

FINAL EXAMINATION VERSION A December 11, 2012

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. Maximum total points are 100.

I. MULTIPLE CHOICE: Circle the one best answer to each question. Use margins for scratch work. [1 pt each—20 pts total]

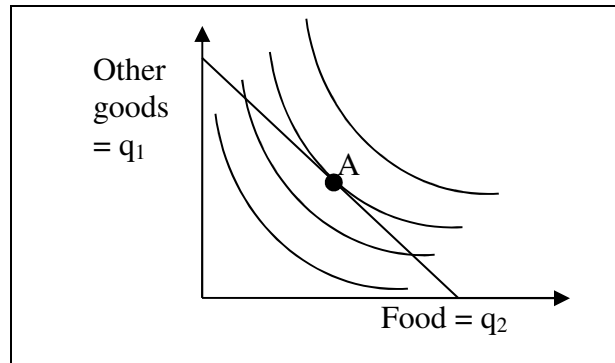
(1) Which utility function below violates the assumption of "monotonicity" or "more is better"?

- a. $U(q_1, q_2) = 2q_1^{1/2} + 5q_2^{1/2}$.
- b. $U(q_1, q_2) = (-2/q_1) + (-5/q_2)$.
- c. $U(q_1, q_2) = q_1^2 q_2^5$.
- d. $U(q_1, q_2) = 2q_1(5 - q_2)$.
- e. $U(q_1, q_2) = -2q_1^{-1/2} - 5q_2^{-1/2}$.

(2) The marginal rate of substitution in consumption (MRSC) of good #2 for good #1 is the slope of the consumer's indifference curve with q_1 on the vertical axis and q_2 on the horizontal axis.

Which expression for the MRSC indicates a violation of the assumption of "diminishing marginal rate of substitution"?

- a. $MRSC = q_1 / q_2$.
- b. $MRSC = q_1^2 / q_2^2$.
- c. $MRSC = (q_1 + 4) / (q_2 + 5)$.
- d. $MRSC = q_1 q_2$.
- e. $MRSC = q_1^{1/2}$.
- f. None of the above.



(3) Suppose the consumer is currently at bundle A for some reason. This consumer could enjoy higher utility, without increasing total spending, by

- a. purchasing less food and more other goods.
- b. purchasing more food and fewer other goods.
- c. purchasing less food and fewer other goods.
- d. any of the above.
- e. none of the above.

The next question refers to the following graph of a consumer's budget line and indifference curves.

(4) Which function is *not* homogeneous of degree zero in income and prices?

- a. $q_1^* = I / (p_1 + p_1^{1/2} p_2^{1/2})$.
- b. $q_1^* = I / (8p_1) + 3$.
- c. $q_1^* = 0.9I - 3p_1 + 0.1p_2$.
- d. $q_1^* = 2p_2/p_1 + I/(6p_1)$.
- e. All are homogeneous of degree zero.

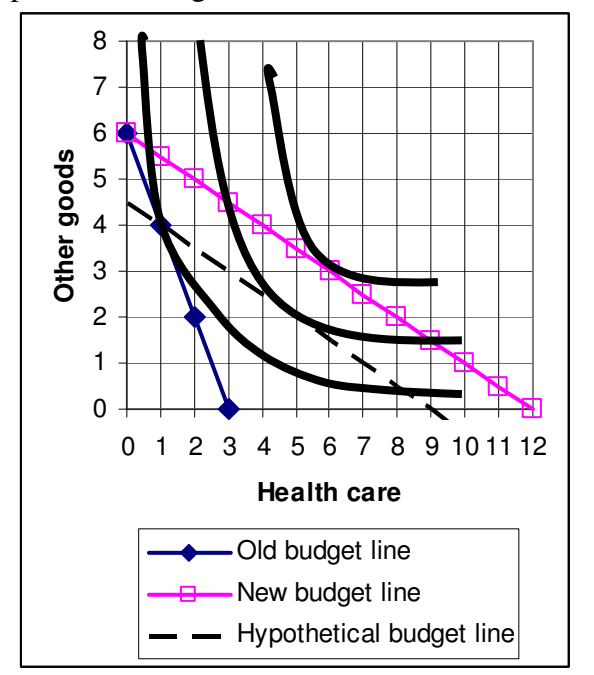
(5) Which of the following demand functions exhibits a constant price elasticity of demand?

