

**EXAMINATION #3 VERSION B**  
**“Producers and Competition”**  
**October 27, 2016**

**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. Use margins for scratch work [1 pt each—10 pts total]

(1) Suppose a production function is given by  $q = 20 x_1^{1/4} x_2^{3/4}$ . Then the marginal product of input #2 is given by

- a.  $5 (x_2/x_1)^{3/4}$ .
- b.  $20 (x_2/x_1)^{3/4}$ .
- c.  $15 (x_1/x_2)^{1/4}$ .
- d.  $20 (x_1/x_2)^{1/4}$ .

(2) “Economies of scale” mean that the firm’s average cost curve

- a. slopes up.
- b. slopes down.
- c. is horizontal.
- d. is vertical.

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

- 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.

(4) In the short run, a firm should continue to operate only if its revenue is greater than its

- a. producer surplus.
- b. total cost.
- c. fixed cost.
- d. variable cost.

(5) When firms leave an industry, the

- a. short-run supply curve shifts left.
- b. short-run supply curve shifts right.
- c. demand curve shifts left.
- d. demand curve shifts right.
- e. long-run supply curve shifts left.
- f. long-run supply curve shifts right.

(6) Price equals marginal cost in markets which are in

- a. short-run competitive equilibrium.
- b. long-run competitive equilibrium.
- c. either short-run or long-run competitive equilibrium.
- d. none of the above.

(7) Suppose that in a certain industry, cost curves for each firm tend to rise as other firms enter the industry and fall as other firms leave the industry. In this case, the long-run supply curve

- a. is vertical (infinite slope).
- b. is horizontal (zero slope).
- c. slopes up (positive slope).
- d. slopes down (negative slope).
- 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.

(9) A quota on sellers of baseball bats would have basically the same effect on the market for baseball bats as

- a. a subsidy for baseball bats.
- b. a free market for baseball bats.
- c. a price ceiling on baseball bats.
- d. a price floor on baseball bats.
- e. a tax on baseball bats.

(10) Which of the following government interventions in a competitive market cause the quantity traded to *increase*?

- a. price floor (legal minimum price).
- b. price ceiling (legal maximum price).
- c. quota on sellers.
- d. tax.
- e. all of the above.
- f. none of the above.

---

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

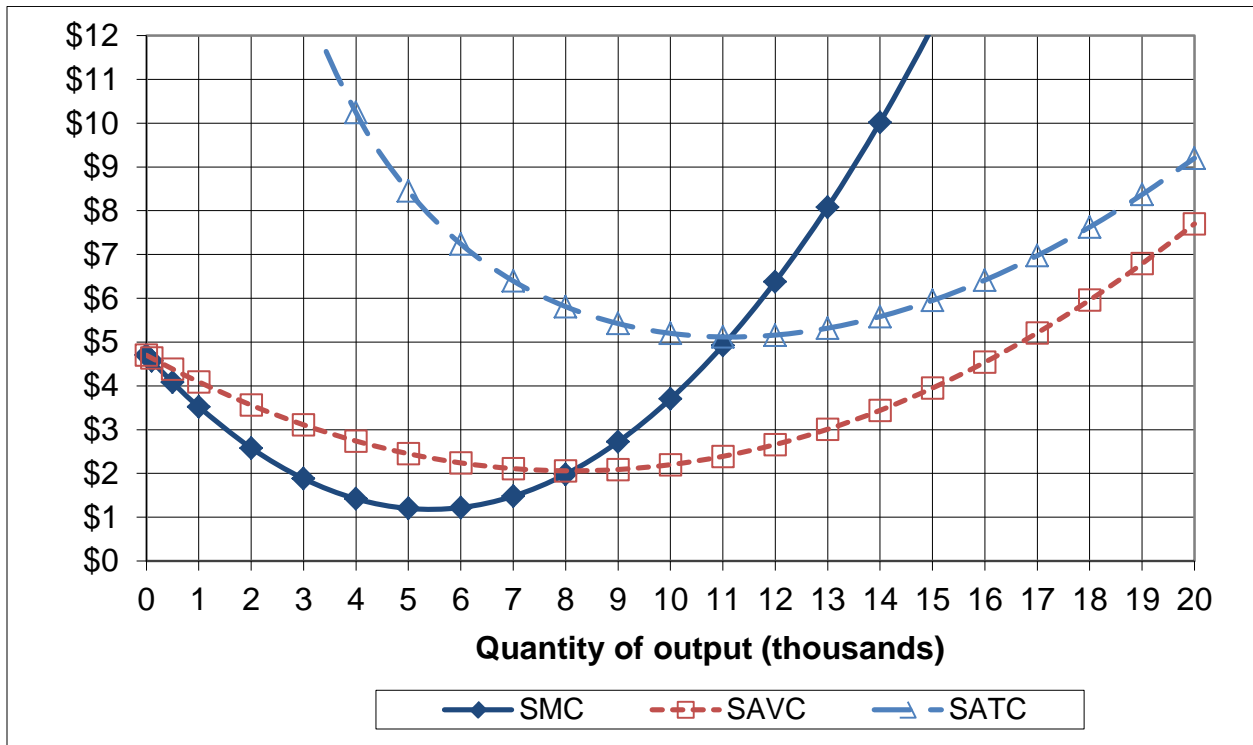
(1) [Technical change: 4 pts] Suppose the elasticity of output with respect to labor input for the US economy as a whole is 0.6, and the elasticity with respect to capital input is 0.4. Suppose labor input increases by 1% and capital input increases by 3%.

