# FINAL EXAMINATION VERSION B

INSTRUCTIONS: This exam is closed-book, closed-notes. Simple calculators are permitted, but graphing calculators or calculators with alphabetical keyboards are NOT permitted. Mobile phones and other electronic devices are NOT permitted. Numerical answers, if rounded, must be correct to at least 3 significant digits. Point values for each question are noted in brackets. Maximum total points are 200.

I. Multiple choice: Please circle the one best answer to each question. [1 pt each, 18 pts total]

(1) The graph below shows Caleb's marginal cost (MC) and marginal benefit (MB) from exercise. If Caleb is rational, he will choose to exercise
a.   20 minutes.
b.   40 minutes.
c.   60 minutes.
d.   80 minutes.
e.   100 minutes
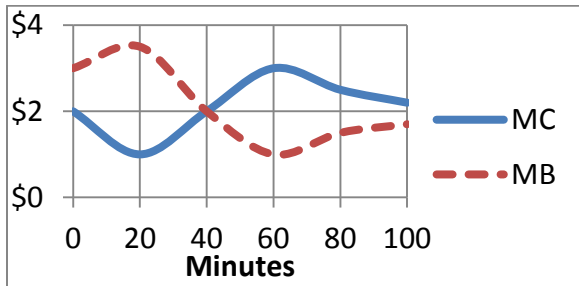
(2) Is the production function below characterized by diminishing returns to labor input?
a.   Yes, for all levels of labor input.
b.   No, not for any levels of labor input.
c.   Yes, but only after 6 hours of labor input.
d.   Yes, but only before 6 hours of labor input.
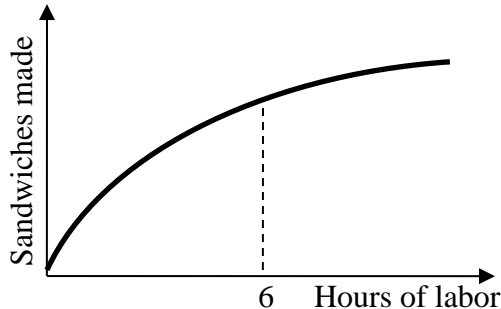
(3) A rise in people's incomes will shift the demand for Ramen noodles to the left, if Ramen noodles are
a.   a complementary good.
b.   a substitute good.
c.   a normal good.
d.   an inferior good.

(4) A fall in the in the price of chips will shift the demand for salsa to the right, assuming chips and salsa are
a.   complementary goods.
b.   substitute goods.
c.   normal goods.
d.   inferior goods.

(5) Which demand curve below is *less* elastic?
a.   Demand curve A.
b.   Demand curve B.
c.   Both have the same elasticity because they pass through the same point.
d.   Cannot be determined from information given.
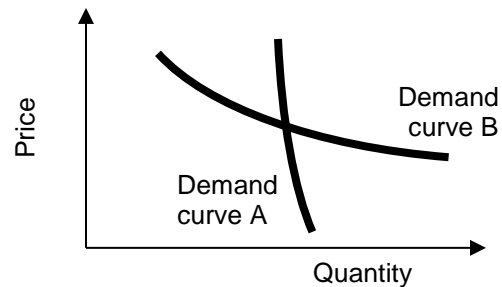
(6) Suppose the price of pumpkins in Des Moines is $5 and the cost of shipping pumpkins between Des Moines and Kansas City is $1.50 per pumpkin. Markets are *in equilibrium* if the price of pumpkins in Kansas City is
a. $1.50 per pumpkin.
b. $3 per pumpkin.
c. $4 per pumpkin.
d. $7 per pumpkin.
e. All of the above.

(7) A quota on *buyers* of tropical fish would have basically the same effect on the market for tropical fish as
a. a subsidy for tropical fish.
b. a free market for tropical fish.
c. a price ceiling on tropical fish.
d. a price floor on tropical fish.
e. a tax on tropical fish.

(8) Suppose the price elasticity of demand for baby food is -0.2 and the price elasticity of supply is 5.0. If a subsidy is given for baby food,
a. Producers will enjoy most of the subsidy.
b. Consumers will enjoy most of the subsidy.
c. Producers and consumers will each enjoy half of the subsidy.
d. Answer depends on which side receives the check from the government.

(9) A change in the amount of red meat that each consumer buys is called a change at the
a. marginal revenue.
b. extensive margin.
c. intensive margin.
d. marginal product.

(10) A small firm in a big market maximizes profit by
a. adjusting output so that price equals marginal cost.
b. moving its cost curves so that price equals marginal cost at its desired output level.
c. adjusting price so that price equals marginal cost.
d. all of the above.

(11) Firms are now entering the smart watch industry because in so doing they hope to
a. lower the profits of existing smart watch producers.
b. enjoy economic profits.
c. increase the total quantity produced in the market.
d. lower the market price.
e. All of the above.

(12) A perfectly competitive firm expects that if it increases its output, this will cause the price to
a. stay the same.
b. increase.
c. decrease.
d. cannot be determined from information given.

(13) Suppose that the bread industry is producing 10 million loaves of bread per month for some reason, and that at this level of output, the marginal benefit to consumers of a loaf of bread is $3, but the marginal cost of producing a loaf of bread is $3. Society would be better off if
a. fewer loaves of bread were produced.
b. more loaves of bread were produced.
c. None of the above.
d. Cannot be determined from information given.

