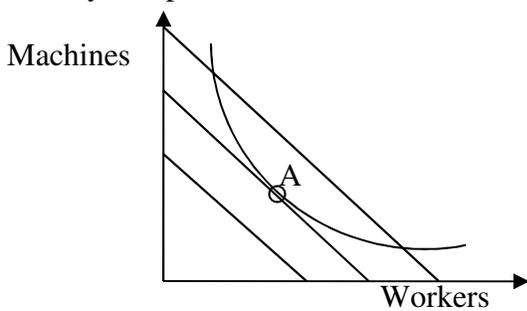


**EXAMINATION #3 VERSION B**  
**“Firms and Competition”**  
**October 31, 2013**

**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]

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.



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

- (2) 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,
- $MP_2/MP_1 < w_2/w_1$ .
  - $MP_2/MP_1 > w_2/w_1$ .
  - $MP_2/MP_1 = w_2/w_1$ .
  - $MP_2 = MP_1$  and  $w_2 = w_1$ .
  - cannot be determined from information given.

- (3) Suppose a competitive firm is now producing 500 units of output per day. Its average cost is \$5, its marginal cost is \$10, and it can sell its output at a price of \$8. 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.

(4) In the short run, a firm should shut down immediately if its

- a. revenue is less than producer surplus.
- b. revenue is less than variable cost.
- c. revenue is less than fixed cost.
- d. profit is negative.

(5) 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.

(6) 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.

(7) Suppose the demand for pomegranate juice suddenly and permanently shifts to the *right* because of a permanent change in eating preferences. The price of pomegranate juice will

- a. rise in the short run but fall back in the long run.
- b. fall in the short run but rebound in the long run.
- c. rise in the short run and rise further in the long run.
- d. fall in the short run and fall further in the long run.
- e. remain constant in the short and long run.

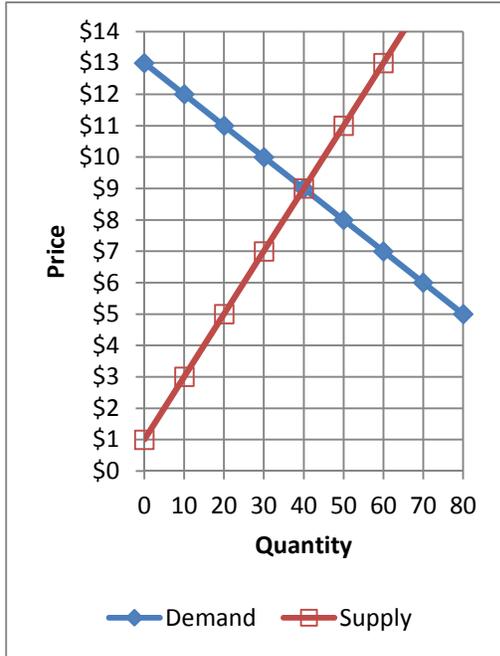
(8) Suppose the price of corn rises. The increase in long-run producer surplus goes to farmers and

- a. food processing companies that use corn to make other products.
- b. ultimate consumers of corn-based products.
- c. all corn buyers.
- d. farmland owners.

(9) Suppose as a result of a change in the economy, farmers' incomes rise by \$5 billion and everyone else's incomes remain unchanged. This is an example of a

- a. Pareto improvement.
- b. potential Pareto improvement (also called an economically-efficient change).
- c. both of the above.
- d. none of the above.

The next four questions refer to the market in the graph below. Suppose a price floor of \$11 is imposed on this market. No one may buy or sell the good for less than \$11. Assume (optimistically) that sellers who actually trade are those whose marginal cost is lowest.



- (10) What quantity will now be traded?
- zero units.
  - 10 units.
  - 20 units.
  - 30 units.
  - 40 units.
  - 50 units.
  - 60 units.
  - 70 units.
  - 80 units.

- (11) As a result of the price floor, consumer surplus
- does not change.
  - decreases by \$2.
  - decreases by \$40.
  - decreases by \$50.
  - decreases by \$60.
  - decreases by \$70.
  - decreases by \$80.
  - decreases by \$100.

- (12) As a result of the price floor, producer surplus
- does not change.
  - increases by \$2.
  - increases by \$40.
  - increases by \$50.
  - increases by \$60.
  - increases by \$70.
  - increases by \$80.
  - increases by \$100.

- (13) The deadweight loss from the price floor is
- zero.
  - \$10.
  - \$20.
  - \$30.
  - \$40.
  - \$50.
  - \$60.
  - \$70.

