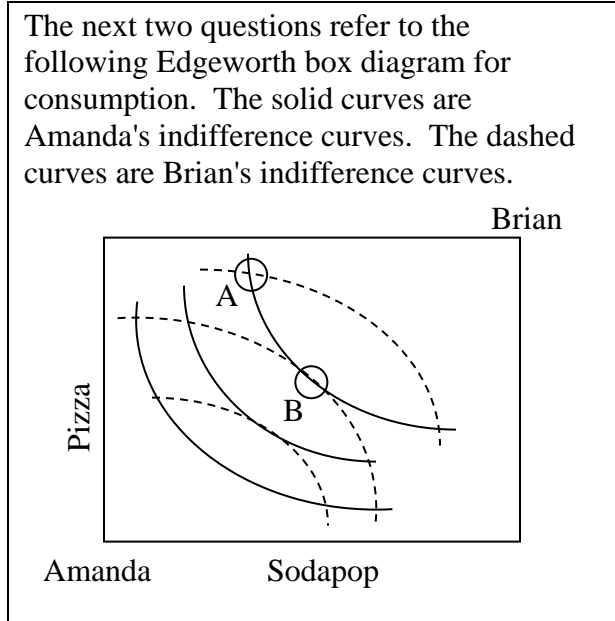


**EXAMINATION #4 VERSION B**  
**“General Equilibrium and Market Power”**  
**November 20, 2018**

**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—11 pts total].

The next two 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.

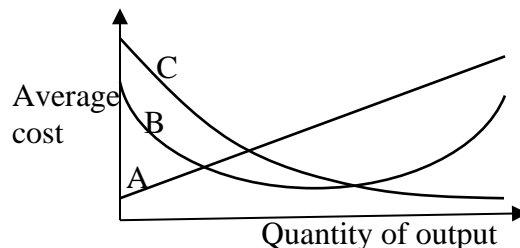


- (1) From allocation A, *both* consumers can enjoy greater utility if
- Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
  - Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
  - Amanda gives Brian some pizza and some sodapop.
  - Brian gives Amanda some pizza and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

- (2) 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.

(3) Which average cost curve below is typical of a firm that enjoys a natural monopoly?

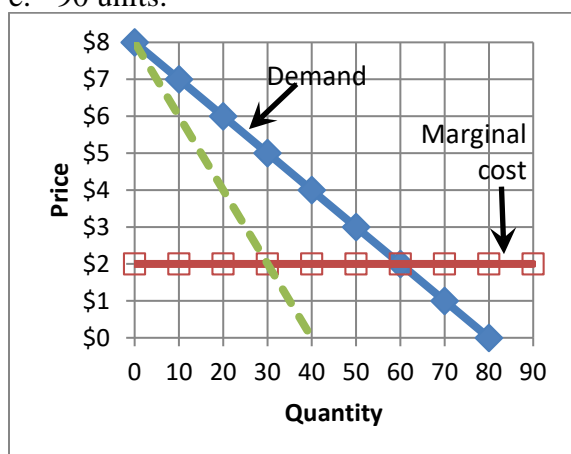
- Average cost curve A.
- Average cost curve B.
- Average cost curve C.
- None of the above.
- Cannot be determined from information given.



- (4) If marginal cost is less than marginal revenue at the current level of output, the firm can increase its profit by
- increasing output.
  - decreasing output.
  - either increasing or decreasing output.
  - none of the above.
  - Cannot be determined from information given.

- (5) Suppose the elasticity of demand for concert tickets is -5 for customer group A, and -2 for customer group B. If the box office can charge a different price to each group, which group should get the higher price, to maximize profit?
- Both groups should get the same price because the marginal cost is the same for each.
  - Group A should get the higher price.
  - Group B should get the higher price.
  - Cannot be determined from information given.

- (6) In the graph below, what quantity of output will the monopolist choose if it can engage in *perfect price discrimination*?
- 30 units.
  - 40 units.
  - 60 units.
  - 80 units.
  - 90 units.



