

FINAL EXAMINATION VERSION B

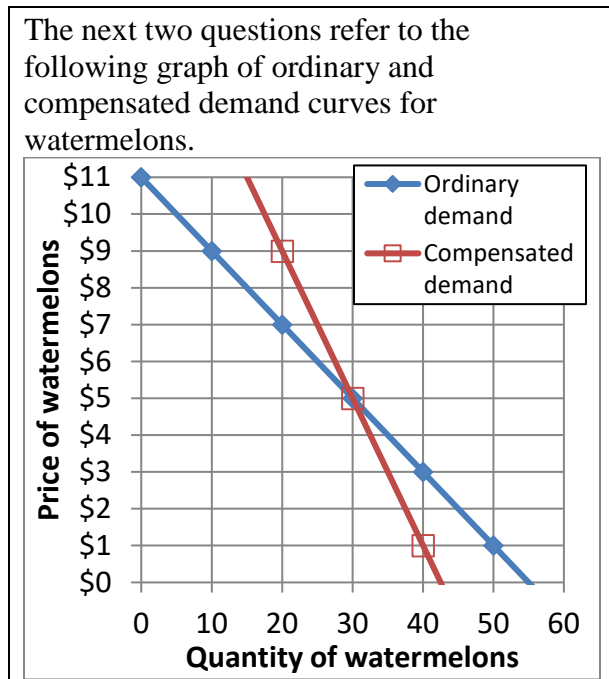
INSTRUCTIONS: This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets. Maximum total points are 200.

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

- (1) The assumption of *diminishing marginal rate of substitution* implies that indifference curves
- slope up.
 - slope down.
 - get flatter as they approach the horizontal axis.
 - get steeper as they approach the horizontal axis.
 - none of the above.

- (2) The decrease in income that would exactly compensate consumers for a fall in price from \$5 to \$1, leaving consumers just as well off as before the price change, would be
- \$4.
 - \$120.
 - \$140.
 - \$160.
 - none of the above.

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



- (3) If the price falls from \$5 to \$1, then consumer surplus increases by
- \$4.
 - \$120.
 - \$140.
 - \$160.
 - none of the above.

The next two questions refer to the following information. The elasticity of output with respect to labor for the US economy as a whole is about $2/3$. The elasticity of output with respect to capital is about $1/3$. Suppose labor input increases by 2% and capital input increases by 5%.

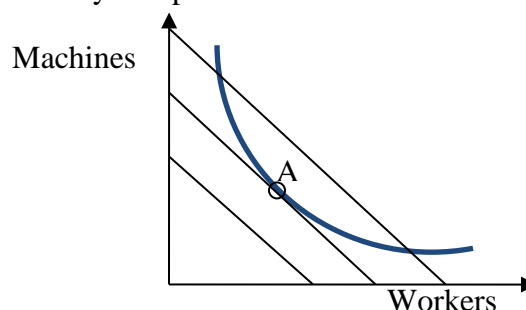
(4) Without any technical change, one would expect output to increase by

- a. 0%.
- b. 1%.
- c. 2%.
- d. 3%.
- e. 4%.
- f. 5%.
- g. 6%.
- h. 7%.

(5) If in fact output increases by 5%, then the Solow residual (that is, the increase in multifactor productivity) is

- a. 0%.
- b. 1%.
- c. 2%.
- d. 3%.
- e. 4%.
- f. 5%.
- g. 6%.
- h. 7%.

The next two questions refer to the following diagram of a firm's isocost lines and an isoquant. Suppose the firm is currently at input combination A.



(6) This firm could lower its total cost, without reducing output, by

- a. using fewer machines and more workers.
- b. using more machines and fewer workers.
- c. either (a) or (b).
- d. neither (a) nor (b).
- e. cannot be determined.

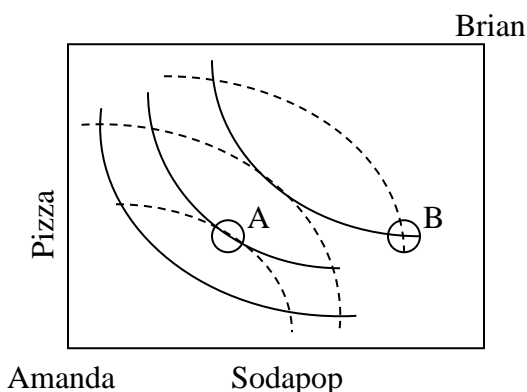
(7) Let MP_1 denote the marginal product of machines and MP_2 the marginal product of workers for this firm. Let w_1 denote the price of machines and w_2 denote the price of workers. At input combination A,

- a. $MP_2/MP_1 < w_2/w_1$.
- b. $MP_2/MP_1 > w_2/w_1$.
- c. $MP_2/MP_1 = w_2/w_1$.
- d. $MP_2 = MP_1$ and $w_2 = w_1$.
- e. cannot be determined from information given.

