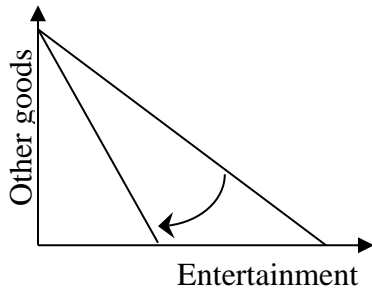


## FINAL EXAMINATION VERSION A

**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 200.

**I. MULTIPLE CHOICE:** Circle the one best answer to each question. Feel free to use margins for scratch work [2 pts each, 40 pts total].

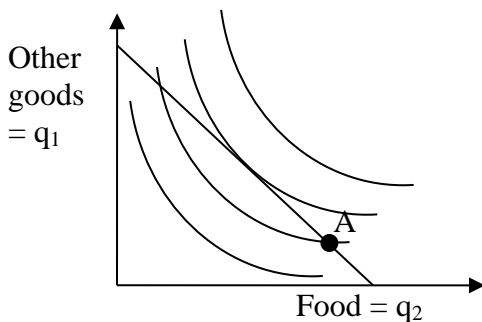
- (1) In the graph below, the rotation in the budget line could be caused by
- an increase in income.
  - a decrease in income.
  - an increase in the price of entertainment.
  - a decrease in the price of entertainment.
  - an increase in the price of other goods.
  - a decrease in the price of other goods.



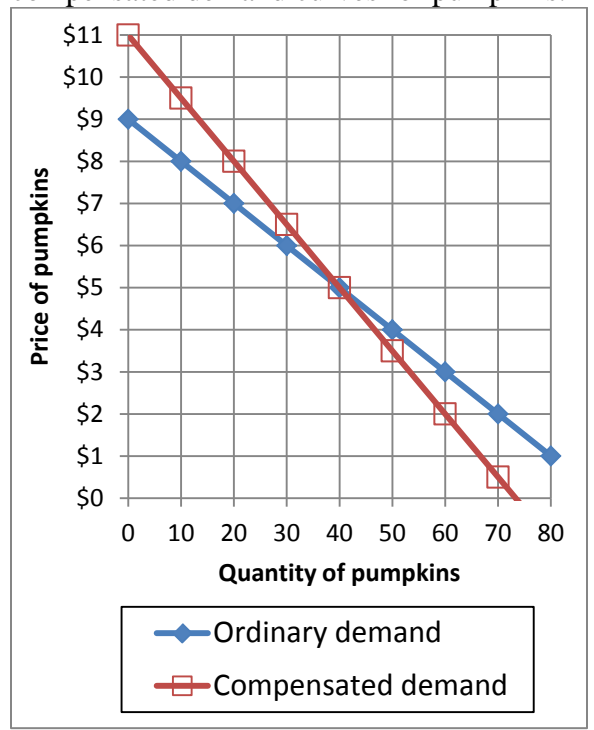
- (2) This consumer could enjoy higher utility, without increasing total spending, by
- purchasing less food and more other goods.
  - purchasing more food and fewer other goods.
  - purchasing less food and fewer other goods.
  - any of the above.
  - none of the above.

- (3) Let  $MU_1$  denote the marginal utility of other goods and  $MU_2$  the marginal utility of food for this consumer. Let  $p_1$  denote the price of other goods and  $p_2$  denote the price of food. At bundle A in the graph above,
- $MU_2 = MU_1$  and  $p_2 = p_1$ .
  - $MU_2/MU_1 = p_2/p_1$ .
  - $MU_2/MU_1 < p_2/p_1$ .
  - $MU_2/MU_1 > p_2/p_1$ .
  - cannot be determined from information given.

The next two questions refer to the following graph of a consumer's budget line and indifference curves. Suppose the consumer is currently at bundle A for some reason.



The next two questions refer to the following graph of ordinary and compensated demand curves for pumpkins.



