# EXAMINATION #3 VERSION B
## "Firms and Competition"
## October 31, 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.

**I. MULTIPLE CHOICE:**  Circle the one best answer to each question.  Feel free to use margins for scratch work.  [1 pt each—13 pts total]

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The next three questions refer to the following information.  Suppose trash is collected using only labor input, with the following production function:
$$q = (3/2) \, x^{4/3} \, ,$$
where q = bags of trash collected, and x = labor hours.

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(1) The marginal product of workers equals
a.  $2 \, x^{1/3}$ .
b.  $2 \, x^{-1/3}$ .
c.  $2 \, x^{-2/3}$ .
d.  $3 \, x^{2/3}$ .
e.  $3 \, x^{-1/3}$ .
f.  $6 \, x^{1/3}$ .

(2) The production function for collecting trash exhibits
a.  no diminishing returns to labor input.
b.  diminishing returns to labor input for all values of x greater than zero.
c.  diminishing returns to labor input only for very high values of x.
d.  diminishing returns to labor input only for very low values of x.
e.  cannot be determined from information given.

(3) Which production function below violates the assumption of "diminishing marginal rate of substitution"?
a.  $q = x_1^3 \, x_2^4$ .
b.  $q = 3 \, x_1^2 + 4 \, x_2^2$ .
c.  $q = x_1^{3/7} \, x_2^{4/7}$ .
d.  $q = 3 \, x_1^{1/2} + 4 \, x_2^{1/2}$ .
e.  All of the above functions show diminishing marginal rates of substitution.

(4) The production function
$$q = 5 \, x_1^{1/4} \, x_2^{1/4}$$
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 diagram of a firm's isocost lines and an isoquant. Suppose the firm is currently at input combination A.
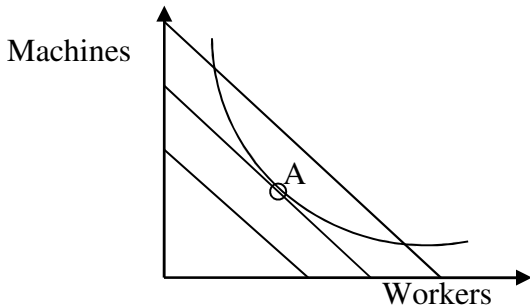


(5) This firm could lower its total cost, without reducing output, by
a. using fewer machines and more workers.
b. using more machines and fewer workers.
c. either (a) or (b).
d. neither (a) nor (b).
e. cannot be determined.

(6) 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.

(7) Suppose a firm's long-run total cost function is given by
$$TC(q) = 0.5q^3 - 50 q^2 + 1270 q .$$
The firm's *average cost* function is
AC(q) =
a. $0.5 q^3 - 50 q^2 + 1270 q$ .
b. $0.5 q^2 - 50 q + 1270$ .
c. $1.5 q^2 - 100 q + 1270$ .
d. $3 q - 100$ .
e. $q - 50$ .

(8) 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
a. increasing its output by one unit.
b. decreasing its output by one unit.
c. It cannot increase its profit by small changes in output.
d. cannot be determined from information given.

(9) If price is less than minimum average cost in a competitive industry,
a. firms will try to lower the price.
b. firms will try to raise the price.
c. new firms will enter the industry.
d. existing firms will leave the industry.

(10) When firms exit from an industry, the industry's
a. demand curve shifts left.
b. short-run supply curve shifts left.
c. long-run supply curve shifts left.
d. demand curve shifts right.
e. short-run supply curve shifts right.
f. long-run supply curve shifts right.

(11) In *short-run* competitive equilibrium,
a. price equals marginal cost.
b. price equals average cost.
c. average cost equals marginal cost.
d. all of the above.

(12) Suppose the demand for vitamins abruptly and permanently shifts to the *left* because of a permanent change in preferences.  The price of vitamins will
a.  rise in the short run and rise further in the long run.
b.  fall in the short run and fall further in the long run.
c.  rise in the short run but fall back in the long run.
d.  fall in the short run but rebound in the long run.
e.  remain constant in the short and long run.

