

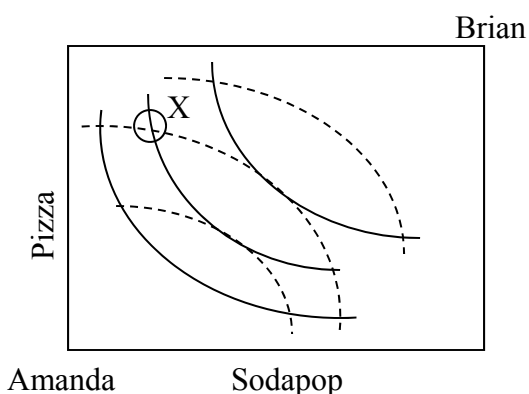
**EXAMINATION #4 VERSION B**  
**“General Equilibrium and Market Power”**  
**November 22, 2016**

INSTRUCTIONS: This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices 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—8 pts total].

(1) Consider the Edgeworth box diagram below. From allocation X, *both* consumers can enjoy greater utility if

- a. Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
- b. Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
- c. Amanda gives Brian some pizza and some sodapop.
- d. Brian gives Amanda some pizza and some sodapop.
- e. No trade will allow both consumers to enjoy greater utility.



(2) A "natural monopoly" is a firm that enjoys

- a. an exclusive government franchise allowing it alone to sell the product.
- b. exclusive ownership of a natural resource essential for producing the product.
- c. a downward-sloping average cost curve.
- d. patent protection.

(3) 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.

(4) The Cournot model of oligopoly assumes that each firm maximizes its profit while taking its rivals'

- a. costs as given.
- b. prices as given.
- c. output quantities as given.
- d. all of the above.

(5) A certain industry is served by a symmetric Cournot oligopoly of four firms. If the elasticity of market demand is -5, the Lerner index (or "price-cost margin") in equilibrium equals

- a. 0.04 .
- b. 0.05 .
- c. 0.20 .
- d. 0.50 .

(6) Suppose consumers do not view breakfast cereal brands as perfect substitutes. For example, some consumers prefer Cheerios, some prefer Kellogg's Corn Flakes, and some are indifferent. Then breakfast cereals are said to be \_\_\_\_\_ products.

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

(7) The model of monopolistic competition is similar to the model of monopoly in that

- a. firms choose a level of output where price exceeds marginal cost.
- b. free entry drives profits to zero.
- c. price equals average cost in the long run.
- d. all of the above.

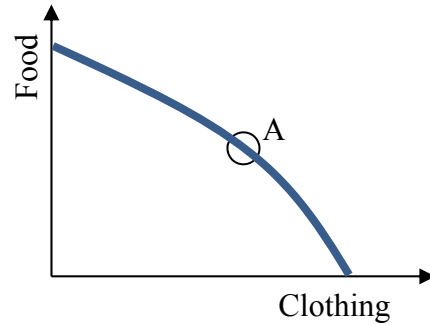
(8) Which of the following characterizes a Nash equilibrium of a game?

- a. Each player is receiving the highest possible payoff in the game.
- b. The sum of the payoffs for both players is maximized.
- c. Neither player wants to change strategies unilaterally.
- d. Neither player can be made better off without the other player being made worse off.

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**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [General equilibrium: 8 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  $-2$ .



- What is the opportunity cost of a unit of clothing? In other words, how many units of food must be given up in order to produce one more unit of clothing?
- What is the opportunity cost of a unit of food? In other words, how many units of clothing must be given up in order to produce one more unit of food?
- Consider the typical consumer's budget line with food on the vertical axis and clothing on the horizontal axis. What must be the slope of every consumer's budget line in this economy?
- If the price of a unit of clothing is \$ 12, then what must be the price of a unit of food?

	units of food
	units of clothing
\$	

(2) [Marginal revenue: 6 pts] Suppose a cupcake vendor with market power is now selling 10 cupcakes per hour at a price of \$3.00. If he cuts the price to \$2.80, he can sell one more cupcake per hour (that is, a total of 11 cupcakes per hour).

