

**EXAMINATION #3 VERSION A**  
**“Firms and Competition”**  
**October 26, 2017**

**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—9 pts total]

- (1) Suppose a production function is given by  $q = 20 x_1^{1/4} x_2^{3/4}$ . The number (1/4) equals the
- marginal product of input #1.
  - marginal rate of substitution in production.
  - returns to scale.
  - elasticity of output with respect to input #1.

The next two questions refer to the following information. A certain kind of machine can produce 100 units of output per hour if it is operated by 3 workers. Fewer workers cannot operate the machine and extra workers contribute nothing. Let  $x_1$  denote the number of machines in use of this type. Let  $x_2$  denote the number of workers assigned to operate these machines. Let  $q$  denote output per hour.

- (2) The equation for the firm’s expansion path is
- $1 = 3$ .
  - $x_1 = (1/3) x_2$ .
  - $x_1 = 3 x_2$ .
  - $100 = x_1 + 3 x_2$ .
  - $100 = x_1 x_2^3$ .

- (3) The formula for the firm’s production function is

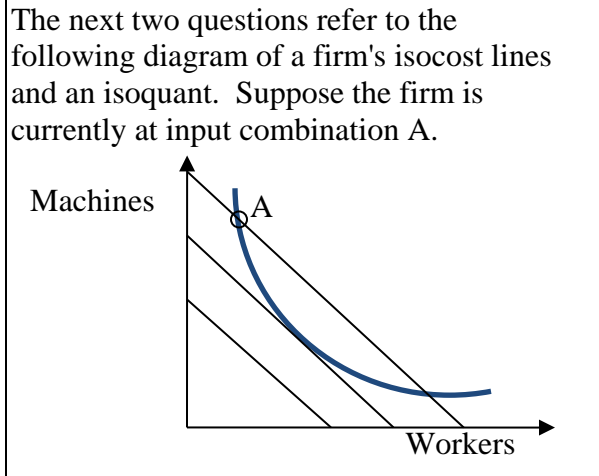
- $q = x_1 + 3x_2$ .
- $q = x_1 + (1/3) x_2$ .
- $q = 100 \min\{x_1, 3x_2\}$ .
- $q = 100 \min\{x_1, (x_2/3)\}$ .
- $q = 100 x_1 x_2^3$ .
- $q = 100 x_1 x_2^{1/3}$ .

- (4) “Economies of scale” means that the firm’s average cost curve

- slopes up.
- slopes down.
- is horizontal.
- is vertical.

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

- revenue is less than fixed cost.
- profit is negative.
- revenue is less than producer surplus.
- revenue is less than variable cost.



- (6) 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.

- (7) 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.

- (8) Suppose the demand for argyle socks abruptly and permanently shifts to the *left* because of a permanent change in preferences. The price of argyle socks will
- rise in the short run but fall back in the long run.
  - fall in the short run but rebound in the long run.
  - rise in the short run and rise further in the long run.
  - fall in the short run and fall further in the long run.
  - remain constant in the short and long run.

- (9) Suppose the price of corn rises. The increase in long-run producer surplus goes to farmers and
- all corn buyers.
  - farmland owners.
  - food processing companies that use corn to make other products.
  - ultimate consumers of corn-based products.

**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 2% and capital input increases by 3%.

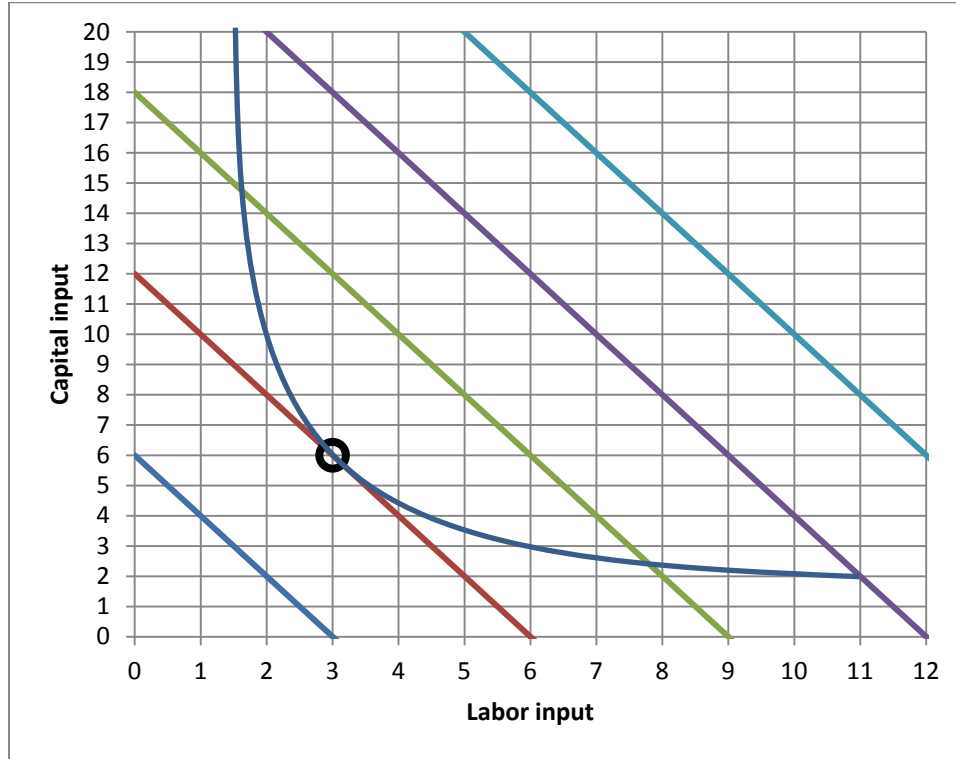
a. By how much would output increase, without any technical change?

