

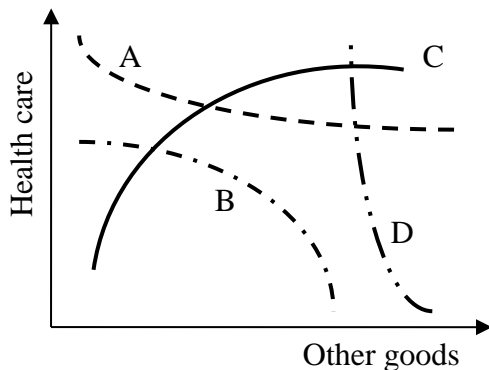
FINAL EXAMINATION VERSION A

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].

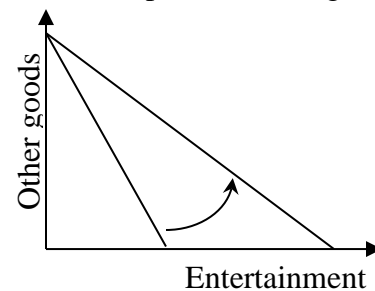
(1) Which indifference curve below violates the assumption of monotonicity?

- a. Curve A.
- b. Curve B.
- c. Curve C.
- d. Curve D.
- e. Curves B and C.
- f. None of the above.

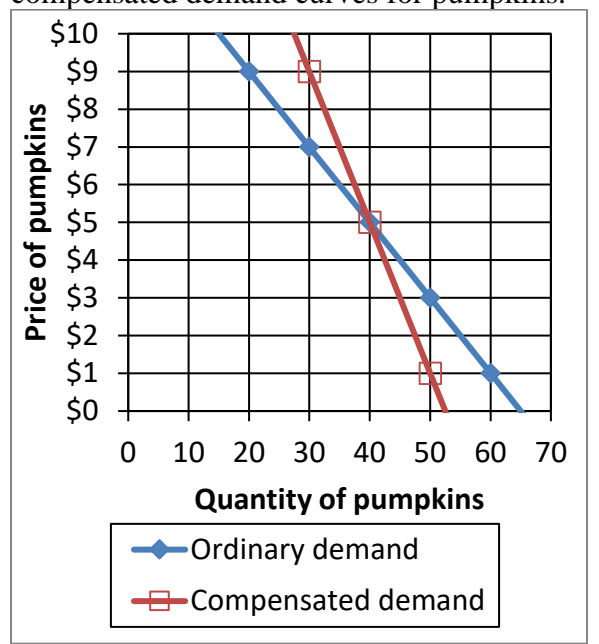


(2) In the graph below, the shift in the budget line could be caused by

- a. an increase in income.
- b. a decrease in income.
- c. an increase in the price of entertainment.
- d. a decrease in the price of entertainment.
- 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 ordinary and compensated demand curves for pumpkins.



(3) If the price rises from \$5 to \$9, then consumer surplus decreases by

- \$4.
- \$120.
- \$140.
- \$160.
- none of the above.

(4) The increase in income that would exactly compensate consumers for a rise in price from \$5 to \$9, leaving consumers just as well off as before the price change, would be

- \$4.
- \$120.
- \$140.
- \$160.
- none of the above.

(5) Suppose a production function is given by $q = 30 x_1^{1/3} x_2^{2/3}$. The number $(1/3)$ equals the

- marginal product of input #1.
- marginal rate of substitution in production.
- returns to scale.
- elasticity of output with respect to input #1.
- average product of input #1.

(6) “Diseconomies of scale” mean that the firm’s average cost curve

- slopes up.
- slopes down.
- is horizontal.
- is vertical.

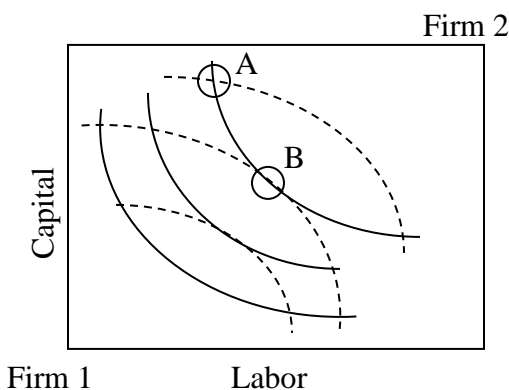
(7) A potential Pareto improvement (also called an *economically efficient change*) is defined as a change in the economy where

- 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.