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

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

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.



(9) 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.

(10) 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.

(11) 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.

(12) Which market model predicts the largest quantity of total output?

- Price competition.
- Collusion to maximize joint profits.
- Cournot oligopoly.
- All models predict the same quantity of output, if all use the same assumptions about market demand and marginal cost.

(13) Unlike other taxes, a pollution tax (also called a Pigou tax)

- affects only producers.
- does not cause deadweight loss.
- causes deadweight loss.
- does not generate any revenue for the government.

(14) An efficient way to distribute pollution permits is

- to sell them at auction.
- to give all polluters the same number of permits.
- either of the above.
- to assign them by a lottery.

(15) A beach can be enjoyed simultaneously by many people. However, it can be fenced and gated so that people must pay an admission charge. Thus a beach is

- a. a rival good.
- b. an excludable good.
- c. both of the above.
- d. none of the above.

(16) In the western United States, water is scarce. Suppose no one can be prevented from taking water from a particular stream. Unfortunately, if any person takes water, there is less for others. Water from this stream is therefore

- a. a nonrival good.
- b. a nonexcludable good.
- c. both a nonrival good and a nonexcludable good.
- d. neither a nonrival good nor a nonexcludable good.

(17) Suppose Adam has utility function $U(I)$, where I denotes income, and Adam is risk-averse. Which is smaller for Adam?

- a. $U(100)$.
- b. $0.5 U(50) + 0.5 U(150)$.
- c. Answers (a) and (b) are equal if Adam is risk-averse.
- d. Cannot be determined from information given.

(18) A risk-averse person's utility function shows

- a. increasing marginal utility of wealth (or income).
- b. decreasing marginal utility of wealth (or income).
- c. constant marginal utility of wealth (or income).
- d. none of the above.

(19) People with serious health problems may be more likely to apply for long-term care insurance. This is an example of

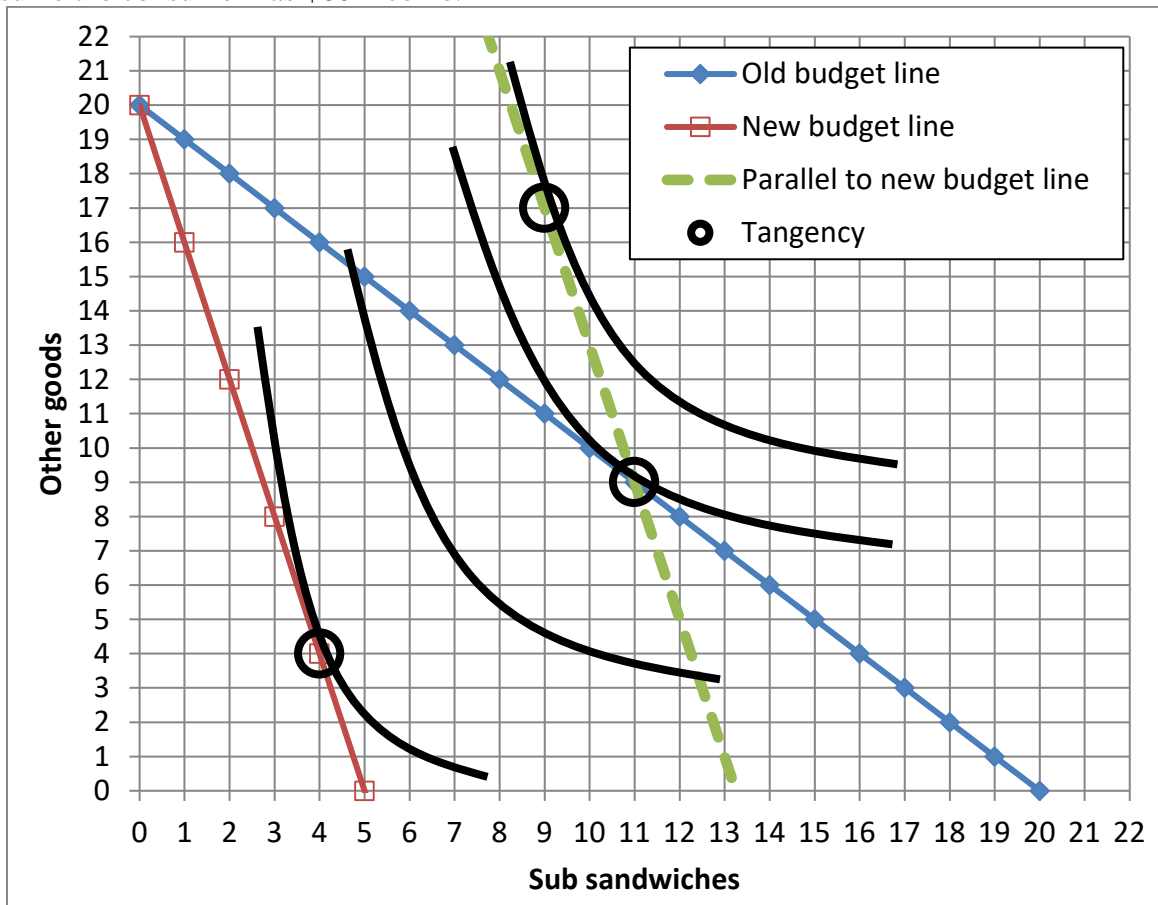
- a. moral hazard.
- b. exchange efficiency.
- c. market power.
- d. adverse selection.