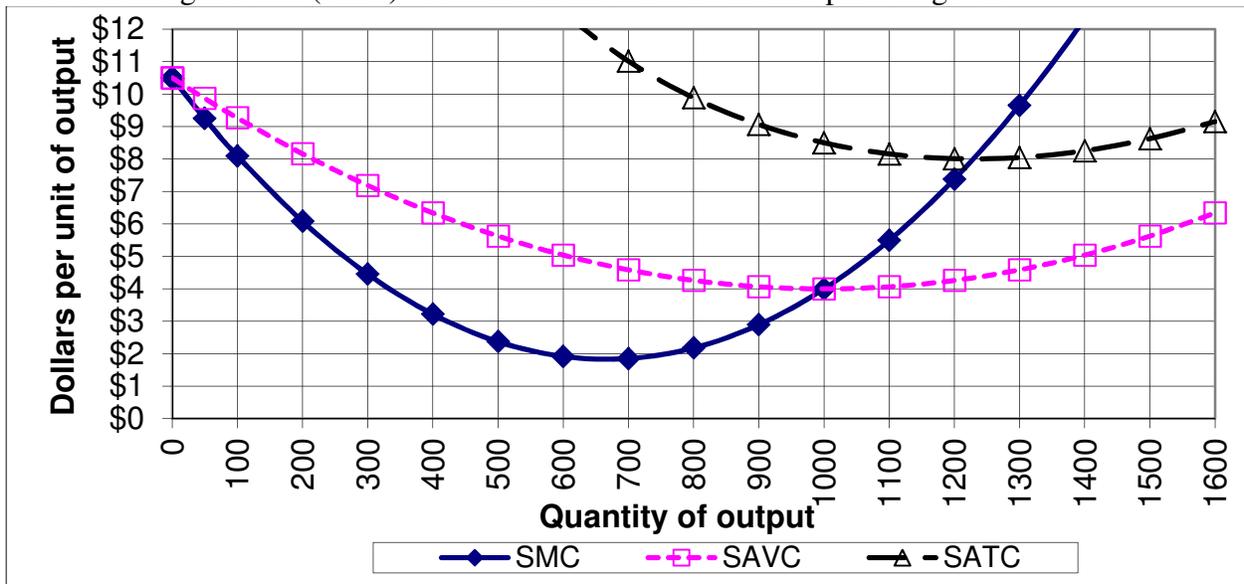
**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(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 2.4%.

- By how much would output increase, without any technical change?
- Suppose output in fact increases by 4.0%. What is the increase in multifactor or total factor productivity (also called the Solow residual)?

	%
	%

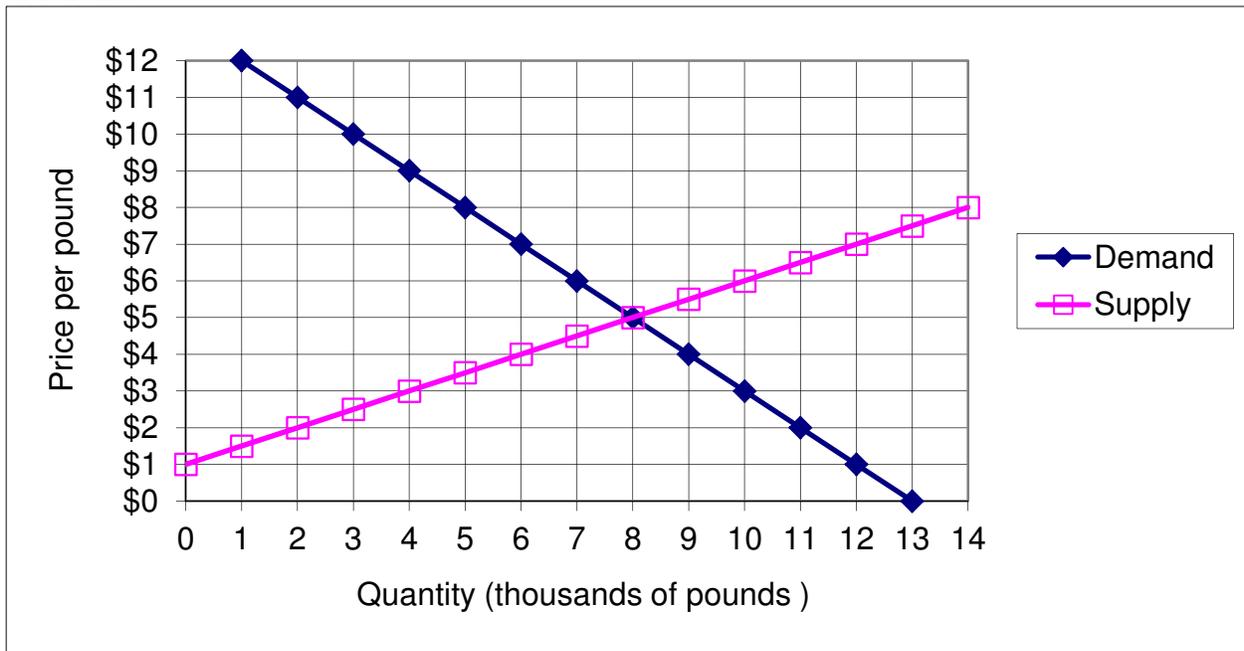
(2) [Short-run cost curves and supply: 10 pts] The following graph shows Acme Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume Acme takes its market price as given.



