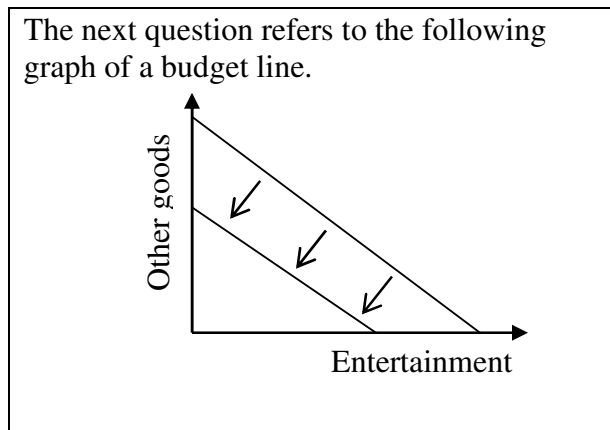


**FINAL EXAMINATION VERSION C**  
**December 15, 2011**

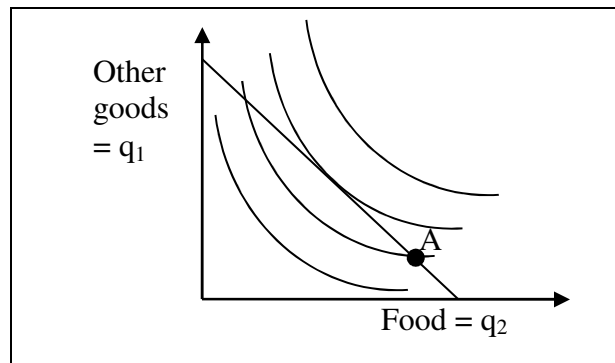
**INSTRUCTIONS:** This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets. Maximum total points are 200.

**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 above, the shift 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.

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.



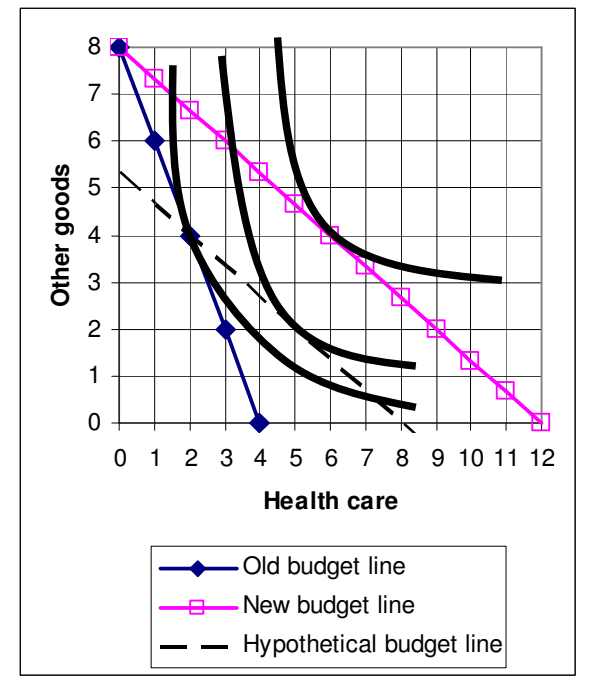
- (2) This consumer could enjoy higher utility, without increasing total spending, by
- purchasing less food and more other goods.
  - purchasing more food and fewer other goods.
  - purchasing less food and fewer other goods.
  - any of the above.
  - none of the above.

- (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,
- $MU_2 = MU_1$  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.

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

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

The next four questions refer to the graph below. Assume the consumer's income is \$60.



(5) The old price of health care was

- \$5.
- \$8.
- \$12.
- \$15.
- \$20.

(6) The new price of health care is

- \$5.
- \$8.
- \$12.
- \$15.
- \$20.

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

- one unit.
- two units.
- three units.
- four units.
- five units.

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

- one unit.
- two units.
- three units.
- four units.
- five units.

(9) The production function

$$q = 5 x_1^{3/4} x_2^{3/4}$$

shows

- constant returns to scale.
- decreasing returns to scale.
- increasing returns to scale.
- cannot be determined from the information given.