- a. $q_1^* = 5 p_1^{-1.2} I^{1.1} p_2^{0.2}$.
- b. $q_1^* = I/(6p_1) + 3$.
- c. $q_1^* = 50 - 2 p_1 + 0.08 I - 0.01 p_2$.
- d. $q_1^* = 2 + 0.9 p_2/p_1 + I/(4p_1)$.
- e. None of the above.

(7) The income effect of the price change causes the quantity demanded of health care to increase by

- a. one unit.
- b. two units.
- c. three units.
- d. four units.
- e. five units.

The next two questions refer to the graph below. The price of health care decreases so that the consumer's budget line moves from "Old budget line" to "New budget line." Assume the consumer's income and the price of other goods remain constant.



(6) The substitution effect of the price change causes the quantity demanded of health care to increase by

- a. one unit.
- b. two units.
- c. three units.
- d. four units.
- e. five units.

(8) Let q_1^{old} and q_2^{old} denote the quantities of good 1 and good 2 purchased by a typical consumer five years ago. Let p_1^{old} and p_2^{old} denote the prices of those goods five years ago. Let q_1^{new} and q_2^{new} denote the quantities of good 1 and good 2 purchased by a typical consumer this year. Let p_1^{new} and p_2^{new} denote the prices of those goods this year. Which formula below tends to *underestimate* the increase in the cost of living from five years ago to this year?

- a. $\frac{p_1^{new} q_1^{new} + p_2^{new} q_2^{new}}{p_1^{old} q_1^{new} + p_2^{old} q_2^{new}}$
- b. $\frac{p_1^{new} q_1^{old} + p_2^{new} q_2^{old}}{p_1^{old} q_1^{old} + p_2^{old} q_2^{old}}$
- c. $\sqrt{\frac{p_1^{new} q_1^{old} + p_2^{new} q_2^{old}}{p_1^{old} q_1^{old} + p_2^{old} q_2^{old}}} \times \frac{p_1^{new} q_1^{new} + p_2^{new} q_2^{new}}{p_1^{old} q_1^{new} + p_2^{old} q_2^{new}}$
- d. all of the above.
- e. none of the above.

(9) At a price of \$3 per gallon, a certain consumer buys 10 gallons of gasoline per week. At a price of \$1.00 per gallon, the same consumer would buy 14 gallons of gasoline per week. If the price were reduced from \$3 to \$1.00, this consumer would enjoy a benefit of about

- a. \$10.
- b. \$20.
- c. \$24.
- d. \$28.
- e. \$30.

The next two questions refer to the following information. Suppose leaves are raked using only labor input, with the following production function:

$$q = 4x^{1/2},$$

where q = bushels of leaves raked, and x = labor hours.

(10) The marginal product of workers equals

- 2.
- 4.
- $2x^{-1/2}$.
- $4x^{1/2}$.
- $2x$.
- $4x^{3/2}$.

(11) The production function for raking leaves exhibits

- no diminishing returns to labor input.
- diminishing returns to labor input for all values of x greater than zero.
- diminishing returns to labor input only for very high values of x .
- diminishing returns to labor input only for very low values of x .
- cannot be determined from information given.

(12) Which production function below has L-shaped isoquants?

- $q = \min\{x_1, (x_2/3)\}$.
- $q = x_1^{1/4} + 3x_2^{3/4}$.
- $q = x_1^{1/4} x_2^{3/4}$.
- $q = x_1 + 3x_2$.
- All of the above.
- None of the above.