- Compute the vendor's marginal revenue for the 11th cupcake.

\$
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Suppose the marginal cost of making a cupcake is \$1.00 per cupcake, and suppose the vendor does lower his price to \$2.80 to sell 11 cupcakes per hour.

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

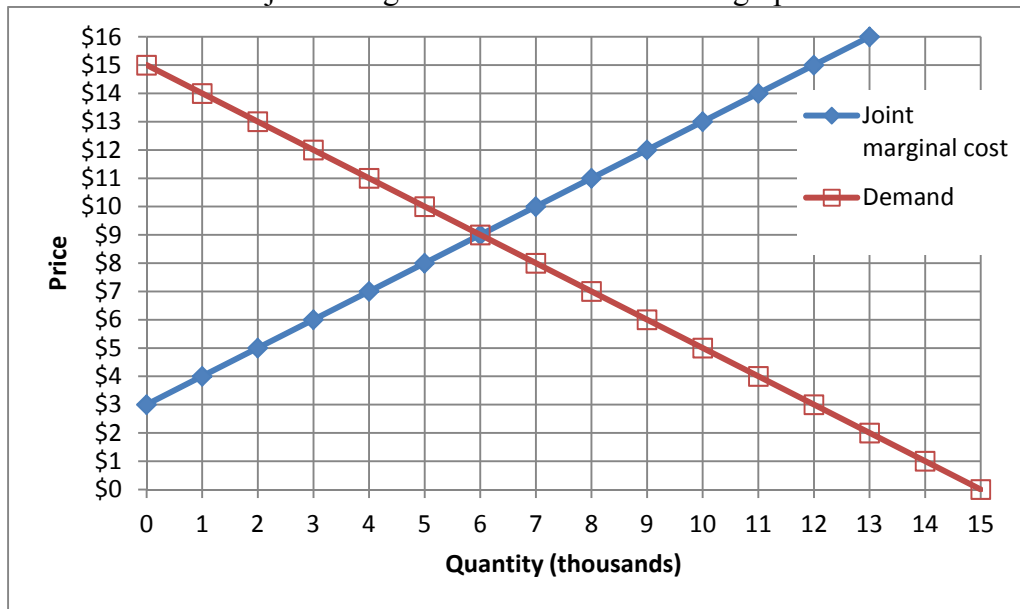
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(3) [Monopoly price discrimination: 4 pts] Suppose the producers of a performance of "The Nutcracker" ballet believe that the elasticity of demand for admission by adults is  $-2$ , and the elasticity of demand by children is  $-5$ . Assume the marginal cost is \$20 per admission.

- Compute the profit-maximizing ticket price for adults.
- Compute the profit-maximizing ticket price for children.

\$
\$

(4) [Collusion/joint profit maximization: 16 pts] Three firms produce a laundry soap. Market demand and the three firms' joint marginal cost are shown in the graph below.



First, suppose these firms engage in price competition.

- Compute competitive equilibrium market price.
- Compute competitive equilibrium market quantity.
- Compute the amount of deadweight loss.

\$	
	thousand
\$	thousand

Now suppose these firms form a cartel to maximize jointly the sum of their profits. The equation for demand is  $P = 15 - Q$ , where  $Q =$  quantity in thousands.

- Find the equation for the cartel's marginal revenue.

MR =

- Carefully plot and label the cartel's marginal revenue curve in the graph above.

- What price will the firms jointly set?
- How much output will the firms produce, in total?
- Compute the amount of deadweight loss.

\$	
	thousand
\$	thousand

(5) [Game theory: 12 pts] An industry consists of two firms. Each firm chooses a low price or a high price. Payoffs are shown in the following game in normal (or strategic) form.

		Firm B	
		High price	Low price
Firm A	High price	Firm A's profit = \$10 million Firm B's profit = \$10 million	Firm A's profit = \$1 million. Firm B's profit = \$15 million.
	Low price	Firm A's profit = \$15 million. Firm B's profit = \$1 million.	Firm A's profit = \$2 million. Firm B's profit = \$2 million.

a. Which outcomes of this game (if any) are Pareto-optimal<sup>1</sup>? Answer "YES" or "NO."