(10) Suppose a competitive firm is now producing 200 units of output per day. Its marginal cost is \$5, its average cost is \$12, and it can sell its output at a market price of \$10. This firm can increase its profit by

- increasing its output by one unit.
- decreasing its output by one unit.
- It cannot increase its profit by small changes in output.
- cannot be determined from information given.

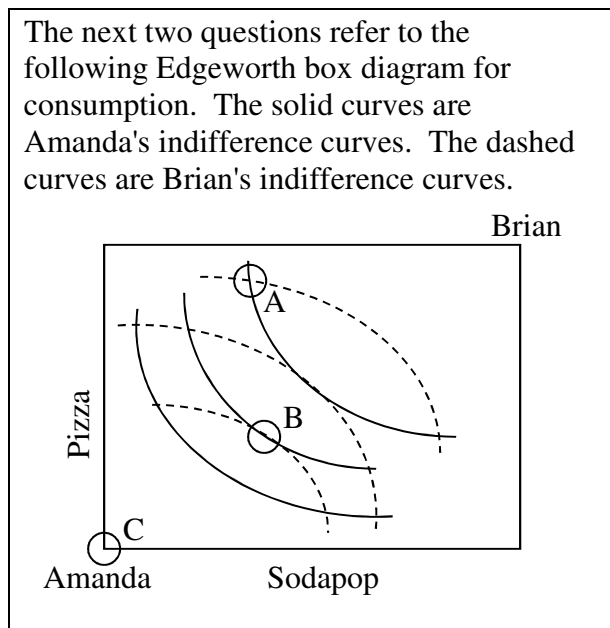
(11) In the short run, a firm should shut down if its revenue is less than its

- total cost.
- variable cost.
- producer surplus.
- fixed cost.

- (12) If price is greater than minimum average cost in a competitive industry,
- new firms will enter the industry.
  - existing firms will leave the industry.
  - firms will try to lower the price.
  - firms will try to raise the price.

- (13) A *Pareto improvement* is defined as a change in the economy where
- at least one person gains and no one loses.
  - the gains to the winners exceed the losses to the losers.
  - everyone gains.
  - at least one person gains.

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.



- (14) From allocation A, *both* consumers can enjoy greater utility if
- Amanda gives Brian some pizza and some sodapop.
  - Brian gives Amanda some pizza and some sodapop.
  - Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
  - Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
  - No trade will allow both consumers to enjoy greater utility.

- (15) From allocation B, *both* consumers can enjoy greater utility if
- Amanda gives Brian some pizza and some sodapop.
  - Brian gives Amanda some pizza and some sodapop.
  - Amanda gives Brian some pizza, and Brian gives Amanda some sodapop.
  - Amanda gives Brian some sodapop, and Brian gives Amanda some pizza.
  - No trade will allow both consumers to enjoy greater utility.

- (16) Which market structure leads to the smallest price-cost margin,  $(P-MC)/P$  ?
- Cournot oligopoly with three firms.
  - Price competition.
  - Monopoly.
  - Cournot duopoly.

- (17) Suppose consumers do not view breakfast cereal brands as perfect substitutes. For example, some consumers prefer Cheerios while others prefer Kellogg's Corn Flakes. Then breakfast cereals are said to be
- differentiated products.
  - normal products.
  - efficient products.
  - elastic products.
  - complementary products.

The next question refers to the following game. Firm A is the dominant firm in the industry. Firm B is a potential entrant into the industry. (Negative payoffs indicate losses.)

		Firm B	
		Enter market	Stay out of market
Firm A	Set high price	A gets \$25 million. B gets \$5 million.	A gets \$50 million. B gets \$0 million.
	Set low price	A gets \$3 million. B gets -\$1 million.	A gets \$20 million. B gets \$0 million.

(18) What is the Nash equilibrium of this game?

- Firm A sets high price, Firm B enters market.
- Firm A sets low price, Firm B enters market.
- Firm A sets high price, Firm B stays out of market.
- Firm A sets low price, Firm B stays out of market.
- There is no Nash equilibrium in this game.