(4) The decrease in income that would exactly compensate consumers for a fall in price from \$5 to \$2, leaving consumers just as well off as before the price change, would be

- a. \$3.
- b. \$120.
- c. \$150.
- d. \$165.
- e. none of the above.

(5) If the price falls from \$5 to \$2, then consumer surplus increases by

- a. \$3.
- b. \$120.
- c. \$150.
- d. \$165.
- e. none of the above.

(6) Suppose a production function is given by  $q = 20 x_1^{1/4} x_2^{3/4}$ . The number (3/4) equals the

- a. marginal product of input #2.
- b. marginal rate of substitution in production.
- c. elasticity of output with respect to input #2.
- d. returns to scale.

(7) A certain kind of machine can produce 100 units of output per hour if it is operated by 3 workers. Fewer workers cannot operate the machine and extra workers contribute nothing. Let  $x_1$  denote the number of machines in use of this type. Let  $x_2$  denote the number of workers assigned to operate these machines. Let  $q$  denote output per hour. The formula for the firm's production function is

- a.  $q = x_1 + 3x_2$ .
- b.  $q = x_1 + (1/3) x_2$ .
- c.  $q = 100 \min\{x_1, 3x_2\}$ .
- d.  $q = 100 \min\{x_1, (x_2/3)\}$ .
- e.  $q = 100 x_1 x_2^3$ .
- f.  $q = 100 x_1 x_2^{1/3}$ .

(8) "Diseconomies of scale" means that the firm's average cost curve

- a. slopes up.
- b. slopes down.
- c. is horizontal.
- d. is vertical.

(9) In the short run, a firm should shut down immediately if its

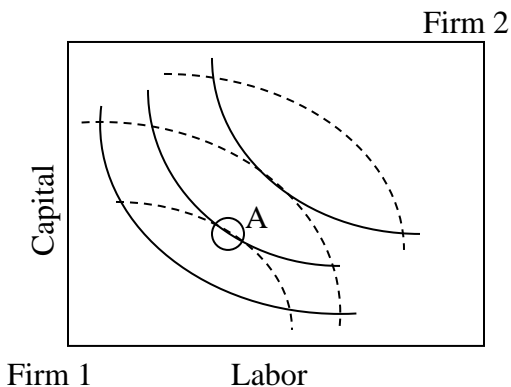
- a. revenue is less than fixed cost.
- b. profit is negative.
- c. revenue is less than producer surplus.
- d. revenue is less than variable cost.

(10) Suppose the price of oil rises. The increase in long-run producer surplus goes to oil producers and

- companies that refine oil into products such as gasoline.
- purchasers of products made from oil, such as gasoline.
- owners of land where oil is drilled.
- all of the above.

(11) The graph below shows an Edgeworth box diagram for production. The solid curves are Firm 1's isoquants. The dashed curves are Firm 2's isoquants. From allocation A, both firms can produce more output if

- Firm 1 gives Firm 2 some capital, and Firm 2 gives Firm 1 some labor.
- Firm 1 gives Firm 2 some labor, and Firm 2 gives Firm 1 some capital.
- Firm 1 gives Firm 2 some capital and some labor.
- Firm 2 gives Firm 1 some capital and some labor.
- No trade will allow both firms to produce more output.



(12) The so-called "First Welfare Theorem" of general equilibrium theory states that

- deadweight loss is measured by the area of a triangle.
- competitive forces push the economy toward the corners of the Edgeworth box.
- any competitive equilibrium is on the contract curve.
- all is for the best in the best of all possible worlds.

(13) Suppose a flower vendor with market power is now selling 5 bouquets per hour at a price of \$10. If she cuts the price to \$9, she can sell one more bouquet per hour (that is, a total of 6 bouquets per hour). The vendor's marginal revenue for the sixth bouquet is therefore

- negative \$1 .
- \$1 .
- \$4 .
- \$9 .
- \$10 .

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

- output quantities as given.
- costs as given.
- prices as given.
- all of the above.