(13) Suppose a firm's long-run total cost function is given by

$$TC(q) = 0.002q^3 - 0.3q^2 + 10q.$$

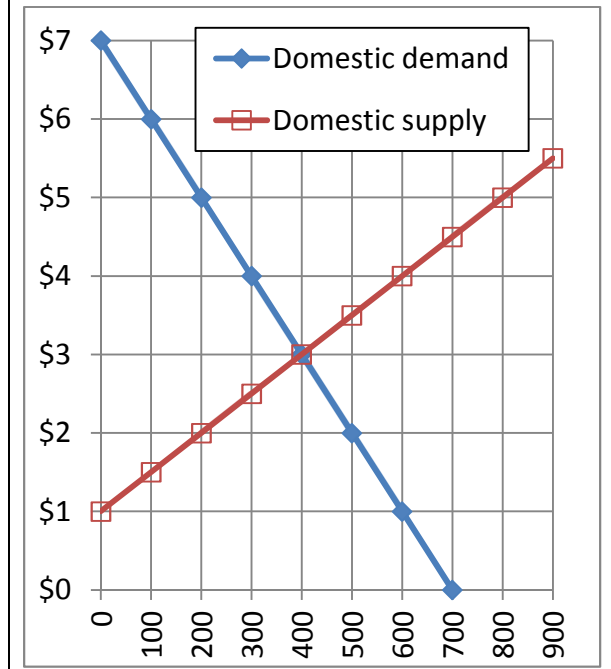
The firm's marginal cost function is

- $MC(q) = 0.004q - 0.3$.
- $MC(q) = 0.012q - 0.6$.
- $MC(q) = 0.002q^2 - 0.3q + 10$.
- $MC(q) = 0.006q^2 - 0.6q + 10$.
- $MC(q) = 0.002q^3 - 0.3q^2 + 10q$.

(14) A *Pareto improvement* is defined as a change in the economy where

- everyone gains.
- at least one person gains.
- at least one person gains and no one loses.
- the gains to the winners exceed the losses to the losers.

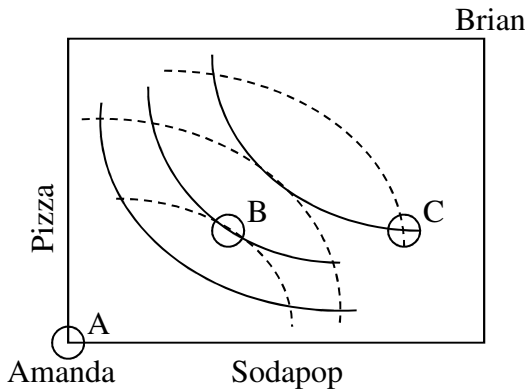
The next question refers to the graph of a market below.



(15) If this market is opened to international trade, and the world price turns out to be \$5, then this country's welfare will

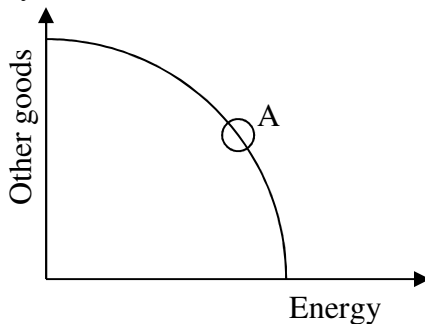
- increase by \$2.
- increase by \$300.
- increase by \$600.
- decrease by \$2.
- decrease by \$300.
- decrease by \$600.
- remain unchanged.

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



- (16) 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.

The next question refers to the following graph 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 (in absolute value).



- (17) If the price of energy in this economy is \$6 per unit, then the price of other goods must be
- \$1.
 - \$2.
 - \$6.
 - \$18.
 - \$36.