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

	%
	%

b. Suppose output in fact increases by 3%. What is the increase in multifactor or total factor productivity (also called the Solow residual)?

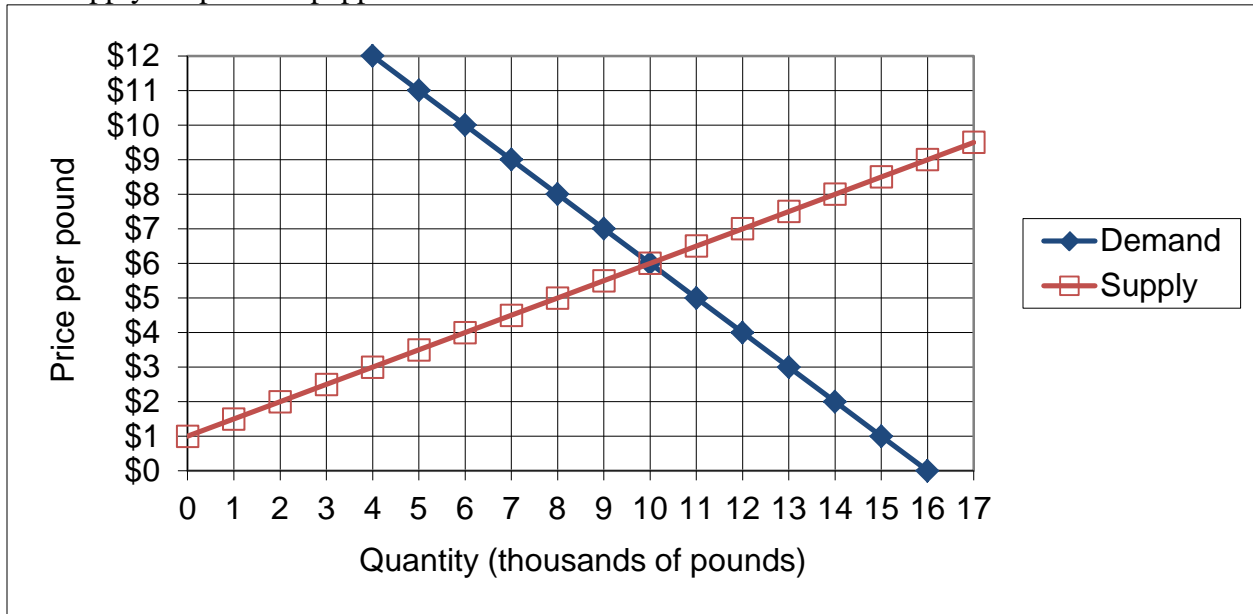
(2) [Short-run cost curves and supply: 10 pts] The following graph shows ACME Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume ACME takes its market price as given.