- (7) The Cournot model of oligopoly assumes that each firm maximizes its profit while taking its rivals'
- costs as given.
  - prices as given.
  - output quantities as given.
  - all of the above.

- (8) According to the model of symmetric Cournot oligopoly, the Lerner index of market power will be smaller,
- the more elastic is market demand.
  - the more firms are in the industry.
  - both (a) and (b).
  - neither (a) nor (b).

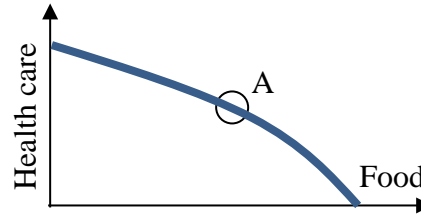
- (9) Which market model predicts the highest equilibrium price?
- Price competition.
  - Collusion to maximize joint profits.
  - Cournot oligopoly.
  - All models predict the same equilibrium price, if all use the same assumptions about market demand and marginal cost.

- (10) The model of monopolistic competition assumes
- firms cooperate to maximize the sum of their profits.
  - firms produce perfect substitutes.
  - free entry of firms.
  - firms take price as given.
  - All of the above.

- (11) Equilibrium in the model of monopolistic competition does *not* imply
- price equals average cost.
  - firms enjoy zero economic profits.
  - each firm's marginal revenue is less than its price.
  - price equals marginal cost.

**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  $-1/3$ .



- What is the opportunity cost of a unit of health care? In other words, how many units of food must be given up in order to produce one more unit of health care?
- What is the opportunity cost of a unit of food? In other words, how many units of health care must be given up in order to produce one more unit of food?
- Consider the typical consumer's budget line with health care on the vertical axis and food 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 health care is \$ 30, then what must be the price of a unit of food?

	units of food
	units of health care
\$	

(2) [Monopoly price discrimination: 4 pts] Suppose an ice rink believes that the elasticity of demand for admission by adults is  $-1.5$ , and the elasticity of demand by children is  $-5$ . Assume the rink's marginal cost is \$4 per admission.

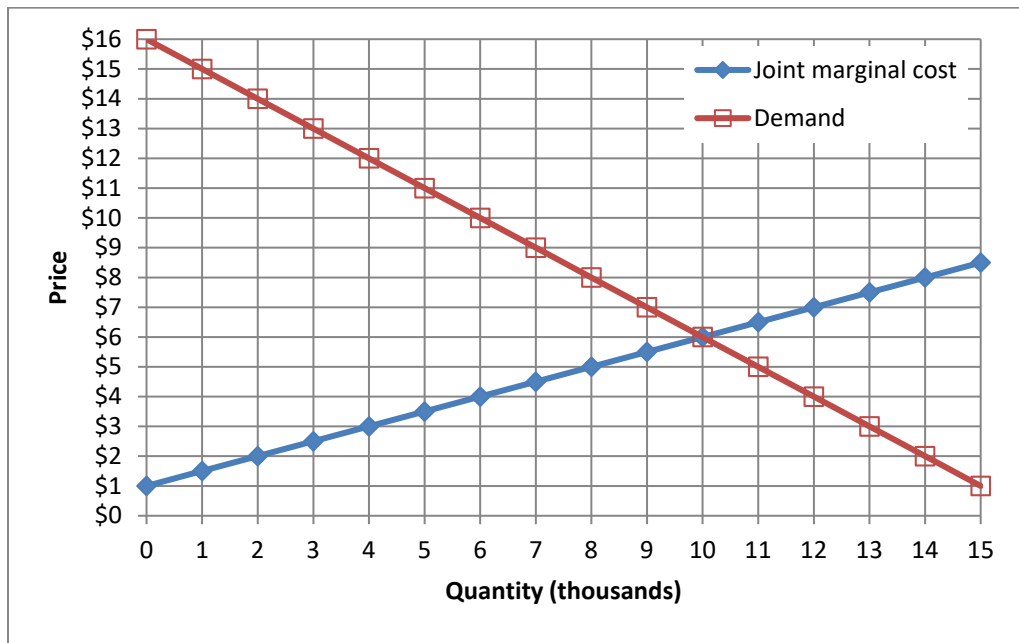
- Compute the profit-maximizing admission price for adults.
- Compute the profit-maximizing admission price for children.