(19) Which utility function shows risk aversion?

- $U(W) = 2 + 5W^2$ .
- $U(W) = 2 \ln(5W)$ .
- $U(W) = 2 + 5^W$ .
- $U(W) = 2 + 5W$ .

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

- adverse selection.
- moral hazard.
- exchange efficiency.
- market power.
- risk aversion.

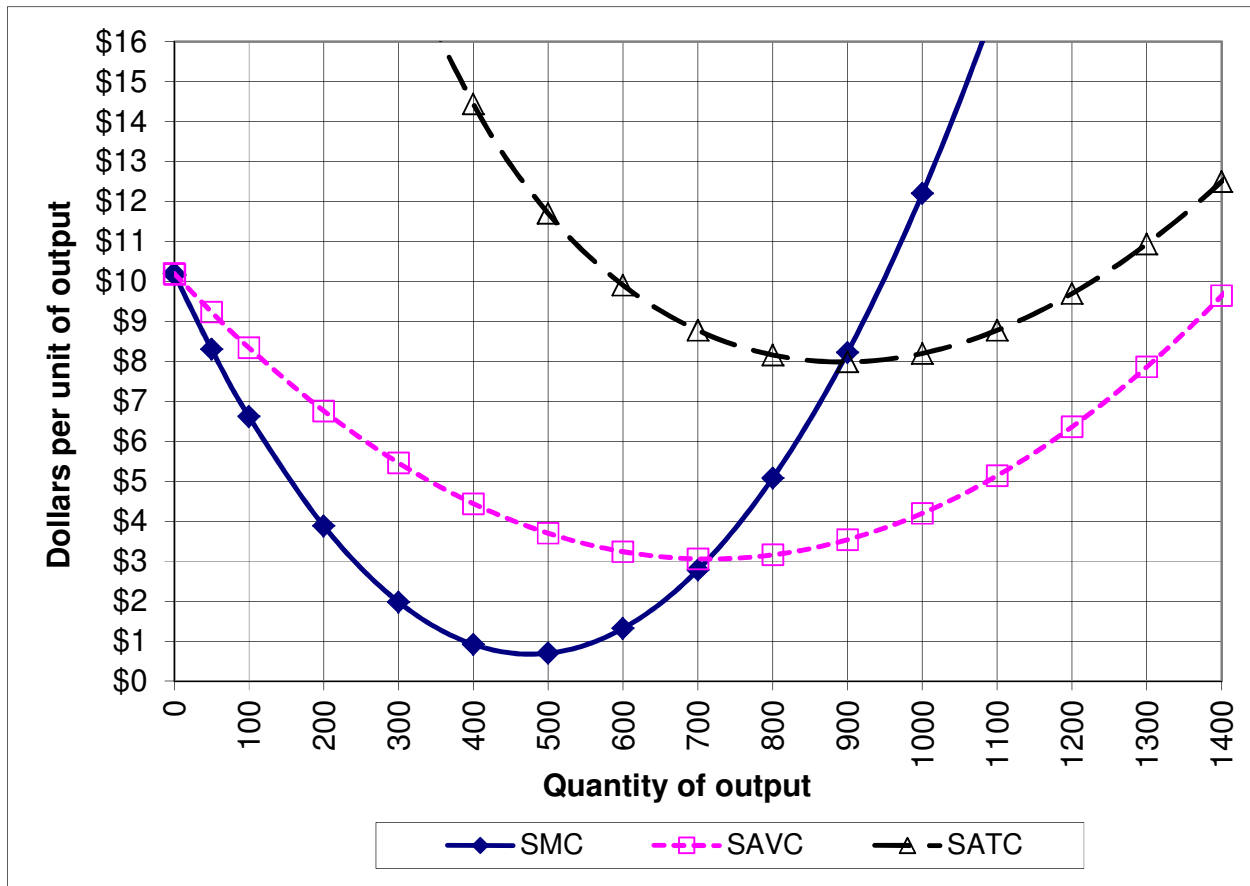
**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins and graphs for scratch work. Work carefully—partial credit is not normally given for questions in this section.