- If the market price is \$10, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$2, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$7, 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 effects of taxes or subsidies: 20 pts] The following graph shows the market for artichokes.



a. Find the equilibrium price without government intervention.

\$
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Suppose the government imposes a **subsidy of \$ 3** per pound.

b. Compute the equilibrium quantity sold.

thousand
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c. Compute the equilibrium total price received by sellers (including the subsidy).

\$	per pound
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d. Compute the equilibrium net price paid by buyers (excluding the subsidy).

\$	per pound
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e. Does producer surplus *increase, decrease, or remain constant* because of the subsidy?

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f. By how much?

\$	thousand
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g. Does consumer surplus *increase, decrease, or remain constant* because of the subsidy?

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h. By how much?

\$	thousand
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i. Compute the direct cost of the subsidy program to the government. In other words, how much should the government budget for payments to buyers and sellers in this market?

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

\$	thousand
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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) [Production functions: 8 pts] Suppose a production function is given by  $q = 12 x_1^{2/4} x_2^{3/4}$ .

- a. [3 pts] Find an expression for the marginal product of input 1. Are there diminishing returns to input 1? Justify your answer.

- b. [3 pts] Find an expression in terms of  $x_1$  and  $x_2$  for the marginal rate of substitution 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. [2 pts] Does this production function have *constant* returns to scale, *increasing* returns to scale, or *decreasing* returns to scale? Justify your answer.

(2) [Fixed-proportions technology: 11 pts] Suppose a particular machine can make 50 parts per hour 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.

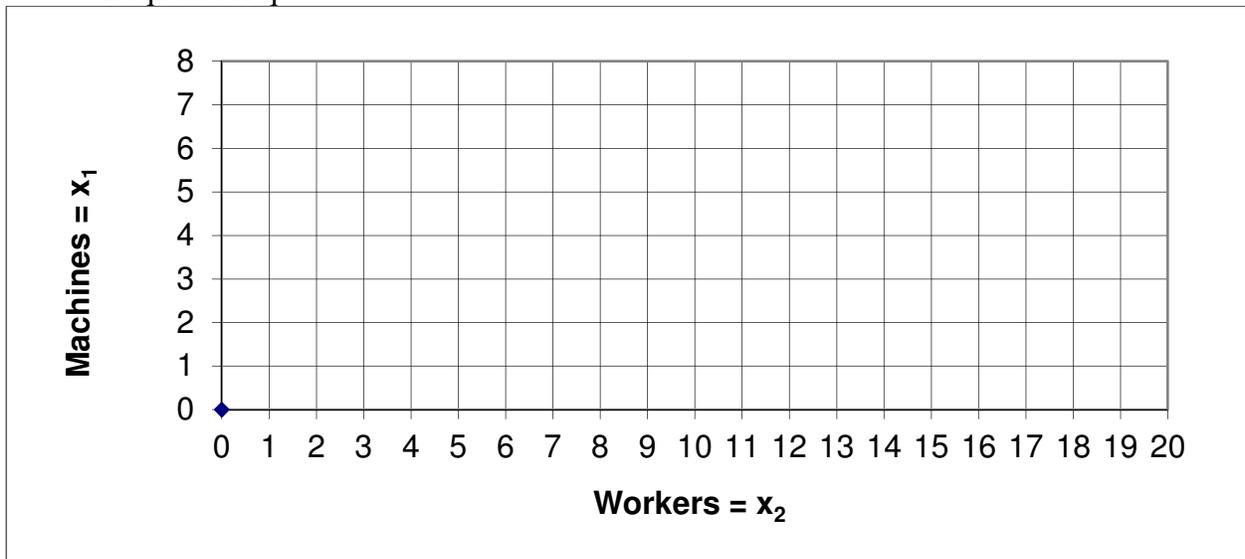
- a. Give an equation for the firm's so-called "expansion path"—that is, the efficient relationship between  $x_1$  and  $x_2$ .