(8) A quota on *sellers* of tropical fish would have basically the same effect on the market for tropical fish as

- a price ceiling on tropical fish.
- a price floor on tropical fish.
- a tax on tropical fish.
- a subsidy for tropical fish.
- a free market for tropical fish.

The next two questions refer to the following Edgeworth box diagram for production. The solid curves are Firm 1's isoquants. The dashed curves are Firm 2's isoquants.



- (9) 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.

- (10) From allocation B, *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.

- (11) Suppose a monopolist faces constant marginal cost, but finds that its price elasticity of demand varies by market segment. In particular, it finds that people with blue eyes have more elastic demand than people with brown eyes. To maximize the monopolist's profit, which market segment should get the *higher* price?
- people with blue eyes.
 - people with brown eyes.
 - both segments should get the same price because marginal cost is constant.
 - cannot be determined from information given.

- (12) 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.

- (13) If a good imposes external costs, and bargaining between affected parties is impractical, then an unregulated market will cause
- the right amount of the good to be produced.
 - too little of the good to be produced.
 - too much of the good to be produced.
 - cannot be determined from information given.

(14) Which method for controlling pollution is theoretically most efficient?

- a. cap-and-trade system for pollution permits.
- b. auction for pollution permits.
- c. pollution fee set equal to marginal external cost.
- d. All three methods are equally efficient.

(15) Suppose a web server can provide pages of information to any number of internet users simultaneously, without slowing down. The web server is thus

- a. a nonexcludable good.
- b. a nonrival good.
- c. a pure private good.
- d. a substitute.
- e. a complement.

(16) In the 1800s and early 1900s, whales were not protected. Anyone could kill them without paying or asking for permission. Unfortunately, many species were nearly wiped out—hunting by one person left fewer whales for others. Therefore whales were

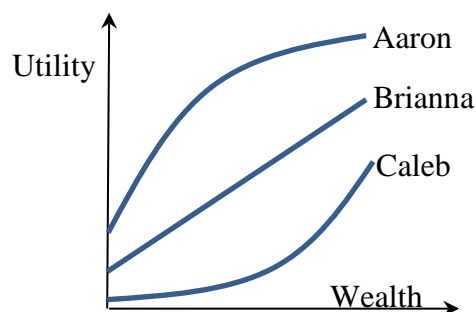
- a. a nonrival good.
- b. a nonexcludable good.
- c. both of the above.
- d. none of the above.

(17) Which utility function shows risk aversion?

- a. $U(W) = 8 - 3W$.
- b. $U(W) = 10 + 4W^{1/2}$.
- c. $U(W) = 5 + 2W^2$.
- d. $U(W) = 3W$.

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

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



(19) Clumsy smart phone users are more likely to apply for extended warranties. This is an example of

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

(20) Suppose that after drivers buy towing insurance, they take less care of their cars. This would be an example of

- a. monotonicity.
- b. moral hazard.
- c. substitution effects.
- d. adverse selection.

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

(1) [Price elasticity of demand: 10 pts] Suppose the price elasticity of demand for gasoline is -0.8 , and the price of gasoline rises by 5 %.

- a. Is the demand for gasoline *elastic* or *inelastic* ?
- b. Will the quantity demanded of gasoline *increase* or *decrease*?
- c. By about how much?
- d. Will consumers' total spending on gasoline *increase* or *decrease*?
- e. By about how much?

	%
	%

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

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

where, as usual, ϵ denotes the own-price elasticity of demand, S denotes the share of total consumer spending devoted to the good (a fraction), η denotes the income elasticity of demand, and ϵ^{comp} denotes the compensated demand elasticity. Suppose that for electricity, $\epsilon = -1.2$, $S = 0.05$, and $\eta = 0.8$.

- a. Compute the compensated demand elasticity (ϵ^{comp}).

