

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.

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

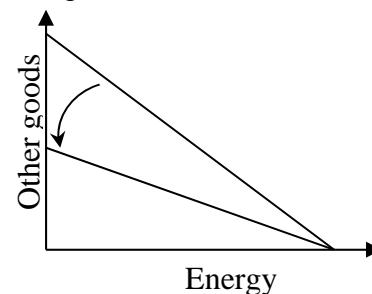
(1) Which utility function below violates the assumption of "monotonicity" or "more is better"?

- a. $U(q_1, q_2) = 7 q_1 q_2$.
- b. $U(q_1, q_2) = (4q_1) / (3q_2)$.
- c. $U(q_1, q_2) = -4q_1^{-1/2} - 3q_2^{-1/2}$.
- d. $U(q_1, q_2) = 7 q_1^4 q_2^3$.
- e. $U(q_1, q_2) = 4 q_1^{1/2} + 3 q_2^{1/2}$.
- f. $U(q_1, q_2) = (-4/q_1) + (-3/q_2)$.

(2) All of the following utility functions yield the same formula for the marginal rate of substitution in consumption *except*

- a. $U(q_1, q_2) = q_1 q_2^3$.
- b. $U(q_1, q_2) = 12 q_1^{1/4} q_2^{3/4}$.
- c. $U(q_1, q_2) = \ln(q_1) + 3 \ln(q_2)$.
- d. $U(q_1, q_2) = q_1 + 3 q_2$.
- e. $U(q_1, q_2) = (q_1 q_2^3)^2 + 16$.

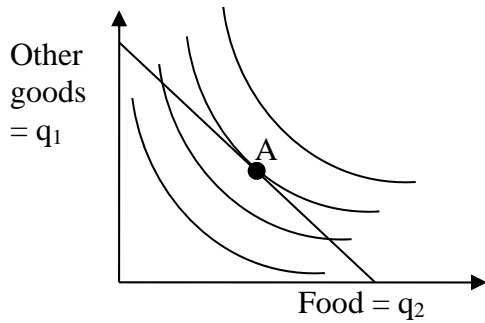
The next question refers to the following graph of a budget line.



(3) In the graph above, the shift in the budget line could be caused by

- a. an increase in income.
- b. a decrease in income.
- c. an increase in the price of energy.
- d. a decrease in the price of energy.
- e. an increase in the price of other goods.
- f. a decrease in the price of other goods.

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.



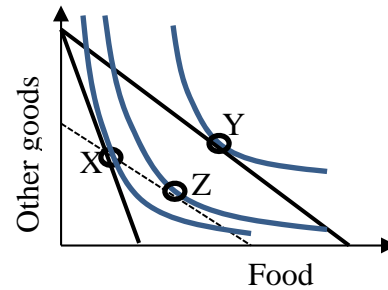
- (4) This consumer could enjoy higher utility, without increasing total spending, by
- purchasing less food and more other goods.
 - purchasing more food and fewer other goods.
 - purchasing less food and fewer other goods.
 - any of the above.
 - none of the above.

- (5) 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,
- $MU_2 = MU_1$ 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.

- (6) Which function is *not* homogeneous of degree zero in income and prices?
- $q_1^* = I / (p_1 + p_1^{1/2} p_2^{1/2})$.
 - $q_1^* = I/(8p_1) + 3$.
 - $q_1^* = 0.9 I - 3p_1 + 0.1 p_2$.
 - $q_1^* = 2p_2/p_1 + I/(6p_1)$.
 - All are homogeneous of degree zero.

- (7) Suppose the income elasticity of demand for coffee is 0.6. Then coffee is
- an inferior good.
 - a necessary good.
 - a luxury (or superior) good.
 - None of the above.

The next two questions refer to following graph, which shows the impact on the consumer of a *decrease* in the price of food. The solid lines are the old and new budget lines. The dashed line is a hypothetical budget line. The curves are indifference curves.



- (8) The *substitution effect* of the price decrease is a move from
- bundle X to bundle Y.
 - bundle X to bundle Z.
 - bundle Z to bundle Y.
 - None of the above.
- (9) The *income effect* of the price decrease is a move from
- bundle X to bundle Y.
 - bundle X to bundle Z.
 - bundle Z to bundle Y.
 - None of the above.