- 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. [3 pts] Draw and label the firm's expansion path, the isoquant for  $q=200$ , and the isoquant for  $q=300$ .



(3) [Cost minimization: 12 pts] Suppose a firm wishes to produce 600 units of output per hour at minimum cost. Machines cost \$10 per hour to rent and workers must be paid \$24 per hour. The firm's hourly production function is given by  $q = 10 x_1 x_2$ , where  $x_1$  denotes the number of machines and  $x_2$  denotes the number of workers.

- 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 600 units of output,  $TC(600)$ .

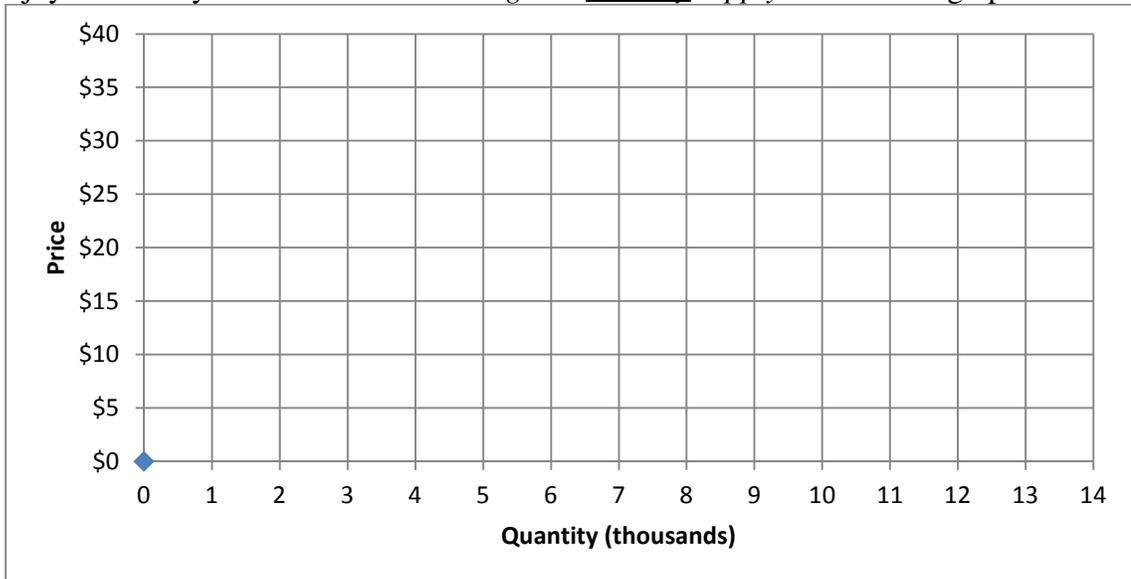
(4) [Long-run profit maximization and supply: 8 pts] Suppose a firm faces a (long-run) total cost function given by  $TC(q) = q^3 - 40q^2 + 430q$ .

- a. Compute the representative 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.

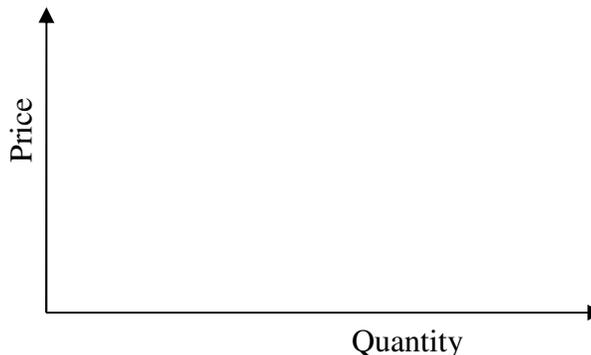
- d. Suppose all firms in this industry have the same costs, and these costs are not affected by other firms in the same industry or by total industry output. Further assume the industry enjoys free entry and exit. Draw the *long-run industry supply curve* in the graph below.



(5) [Welfare analysis of international trade: 12 pts] Suppose domestic demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

Demand:  $Q_D = 100 - 10 P$

Supply:  $Q_S = 20 P - 50$



First consider the domestic market without international trade.

- a. Compute the equilibrium price without international trade.

Now suppose the market is opened to international trade, and the world price turns out to be \$3 .

- b. Does consumer surplus *increase* or *decrease* as a result of international trade? By how much?

- c. Does producer surplus *increase* or *decrease* as a result of international trade? By how much?

- d. Does the country as a whole (consumers and producers) *gain* or *lose* as a result of international trade? 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 perfectly elastic (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? Explain your answer using a graph. [Hint: "Bear the burden" means "suffer a 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, legible writing, accurate spelling, and correct reasoning.



[end of exam]