- (18) Suppose a monopolist faces the demand curve $P = 20 Q^{-0.4}$. The monopolist's marginal revenue function is
- $MR(Q) = -8 Q^{-1.4}$.
 - $MR(Q) = 8 Q^{0.6}$.
 - $MR(Q) = 20 Q^{-0.4}$.
 - $MR(Q) = 20 Q^{0.6}$.
 - $MR(Q) = 12 Q^{-0.4}$.

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

- (20) The term "differentiated products" means, in economics,
- products for which different consumers have different elasticities of demand.
 - the derivative of a firm's production function.
 - the derivative of a firm's revenue with respect to its output.
 - products that are close but not perfect substitutes.
 - products that a firm sells to different customers at different prices.

II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work. [12 pts total]

(1) [Price elasticity of demand: 4 pts] Suppose the price elasticity of demand for electricity equals -0.6 . Suppose the electric company raises the price of electricity by 5% .

- a. Compute the approximate percent change in the quantity demanded of electricity. Include a positive or negative sign (+ or -) as appropriate.
- c. Compute the approximate percent change in revenue received by the electric company. Include a positive or negative sign (+ or -) as appropriate.

	%
	%

(2) [Technical change: 4 pts] The elasticity of output with respect to labor input for the US economy as a whole is about $2/3$. The elasticity of output with respect to capital input is about $1/3$. Suppose labor input increases by 1.5% and capital input increases by 6.0% .

- a. By how much would output increase, without any technical change?
- b. Suppose output in fact increases by 3.5% . What is the increase in multifactor or total factor productivity (also called the Solow residual)?

	%
	%

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

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

	\$
	\$

III. PROBLEMS: Please write your answers in the boxes on this question sheet. Show your work and circle your final answers. [60 pts total]

(1) [Individual demand: 12 pts] Brianna has the following utility function:

$U(q_1, q_2) = q_1^2 (q_2 - 2)$, where q_1 denotes the quantity of ebooks and q_2 denotes the quantity of protein bars.

- a. Find a formula for Brianna's marginal rate of substitution of protein bars for ebooks—that is, the slope of Brianna's indifference curve with ebooks on the vertical axis and protein bars on the horizontal axis. The variables q_1 and q_2 should be the only unknowns. Circle your final answer.

Let p_1 denote the price of ebooks and let p_2 denote the price of protein bars. Let I denote Brianna's income.

- b. Solve for Brianna's demand function for ebooks—that is, the formula showing q_1^* as a function of p_1 , p_2 , and I . Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

- c. Solve for Brianna's demand function for protein bars—that is, the formula showing q_2^* as a function of p_1 , p_2 , and I . Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

(2) [Cost minimization: 12 pts] Suppose a firm wishes to produce 60 units of output per hour at minimum cost. Machines cost \$4 per hour to rent and workers must be paid \$9 per hour. The firm's hourly production function is given by $q = 5(x_1^{-1} + x_2^{-1})^{-1}$ where x_1 denotes the number of machines and x_2 denotes the number of workers.

- a. [2 pts] Give an equation for the firm's target isoquant. The variables x_1 and x_2 should be the only unknowns.

- b. [4 pts] Find a formula for the firm's marginal rate of substitution in production of workers for machines—that is, the slope of the firm's isoquant with machines on the vertical axis and workers on the horizontal axis. The variables x_1 and x_2 should be the only unknowns. Circle your final answer.

- c. [4 pts] Solve for the number of machines (x_1^*) and workers (x_2^*) required to produce the firm's target output at minimum cost. Circle your final answers.

- d. [2 pts] Compute the total cost to produce 60 units of output, $TC(60)$.

(3) [Welfare analysis of tax or subsidy: 12 pts] Suppose demand and supply for a good are given by the following equations.

Demand: $P_D = 20 - (Q/10)$

Supply: $P_S = 5 + (Q/20)$.

First consider the unregulated market.

a. Compute the equilibrium quantity.

units
\$

b. Compute the equilibrium price.