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

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

(16) If a good imposes external costs, and bargaining between affected parties is impractical, then an unregulated market will cause

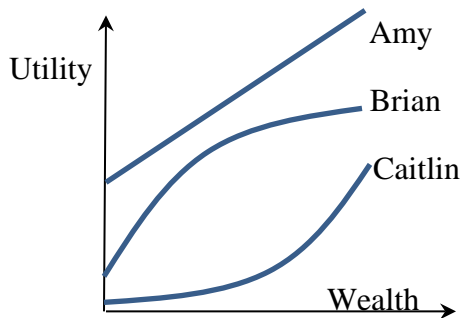
- a. the right amount of the good to be produced.
- b. too little of the good to be produced.
- c. too much of the good to be produced.
- d. cannot be determined from information given.

(17) Since many people can enjoy a television broadcast simultaneously, without detracting from each other's experience, television broadcasts are an example of a

- a. private good.
- b. nonexcludable good.
- c. nonrival good.
- d. common-property resource.

(18) The graph below shows utility functions for three people. Who is risk-averse?

- a. Amy.
- b. Brian.
- c. Caitlin.
- d. All of the above.
- e. None of the above.



(19) Healthy individuals are less likely to apply for health insurance. This is an example of

- a. adverse selection.
- b. moral hazard.
- c. exchange efficiency.
- d. market power.
- e. risk aversion.

(20) When a person is covered by auto insurance, often they drive less carefully.

- This is an example of
- a. adverse selection.
  - b. moral hazard.
  - c. exchange efficiency.
  - d. market power.
  - e. risk aversion.

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

(1) [Income elasticity of demand: 10 pts] Suppose that a consumer's income rises by 5%, and the income elasticity of demand for energy is 0.8 .

- a. Does the income elasticity indicate that energy is an *inferior* good, a *necessary* good, or a *luxury or superior* good?
- b. Will the quantity demanded of energy *increase* or *decrease*?
- c. By about how much?
- d. Will the share of the consumer's budget devoted to energy *increase* or *decrease*?
- e. By about how much?

	%
	%

(2) [Slutsky equation: 10 pts] The Slutsky equation in elasticity form is given by the following equation.

$$\epsilon = -S \eta + \epsilon^{\text{comp}}$$

where, as usual,  $\epsilon$  denotes the own-price elasticity of demand,  $S$  denotes the share of total consumer spending devoted to the good (a fraction),  $\eta$  denotes the income elasticity of demand, and  $\epsilon^{\text{comp}}$  denotes the compensated demand elasticity. Suppose that for food,  $\epsilon = -0.3$ ,  $S = 0.25$ , and  $\eta = 0.2$  .

- a. Compute the compensated demand elasticity ( $\epsilon^{\text{comp}}$ ).