(20) Sometimes people who have fire insurance for their house are less likely to install smoke detectors. This is an example of

- a. moral hazard.
- b. income and substitution effects.
- c. adverse selection.
- d. exchange efficiency.

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

(1) [Substitution and income effects: 12 pts] Consider the indifference-curve diagram below. Assume the consumer has \$60 income.



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

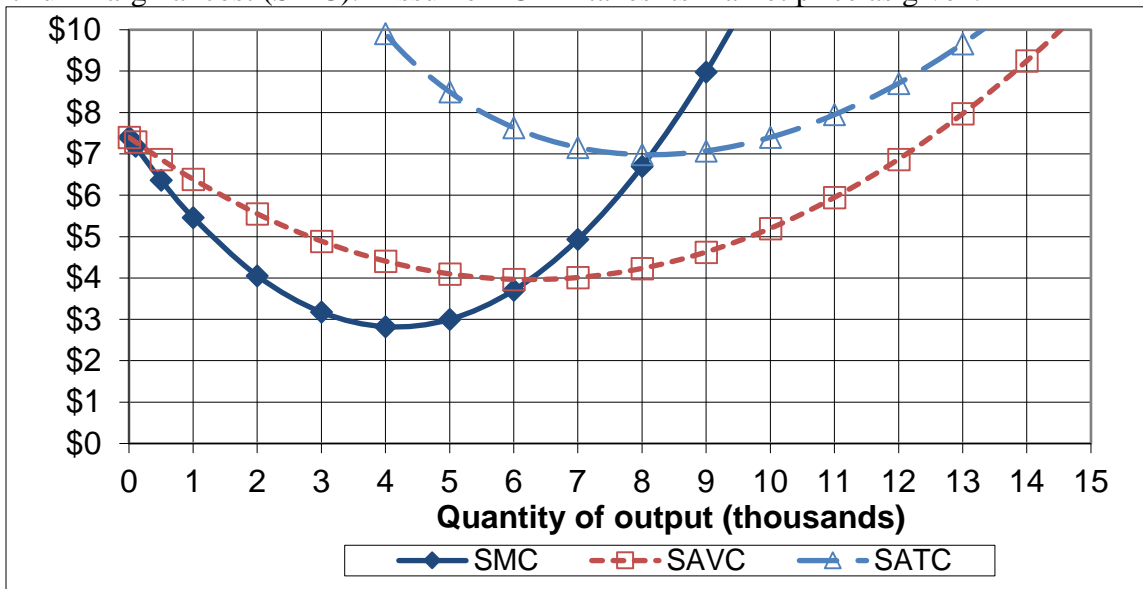
\$	
	sandwiches
\$	
	sandwiches
	sandwiches
	sandwiches

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

- Is the demand for milk *elastic* or *inelastic* ?
- Will the quantity demanded of milk *increase* or *decrease*?
- By about how much?
- Will consumers' total spending on milk *increase* or *decrease*?
- By about how much?