Now suppose a **tax of \$3** per unit is imposed on this market. (Use the space and graph below for scratch work.)

c. Compute the new equilibrium quantity.

units
\$
\$
\$

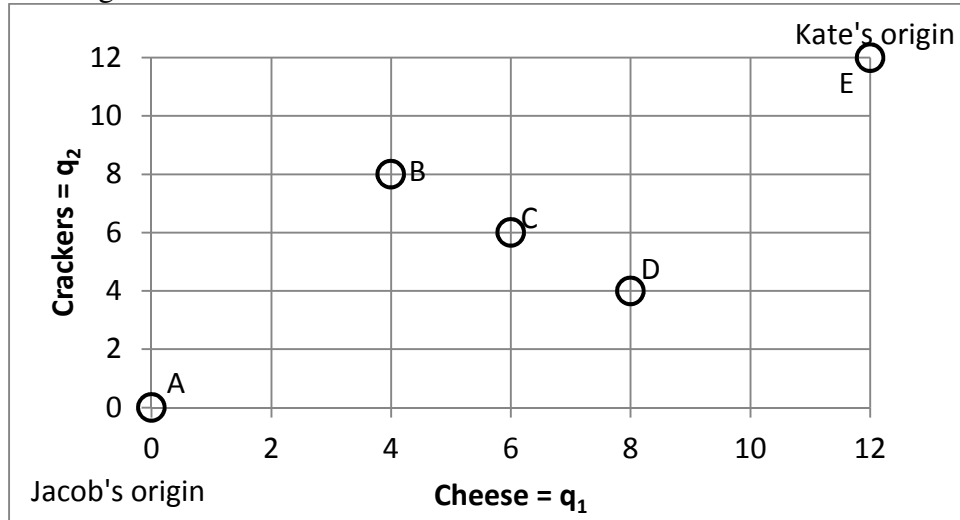
d. Compute the total price (including the tax) paid by demanders.

e. Compute the net price (excluding the tax) received by suppliers.

f. Compute the social deadweight loss from the tax.



(4) [Exchange efficiency: 12 pts] Jacob and Kate both like cheese (q_1) and crackers (q_2). Jacob's utility function is $U_J = q_{1J} q_{2J}^2$. Kate's utility function is $U_K = q_{1K}^2 q_{2K}$. A total of 12 crackers and 12 pieces of cheese 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 the contract curve in the Edgeworth box above.

(5) [Joint profit maximization: 12 pts] Suppose an industry is served by two firms with identical, constant marginal cost given by: $MC = AC = \$3$. Market demand is given by $P = 15 - (Q/100)$. Suppose the two firms *collude* to maximize the sum of their profits.

a Find an expression for the two firm's joint marginal cost.

b. Find an expression for the market marginal revenue function $MR(Q)$.

c. [4 pts] Compute the firms' total quantity Q^* and price P^* .