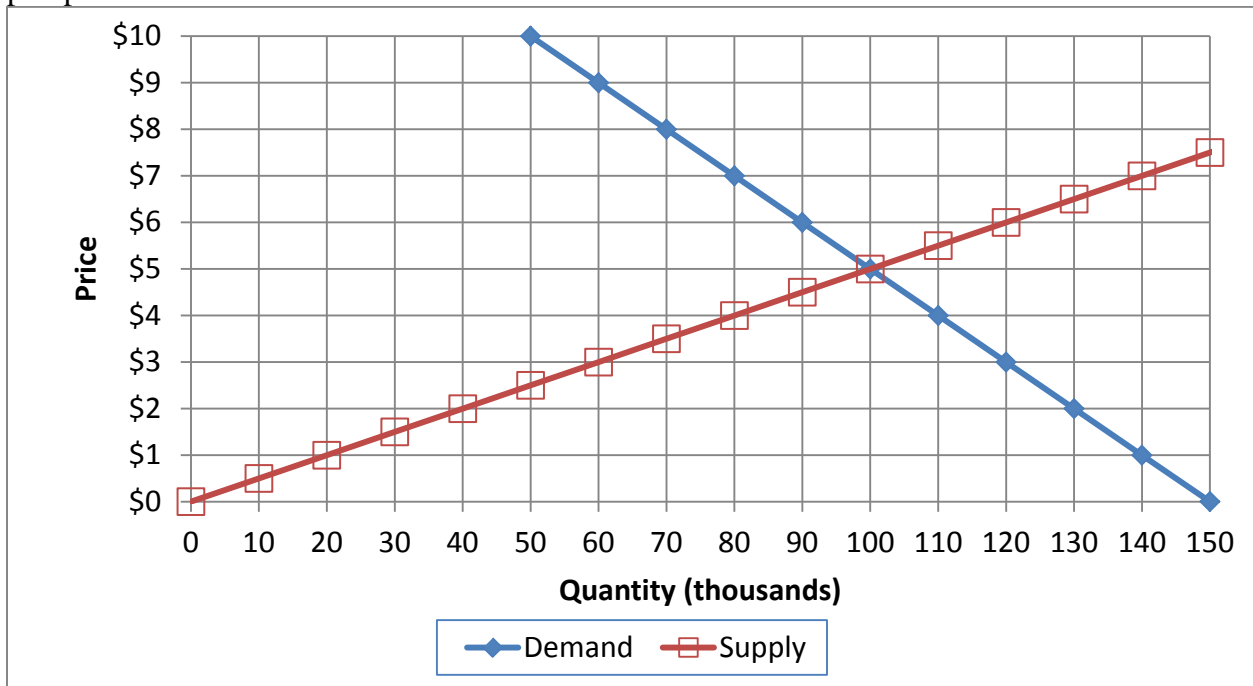
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Suppose the price of food rises by 10%, but the consumer's income does *not* change.

- b. Does the quantity demanded of food *increase* or *decrease*?
- c. By about how much?
- d. How much of this change is due to the income effect alone?
- e. How much of this change is due to the substitution effect alone?

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(3) [Welfare analysis of market controls: 16 pts] The following graph shows the market for pumpkins.



Suppose the government imposes a **price floor (or legal minimum price) of \$ 7**. No pumpkins may be sold for a price less than the price floor.

- How many pumpkins will actually be sold?
- Will there be *excess demand*, *excess supply*, or *neither*?
- How much?
- Does producer surplus *increase*, *decrease*, or *remain constant* because of the price floor, as compared to the market without government intervention? (Assume optimistically that pumpkins are sold by those producers who have the lowest cost.)
- By how much?
- Does consumer surplus *increase*, *decrease*, or *remain constant* because of the price floor, as compared to the market without government intervention?
- By how much?
- Compute the deadweight social loss caused by the price floor.

	thousand
	thousand
\$	thousand
\$	thousand
\$	thousand

(4) [Monopoly price discrimination: 4 pts] Suppose a movie theatre believes that the elasticity of demand for admission by adults is  $-3$ , and the elasticity of demand by children is  $-9$ . Assume the theatre's marginal cost is \$4 per admission.

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

\$
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b. Compute the profit-maximizing admission price for children.

\$
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(5) [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  $-2$ .

a. Compute the Lerner index if this market is a monopoly.

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

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c. Compute the Lerner index if this market is a symmetric Cournot oligopoly with a very large number of firms (approaching infinity).

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(6) [Game theory: 12 pts] Restaurant chains A and B want more customers. Each chain finds that advertising is costly but helps attract customers away from its rival. Their situation is expressed by the following game in normal form.

		Chain B	
		Advertise	Do not advertise
Chain A	Advertise	A gets \$2 million. B gets \$2 million.	A gets \$5 million. B gets \$1 million.
	Do not advertise	A gets \$1 million. B gets \$5 million.	A gets \$4 million. B gets \$4 million.