(14) Marginal-cost pricing occurs in markets characterized by
a. perfect competition.
b. monopoly.
c. monopolistic competition.
d. both (a) and (c).

(15) A large grocery store attracts many customers who also stop to shop at *other* nearby smaller stores. Those nearby stores become more profitable as a result. A large grocery store therefore creates
a. an external benefit.
b. an external cost.
c. a differentiated product.
d. a superior good.

(16) Suppose a large city park is spacious and never crowded, so one person using the park does not interfere with others using it. Moreover, the city has no way to charge admission to the park. Therefore the park is
a. a rival good.
b. an excludable good.
c. both of the above.
d. none of the above.

(17) Satellite radio broadcasts (like Sirius XM) can be enjoyed by many people without interfering with each other. But unlike over-the-air broadcasters, the satellite broadcaster encrypts the signal, so no one can listen without paying. Satellite radio broadcasts are therefore
a. a rival good.
b. an excludable good.
c. both of the above.
d. none of the above.

(18) 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 rival good.
b. an excludable good.
c. both of the above.
d. none of the above.

II. Problems: Insert your answer to each question in the box provided. Use margins and graphs for scratch work. Only the answers in the boxes will be graded. Work carefully—partial credit is not normally given for questions in this section.

(1) [Production functions: 8 pts] A crew of technicians repairs and refurbishes computers. Complete the table by computing the crew's average product and marginal product, placing your answers in the unshaded cells of the third and fourth columns below. Then answer the question at the bottom.

Number of technicians	Number of computers serviced	Average Product	Marginal Product
0 technicians	0 computers		
			computers per technician
2 technicians	20 computers	computers per technician	
			computers per technician
4 technicians	32 computers	computers per technician	
			computers per technician
6 technicians	36 computers	computers per technician	

[2 pts] Is the crew's production function characterized by *diminishing returns* to their labor input? Answer "YES" or "NO."

(2) [Calculating elasticities: 2 pts] Suppose that if the price of admission to an amusement park is $12, attendance is 13 thousand per day. If the price is $18, attendance is 7 thousand per day. Compute the price elasticity of demand for the amusement park using the "arc-elasticity" formula.

(3) [Comparative advantage, gains from trade: 17 pts] Country A and Country B can each produce wheat and petroleum. They each face a tradeoff between these two products because of limited workforces. Their production possibility curves are shown below.
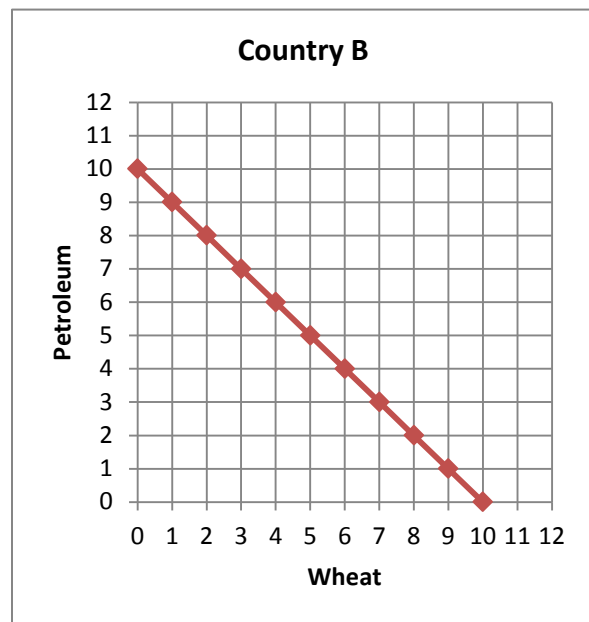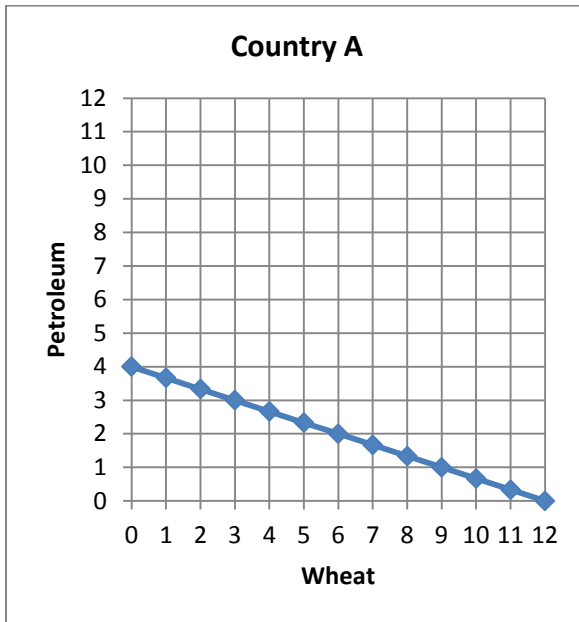
Country A

Country B

a. What is Country A's opportunity cost of producing a unit of wheat? — units of petroleum

b. What is Country B's opportunity cost of producing a unit of wheat? — units of petroleum

c. What is Country A's opportunity cost of producing a unit of petroleum? — units of wheat

d. What is Country B's opportunity cost of producing a unit of petroleum? — units of wheat

e. Which country has a comparative advantage in producing wheat?

f. Which country has a comparative advantage in producing petroleum?

g. [3 pts] Fill in the blanks: *Both* countries can consume combinations of products *outside* their individual

   production possibility curves if _____ exports *three* units of wheat to

   _____, which exports _____ units of petroleum in return.

h. **Plot** the trade that you propose in part (g) on the graphs above. For each country, plot the starting point representing **production before trade**, and the ending point representing **consumption after trade**.

