Compute the concert's profit-maximizing ticket price for children.

\$
\$

(5) [Lerner index of market power: 6 pts] The Lerner index of market power is defined as the fraction of price that is represents a markup over marginal cost:  $L = (P-MC)/P$ . Suppose the market for automobiles has a price elasticity of demand of  $-4$ .

- a. Compute the Lerner index if the market for automobiles is a monopoly.
- b. Compute the Lerner index if the market for automobiles is a symmetric Cournot oligopoly of two firms.
- c. Compute the Lerner index if the market for automobiles is a symmetric Cournot oligopoly of twenty-five firms.


**III. PROBLEMS:** Please write your answers in the boxes on this question sheet. Show your work and circle your final answers.

(1) [General equilibrium, exchange efficiency: 14 pts] Firms A and B produce automobiles and bicycles, respectively. Firm A's production function is given by  $q_A = x_{1A}^{4/5} x_{2A}^{1/5}$ , where  $x_{1A}$  denotes the number of machines and  $x_{2A}$  denotes the number of workers used by Firm A. Firm B's production function is given by  $q_B = x_{1B}^{1/2} x_{2B}^{1/2}$ , where  $x_{1B}$  denotes the number of machines and  $x_{2B}$  denotes the number of workers used by Firm B.

- a. [2 pts] Find a formula for Firm A's marginal rate of substitution in production of workers for machines—that is, the slope of Firm A's isoquant with machines ( $x_{1A}$ ) on the vertical axis and workers ( $x_{2A}$ ) on the horizontal axis.

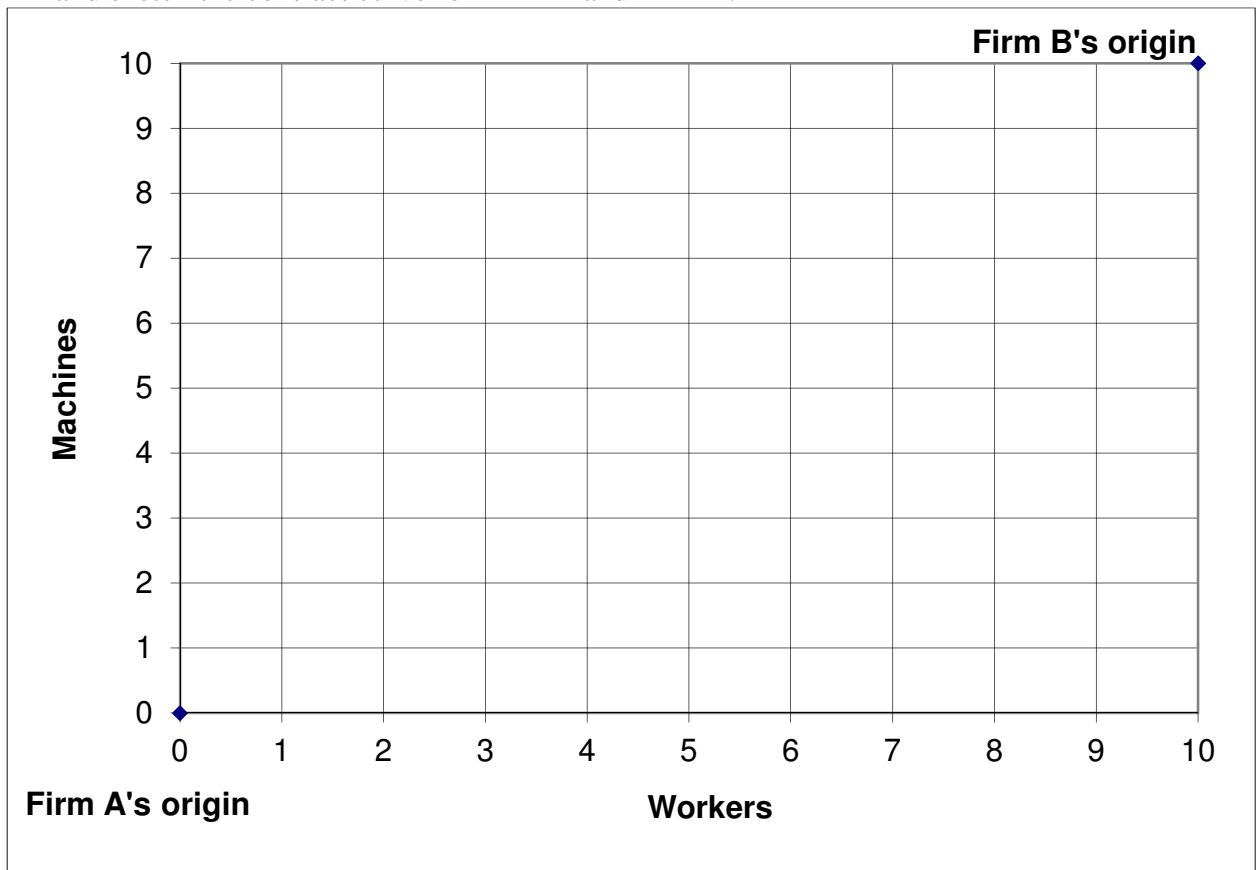
- b. [2 pts] Find a formula for Firm B's marginal rate of substitution in production of workers for machines—that is, the slope of Firm B's isoquant with machines ( $x_{1B}$ ) on the vertical axis and workers ( $x_{2B}$ ) on the horizontal axis.