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

Chain A plays “Advertise” and Chain B plays “Advertise”	
Chain A plays “Advertise” and Chain B plays “Do not advertise”	
Chain A plays “Do not advertise” and Chain B plays “Advertise”	
Chain A plays “Do not advertise” and Chain B plays “Do not advertise”	

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

Chain A plays “Advertise” and Chain B plays “Advertise”	
Chain A plays “Advertise” and Chain B plays “Do not advertise”	
Chain A plays “Do not advertise” and Chain B plays “Advertise”	
Chain A plays “Do not advertise” and Chain B plays “Do not advertise”	

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

Chain A plays “Advertise” and Chain B plays “Advertise”	
Chain A plays “Advertise” and Chain B plays “Do not advertise”	
Chain A plays “Do not advertise” and Chain B plays “Advertise”	
Chain A plays “Do not advertise” and Chain B plays “Do not advertise”	

<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) [Finding individual demand functions: 12 pts] A consumer has the following utility function:  $U(q_1, q_2) = q_1^4 q_2$ , where  $q_1$  denotes the quantity of gasoline and  $q_2$  denotes the quantity of other goods.

- a. Find a formula for the consumer's marginal rate of substitution in consumption of other goods for gasoline—that is, the |slope| of the consumer's indifference curve with gasoline on the vertical axis and other goods 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 gasoline and let  $p_2$  denote the price of other goods. Let  $I$  denote the consumer's income.

- b. Solve for the consumer's demand function for gasoline—that is, the formula showing  $q_1^*$  as a function of  $p_1$ ,  $p_2$ , and  $I$  (but not  $q_2$ ). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

- c. Solve for the consumer's demand function for other goods—that is, the formula showing  $q_2^*$  as a function of  $p_1$ ,  $p_2$ , and  $I$  (but not  $q_1$ ). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

(2) [Production functions: 12 pts] Suppose a production function is given by

$$q = 2x_1^{1/2} + 4x_2^{1/2}.$$

- a. Find an expression for the marginal product of input 1. Are there diminishing returns to input 1? Justify your answer.

- b. Find an expression in terms of  $x_1$  and  $x_2$  for the marginal rate of substitution in production of input 2 for input 1—that is, the absolute value of the slope of an isoquant, with  $x_1$  on the vertical axis and  $x_2$  on the horizontal axis. Does production show a diminishing marginal rate of substitution? Justify your answer.

- c. Does this production function have *constant* returns to scale, *increasing* returns to scale, or *decreasing* returns to scale? Justify your answer.

(3) [Short-run profit maximization and supply: 12 pts] Suppose a firm faces short-run fixed cost of \$4 and short-run variable cost given by  $SVC(q) = 0.25q^2 + q$ , where  $q$  denotes the number of units of output. Suppose the market price is \$5.

- a. How much output  $q$  will the firm produce in order to maximize profit? Show your work and circle your final answer.

- b. Compute the firm's profit at this price.

- c. Compute the firm's breakeven price—the minimum price at which it will avoid losses. Show your work and circle your final answer.

(4) [Welfare effects of international trade: 15 pts] Suppose domestic demand and supply for a good are given by the following equations. Answer the questions below. Show your work and circle your final answers. (Use the graph at right for scratch work.)

Domestic demand:

$$Q_D = 2000 - 100 P$$

Domestic supply:

$$Q_S = 200 P - 100$$



First consider the market without international trade.

a. Compute the equilibrium price and quantity.

Now suppose the market is opened to international trade, and the world price of the good turns out to be **\$6**.

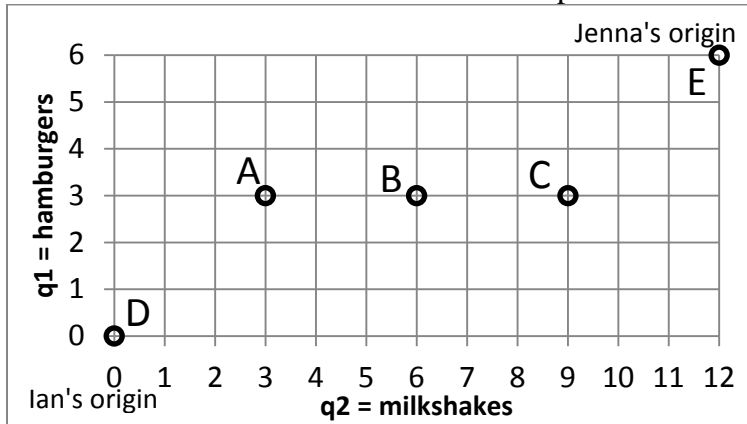
b. Will the country now *import* or *export* the good? How much?