- If the market price is \$4, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$10, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$1, about how much output will ACME try to produce (to the nearest thousand)?
- What is ACME's *breakeven price*—that is, the lowest price at which ACME can produce output without making losses in the short run?
- What is ACME's *shutdown price*—that is, the lowest price at which ACME will continue to operate in the short run?

	thousand
	thousand
	thousand
\$	
\$	

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



At first, international trade in poblano peppers is not permitted. Then this industry is opened to international trade and the international price of poblano peppers turns out to be \$ 8 per pound.

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

	thousand pounds
\$	thousand
\$	thousand
\$	thousand

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

(1) [Production functions: 12 pts] Suppose a production function is given by  $q = 10 x_1^{0.3} x_2^{0.6}$ .

- 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.

(2) [Fixed-proportions technology: 11 pts] Suppose a commercial dishwashing machine can wash 40 plates per minute if it is operated by three workers. This machine cannot be operated by fewer than three workers, and extra workers on the same machine add nothing to output. A food-service 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 employed by the firm. Let  $q$  denote the number of plates washed.

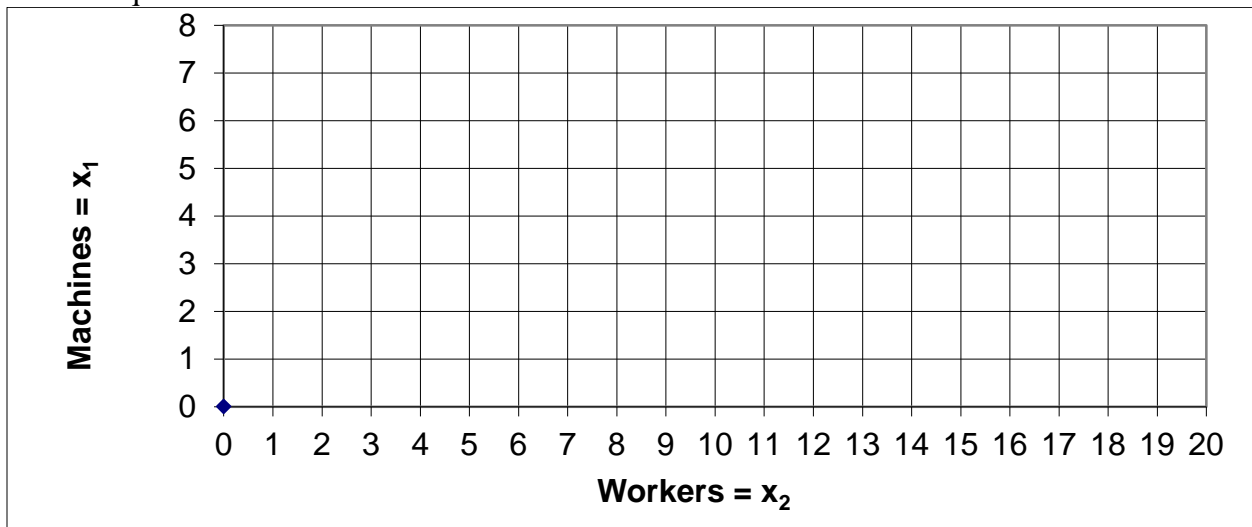
- a. Give an equation for the firm's so-called "expansion path"—that is, the efficient relationship between  $x_1$  and  $x_2$ .

- 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  $q=80$ , and the isoquant for  $q=120$ .



(3) [Cost minimization: 10 pts] Suppose a firm wishes to produce 12 units of output per hour at minimum cost. Machines cost \$40 per hour to rent and workers must be paid \$10 per hour. The firm's hourly production function is given by  $q = x_1^{0.5} x_2^{0.5}$ , where  $x_1$  denotes the number of machines and  $x_2$  denotes the number of workers.

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

- b. 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. Compute the total cost to produce 12 units of output,  $TC(12)$ .