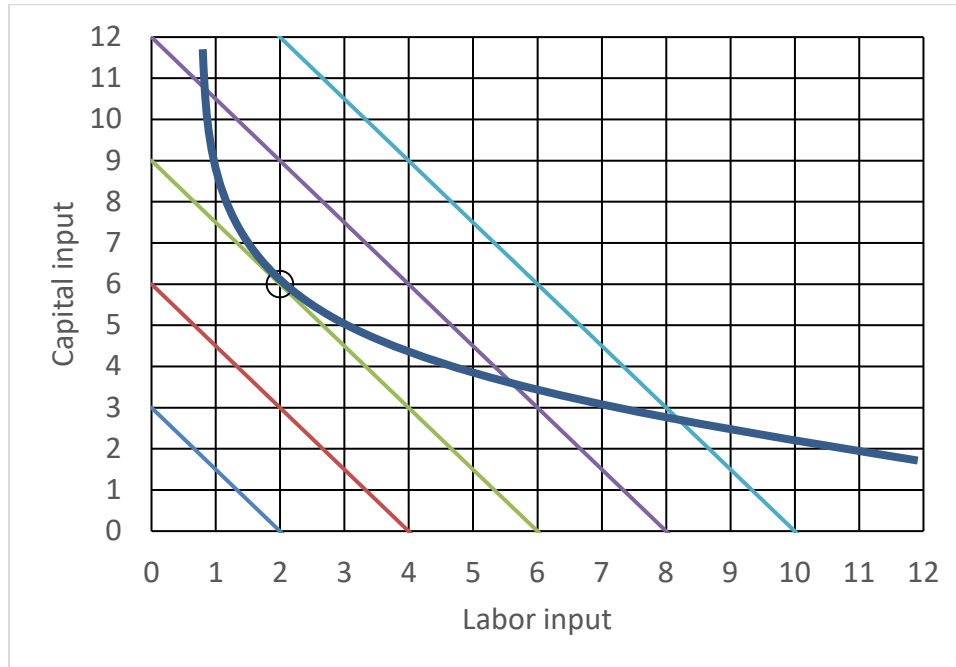
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Suppose the price of electricity falls by 10%, but the consumer's income does *not* change.

- b. Does the quantity demanded of electricity *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?

	%
	%
	%

(3) [LR versus SR cost: 10 pts] Firm ABC wants to produce 100 units of output at lowest cost. This firm must pay \$15 per hour for labor and \$10 per hour for capital. The graph below shows the firm's isoquant for 100 units of output per hour and several isocost lines. The small circle marks a tangency.



First, suppose the firm can hire whatever amounts of labor and capital it wants.

- a. How many units of labor will it hire?
- b. How many units of capital will it hire?
- c. Compute Firm X's total cost.