(4) [Market equilibrium: 12 pts] Suppose seven buyers and seven sellers engage in a market similar to the exercise we did in class. Each buyer may buy at most one unit and each seller may sell at most one unit, but no one is forced to trade. Assume that buyers and sellers are each trying to maximize their personal surplus (or "gains from trade"). Surplus for each buyer equals the buyer's value of the good minus the price paid. Surplus for each seller equals the price received minus the seller's cost of the good. Surplus of persons who do not trade are zero. Buyers' values and sellers' costs are given in the following table.

Buyer	Value	Seller	Cost
Bob	$12	Sue	$ 1
Barb	$11	Steve	$ 1
Ben	$10	Sam	$ 1
Bailey	$ 9	Sven	$ 1
Brian	$ 8	Sarina	$ 1
Brittany	$ 6	Sam	$10
Brandon	$ 4	Sophia	$12
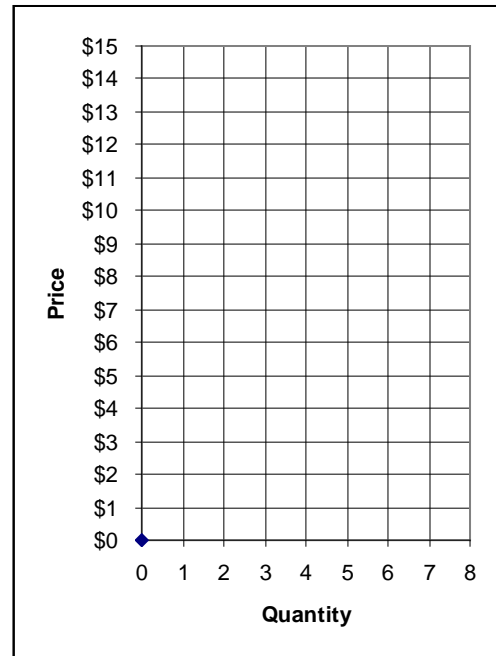
Suppose with some experience, the market settles on a single price. All trades are made at that price. (You can use the graph at right for scratch work.)

a. If the price were $3, would there by *excess demand, excess supply*, or *neither*?

Now consider the market equilibrium.

b. What is the equilibrium price? Give an answer to the nearest whole dollar.

$

c. How many units of the good will be sold in this market?

units

d. Compute the total revenue received by sellers (which equals the total spending by buyers).

$

e. Compute the combined total surplus (or gains from trade) of all buyers and sellers. (Check your answer carefully! No partial credit for being "close"!)

$

f. Who enjoys higher surplus in this particular market, the *buyers* or the *sellers?* Or is buyers' total surplus *equal* to sellers' total surplus?

(5) [Using income elasticities: 10 pts] Suppose the income elasticity of demand for health care is 0.4. Now suppose consumer income *rises* by 5%. Assume the price of health care does not change.

a. According to the information above, is health care a *necessary good*, an *inferior good*, or a *luxury (or superior) good*?

b. As income rises, will the quantity of health care demanded *increase*, *decrease*, or remain *constant*?

c. ... by about how much?

%

d. Will consumer spending on health care, as a fraction of a consumer's total budget, *increase*, *decrease*, or remain *constant*?

e. ... by about how much?

%

(6) [Welfare analysis of tax or subsidy: 18 pts] The graph below shows the market for bottled water.
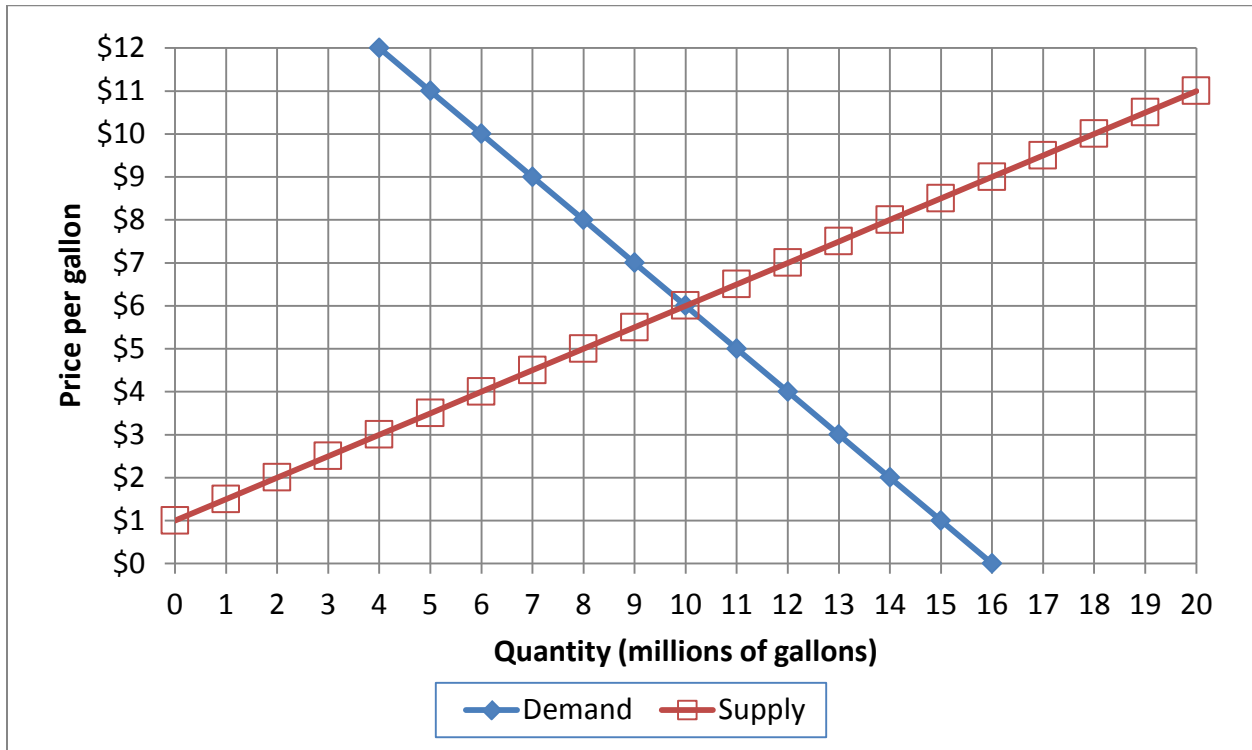
Suppose the government offers a **subsidy of $ 3** per gallon.