(10) The production function
 $q = 2 x_1^{2/3} x_2^{2/3}$

shows

- a. constant returns to scale.
- b. decreasing returns to scale.
- c. increasing returns to scale.
- d. cannot be determined from the information given.

The next two questions refer to the following information. Suppose a firm's long-run total cost function is given by $TC(q) = 0.5q^3 - 50q^2 + 1270q$.

(11) The firm's average cost function is

$AC(q) =$

- a. $0.5q^3 - 50q^2 + 1270q$.
- b. $0.5q^2 - 50q + 1270$.
- c. $1.5q^2 - 100q + 1270$.
- d. $3q - 100$.
- e. $q - 50$.

(12) The firm's marginal cost function is

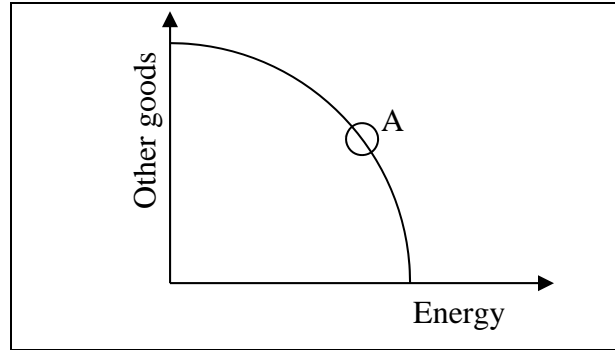
$MC(q) =$

- a. $0.5q^3 - 50q^2 + 1270q$.
- b. $0.5q^2 - 50q + 1270$.
- c. $1.5q^2 - 100q + 1270$.
- d. $3q - 100$.
- e. $q - 50$.

(13) In *long-run* competitive equilibrium,

- a. price equals marginal cost.
- b. price equals average cost.
- c. average cost equals marginal cost.
- d. all of the above.

The next two questions refer 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 4 (in absolute value).



(14) If this economy were to produce two more units of energy, it would have to reduce production of other goods by about

- a. one unit.
- b. two units.
- c. four units.
- d. six units.
- e. eight units.

(15) If the price of energy in this economy is \$4 per unit, then the price of other goods must be

- a. \$1.
- b. \$2.
- c. \$4.
- d. \$8.
- e. \$16.

(16) Suppose the demand for a monopolist's product has an elasticity of -3, and the monopolist's marginal cost is \$20. Then the profit-maximizing price is

- a. \$3.00.
- b. \$7.33.
- c. \$14.67.
- d. \$20.00.
- e. \$30.00.
- f. \$60.00.

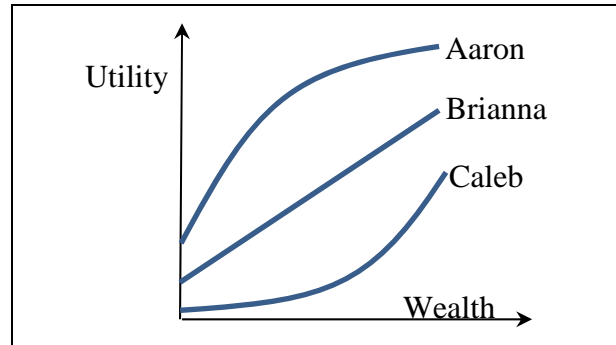
(17) One implication of the Cournot model of oligopoly is that the equilibrium price is lower

- a. the more firms are in the industry.
- b. the more elastic is market demand.
- c. both of the above.
- d. none of the above.

(18) 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.

The next question refers to the following graph, which shows utility functions for three people.



(19) Who is risk-averse?

- a. Aaron.
- b. Brianna.
- c. Caleb.
- d. All of the above.
- e. None of the above.

(20) 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.

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

(1) [Price elasticity of demand: 5 pts] Suppose the price elasticity of demand for water is -0.8 , and the Water Works Department raises the price by 5 %.

- a. Is the demand for water *elastic* or *inelastic* ?
- b. Will the quantity demanded of water *increase* or *decrease*?
- c. By about how much?
- d. Will the revenue received by the Water Works Department *increase* or *decrease*?
- e. By about how much?