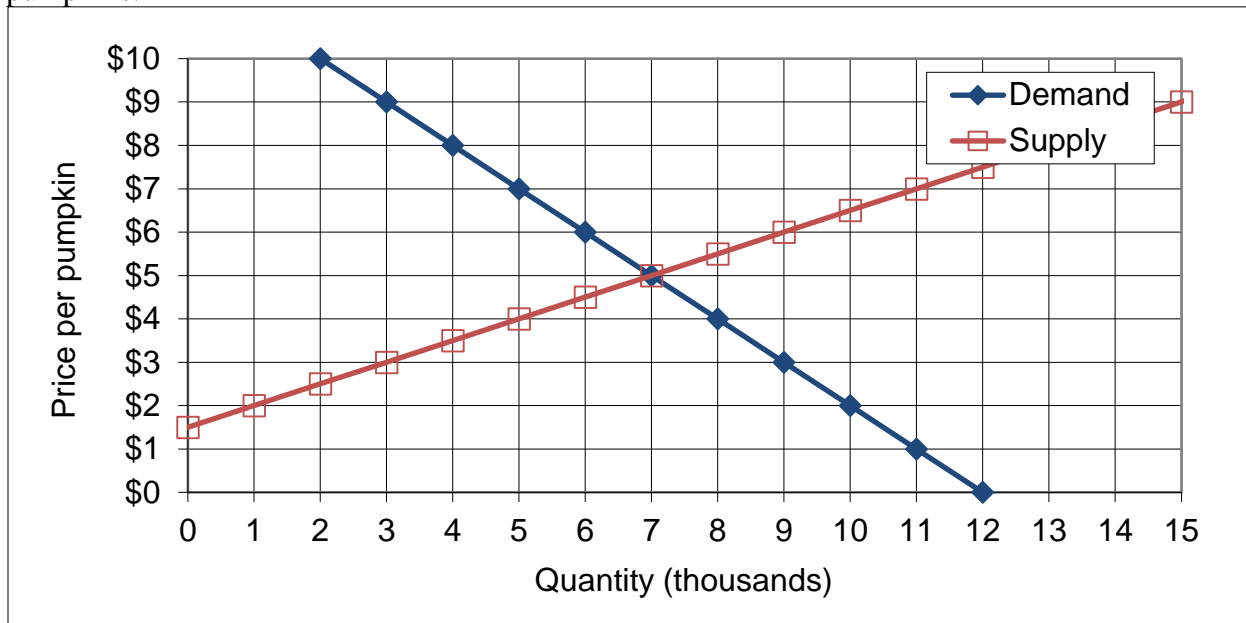
units
units
\$

Alternatively, suppose the firm's capital input is fixed in the short run at 5 units, but the firm's labor input is variable. The firm still wants to produce 100 units of output.

- d. How many units of labor will it hire?
- e. Compute Firm ABC's total cost in the short run.

units
\$

(4) [Welfare effects of taxes or subsidies: 20 pts] The following graph shows the market for pumpkins.



a. Find the equilibrium price without government intervention.

\$

Suppose the government imposes an excise **tax of \$ 3** per pumpkin.

b. Compute the equilibrium quantity sold.

thousand

c. Compute the equilibrium net price received by sellers (excluding the tax).

\$	per pumpkin
----	-------------

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

\$	per pumpkin
----	-------------

e. Does producer surplus *increase, decrease, or remain constant* because of the tax?

f. By how much?

\$	thousand
----	----------

g. Does consumer surplus *increase, decrease, or remain constant* because of the tax?

h. By how much?

\$	thousand
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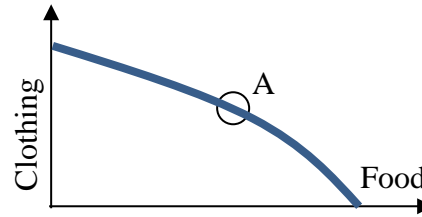
i. Compute the total tax revenue collected by the government.

\$	thousand
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j. Compute the deadweight social loss caused by the tax.

\$	thousand
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(5) [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 $-1/4$.



- 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 clothing 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 clothing is \$ 12, then what must be the price of a unit of food?

	units of food
	units of clothing
\$	

(6) [Comparison of models: 6 pts] In long-run equilibrium, which models predict that price equals each firm's marginal cost, and which models predict that price equals each firm's average cost? Write YES or NO in each box.

- Perfect competition.
- Monopoly.
- Monopolistic competition.

	$P = MC$	$P = AC$
a. Perfect competition.		
b. Monopoly.		
c. Monopolistic competition.		

(7) [Game theory: 12 pts] Grocery chains A and B are choosing locations for a new store. The downtown location is more profitable than the uptown location, but if the chains choose the same location, they split the business. Their situation is expressed by the following game in normal form.

		Chain B	
		Locate uptown	Locate downtown
Chain A	Locate uptown	A gets \$2 million. B gets \$2 million.	A gets \$4 million. B gets \$6 million.
	Locate downtown	A gets \$6 million. B gets \$4 million.	A gets \$3 million. B gets \$3 million.

- a. Which outcomes of this game (if any) are Pareto-optimal¹? Answer “YES” or “NO.”

Chain A plays “Uptown” and Chain B plays “Uptown.”	
Chain A plays “Downtown” and Chain B plays “Downtown.”	
Chain A plays “Uptown” and Chain B plays “Downtown.”	
Chain A plays “Downtown” and Chain B plays “Uptown.”	

- b. Which outcomes of this game (if any) are dominant-strategy equilibria²? Answer “YES” or “NO.”

Chain A plays “Uptown” and Chain B plays “Uptown.”	
Chain A plays “Downtown” and Chain B plays “Downtown.”	
Chain A plays “Uptown” and Chain B plays “Downtown.”	
Chain A plays “Downtown” and Chain B plays “Uptown.”	

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

Chain A plays “Uptown” and Chain B plays “Uptown.”	
Chain A plays “Downtown” and Chain B plays “Downtown.”	
Chain A plays “Uptown” and Chain B plays “Downtown.”	
Chain A plays “Downtown” and Chain B plays “Uptown.”	