\$
\$

(3) [Lerner index of market power: 3 pts] The Lerner index of market power is defined as the fraction of price that represents a markup over marginal cost:  $L = (P-MC)/P$ . Suppose the market for mobile phone service has a price elasticity of demand of  $-3/2$ .

- Compute the Lerner index if this market is a monopoly.
- Compute the Lerner index if this market is a symmetric Cournot oligopoly of two firms.
- Compute the Lerner index if this market is a symmetric Cournot oligopoly of five firms.


(4) [Collusion/joint profit maximization: 16 pts] Three firms produce a particular widely-used food additive. Market demand and the three firms' joint marginal cost are shown in the graph below.



First, suppose these firms engage in price competition.

a. Compute competitive equilibrium market price.

\$	
	thousand
\$	thousand

b. Compute competitive equilibrium market quantity.

c. Compute the amount of deadweight loss.

Now suppose these firms form a cartel to maximize jointly the sum of their profits. The equation for demand is  $P = 16 - Q$ , where  $Q =$  quantity in thousands.

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

MR =
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e. Carefully plot and label the cartel's marginal revenue curve in the graph above.

f. What price will the firms jointly set?

\$	
	thousand
\$	thousand

g. How much output will the firms produce, in total?

h. Compute the amount of deadweight loss.

(5) [Game theory: 12 pts] Firms A and B are choosing technical standards for a new electronic device. Firm A prefers the “Thunderbolt” standard and Firm B prefers the “Zap” standard. However, if they choose different standards, their products cannot interconnect and they both lose many customers. Their situation is expressed by the following game in normal form.

		Firm B	
		Thunderbolt	Zap
Firm A	Thunderbolt	Firm A gets \$100 million. Firm B gets \$30 million.	Firm A gets \$5 million. Firm B gets \$5 million.
	Zap	Firm A gets \$5 million. Firm B gets \$5 million.	Firm A gets \$30 million. Firm B gets \$100 million.

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

Firm A plays “Thunderbolt” and Firm B plays “Thunderbolt”	
Firm A plays “Thunderbolt” and Firm B plays “Zap”	
Firm A plays “Zap” and Firm B plays “Thunderbolt”	
Firm A plays “Zap” and Firm B plays “Zap”	

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

Firm A plays “Thunderbolt” and Firm B plays “Thunderbolt”	
Firm A plays “Thunderbolt” and Firm B plays “Zap”	
Firm A plays “Zap” and Firm B plays “Thunderbolt”	
Firm A plays “Zap” and Firm B plays “Zap”	

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

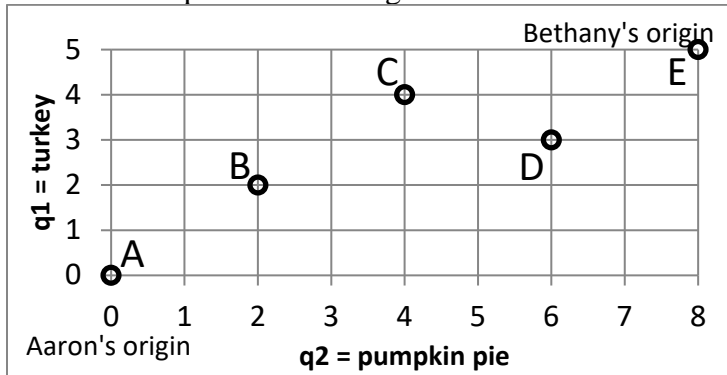
Firm A plays “Thunderbolt” and Firm B plays “Thunderbolt”	
Firm A plays “Thunderbolt” and Firm B plays “Zap”	
Firm A plays “Zap” and Firm B plays “Thunderbolt”	
Firm A plays “Zap” and Firm B plays “Zap”	