	%
	%

(2) [Substitution and income effects: 6 pts] Consider the indifference-curve diagram below. Assume the consumer has income equal to \$60. The straight lines are budget lines. The curves are consumer's indifference curves.



- What was the price of food on the old budget line?
- Given the old budget line, how much food does the consumer demand?
- What is the price of food on the new budget line?
- Given the new budget line, how much food does the consumer demand?
- Compute the change in quantity of food demanded due to the substitution effect: Δq^{sub} .
- Compute the change in quantity of food demanded due to the income effect: Δq^{inc} .

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

(1) [Cost minimization: 9 pts] Suppose a firm wishes to produce 180 units of output per hour at minimum cost. Machines cost \$40 per hour to rent and workers must be paid \$10 per hour. The firm's hourly production function is given by $q = 10 x_1^{1/2} x_2^{1/2}$, where x_1 denotes the number of machines and x_2 denotes the number of workers.

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

- b. 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. [3 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. Compute the total cost to produce 180 units of output, $TC(180)$.

(2) [Welfare effects of tax or subsidy: 10 pts] Suppose demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

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

Supply: $P_S = 2 + (Q/200)$



First consider the market without any tax or subsidy.

- a. Compute the equilibrium price and quantity.

Now suppose the government offers a **subsidy of \$ 3** per unit.

- b. Compute the new equilibrium quantity.

- c. Does consumer surplus *increase* or *decrease* as a result of the subsidy? By how much?

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

e. Does society as a whole *gain* or *lose* as a result of the subsidy? By how much?

(3) [Monopoly: 14 pts] Suppose a monopolist has total cost function given by $TC(Q) = Q + (Q^2/20)$. This monopolist faces a demand curve given by $P = 25 - (Q/20)$. Note: question continues on next page. Use graph at the 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^* .

e. Compute the monopolist's profit-maximizing price P^* .

f. Compute the monopolist's profit.

g. Compute the social deadweight loss caused by the monopolist.



(4) [External benefit and Pigou subsidy: 8 pts] Suppose supply and demand for a particular vaccine are given by the following equations. Use the space at the bottom of this page for scratch work. . (Use the graph at right for scratch work.)

Demand: $P_D = 17 - (Q/10)$

Supply: $P_S = 2 + (Q/20)$



- a. Compute the unregulated equilibrium price and quantity.

Persons who are vaccinated lower the risk of disease to everyone around them, creating an external benefit. Marginal external benefit per vaccine is estimated to be $MEB = 9 - (Q/20)$.

- b. Find a formula for the marginal social benefit of the vaccine.

- c. Compute the socially-optimal quantity of vaccinations.

- d. Compute the Pigou subsidy rate on this vaccine, in dollars per unit, that would result in the socially-optimal quantity of vaccinations.

(5) [Congestion pricing: 10 pts] Freeways typically save time for drivers versus taking an alternate route. But with too many cars, freeways become congested. Therefore, the average amount of time saved depends negatively on the number of cars on a freeway. Suppose that for a particular freeway, the average time saved in minutes (ATS) depends on the number of cars (Q) according to the following function:

$$ATS(Q) = 20 - (Q/10) .$$

- a. Assume that cars enter the freeway until the average time saved drops to zero. How many cars (Q) will use the freeway?

Suppose our objective is to maximize total time saved (TTS), defined as average time saved times the number of cars on the freeway. (Note that TTS is zero when cars are permitted to enter the freeway without restriction as in part (a) above.)

- b. Find an expression for TTS(Q).

- c. Compute the number of cars Q^* that maximizes total time saved.

- d. Compute TTS(Q^*) and ATS(Q^*).

- e. Suppose we wish to control the number of cars so as to maximize the total time saved by imposing a fee or toll on every car entering the freeway. If each driver is willing to pay \$0.50 for every minute of time saved, what should that fee be? In other words, what fee would make the average driver indifferent between taking the freeway and paying the fee, versus taking an alternate route and not paying the fee?