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

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

(1) [Technical change: 4 pts]  The elasticity of output with respect to labor input for the US economy as a whole is about 2/3.  The elasticity of output with respect to capital input is about 1/3.  Suppose labor input increases by 1.5% and capital input increases by 2.7%.

a. By how much would output increase, without any technical change?

| | |
|---|---|
| | % |

b. Suppose output in fact increases by 3.5%.  What is the increase in multifactor or total factor productivity (also called the Solow residual)?

| | |
|---|---|
| | % |

(2) [Long-run cost: 4 pts]  Suppose a firm's long-run total cost function is given by

$$TC(q) = 0.2\,q^3 - 12\,q^2 + 250\,q\,.$$

a. Compute the firm's efficient scale of output ("$q_{ES}$").

| | units |
|---|---|

b. Compute the lowest price at which the firm can avoid making losses.

| $ | |
|---|---|

(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.
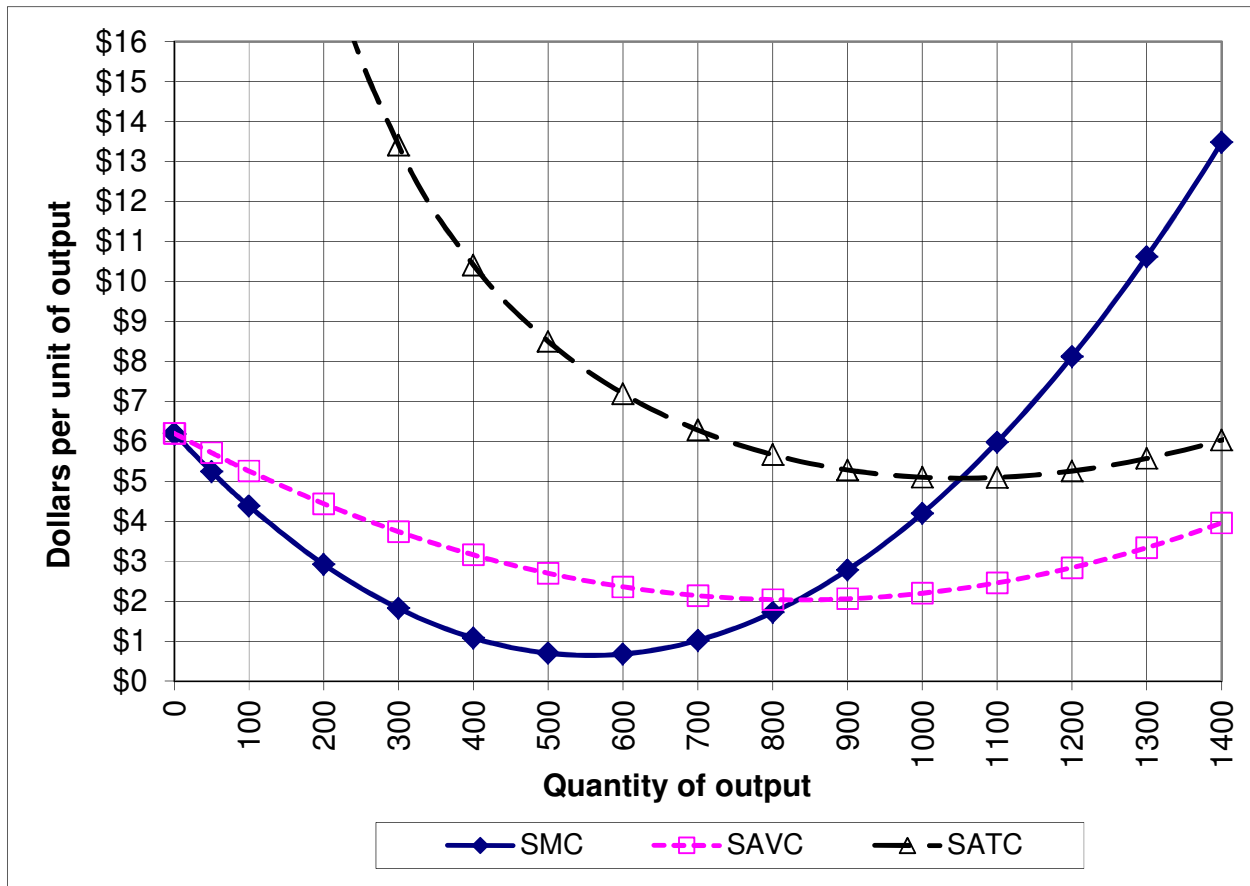


a. If the market price is $4, about how much output will Acme try to produce?  Give an answer to the nearest 100.