	million gallons
a. Compute the equilibrium quantity sold.	
b. Compute the equilibrium net price paid by buyers (excluding the subsidy).	$ per gallon
c. Compute the equilibrium total price received by sellers (including the subsidy).	$ per gallon
d. Does producer surplus *increase, decrease,* or *remain constant* because of the subsidy?	
e. By how much?	$ million
f. Does consumer surplus *increase, decrease,* or *remain constant* because of the subsidy?	
g. By how much?	$ million
h. Compute the direct cost of the subsidy to the government—that is, the amount that the government will have to pay buyers and sellers.	$ million
i. Compute the deadweight social loss caused by the subsidy.	$ million

(7) [Consumer choice and demand: 16 pts]   The indifference curves in the graph below represent Ben's preferences for fruit smoothies and other goods.
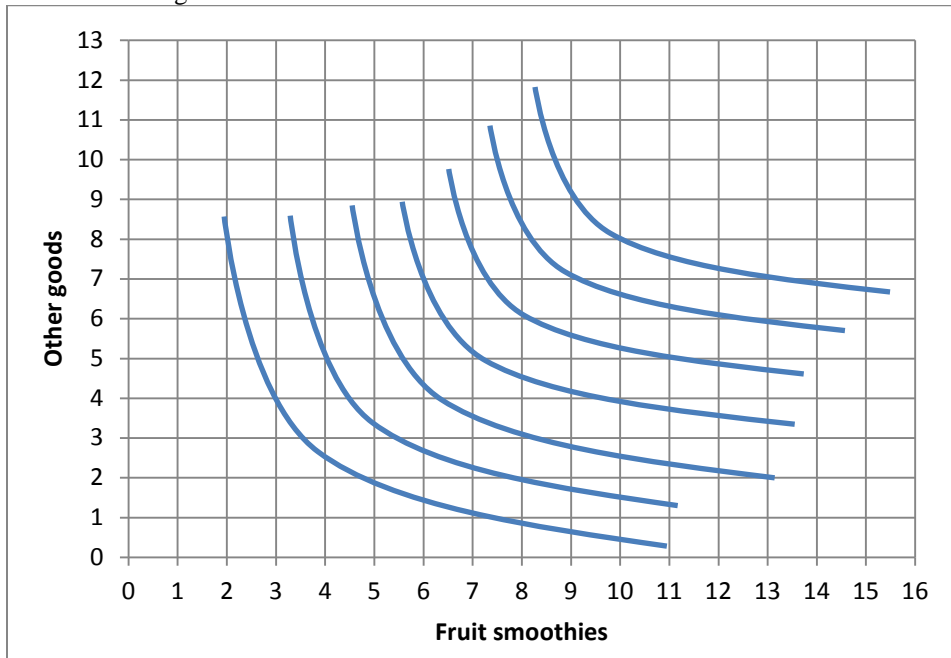
a. Would Ben rather have 2 smoothies and 8 units of other goods, or 4 smoothies and 5 units of other goods?

smoothies	units of
and	other goods

b. Would Ben rather have 13 smoothies and 2 units of other goods, or 7 smoothies and 5 units of other goods?

| smoothies	units of
and	other goods

Suppose Ben has a budget of $48 to spend on smoothies and other goods. The price of other goods is $4.

c. **Using a straightedge**, carefully draw Ben's budget line when the price of smoothies is $3. Label this budget line "A".

d. How many smoothies will Ben buy if the price of smoothies is $3?

smoothies

e. **Using a straightedge**, carefully draw Ben's budget line when the price of smoothies is $4. Label this budget line "B".

f. How many smoothies will Ben buy if the price of smoothies is $4?