¹ Ignore the welfare of consumers.

² "Equilibria" is the plural form of "equilibrium."

(8) [Cost-of-living indexes: 6 pts] Suppose we are given the following data on prices and quantities consumed of food and other goods.

	Food		Other goods	
	Price	Quantity	Price	Quantity
Old period	\$4	20 units	\$5	4 units
New period	\$6	15 units	\$5	8 units

Assume that all cost-of-living indexes equal 100 in the old period.

- Compute the *value* of the Laspeyres cost-of-living index in the new period.
- Compute the *value* of the Paasche cost-of-living index in the new period.
- Give a *formula* for the Fisher cost-of-living index in the new period. The formula should include numbers but no variables.

(9) [Nonrival goods: 6 pts] Suppose a housing development with 5 families is planted with flowers in the middle that everyone can enjoy simultaneously. The marginal benefit of flowers for each family is given by $MB = 8 - Q$, where Q denotes the number of flowers. The marginal cost of each flower \$5.

- If an individual family must pay the cost of flowers, how many will it choose to plant?
- Give an expression for marginal social benefit of flowers.
- What is the socially-optimal number of flowers for this housing development?

flowers
MSB =
flowers

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: $U(q_1, q_2) = q_1 q_2^4$, where q_1 denotes the quantity of housing 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 housing—that is, the |slope| of the consumer's indifference curve with housing 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 housing 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 housing—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.]

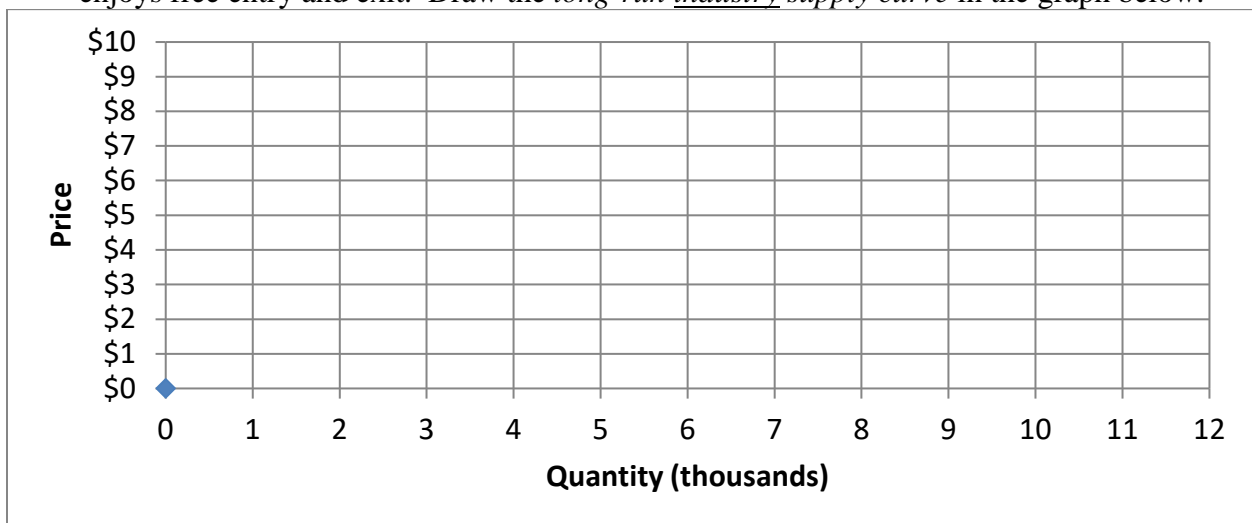
(2) [Long-run profit maximization and supply: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.01q^3 - 0.4q^2 + 10q$.

a. Compute the typical firm's efficient scale q_{ES} . Show your work and circle your final answer.

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

c. Find an equation for the *firm's supply curve*. Show your work and circle your final answer.

d. Suppose all firms in this industry have the same costs, and these costs are not affected by other firms in the same industry or by total industry output. Further assume the industry enjoys free entry and exit. Draw the *long-run industry supply curve* in the graph below.



(3) [Monopoly, profit maximization: 14 pts] Suppose a monopolist has total cost function given by $TC(Q) = 2Q + (Q^2/40)$. This monopolist faces a demand curve given by $P = 11 - (Q/20)$. 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.