| | |
|---|---|
| | units |

b. If the market price is $1, about how much output will Acme try to produce?  Give an answer to the nearest 100.

| | |
|---|---|
| | units |

c. If the market price is $8, about how much output will Acme try to produce?  Give an answer to the nearest 100.

| | |
|---|---|
| | units |

d. 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.

| | |
|---|---|
| $ | |

e. 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.

| | |
|---|---|
| $ | |

(4) [Welfare analysis of price controls: 16 pts]  The graph below shows the market for cheese.
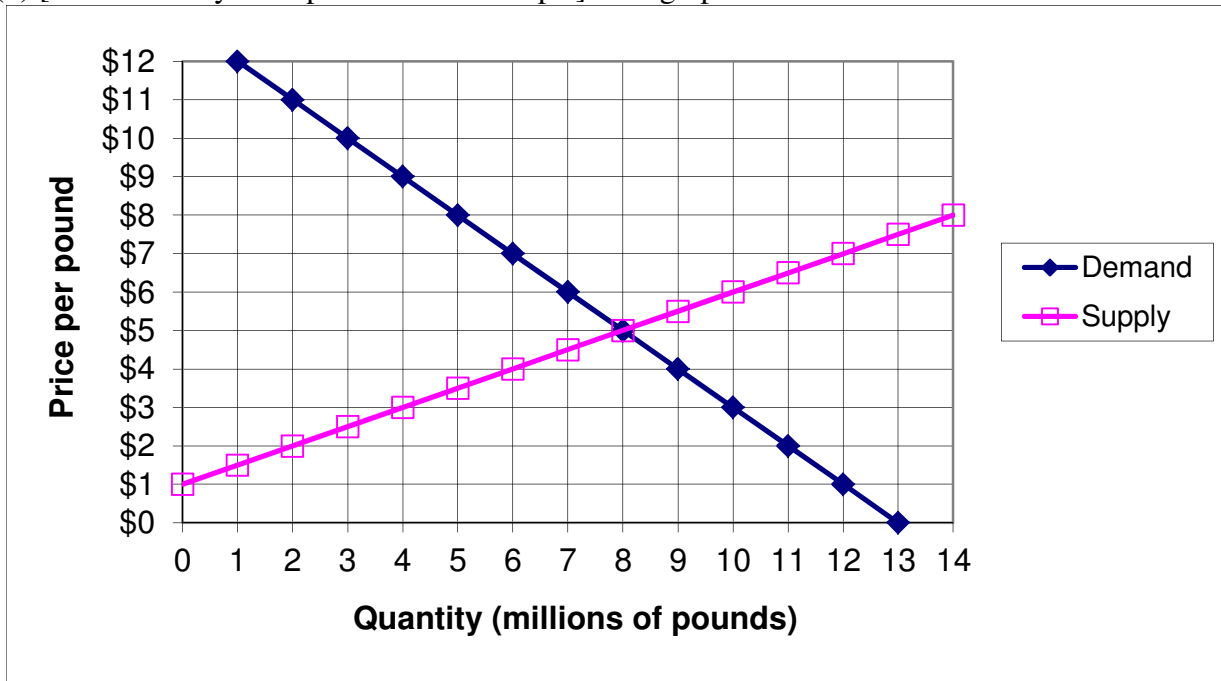


Suppose a **price floor (or legal minimum price) of $ 7** is imposed on the market for cheese.  No cheese may be sold for less than the price floor.

| | |
|---|---|
| a. Compute the quantity traded with the price floor. | million pounds |
| b. Does the price floor create  *excess demand*,  *excess supply*,  or  *neither*? | |
| c. How much? | million pounds |
| d. Does producer surplus *increase or decrease* because of the price floor, as compared to the market without government intervention?  (Assume optimistically that cheese is actually produced by those sellers whose costs are lowest.) | |
| e. By how much? | $           million |
| f. Does consumer surplus *increase or decrease* because of the price floor, as compared to the market without government intervention? | |
| g. By how much? | $           million |
| h. Compute the deadweight social loss caused by the price floor. | $           million |