	%
	%

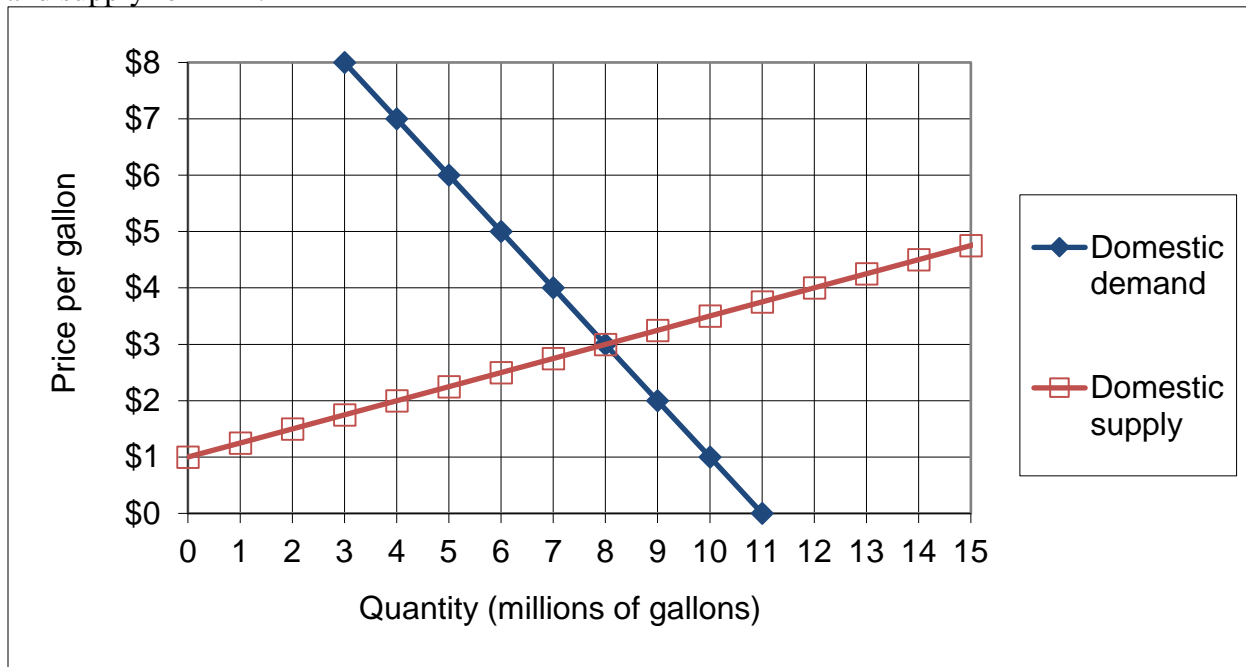
(3) [Short-run cost curves and supply: 10 pts] The following graph shows ACME Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume ACME takes its market price as given.



- If the market price is \$9, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$3, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$5, about how much output will ACME try to produce (to the nearest thousand)?
- What is ACME's *shutdown price*—that is, the lowest price at which ACME will continue to operate in the short run?
- What is ACME's *breakeven price*—that is, the lowest price at which ACME can produce output without making losses in the short run?

	thousand
	thousand
	thousand
\$	
\$	

(4) [Welfare effects of international trade: 16 pts] The following graph shows domestic demand and supply for milk.