Note: question continues on next page.

[6 pts] There are a total of 10 machines and 10 workers available. Six examples of feasible allocations are given below. State whether each allocation is technically *efficient* or *inefficient*.

Allocation	Firm A		Firm B		<i>Efficient or inefficient?</i>
	Machines ( $q_{1A}$ )	Workers ( $q_{2A}$ )	Machines ( $q_{1B}$ )	Workers ( $q_{2B}$ )	
C	5	5	5	5	
D	10	10	0	0	
E	5	2	5	8	
F	8	5	2	5	
G	8	2	2	2	
H	0	0	10	10	

(i) [4 pts] Plot and label the above *efficient* allocations only in the Edgeworth box below, and sketch the contract curve for Firm A and Firm B.



(2) [Monopoly, price discrimination: 16 pts] Suppose a monopolist faces the following demand curve:  $P = 10 - (Q/100)$ . Further suppose that the monopolist's marginal cost and average cost are constant and equal to \$4. Assume initially that the monopolist must charge the same price for all units sold—that is, price discrimination is *impossible*. Circle your final answers. Use the space at the bottom of the next page for scratch work.

- a. Find the monopolist's marginal revenue function  $MR(Q)$ .

- b. Compute the monopolist's profit-maximizing quantity of output.

- c. Compute the monopolist's profit-maximizing price.

- d. Compute monopoly profit at this price.

- e. Compute social deadweight loss at this price.

Note: question continues on next page.

Alternatively, assume that *perfect price discrimination* is possible. Each unit of output may be sold at a different price, equal to the maximum amount the buyer is willing to pay for that unit.

- f. Compute the monopolist's profit-maximizing quantity of output with perfect price discrimination.

- g. Compute monopoly profit with perfect price discrimination.

- h. Compute social deadweight loss with perfect price discrimination.





(3) [Cournot duopoly: 14 pts] Suppose two firms form a symmetric Cournot duopoly, each firm setting its own quantity while taking the other firm's quantity as given. Let  $q_1$  = firm #1's quantity and  $q_2$  = firm #2's quantity, so that total market quantity  $Q = q_1 + q_2$ . The market demand curve is  $P = 10 - (Q/100)$ . Each firm has constant marginal and average cost equal to \$4. Circle your final answers. Use the space at the bottom of the next page for scratch work.

- a. Find an expression for firm #1's revenue, as a function of its own quantity and the quantity produced by the other firm:  $Rev_1(q_1, q_2)$ . [Hint: By definition,  $Rev_1 = P q_1$ . Here, replace P by the equation for the demand curve, and then replace Q by  $(q_1 + q_2)$ .]

- b. Find an expression for firm #1's marginal revenue, as a function of its own quantity and the quantity produced by the other firm:  $MR_1(q_1, q_2)$ . [Hint:  $MR_1(q_1, q_2) = \partial Rev_1(q_1, q_2) / \partial q_1$ .]

- c. Find an expression for firm #1's reaction function, showing how much firm #1 will produce for any given level of quantity set by the other firm:  $q_1^* = f(q_2)$ . [Hint: Set  $MR_1 = MC$  and solve for  $q_1$  as a function of  $q_2$ .]

- d. Assume the equilibrium is symmetric (that is, assume  $q_1^* = q_2^*$ ) and compute firm #1's equilibrium quantity  $q_1^*$ .

Note: question continues on next page.

e. Compute total market quantity  $Q^*$  and the equilibrium price  $P^*$ .

f. Compute the total profit of both firms.

g. Compute the social deadweight loss.



(4) [Game theory: 9 pts] Firms A and B are setting prices. If they set the same high price, they both enjoy high profits. If one firm defects to a lower price, it attracts all the customers while the other high-price firm makes losses. If both firms set low prices, they both make low profits. The firms' situation is depicted by the following game in normal form.

		Firm B	
		Low price	High price
Firm A	Low price	A gets \$10 million. B gets \$10 million.	A gets \$25 million. B gets -\$5 million.
	High price	A gets -\$5 million. B gets \$25 million.	A gets \$20 million. B gets \$20 million.

- a. Find all the Pareto-optimal outcomes of this game (if there are any). Describe each such outcome by listing the *strategies* chosen by each firm.

1.
2.
3.
4.

- b. Find all the dominant-strategy equilibria<sup>1</sup> of this game (if there are any). Describe each such equilibrium by listing the *strategies* chosen by each firm.

1.
2.
3.
4.

- c. Find all the Nash equilibria in pure strategies of this game (if there are any). Describe each such equilibrium by listing the *strategies* chosen by each firm.

1.
2.
3.
4.

<sup>1</sup> "Equilibria" is the plural form of "equilibrium."