(5) [Welfare analysis of tax or subsidy: 18 pts]  The graph below shows demand and supply for gasoline.  Suppose the government imposes a tax of **$ 6** per gallon.
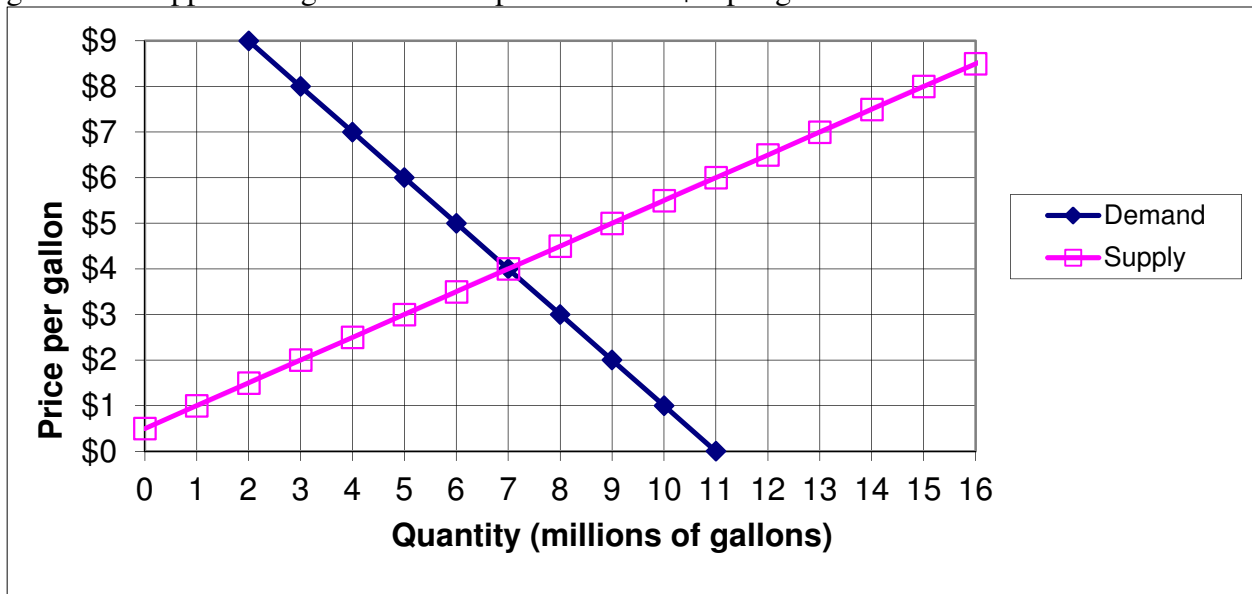


a. Give the new equilibrium quantity as a result of the tax.

| million gallons |
| --- |

b. Give the new total price paid by buyers, including the tax.

$

c. Give the new net price received by sellers, excluding the tax.

$

d. As a result of the tax, will consumer surplus *increase* or *decrease*?

e. By how much?

$ million

f. As a result of the tax, will producer surplus *increase* or *decrease*?

g. By how much?

$ million

h. How much tax revenue will the government receive?

$ million

i. Compute the social deadweight loss from the tax.

$ million

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

(1) [Fixed-proportions technology: 10 pts]  Suppose a particular machine can make 10 parts per day if it is operated by three workers.  The machine cannot be operated by fewer than three workers, and extra workers on the same machine add nothing to output.  A firm can use as many machines as desired, with no loss in output per machine, provided each machine is operated by at least three workers.  Let $x_1$ denote the number of machines and $x_2$ denote the number of workers used by the firm.  Let $q$ denote the number of parts produced.

    a.  Give an equation for the firm's so-called "expansion path"—that is, the efficient relationship between $x_1$ and $x_2$ .

    b.  If there are plenty of workers, what is the relationship between output $q$ and the number of machines $x_1$ ?  Give an equation with $q$ on the left side.

    c.  If there are plenty of machines, what is the relationship between output $q$ and the number of workers $x_2$ ?  Give an equation with $q$ on the left side.