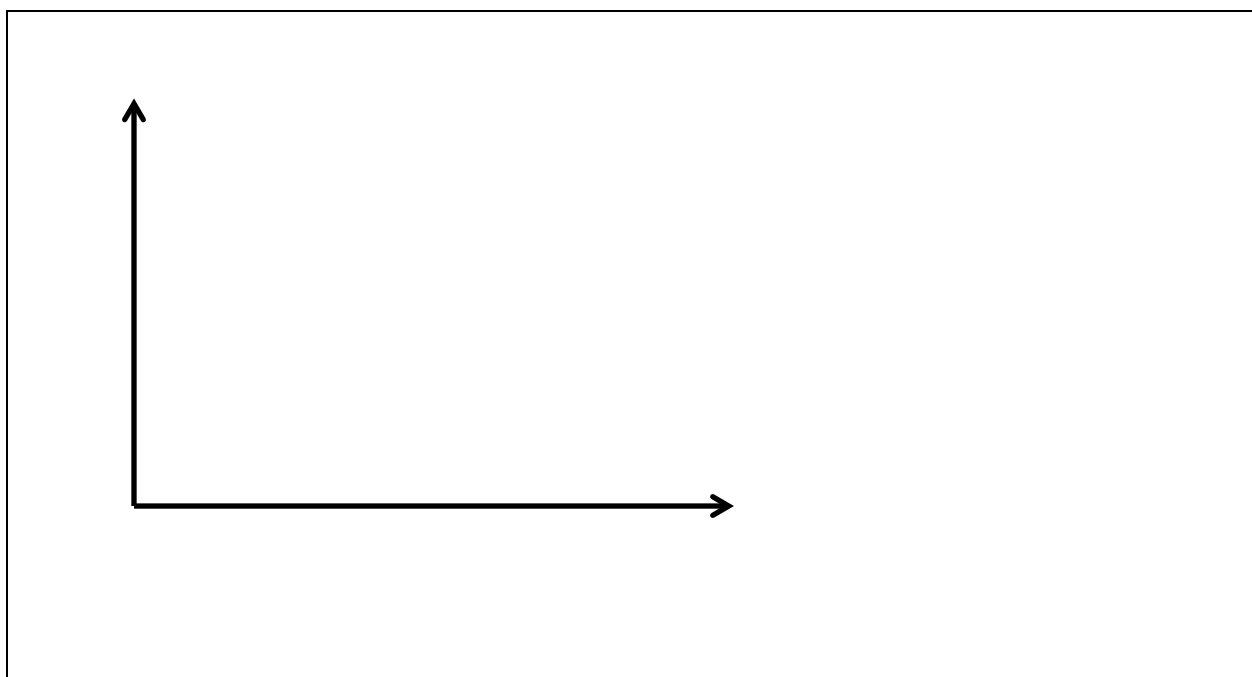
- c. Find the monopolist's marginal revenue function.

- 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.)



(4) [External cost and Pigou tax: 10 pts] Suppose supply and demand for a particular chemical are given by the following equations. (Use the graph at right for scratch work.)

Demand: $P_D = 13 - (Q/10)$

Supply: $P_S = 3 + (Q/10)$



- a. Compute the unregulated equilibrium price and quantity.

Unfortunately, the use of this chemical causes harm to ocean fisheries, creating an external cost. Marginal external cost per unit is estimated to be $MEC = 1 + (Q/10)$.

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

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

- d. Compute the deadweight loss from unregulated competition.

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

(5) [Uncertainty, risk aversion, demand for insurance: 10 pts] Becca has \$25 in wealth but faces a 50% chance of losing \$16 and thus being reduced to only \$9 in wealth. Becca's utility function is given by $U(W) = W^{1/2}$, where I denotes income.

- a. Compute Becca's expected wealth (in dollars).

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

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

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

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

(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 $EL = 400 - 0.2 Q$. (Thus the last person's expected loss is about \$200.) 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?