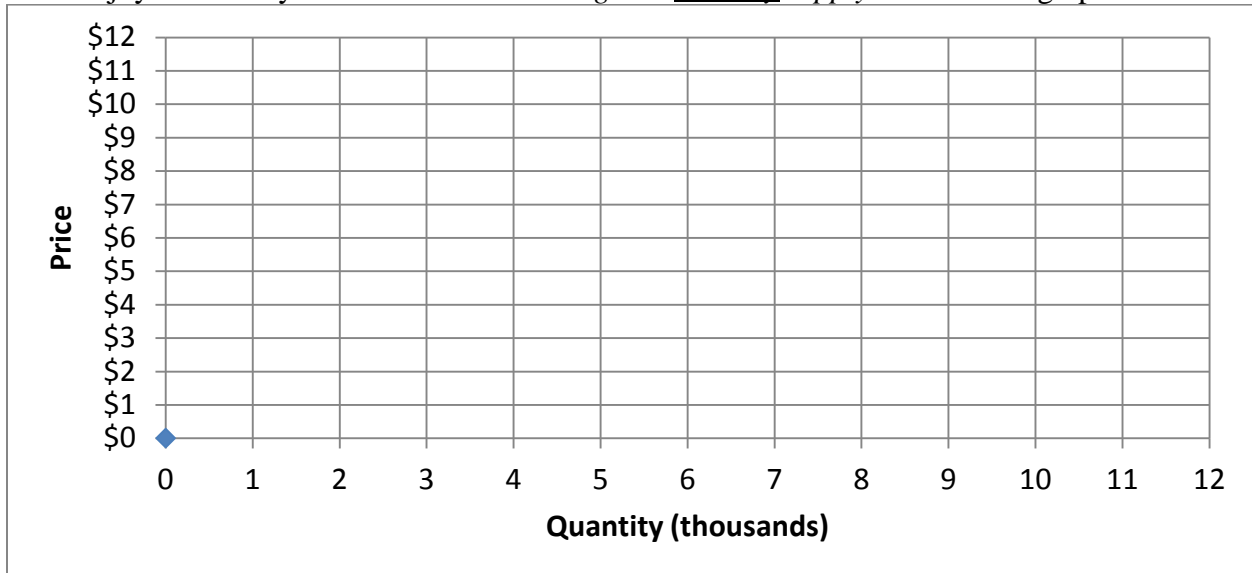
(4) [Long-run profit maximization and supply: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by  $TC(q) = 0.2q^3 - 2q^2 + 7q$ .

- a. Compute the typical 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 effects of tax or subsidy: 15 pts] Suppose demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

Demand:

$$P_D = 14 - (Q/10)$$

Supply:

$$P_S = 2 + (Q/20)$$



First consider the market without government intervention.

- a. Compute the equilibrium price and quantity.

Now suppose the government offers a **subsidy of \$3** per unit.

- b. Compute the new equilibrium quantity.

c. Does consumer surplus *increase* or *decrease* as a result of the subsidy? By how much?

d. Does producer surplus *increase* or *decrease* as a result of the subsidy? By how much?

e. Does society as a whole *gain* or *lose* as a result of the subsidy? By how much?

**IV. CRITICAL THINKING:** Answer just *one* of the questions below (your choice). [4 pts]

(1) Suppose a firm with two factories wants to produce 20 units of output at the lowest possible combined total costs. Factory A has total cost function  $TC_A(q_A) = 0.5 q_A^2 + 4 q_A + 5$ . Meanwhile, Factory B has total cost function  $TC_B(q_B) = 0.5 q_B^2 + 3$ . How much should each factory produce to meet the output target  $q_A + q_B = 20$  while minimizing combined total firm costs  $TC(q_A) + TC(q_B)$ ? Explain your reasoning and show your work.

(2) Consider again short-answer question (2), which gives a graph of a firm's short-run cost curves. The firm's fixed cost is not shown in the graph but it can be inferred. Compute the firm's short-run fixed cost. Explain your reasoning and show your work.

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]