(6) [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 $EL = 300 - 0.2 Q$. (Thus the last person's expected loss is about \$100.) Everyone is risk-averse, and willing to pay \$40 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.)

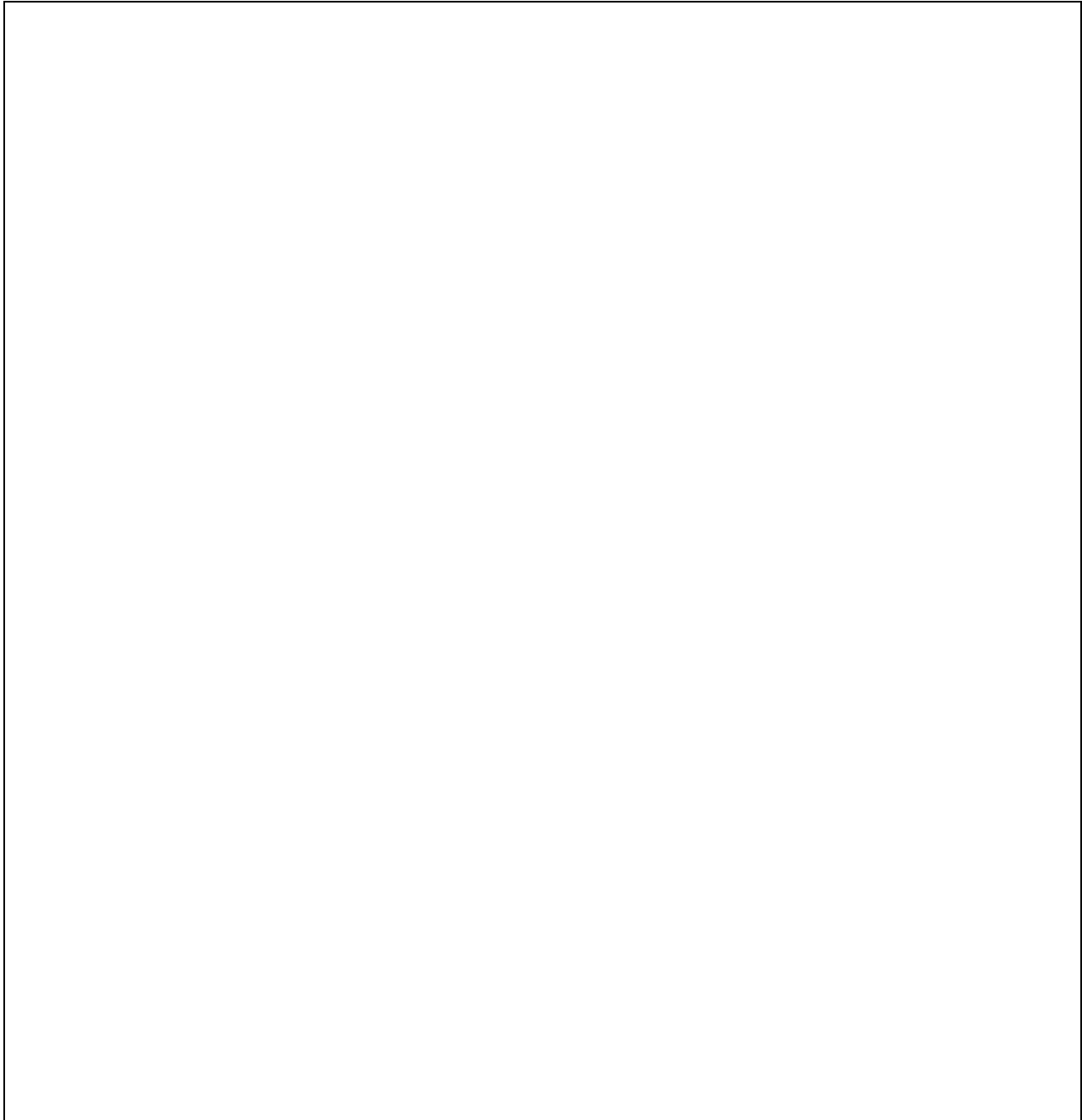
- c. If the market were efficient, how many people would get insurance?