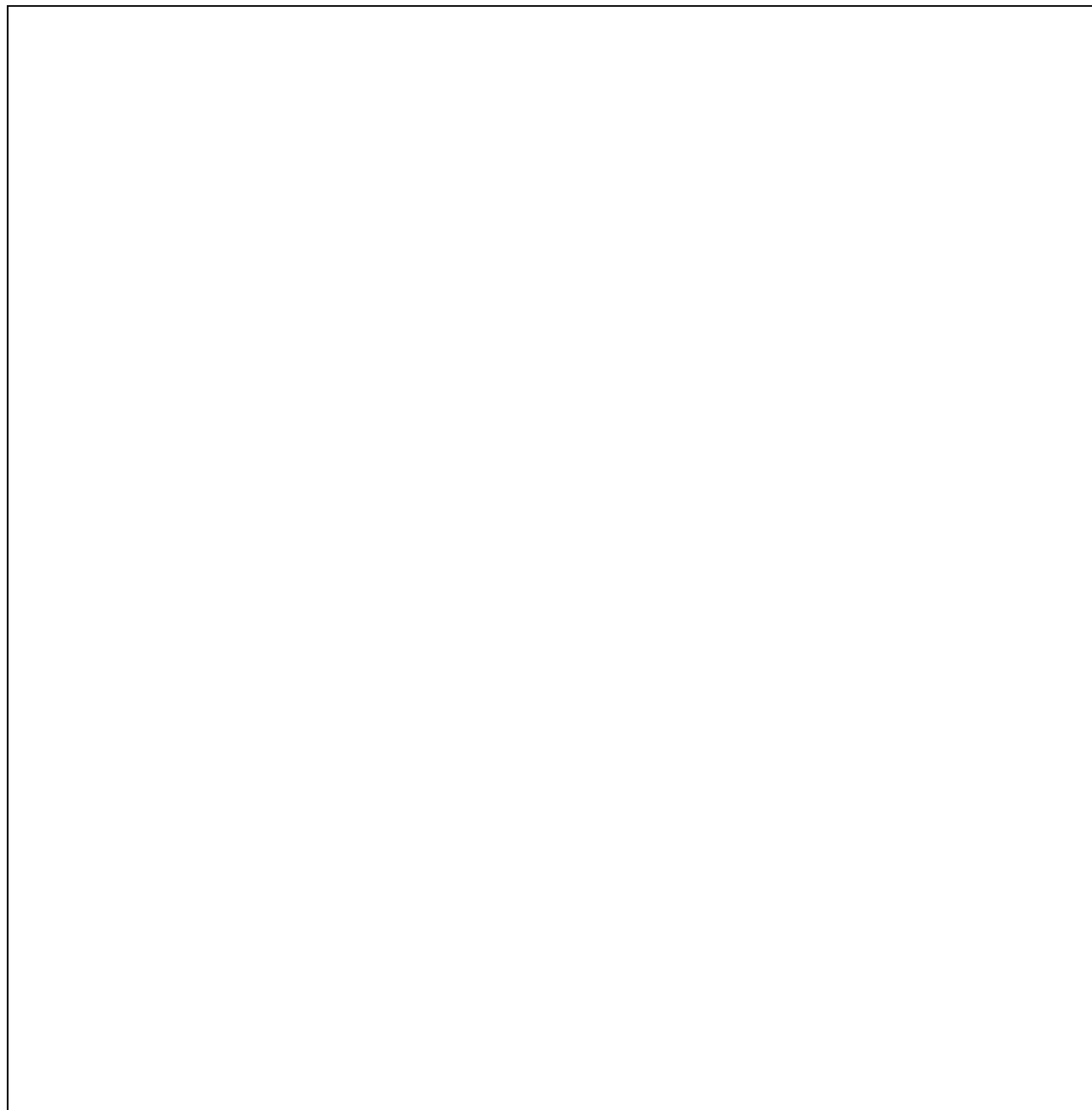
- d. Give an equation for the average cost of insurance AC as a function of Q . [Hint: AC has the same intercept but half the slope of MC .]

- 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 including complete sentences, accurate spelling, and correct reasoning.

Consider the following argument. “If the market price goes up, consumer surplus decreases and producer surplus increases. If the price goes down, consumer surplus increases and producer surplus decreases. But total social welfare remains the same. Therefore, the government can regulate the market price to improve equity without affecting total social welfare.” Do you agree or disagree? Explain your reasoning using supply-and-demand graphs. Label all axes and curves.





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]