(1) [Price elasticity of demand: 10 pts] Suppose the price elasticity of demand for Kindles is  $-1.4$ , and the price of Kindles falls by 5 %.

- Is the demand for Kindles *elastic* or *inelastic*?
- Will the quantity of Kindles purchased *increase* or *decrease*?
- By about how much?
- Will the revenue received by the Kindle seller (Amazon) *increase* or *decrease*?
- By about how much?

%
%

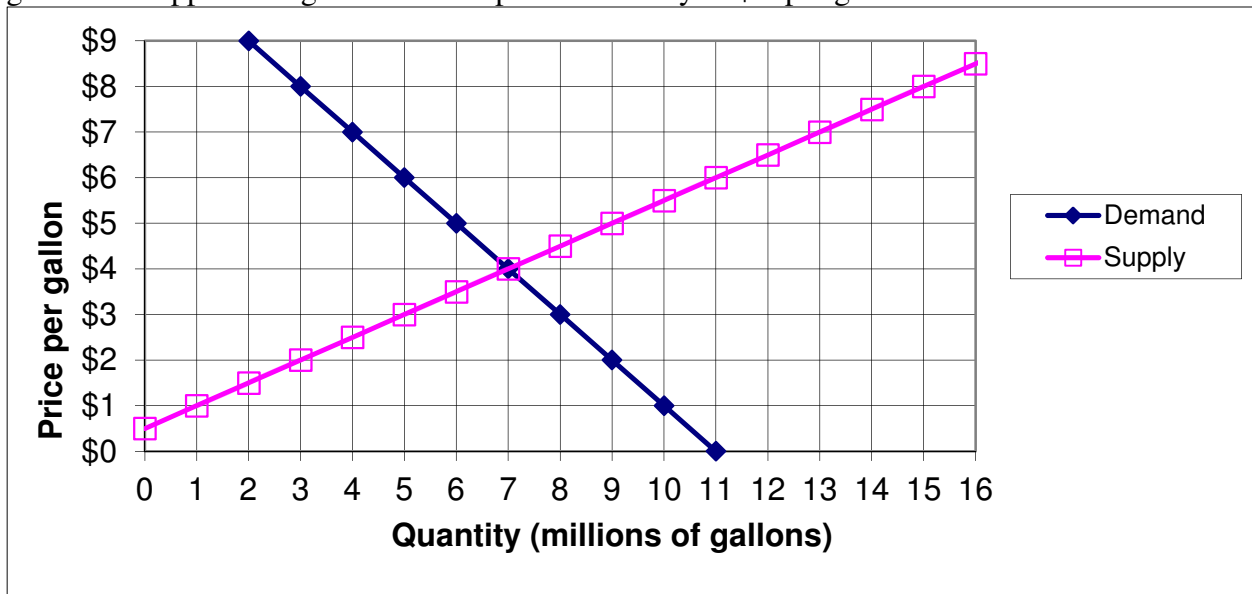
(2) [Short-run cost curves and supply: 10 pts] The following graph shows Acme Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume Acme takes its market price as given.



- If the market price is \$1, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$12, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$5, about how much output will Acme try to produce? Give an answer to the nearest 100.
- What is Acme's *breakeven price*—that is, the lowest price at which Acme will avoid losses in the short run? Give an answer to the nearest dollar.
- What is Acme's *shutdown price*—that is, the lowest price at which Acme will continue to operate in the short run? Give an answer to the nearest dollar.

	units
	units
	units
\$	
\$	

(3) [Welfare analysis of tax or subsidy: 18 pts] The graph below shows demand and supply for gasoline. Suppose the government imposes a subsidy of \$ 3 per gallon.



- Give the new equilibrium quantity as a result of the subsidy.
- Give the new net price paid by buyers, excluding the subsidy.
- Give the new total price received by sellers, including the subsidy.
- As a result of the subsidy, will consumer surplus *increase* or *decrease*?
- By how much?
- As a result of the subsidy, will producer surplus *increase* or *decrease*?
- By how much?
- Compute the direct cost of the subsidy to the government. That is, compute the amount of money that the government will have to pay to market participants.
- Compute the social deadweight loss from the subsidy.