smoothies

g. Plot two points on Ben's demand curve for smoothies, and sketch his demand curve at right.
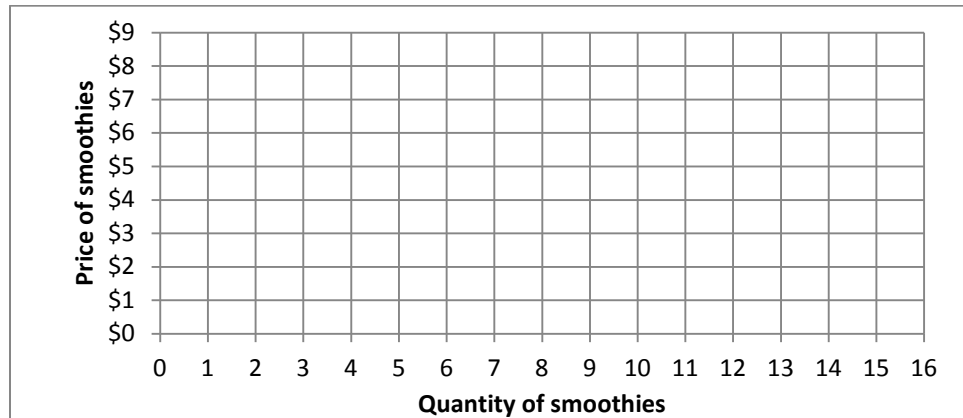
(8) [Rational choice: 10 pts] The government is considering building a new runway at the county airport. The following are cost and benefit estimates for runways of different lengths.

Miles	Total cost	Total benefit	Marginal cost per mile	Marginal benefit per mile
0	$ 0	$0		
			$ million	$ million
0.5	$0.3 million	$2.0 million		
			$ million	$ million
1.0	$0.7 million	$2.3 million		
			$ million	$ million
1.5	$1.2 million	$2.6 million		
			$ million	$ million
2.0	$1.8 million	$2.8 million		

a. [4 pts] Compute the marginal cost schedule. Insert your answers above.
b. [4 pts] Compute the marginal benefit schedule. Insert your answers above.
c. [2 pts] How long should the runway be? (Answer must be 0, 0.5, 1.0, 1.5, or 2.0 miles.)

miles

(9) [Basic definitions, cost and revenue: 3 pts] Insert the appropriate term from the list below in each box. The same term may be entered in more than one box.

Total revenue   *Average revenue*   *Marginal revenue*
Total cost   *Average cost*   *Marginal cost*

a. Increase in total revenue from producing and selling another unit of output.

b. Total cost divided by the quantity of output.

c. Price times quantity of output.

(10) [Economy-wide efficiency: 20 pts] The graph at right shows a country's production possibility curve.

a. What is this **country's** opportunity cost of a hamburger?

b. What is this **country's** opportunity cost of a serving of French fries?

servings of French fries
hamburgers

Assume this country's economy is in competitive equilibrium in all markets and the price of a hamburger is $6.

c. What must be the marginal cost of producing hamburgers?

$

d. What must be the price of a serving of French fries?

$

e. What must be the marginal cost of producing French fries?

$

Production-possibility curve

French fries (billions of servings) vs Hamburgers (billions)
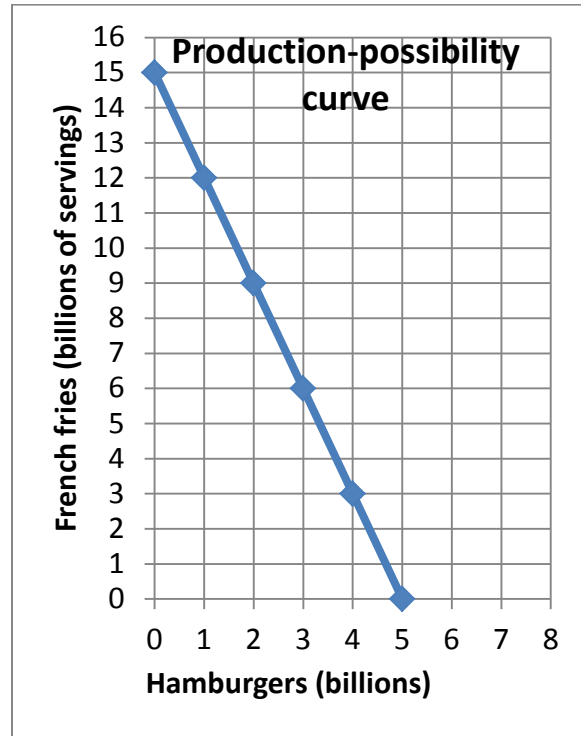
Luke is a consumer in this economy. He has an income of **$ 60**.

f. *Using a straightedge,* draw Luke's budget line in the graph at right.

g. What is the slope of Luke's budget line?

h. What is **Luke's** opportunity cost of a hamburger?

i. What is **Luke's** opportunity cost of a serving of French fries?

servings of French fries
hamburgers

j. What is Luke's marginal rate of substitution of hamburgers for French fries—that is, the slope of his indifference curve—at his preferred bundle on this budget line?