c. Does consumer surplus *increase* or *decrease* as a result of international trade? By how much?

d. Does producer surplus *increase* or *decrease* as a result of international trade? By how much?

e. Does the country as a whole *gain* or *lose* as a result of international trade? By how much?

(5) [Exchange efficiency: 12 pts] Ian and Jenna both like hamburgers and milkshakes. Let  $q_1$  denote hamburgers and  $q_2$  denote milkshakes. Ian's utility function is  $U_I = q_1 q_2^2$ . Jenna's utility function is  $U_J = q_1^3 q_2^2$ . A total of 6 hamburgers and 12 milkshakes 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.

(6) [External cost and Pigou tax: 10 pts] Suppose supply and demand for a particular pesticide are given by the following equations. Use the space at the bottom of this page for scratch work.

Demand:  $P_D = 20 - (Q/100)$

Supply:  $P_S = 4 + (Q/100)$ .

- a. Compute the unregulated equilibrium price and quantity.

Unfortunately, the use of this pesticide causes harm to beekeepers, creating an external cost. Marginal external cost per unit is estimated to be  $MEC = 1 + (Q/100)$ .

- b. Find a formula for the marginal social cost of the pesticide.

- c. Compute the socially-optimal quantity of output of the pesticide.

- d. Compute the deadweight loss from unregulated competition.

- e. Compute the Pigou tax rate on this pesticide, in dollars per unit, that would result in the socially-optimal quantity of the chemical.



(7) [Uncertainty, risk aversion, demand for insurance: 10 pts] Anna has \$40 in income but faces a 50% chance of losing \$30 and thus being reduced to only \$10 in income. Anna's utility function is given by  $U(I) = 10 - (80/I)$ , where  $I$  denotes income.

- a. Compute Anna's expected income (in dollars).

- b. Compute Anna's expected utility (in utils).

- c. Compute the level of risk-free income that would be just as desirable as Anna's current risky situation (in dollars).

- d. Compute the maximum insurance premium Anna would be willing to pay for full insurance against potential loss.

- e. Compute the so-called "fair insurance" premium for full insurance against Anna's potential loss.



(8) [Hidden characteristics and adverse selection: 10 pts] Suppose the market for homeowners insurance consists of 1000 people. Order these people from high-risk to low-risk, and index them by  $Q = 0$  to 1000. The expected loss of the  $Q$ th person is given by  $EL = 200 - 0.1 Q$ . (Thus the last person's expected loss is about \$100.) Everyone is risk-averse, and willing to pay \$20 more than their expected loss (EL) for insurance.

- a. Give an equation for the demand for insurance  $P_D$  or willingness-to-pay, as a function of  $Q$ .

- b. Give an equation for the marginal cost of insurance  $MC$ , as a function of  $Q$ . (Assume there are no administrative costs.)