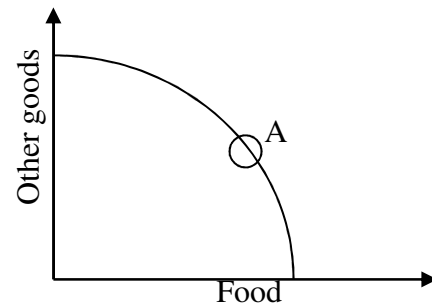
	million gallons
\$	
\$	
\$	million
\$	million
\$	million
\$	million

(4) [Cost minimization across firms: 6 pts] Suppose Firm A and Firm B must together produce a total of 50 units of output at *minimum total cost*. Firm A's total cost function is given by  $TC_A = 2q_A + (q_A^2/8)$ , where  $q_A$  denotes Firm A's output level. Firm B's total cost function is given by  $TC_B = 7q_B + (q_B^2/4)$ , where  $q_B$  denotes Firm B's output level.

- What output level  $q_A$  should be produced by Firm A?
- What output level  $q_B$  should be produced by Firm B?
- Suppose Firm A and Firm B are competitive firms, taking price as given. What market price would motivate Firm A and Firm B to produce these output levels?

	units
	units
	\$

(5) [General equilibrium: 10 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  $-2$ .



- Suppose this country wants to produce 24 more units of other goods. To do so, must the country *increase* or *decrease* production of food?
- By how much?
- What is this country's opportunity cost of a single unit of *food*?
- Consider the consumer's budget line with food on the horizontal axis and other goods on the vertical axis. What must be the slope of every consumer's budget line in this economy?
- If the price of other goods is \$5 per unit, then what must be the price of food?

units of food
units of other goods
\$

(6) [Lerner index of market power: 6 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 automobiles has a price elasticity of demand of -5.

- a. Compute the Lerner index if the market for automobiles is a monopoly.
- b. Compute the Lerner index if the market for automobiles is a symmetric Cournot oligopoly of two firms.
- c. Compute the Lerner index if the market for automobiles is a symmetric Cournot oligopoly of one hundred firms.


(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  $Q_{new} = 50 - 5 MB$ .

- a. 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  $Q_{tot} = 30$  units. It has created 30 permits to emit one unit of pollution and will sell them at auction.

- b. 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.]
- c. How many permits will the old factory buy?
- d. How many permits will the new factory buy?

\$
permits
permits

(8) [Public goods: 4 pts] Suppose 1000 people live near a proposed bike trail. The trail will cost \$20,000 per mile to build. Let  $Q$  denote the length of the bike trail in miles. A typical individual person's marginal benefit from this bike trail is given by the following expression (or formula):  $MB = 60 - 5 Q$ .

- a. Give an expression (or formula) for the marginal social benefit from the bike trail. [Hint: This must be a formula containing one variable:  $Q$ .]
- b. Compute  $Q^*$  the socially-optimal length of the bike trail.

MSB =
miles



**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: 12 pts] A consumer has the following utility function:  
 $U(q_1, q_2) = q_1^3 q_2^2$ , where  $q_1$  denotes the quantity of energy and  $q_2$  denotes the quantity of other goods. The price of energy is \$6 and the price of other goods is \$2. The consumer has \$150 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 of other goods for energy—that is, the slope of the consumer's indifference curve with energy 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. [4 pts] Solve for the quantities of energy ( $q_1^*$ ) and other goods ( $q_2^*$ ) that this consumer will choose. Circle your final answers.

(2) [Individual demand and elasticity: 6 pts] Consider the following alleged individual demand function:

$$q_1^* = 3 p_1^{-0.9} p_2^{-0.2} I^{1.1} .$$

- a. [3 pts] Find the own-price elasticity of demand for this function. Justify your answer either from the definition of elasticity, or from a rule of thumb. Circle your final answer.

- b. [3 pts] Determine if the function is homogeneous of degree zero in income and prices. Show your work. Then answer “yes” or “no.”