Budget line

French fries (servings) vs Hamburgers
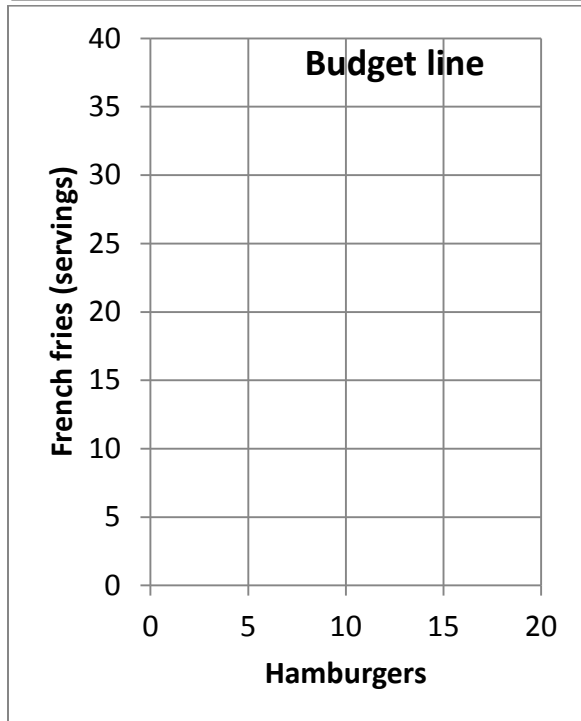
(11) [Monopoly, price discrimination: 20 pts] Zippy Roller Rink is the only roller rink in town, so it enjoys a local monopoly. Its annual marginal cost, average cost, and demand curves are shown below.
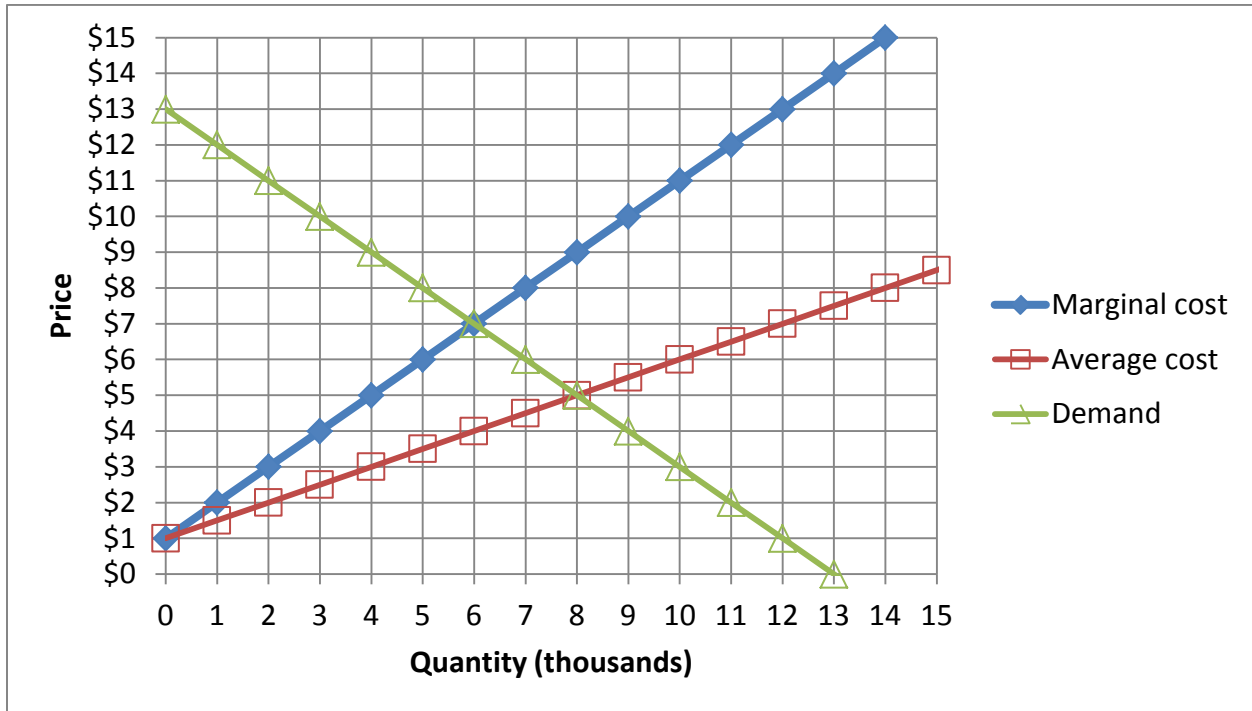
First, suppose Zippy must charge the same admission price to everyone.
   a. *Using a straightedge*, draw and label Zippy's marginal revenue curve.

   b. Compute Zippy's profit-maximizing quantity.

	thousand

   c. Compute the price that Zippy would charge.

$	

   d. Compute Zippy's profit.

$	thousand

   e. Compute consumer surplus

$	thousand

   f. Compute the social deadweight loss from this pricing scheme.

$	thousand

Second, suppose Zippy can charge a different admission price to each person, equal to the maximum price that person is willing to pay. In other words, suppose *perfect price discrimination* is possible.
   g. Compute Zippy's profit-maximizing quantity.

	thousand

   h. Compute Zippy's revenue.

$	thousand

   i. Compute Zippy's profit.

$	thousand

   j. [1 pt] Compute consumer surplus.

$	thousand

   k. [1 pt] Compute the social deadweight loss from this pricing scheme.