<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] Aaron and Bethany both like turkey ( $q_1$ ) and pumpkin pie ( $q_2$ ). Aaron's utility function is  $U_A = q_1 q_2$ . Bethany's utility function is  $U_B = q_1^2 q_2$ . A total of 5 servings of turkey and 8 slices of pumpkin pie 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, profit maximization: 14 pts] Suppose a monopolist has total cost function given by  $TC(Q) = (Q^2/20)$ . This monopolist faces a demand curve given by  $P = 12 - (Q/20)$ . Note: question continues on next page. Use graph at bottom of next page for scratch work.

- a. Find the monopolist's marginal cost function.

- b. Find the monopolist's average cost function.

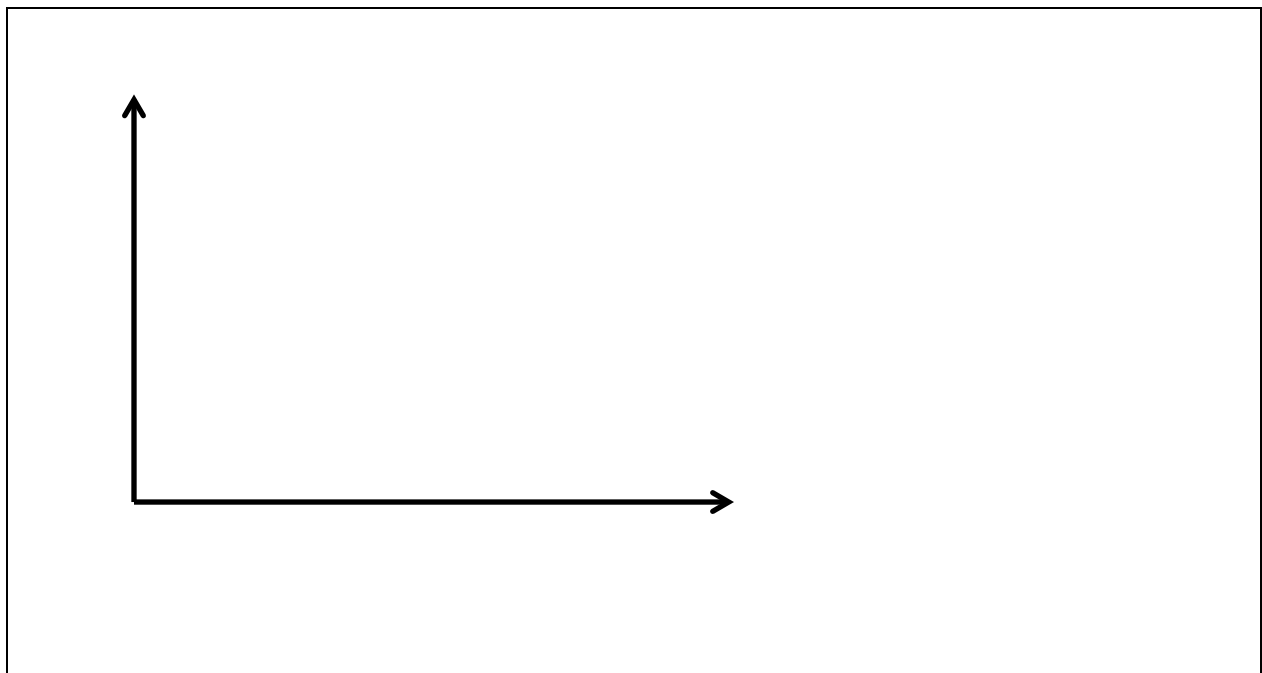
- c. Find the monopolist's marginal revenue function.

- d. Compute the monopolist's profit-maximizing level of output  $Q_M$ .

- e. Compute the monopolist's profit-maximizing price  $P_M$ .

f. Compute the monopolist's profit.

g. Compute the social deadweight loss caused by the monopolist. (You may use the graph for scratch work.)