(3) [Welfare analysis of international trade: 20 pts] Suppose domestic demand and supply for a good are given by the following equations.

Demand:  $Q_D = 150 - 10 P$

Supply:  $Q_S = 20 P - 30$ .

First consider the domestic market without international trade.

a. Compute the equilibrium quantity.

units
\$

b. Compute the equilibrium price.

Now suppose the market is opened to international trade, and the world price of the good turns out to be \$ 8 . (Use the graph below for scratch work.)

c. Will the country now *import* or *export* the good?

d. How much?

e. Will consumer surplus *increase* or *decrease* as a result of international trade?

f. By how much?

g. Will producer surplus *increase* or *decrease* as a result of international trade?

h. By how much?

i. Will total social welfare in the country *increase* or *decrease* as a result of international trade?

j. By how much?

units
\$
\$
\$



(4) [Monopoly, price discrimination: 16 pts] Suppose a monopolist faces the following demand curve:  $P = 20 - (Q/20)$ . Further suppose that the monopolist's marginal cost and average cost are constant and equal to \$2. Assume initially that the monopolist must charge the same price for all units sold—that is, price discrimination is *impossible*. Circle your final answers. Use the space at the bottom of the next page for scratch work.

- a. Find the monopolist's marginal revenue function  $MR(Q)$ .

- b. Compute the monopolist's profit-maximizing quantity of output.

- c. Compute the monopolist's profit-maximizing price.

- d. Compute monopoly profit at this price.

- e. Compute social deadweight loss at this price.

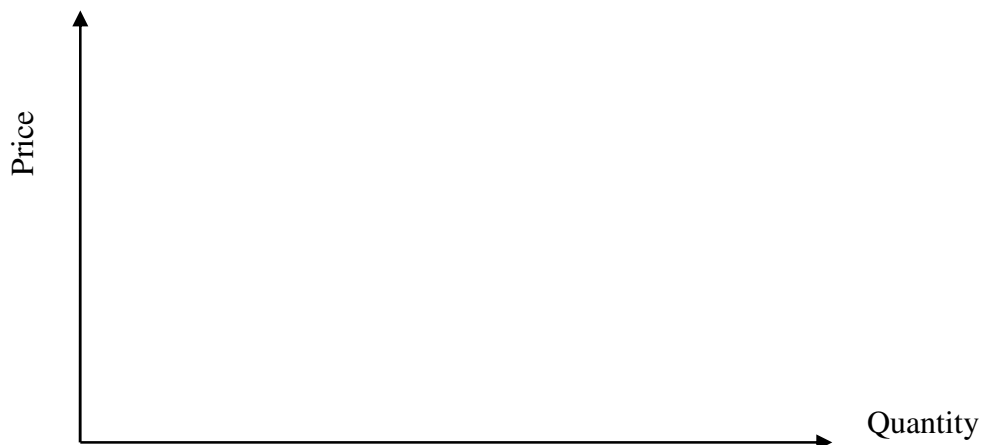
Note: question continues on next page.

Alternatively, assume that *perfect price discrimination* is possible. Each unit of output may be sold at a different price, equal to the maximum amount the buyer is willing to pay for that unit.

- f. Compute the monopolist's profit-maximizing quantity of output with perfect price discrimination.

- g. Compute monopoly profit with perfect price discrimination.

- h. Compute social deadweight loss with perfect price discrimination.



(5) [External cost and Pigou tax: 8 pts] Suppose supply and demand for a particular chemical are given by the following equations. Use the space at the bottom of this page for scratch work.

Demand:  $P_D = 15 - (Q/100)$

Supply:  $P_S = 1 + (Q/100)$ .

- 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  $MEC = 2 + Q/100$ .