**IV. CRITICAL THINKING:** Answer just *one* of the questions below (your choice). [4 pts]

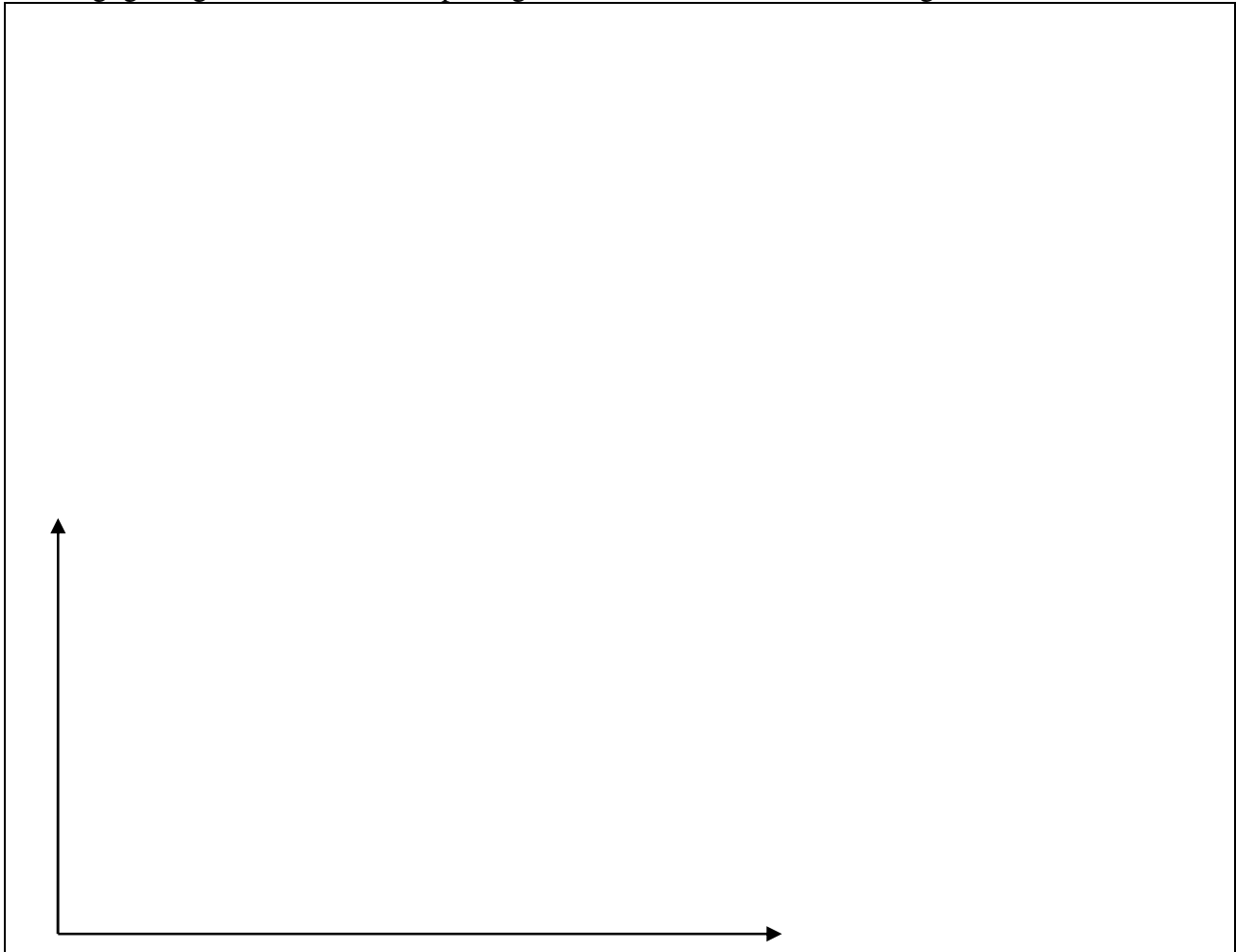
(1) Suppose a fixed amount of turkey ( $q_1$ ) and pumpkin pie ( $q_2$ ) must be allocated efficiently among three people: Adam, Becky, and Caleb. Suppose Adam's utility function is  $U_A(q_{1A}, q_{2A}) = q_{1A}^{1/2} + q_{2A}^{1/2}$ , Becky's utility function is  $U_B(q_{1B}, q_{2B}) = q_{1B} q_{2B}$ , and Caleb's utility function is  $U_C(q_{1C}, q_{2C}) = -q_{1C}^{-1} - q_{2C}^{-1}$ . Obviously, an efficient allocation must be feasible, so it must satisfy these two equations:

$$q_1 = q_{1A} + q_{1B} + q_{1C} \quad \text{and} \quad q_2 = q_{2A} + q_{2B} + q_{2C} .$$

Give *two more equations* that an efficient (or Pareto-optimal) allocation must satisfy. Explain why these two equations must be satisfied.

(2) Consider the following statement. "Profits are higher for all firms under a cartel than under competition. So the government should encourage cartels." Do you agree or disagree? Why? Justify your answer with a graph.

Circle the question you are answering and write your answer below. Full credit requires legible writing, good grammar, accurate spelling, and correct economic reasoning.



[end of exam]