Firm A plays "High price" and Firm B plays "High price"	
Firm A plays "Low price" and Firm B plays "Low price"	
Firm A plays "High price" and Firm B plays "Low price"	
Firm A plays "Low price" and Firm B plays "High price"	

b. Which outcomes of this game (if any) are dominant-strategy equilibria<sup>2</sup>? Answer "YES" or "NO."

Firm A plays "High price" and Firm B plays "High price"	
Firm A plays "Low price" and Firm B plays "Low price"	
Firm A plays "High price" and Firm B plays "Low price"	
Firm A plays "Low price" and Firm B plays "High price"	

c. Which outcomes of this game (if any) are Nash equilibria in pure strategies? Answer "YES" or "NO."

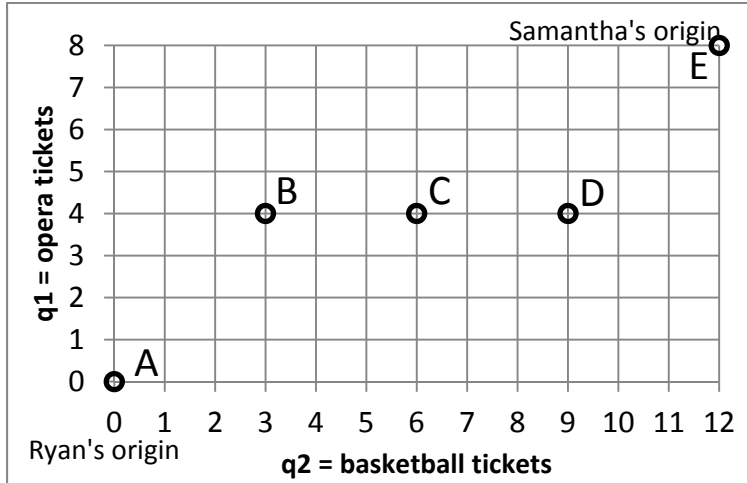
Firm A plays "High price" and Firm B plays "High price"	
Firm A plays "Low price" and Firm B plays "Low price"	
Firm A plays "High price" and Firm B plays "Low price"	
Firm A plays "Low price" and Firm B plays "High price"	

<sup>1</sup> Ignore the welfare of consumers.

<sup>2</sup> "Equilibria" is the plural form of "equilibrium."

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

(1) [Exchange efficiency: 12 pts] Ryan and Samantha both enjoy opera and basketball. Let  $q_1$  denote opera tickets and  $q_2$  denote basketball tickets. Ryan's utility function is  $U_R = q_1 q_2$ . Samantha's utility function is  $U_S = q_1^3 q_2$ . A total of 8 opera tickets and 12 basketball tickets must be divided between them. Consider the allocations depicted in the Edgeworth box below.



a. Is allocation A Pareto-efficient? Why or why not?

b. Is allocation B Pareto-efficient? Why or why not?

c. Is allocation C Pareto-efficient? Why or why not?

d. Is allocation D Pareto-efficient? Why or why not?

e. Is allocation E Pareto-efficient? Why or why not?

f. Sketch and label the contract curve in the Edgeworth box above.

(2) [Monopoly pricing, deadweight loss: 16 pts] An electronics company is considering whether to develop and patent a new computer chip. Annual demand for the chip is predicted to be given by  $P = 15 - (Q/100)$ . Marginal cost of production is predicted to be constant and equal to \$5. There are also up-front costs (sometimes called “quasi-fixed costs”) of developing the chip and acquiring a patent.

- a. If the company were to develop and patent the chip, what quantity would it produce and what price would it set?

- b. What is the maximum amount of up-front costs the company would pay for developing and patenting the chip? For simplicity, assume the patent would be valid for only one year.

- c. After the patent runs out, other companies could produce the chip with same marginal cost, but without having to incur up-front costs. What quantity would then be produced and what price would prevail in the market, which is now competitive?