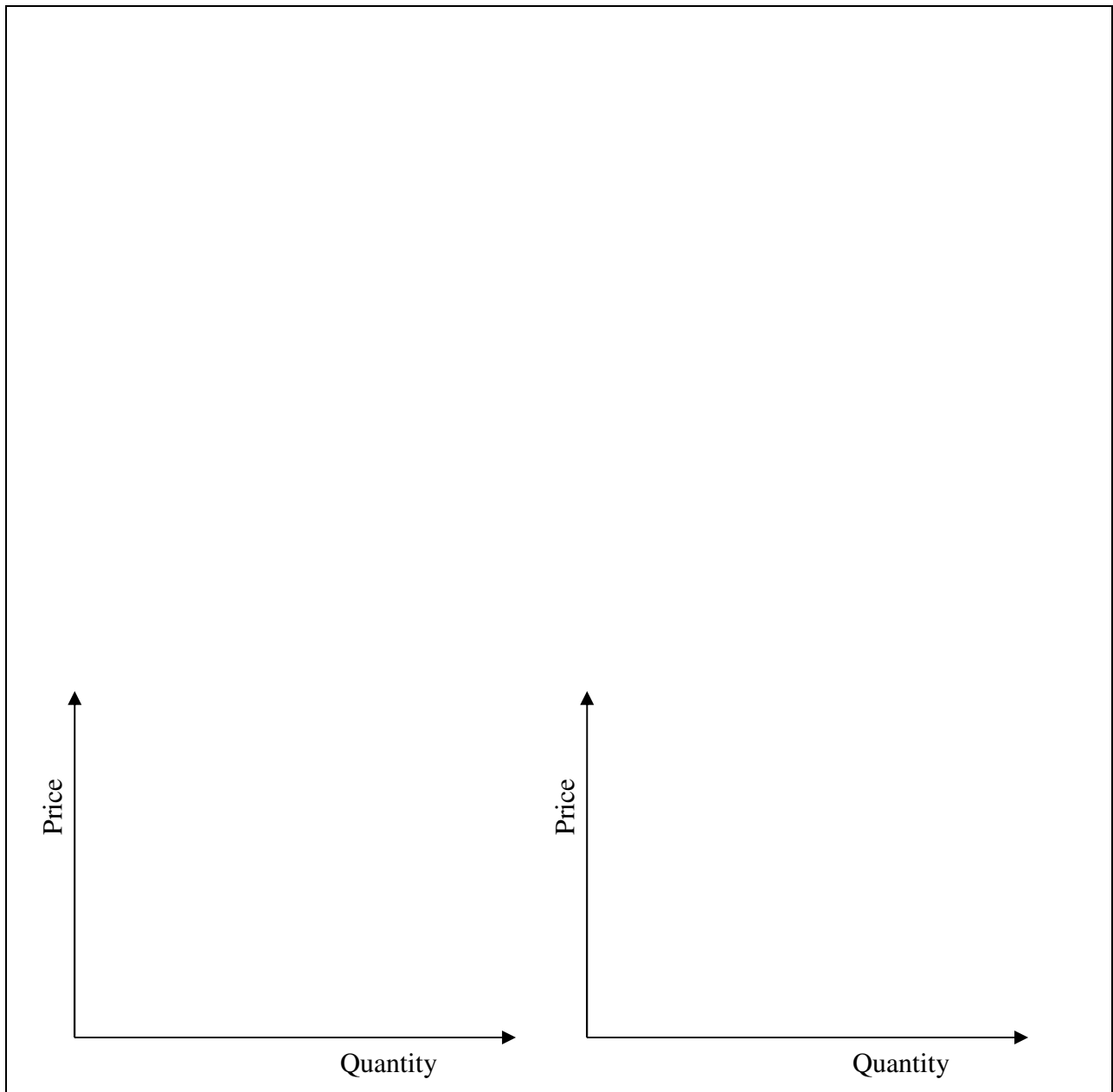
d. Compute the combined total profit of the two firms.

e. Compute the social deadweight loss.



IV. ESSAY: Write an essay of at least 100 words answering the following question. [8 pts]
Continue on the next page if necessary. Full credit requires good grammar, accurate spelling,
and correct reasoning.

Consider the following claim: “To gain the greatest advantage, a country should *permit* international trade in any good where its industry is competitive—that is, where the world price is *greater* than the domestic price. However, it should *prohibit* international trade in any good where its industry is not competitive—that is, where the world price is *less* than the domestic price.” Do you agree or disagree? Justify your answer with supply-and-demand graphs.





Scoring rubric

- | | |
|-------|---|
| 2 pts | Explanation shows very limited understanding of the underlying concepts needed to analyze the information. Explanation is difficult to understand and is missing several components. |
| 4 pts | Explanation shows some understanding of the economic concepts and models needed to analyze the information. Explanation is a little difficult to understand but includes critical components. |
| 6 pts | Explanation shows substantial understanding of the economic concepts and models used to analyze the information. Explanation is clear. |
| 8 pts | Explanation shows complete understanding of the economic concepts and models used to analyze the information. Explanation is detailed and clear. |

[end of exam]