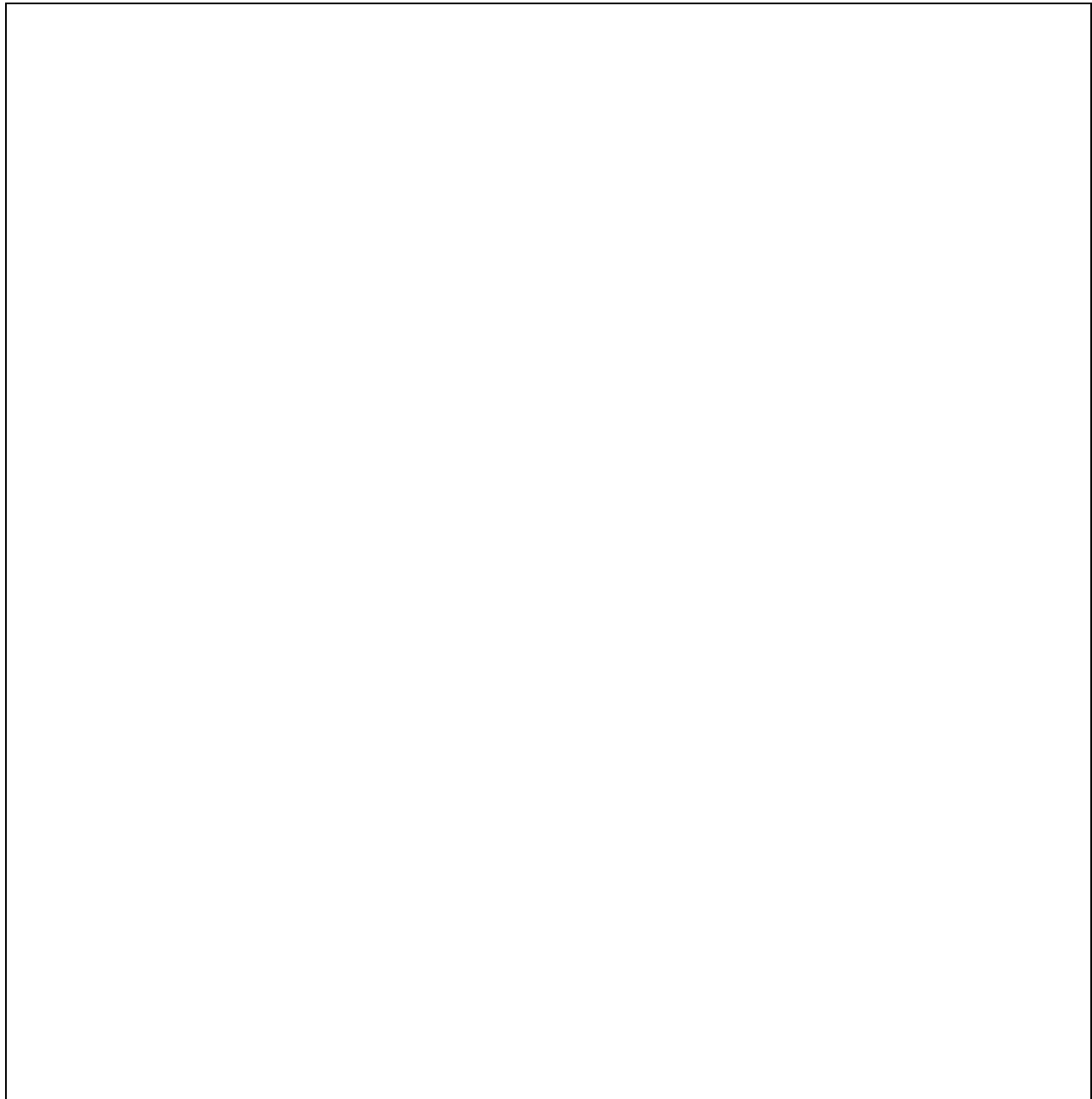
- c. If the market were efficient, how many people would get insurance? Why?

- d. Give an equation for the average cost of insurance  $AC$  as a function of  $Q$ . [Hint:  $AC$  has the same intercept but half the slope of  $MC$ .]