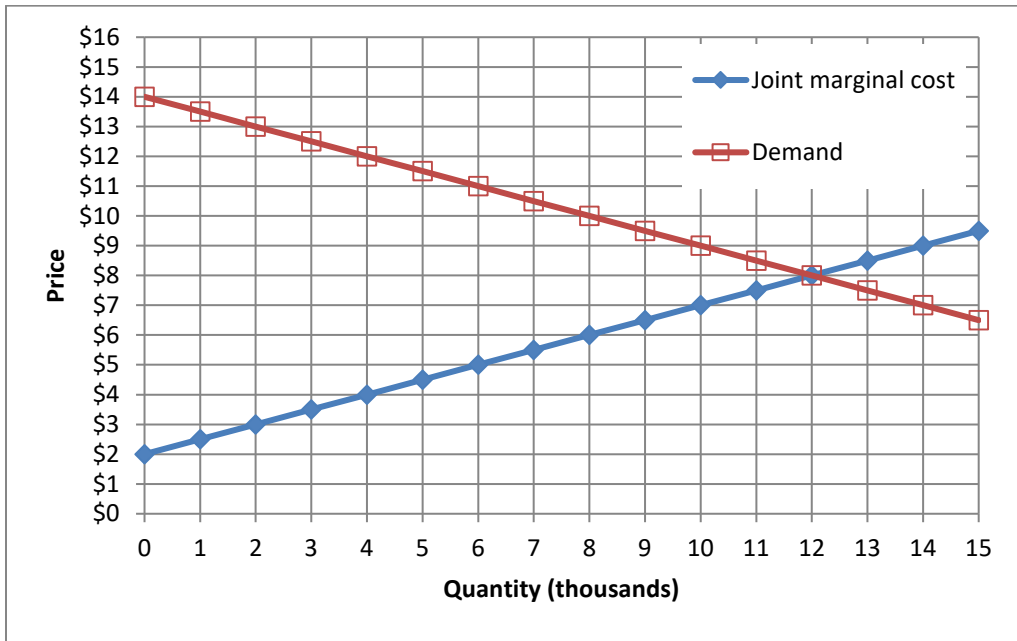


At first, international trade in milk is not permitted. Then this industry is opened to international trade and the international price of milk turns out to be \$ 2.

- Will this country now *export* or *import* milk?
- How many?
- Does consumer surplus in this country *increase* or *decrease* from international trade in milk?
- By how much?
- Does producer surplus in this country *increase* or *decrease* from international trade in milk?
- By how much?
- Does total social welfare in this country *increase* or *decrease* from international trade in milk?
- By how much?

	million gallons
\$	million
\$	million
\$	million

(5) [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 $P = 14 - (Q/2)$, where Q = quantity in thousands.

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

MR =

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

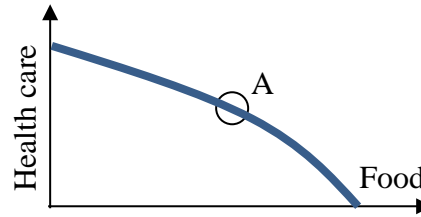
f. What price will the firms jointly set?

\$	
	thousand
\$	thousand

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

h. Compute the amount of deadweight loss.

(6) [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 food 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
	\$

(7) [Auctioning pollution permits: 10 pts] Suppose two factories are producing pollution (Q). The old factory has marginal benefit from pollution (reflecting increased profit) given by the equation $Q_{old} = 100 - 10 MB$. The new factory has marginal benefit from pollution given by the equation $Q_{new} = 50 - 5 MB$.

- If there is no penalty for pollution, how much pollution will the two factories produce, in total?

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Now suppose the government has determined that pollution must be reduced to $Q_{tot}=60$ units. It has created 60 permits to emit one unit of pollution and will sell them at auction.

- Compute the equilibrium auction price of a pollution permit. [Hint: the equilibrium price is the price where the total number of permits demanded by the two factories equals the number of available permits.]
- How many permits will the old factory buy?
- How many permits will the new factory buy?

	\$
	permits
	permits

Alternatively, instead of selling permits, suppose the government decides to impose an emission fee to reduce pollution. Its goal is still to reduce pollution to $Q_{tot}=60$ units.

- What emission fee per unit of pollution will induce the factories to produce only 60 units of pollution?

	\$
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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) [Budgets and choice: 14 pts] A consumer has the following utility function:

$U(q_1, q_2) = q_1^{1/2} + 2q_2^{1/2}$, where q_1 denotes the quantity of cupcakes and q_2 denotes the quantity of other goods. The price of cupcakes is \$3 and the price of other goods is \$2. The consumer has \$42 in income to spend on these items.

- a. [4 pts] Give an equation for the consumer's budget line. The variables q_1 and q_2 should be the only unknowns.

- b. [4 pts] Find a formula for the consumer's marginal rate of substitution in consumption of other goods for cupcakes—that is, the |slope| of the consumer's indifference curve with cupcakes 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.

- c. [6 pts] Solve for the quantities of cupcakes (q_1^*) and other goods (q_2^*) that this consumer will choose. Circle your final answers.

(2) [Production functions: 12 pts] Suppose a production function is given by $q = (x_1 + x_2)^2$.

- 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) [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 $P = 15 - (Q/100)$. Each firm has constant marginal and average cost equal to \$3. 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.



(4) [External benefit and Pigou subsidy: 10 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.

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 deadweight loss from unregulated competition.

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



(5) [Uncertainty, risk aversion, demand for insurance: 10 pts] Arne has \$40 in income but faces a 25% chance of losing \$32 and thus being reduced to only \$8 in income. Arne's utility function is given by $U(I) = 9 - (40/I)$, where I denotes income.