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

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

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



(6) [Congestion pricing: 9 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:

$$ATS(Q) = 60 - (Q/100) .$$

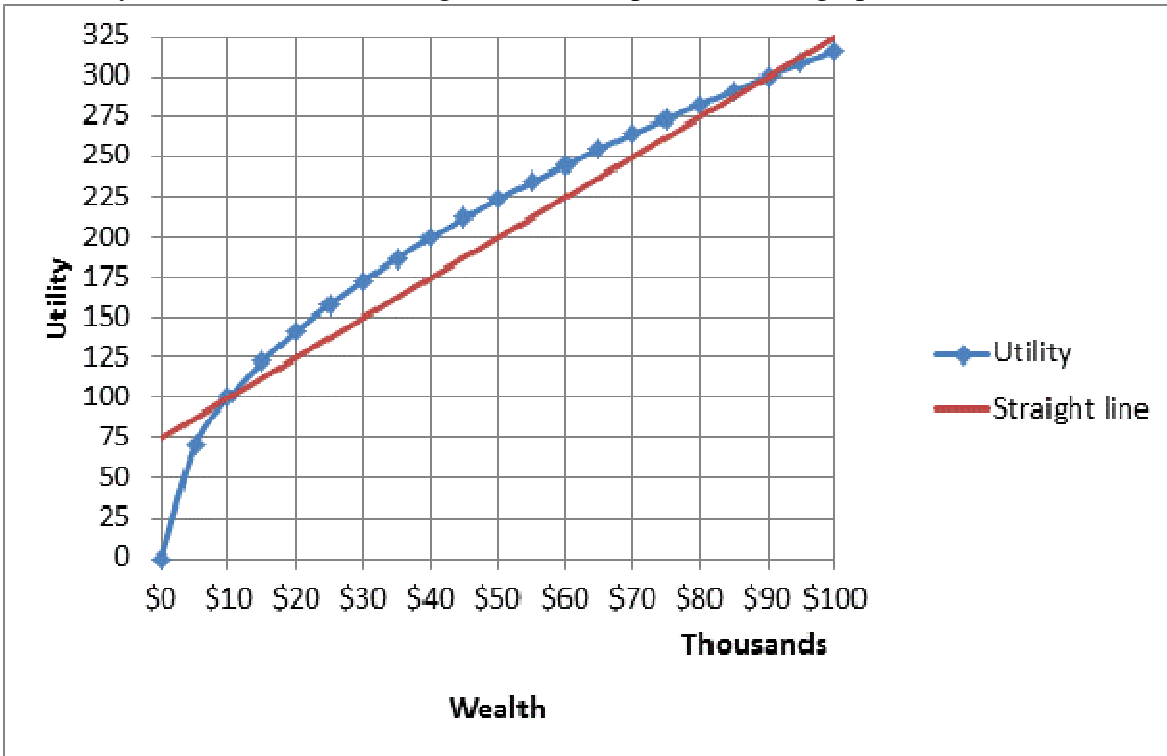
- a. Assume that cars enter the freeway until the average time saved drops to zero. How many cars (Q) will use the freeway?

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

- c. 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 **\$0.10** 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?

(7) [Uncertainty, risk aversion, demand for insurance: 10 pts] Person X now has a wealth equal to \$90 thousand dollars, but faces a 50% chance of losing \$80 thousand and thus being reduced to only \$10 thousand in wealth. The graph below shows Person X's utility function of wealth  $U(W)$ . For your convenience, a straight line is also plotted on the graph.



a. Compute Person X's expected wealth (in dollars).

b. Use the graph to find Person X's expected utility (in utils).

c. Use the graph to find the level of risk-free wealth that would be just as desirable as Person X's current risky situation (in dollars).