- d. Compute the predicted deadweight loss to society from monopoly pricing of this chip. [Hint: First sketch the graph.]

(3) [Cournot duopoly: 14 pts] Suppose two makers of a consumer good 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  $P = 20 - (Q/10)$ . Each firm has constant marginal and average cost equal to \$2. Note: question continues on next page. Use graph at bottom of 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:  $Rev_1(q_1, q_2)$ .

- 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:  $MR_1(q_1, q_2)$ .

- c. Find an expression for firm #1's reaction function, showing how much firm #1 will produce for any given quantity set by the other firm:  $q_1^* = f(q_2)$ .

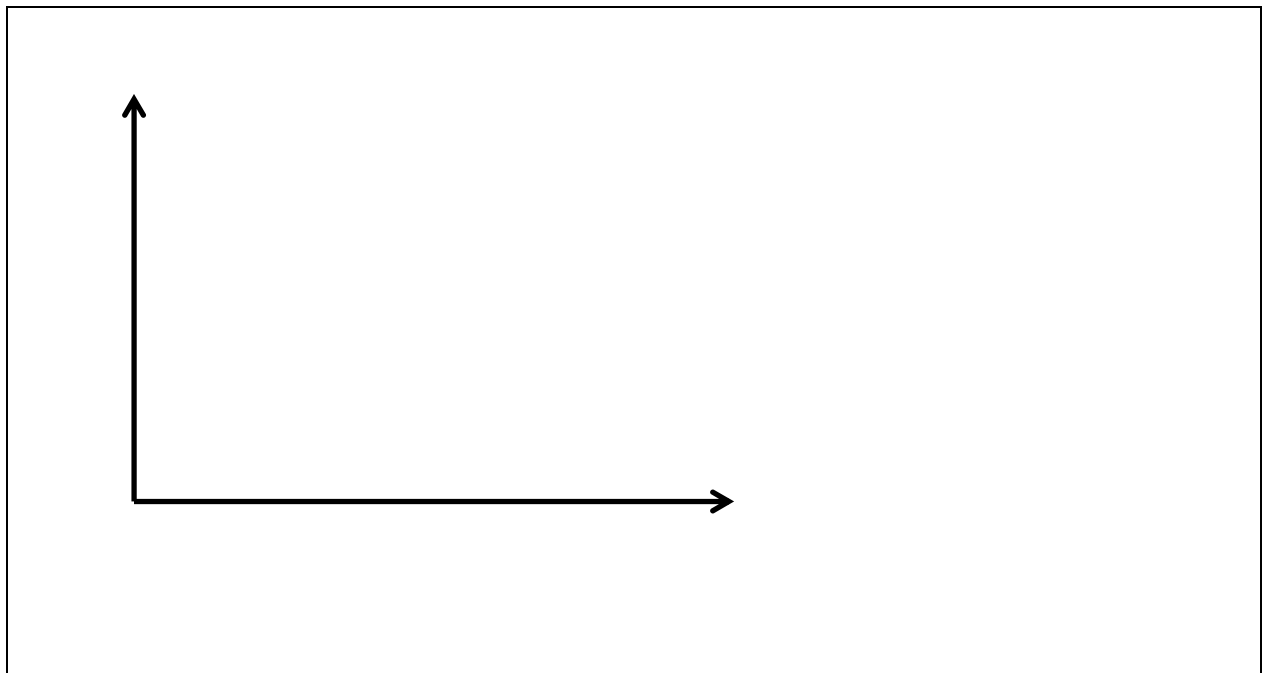
- d. Assume the equilibrium is symmetric (that is, assume  $q_1^* = q_2^*$ ) and compute firm #1's equilibrium quantity  $q_1^*$ .



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

f. Compute the combined total profit of both firms.

g. Compute the social deadweight loss.



**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) Would a monopolist ever set price and quantity on the *inelastic* ( $|\epsilon| < 1$ ) part of its demand curve? Why or why not?

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

[end of exam]