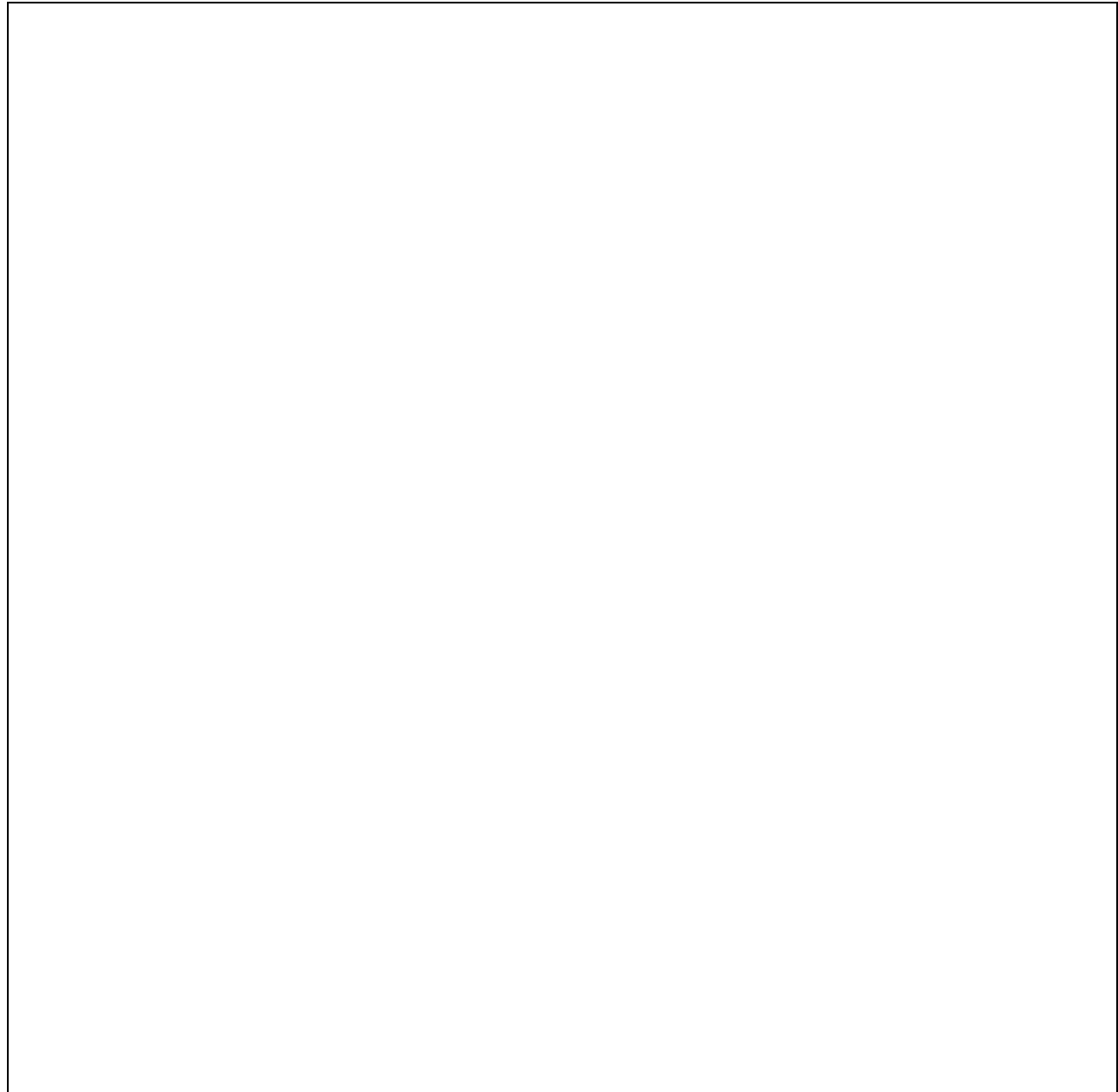
- d. Give an equation for the average cost of insurance AC as a function of Q . [Hint: AC has the same intercept but half the slope of MC .]

- 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.

Consider the following claim: “Taxes reduce economic efficiency because they discourage production, but subsidies increase economic efficiency because they encourage production.” 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]