$	thousand

(12) [Regulating pollution: 20 pts] Seven factories are each producing one unit of pollution per year. The government has determined that total pollution must be reduced to **3** units per year (a reduction of **4** units). The cost of cleaning up pollution at each factory is given below.

| Factory	A	B	C	D	E	F	G
Annual cost of cleaning up pollution	$100	$400	$900	$800	$600	$1000	$200

Command-and-control:
   a. To minimize the total cost of cleaning up, which **4** factories should be commanded to clean up? Give their letters.

   b. What would be the total cost of cleaning up for these **4** factories together? $

Now suppose the government does not know each factory's cost of cleaning up, so the command-and-control approach is infeasible. Consider the following alternative approaches.

Auction: Suppose **3** permits (or waivers) to pollute were sold by the government to factories at auction.

   c. [6 pts] Draw the factories' demand curve for permits in the graph at right. (Be sure to draw correct "stairsteps.")
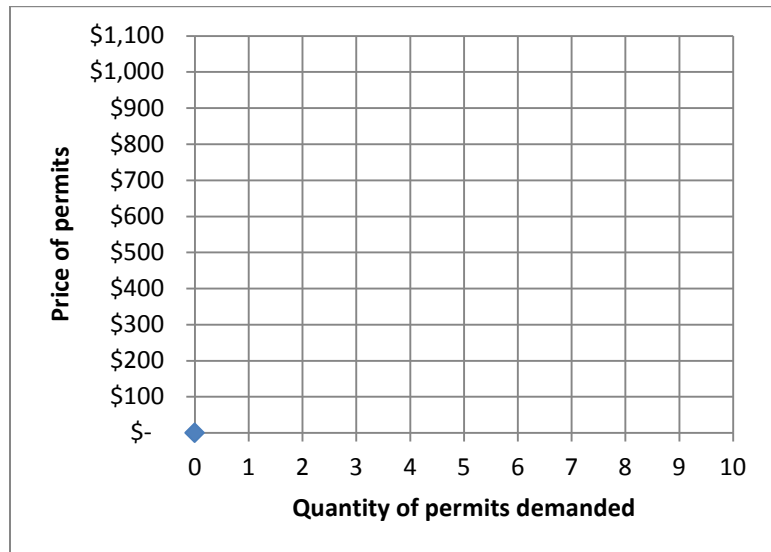
In this auction, the price rises in increments of $100.
   d. Which **3** factories would win the permits? Give their letters.

   e. What would be the final auction price of a permit to pollute? $

   f. What would be the total cost of cleaning up for those **4** factories that did not win permits in the auction? $

Pollution fee: Suppose the government imposed a fee for pollution. Factories could either pay the fee or pay the cost of cleaning up.
   g. What fee would reduce the amount of pollution to **3** units? Give an answer to the nearest hundred dollars. $

   h. What would be the total cost of cleaning up for those **4** factories that chose not to pay the fee? $

(13) [Externalities: 12 pts] The graph below shows the market for a particular vaccine. A vaccination protects the purchaser of the vaccine, but also reduces the chances of other people catching the illness. Therefore, in addition to demand and supply curves, a curve representing marginal social benefit is shown.
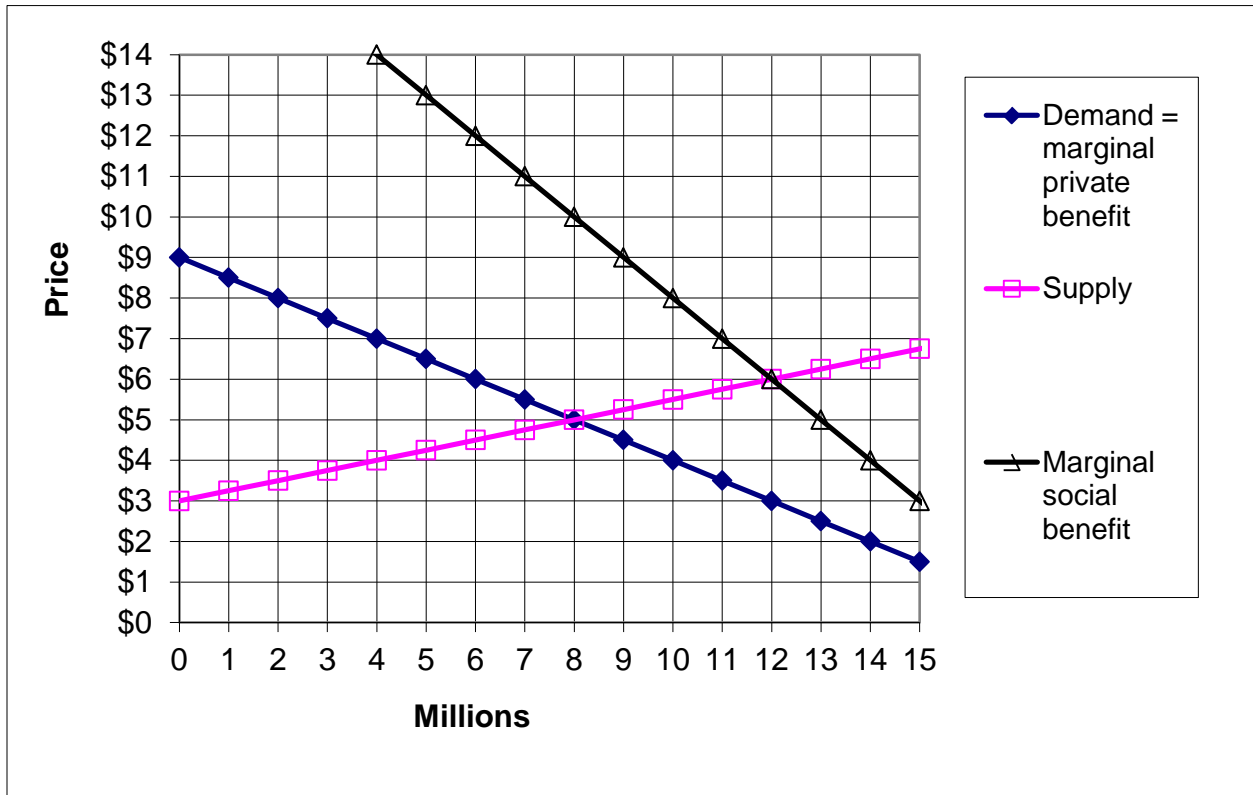
a. Compute the (unregulated) competitive equilibrium price.