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

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

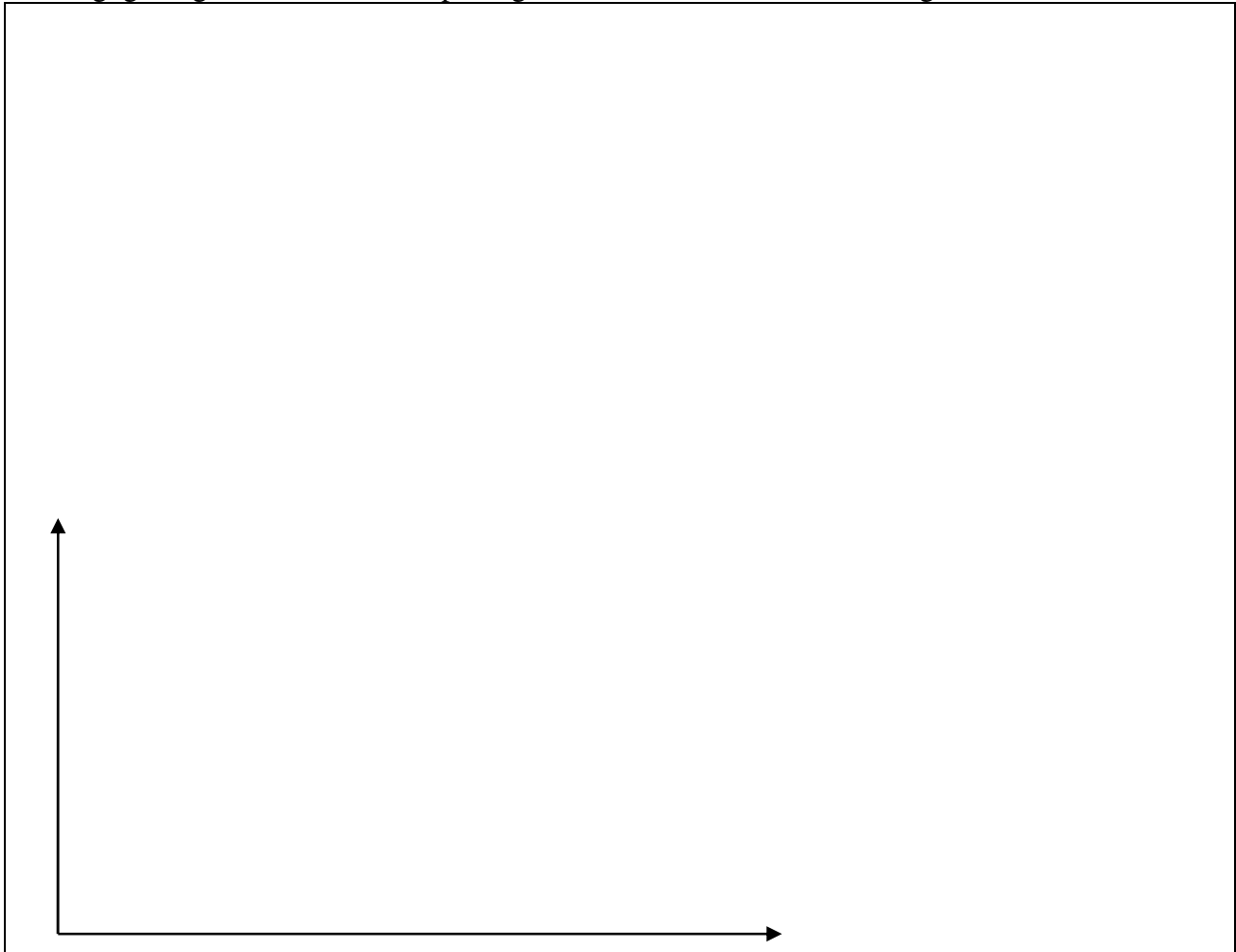


**IV. CRITICAL THINKING:** Answer just *one* of the questions below (your choice). [5 pts]

(1) Suppose a tax is placed on a market, but all tax revenue is returned to the people. To fix ideas, suppose tax revenue equal to \$1 billion is collected. Then the government sends each person a check for  $(\$1 \text{ billion} / N)$ , where  $N$  is the population of the country. Ignore any administrative costs of collecting the tax and sending the checks. Is the country *better off*, *worse off*, or *just as well off* as if the tax and rebate did not exist? Use the concepts of consumer and producer surplus to formulate your answer. Illustrate your answer with a supply-and-demand graph.

(2) Consider the following statement. "Non-profit arts organizations—like museums, symphonies, operas, and ballets—give discount tickets to students and senior citizens because their focus is on the public good, not their bottom line." Do you agree or disagree? Explain why.

Circle the question you are answering and write your answer below. Full credit requires legible writing, good grammar, accurate spelling, and correct economic reasoning.



[end of exam]