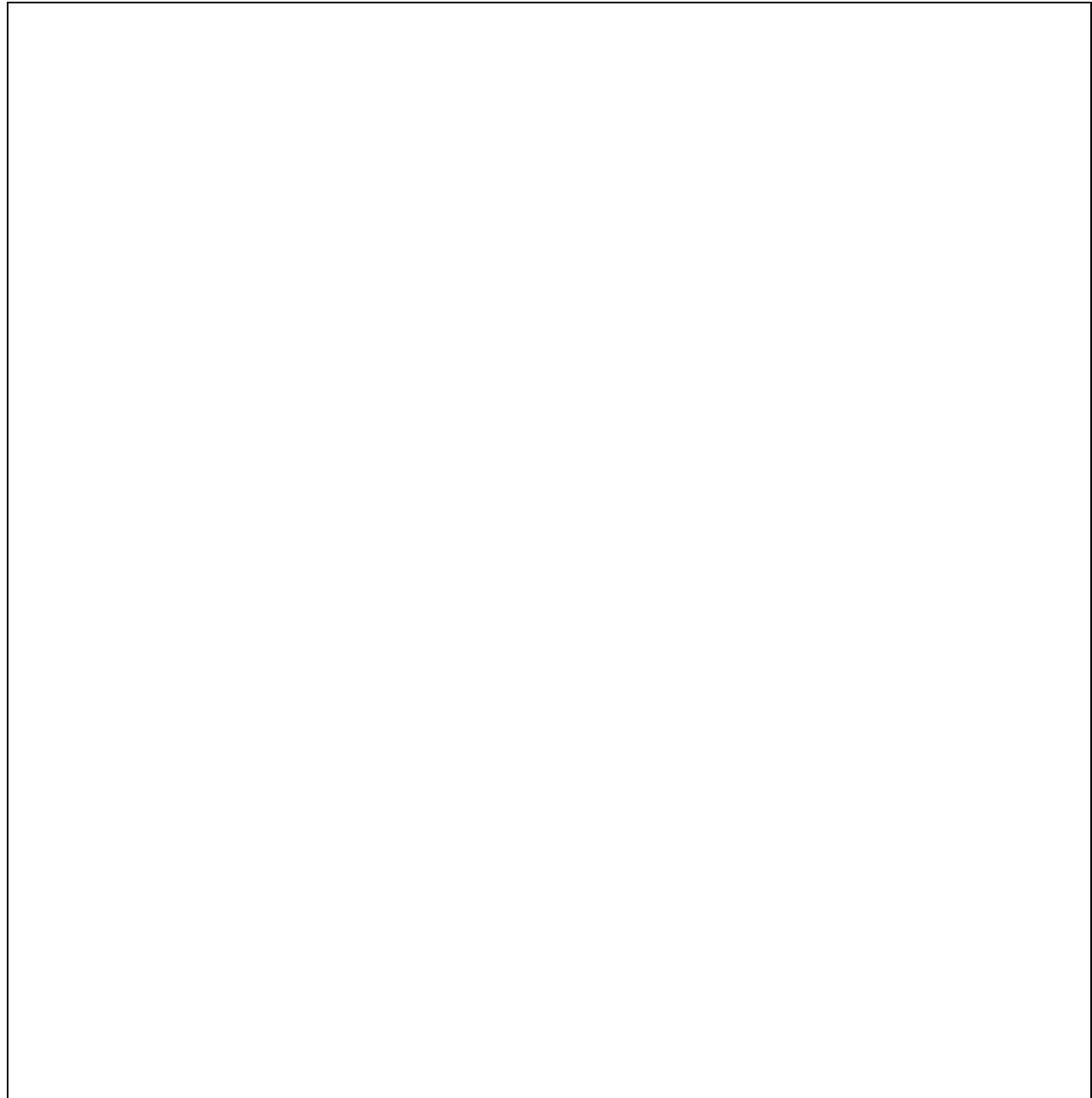
- e. Assume the market is competitive, but that insurance companies cannot observe individual persons' expected loss. Find the equilibrium price  $P$  and quantity  $Q$  of insurance.

**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.

**Economic efficiency can be hindered by market failure or government failure. Give an example of a market failure and explain how it decreases economic efficiency. Give an example of a government failure—that is, an ill-advised government intervention in a market—and explain how it decreases economic efficiency. Illustrate your explanations with graphs.**



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**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]