$ _____

b. Compute the (unregulated) competitive equilibrium quantity.

_____ million

c. Compute the economically efficient (or socially optimal) quantity.

_____ million

d. Compute the deadweight loss from unregulated competition.

$ _____ million

e. To eliminate this deadweight loss, should the government impose a *tax* or a *subsidy*?

f. What should be the tax rate or subsidy rate?

$ _____ per vaccination

(14) [Nonrival goods: 4 pts] A village government will offer a free outdoor movie series during the summer in a neighborhood park. About **500** people are likely to enjoy the movies. Each movie costs $1000 to show. Let Q denote the number of movies. A typical individual person's marginal benefit from the movie series is given by the following expression (or formula): **MB = 8 – Q** .

    a. Give an expression (or formula) for the marginal social benefit from the movie series. [Hint: This must be a formula containing one variable: Q.]

    b. Compute Q* the socially-optimal number of movies.

$$MSB =$$

movies

(15) [Common property resources: 6 pts] A certain freeway can easily get congested. It is the quickest route to downtown, but during rush hour, when one car enters the freeway, all the cars already on the freeway slow down a bit. The graph below shows the time saved by each new car, and the change in total time saved by all cars, as that new car enters the freeway. Note that the change in total time saved by all cars turns negative as the freeway becomes congested.
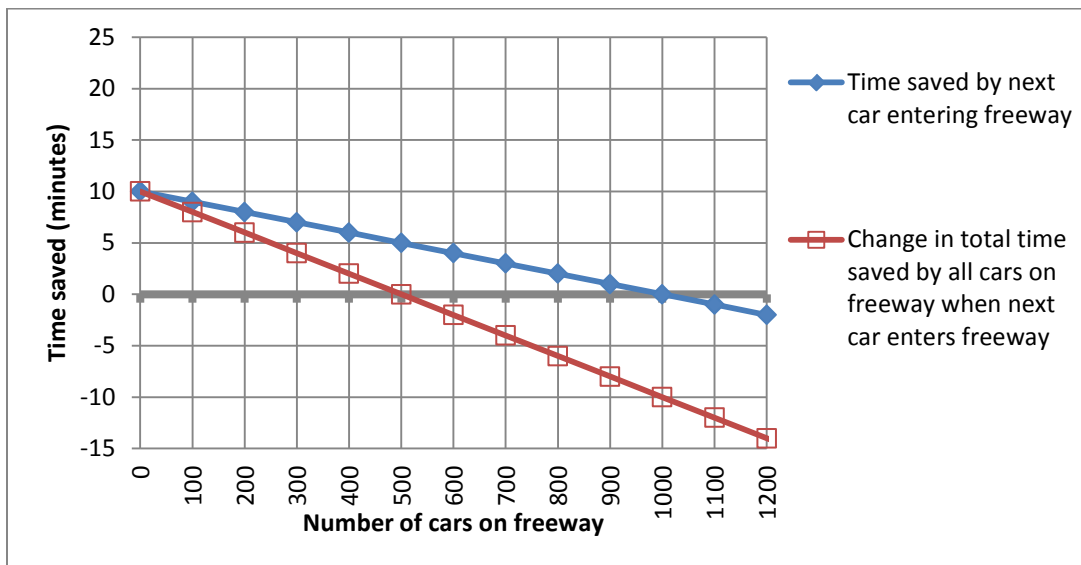
    a. How many cars will enter the freeway if entry onto the freeway is unregulated?

cars

    b. What is the socially-optimal number of cars on the freeway—that is, the number of cars that maximizes total time saved by all cars on the freeway?

cars

    c. Suppose a typical driver is willing to pay $1 for each five minutes saved by entering the freeway. What toll (in dollars) would ensure that the optimal number of cars entered the freeway?

$

III. Critical thinking: Write a one-paragraph essay answering *one* question below (your choice). [4 pts]

(1) In this class we have discussed how to reduce pollution efficiently. Why not ban pollution altogether? Illustrate your answer with a supply-and-demand graph.

(2) Suppose a country opens its tee-shirt industry to international trade. As a consequence, the price of tee-shirts falls from $10 to $6, and 15 million tee-shirts are imported. Does the country's overall welfare *increase* or *decrease* as a result of this change? By how much? Sketch a graph, show your work and circle your final answer.

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

[end of exam]