    d.  Give an equation for the firm's production function using the minimum function "$min\{\ ,\ \}$".

    e.  Sketch and label the firm's expansion path.  Also sketch and label the isoquant for $q = 20$.
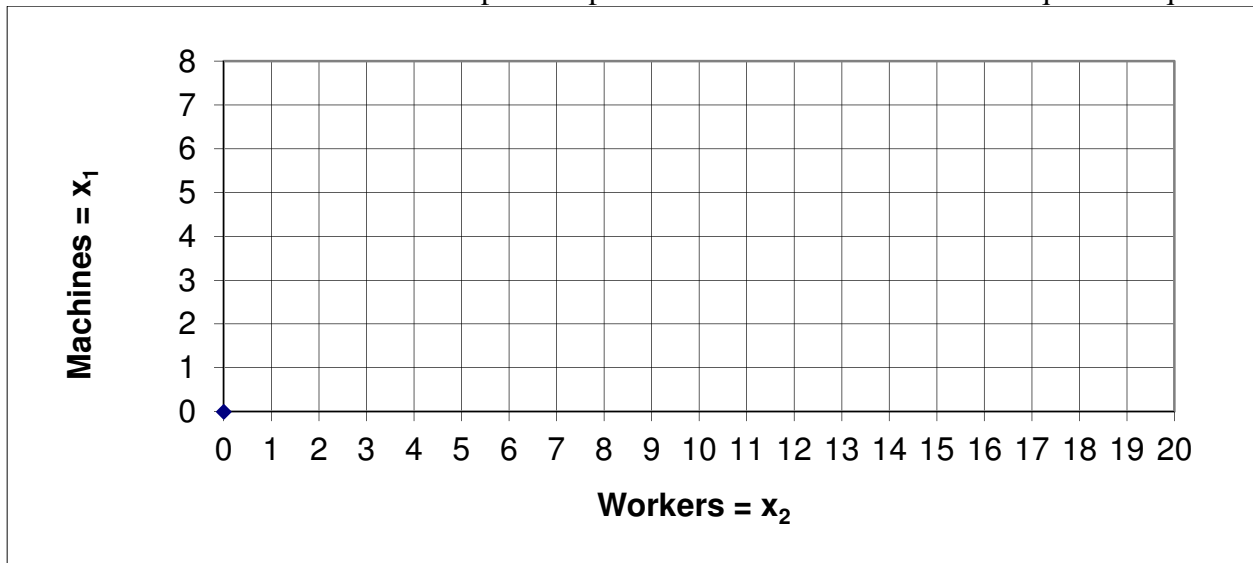
(2) [Cost minimization: 12 pts]  Suppose a firm wishes to produce 75 units of output per hour at minimum cost.  The firm's hourly production function is given by

$$q = 5\, x_1^{1/2}\, x_2^{1/2} \; ,$$

where $x_1$ denotes the number of machines and $x_2$ denotes the number of workers.  Machines cost $50 per hour to rent and workers must be paid $18 per hour.

    a.  [2 pts] Give an equation for the firm's target isoquant.  The variables $x_1$ and $x_2$ should be the only unknowns.

    b.  [4 pts] 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.  [4 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.  [2 pts] Compute the total cost to produce 75 units of output, TC(75).

(3) [Welfare analysis of international trade: 10 pts]  Suppose domestic demand and supply for a good are given by the following equations.

$$\text{Demand: } Q_D = 150 - 10\,P \qquad\qquad \text{Supply: } Q_S = 20\,P - 30 .$$

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 **$ 3** .  (Use the graph below for scratch work.)

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

d. How much?

| | units |
|---|---|

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?