(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  $P = 14 - (Q/50)$ . 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 total revenue, as a function of its own quantity and the quantity produced by the other firm:  $TR_1(q_1, q_2)$ .

- 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:  $MR_1(q_1, q_2)$ .

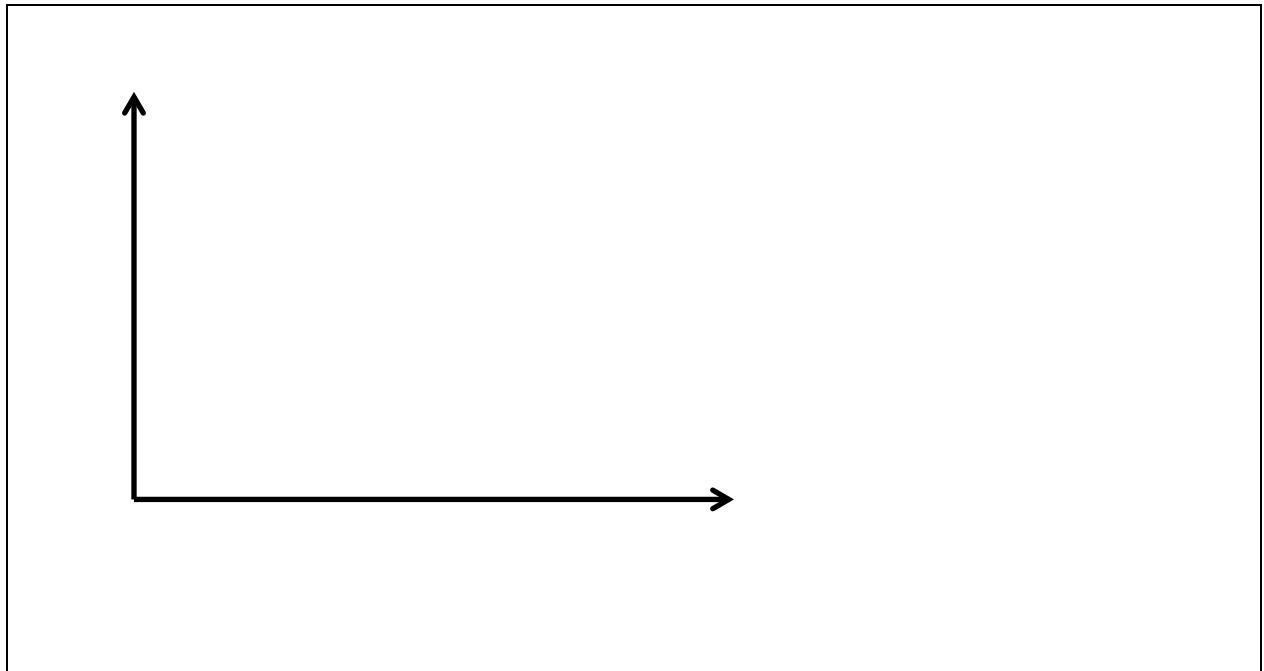
- c. Find an expression for firm #1's reaction function, showing how much firm #1 will produce for any given quantity set by the other firm:  $q_1^* = f(q_2)$ .

- 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). [6 pts]

- (1) Suppose a monopolist has constant marginal cost, also equal to average cost, of  $MC=AC=\$2$ . The monopolist faces a demand curve given by  $P = 20 Q^{-0.5}$ . What quantity should the monopolist produce to maximize profit? What price should it charge? How much profit will it enjoy? Show your work and circle your final answers.
- (2) Suppose three firms form a symmetric Cournot triopoly. Each firm chooses its quantity of output to maximize its own profit, taking as given the output levels of the other two firms. The marginal cost of each firm is constant and equal to  $\$2$ . The market demand curve is given by  $P = 14 - (Q/50)$ . What quantity will each firm produce? What will be the market price? Show your work and circle your final answers.

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]