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

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

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

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

- e. Compute the so-called "fair insurance" premium for full insurance against Arne'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 $EL = 500 - 0.2 Q$. (Thus the last person's expected loss is about \$300.) Everyone is risk-averse, and willing to pay \$60 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.)

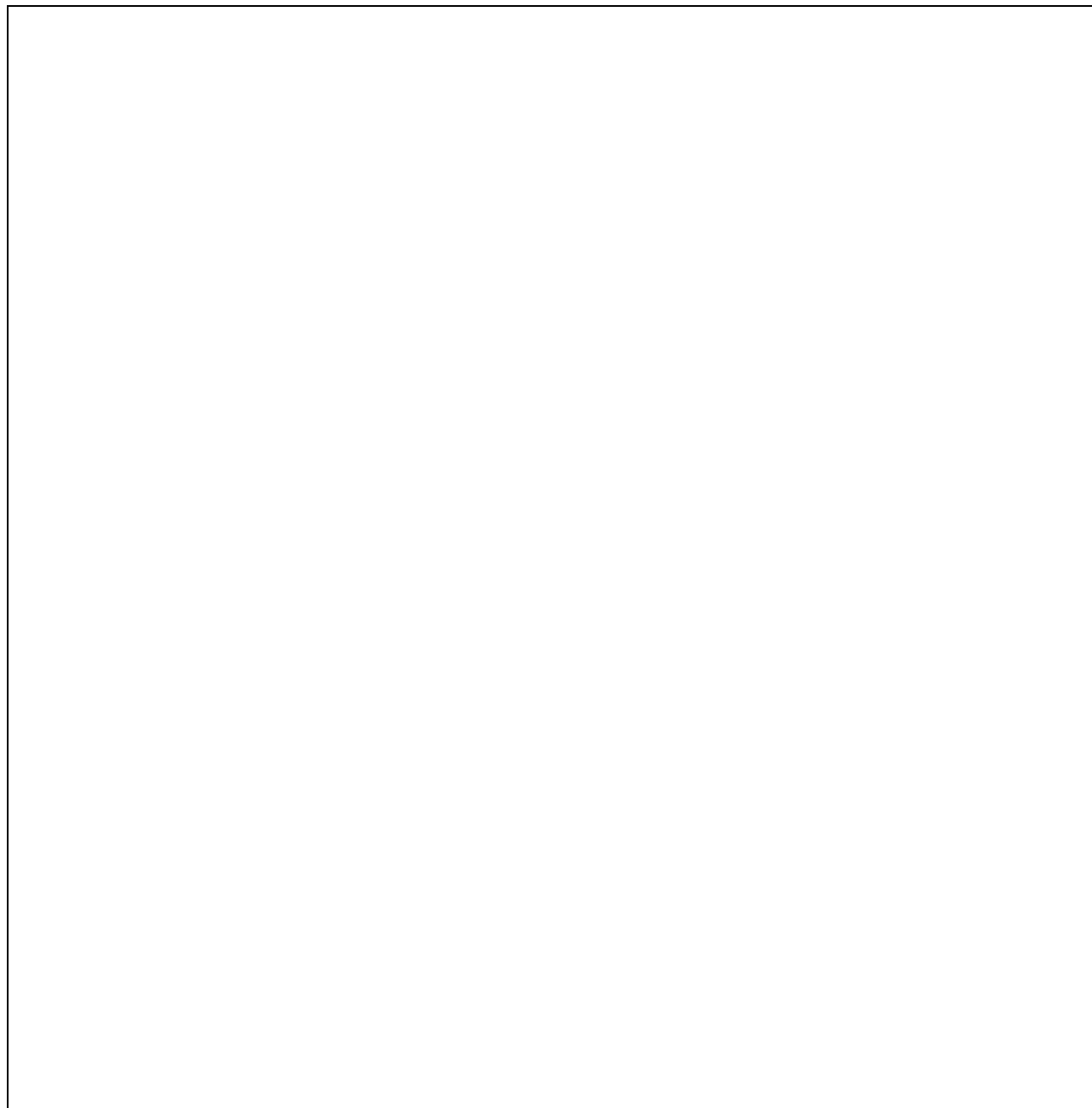
- c. If the market were efficient, how many people would get insurance? Why?

- 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.

Sometimes markets produce too much output and sometimes too little output. Give one example of each situation. For each example, use graphs and words to show (a) what the optimal output level should be in the market and why, (b) what output level actually occurs and why, and (c) how the social welfare loss from incorrect output can be computed.



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]