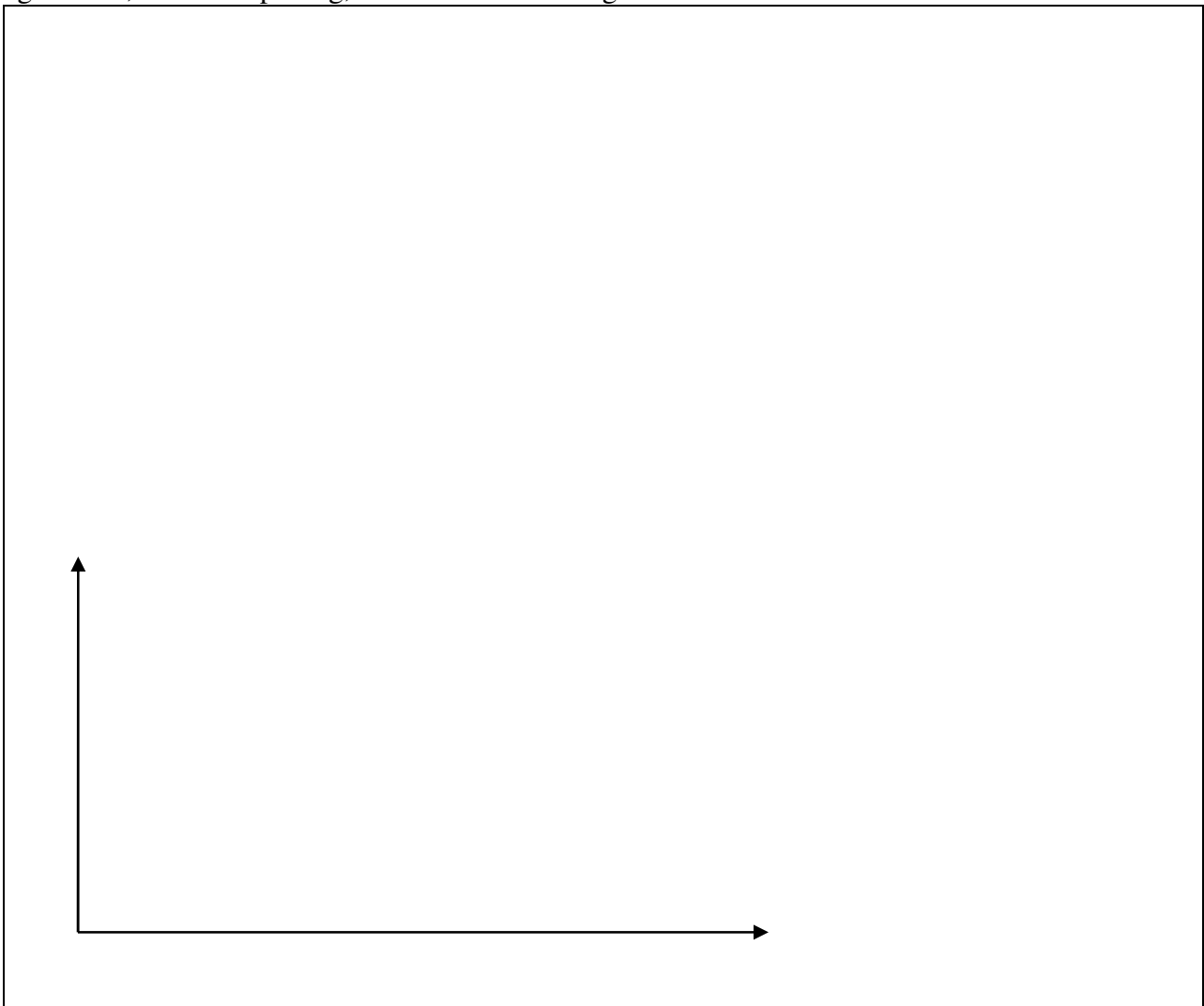j.  By how much?

| $ | |
|---|---|

**IV. CRITICAL THINKING:** Answer just *one* of the questions below (your choice). [3 pts]

(1) Goods that are manufactured for a national market (like automobiles, electronics, etc.) have a horizontal supply curve in Iowa. If Iowa put a tax on such a good, who would bear the burden of the tax—consumers, manufacturers, or both? Justify your answer with supply-and-demand graphs. [Hint: "Bear the burden" means "suffer an adverse change in price."]

(2) Consider the following claim: "To gain the greatest advantage, a country should *permit* international trade in any good where its industry is competitive—that is, where the world price is *greater* than the domestic price. However, it should *prohibit* international trade in any good where its industry is not competitive—that is, where the world price is *less* than the domestic price." Do you agree or disagree? Justify your answer with supply-and-demand graphs.

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

[end of exam]