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

	%
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(2) [LR versus SR cost: 10 pts] Firm X wants to produce 200 units of output at lowest cost. This firm must pay \$10 per hour for labor and \$5 per hour for capital. The graph below shows the firm's isoquant for 200 units of output per hour and several isocost lines. The small circle marks a tangency.



First, suppose the firm can hire whatever amounts of labor and capital it wants.

a. How many units of labor will it hire?

units
units
\$

b. How many units of capital will it hire?

c. Compute Firm X's total cost.

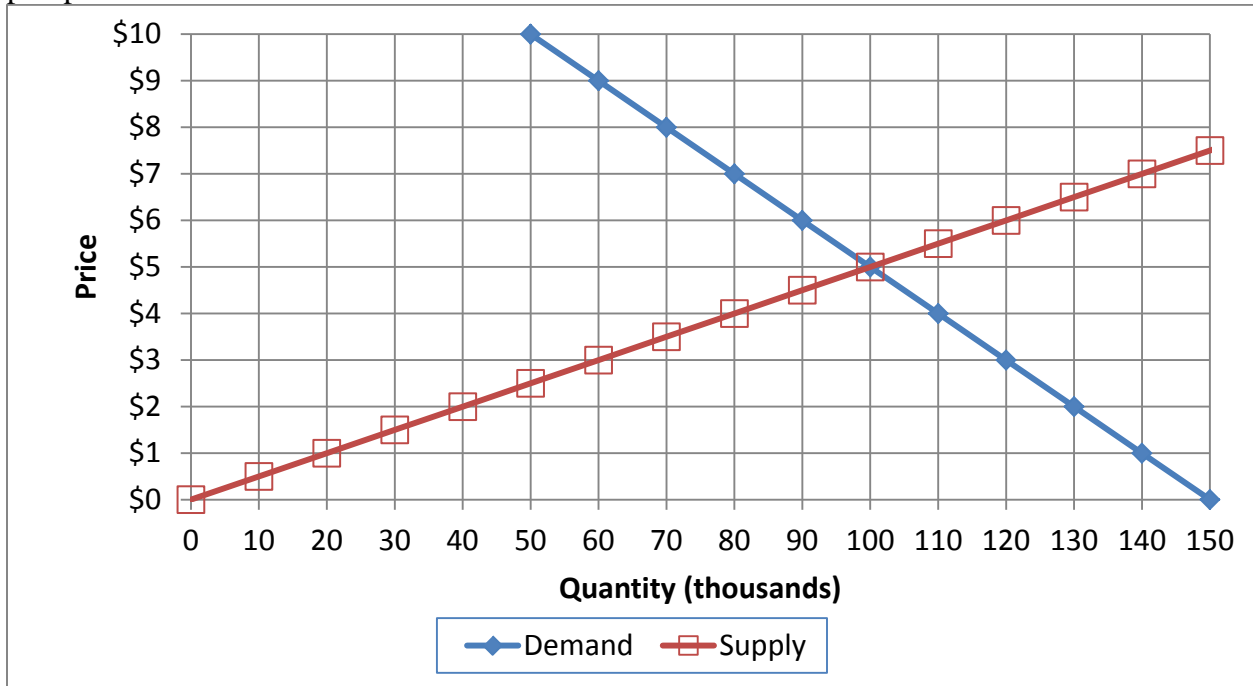
Alternatively, suppose the firm's capital input is fixed in the short run at 3 units, but the firm's labor input is variable. The firm still wants to produce 200 units of output.

d. How many units of labor will it hire?

units
\$

e. Compute Firm X's total cost in the short run.

(3) [Welfare analysis of market controls: 16 pts] The following graph shows the market for pumpkins.



Suppose the government imposes a **price ceiling (or legal maximum price) of \$ 4** . No pumpkins may be sold for a price more than the price ceiling.

- How many pumpkins will actually be sold?
- Will there be *excess demand*, *excess supply*, or *neither*?
- How much?
- Does producer surplus *increase*, *decrease*, or *remain constant* because of the price ceiling, as compared to the market without government intervention?
- By how much?
- Does consumer surplus *increase*, *decrease*, or *remain constant* because of the price ceiling, as compared to the market without government intervention? (Assume optimistically that pumpkins are purchased by those consumers who value pumpkins the most.)
- By how much?
- Compute the deadweight social loss caused by the price ceiling.

	thousand
	thousand
\$	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  $q = 2x_1^{1/2} + 4x_2^{1/2}$ .

- 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) [Cost minimization: 10 pts] ] Suppose a firm wishes to produce 200 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  $q = 4 x_1^{1/2} x_2^{1/2}$ , 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 200 units of output,  $TC(200)$ .

(3) [Short-run profit maximization and supply: 12 pts] Suppose a firm faces short-run fixed cost of \$8 and short-run variable cost given by  $SVC(q) = 0.5q^2 + q$ , where  $q$  denotes the number of units of output. Suppose the market price is \$11.

- a. How much output  $q$  will the firm produce in order to maximize profit? Show your work and circle your final answer.

- b. Compute the firm's profit at this price.

- c. Compute the firm's breakeven price—the minimum price at which it will avoid losses. Show your work and circle your final answer.

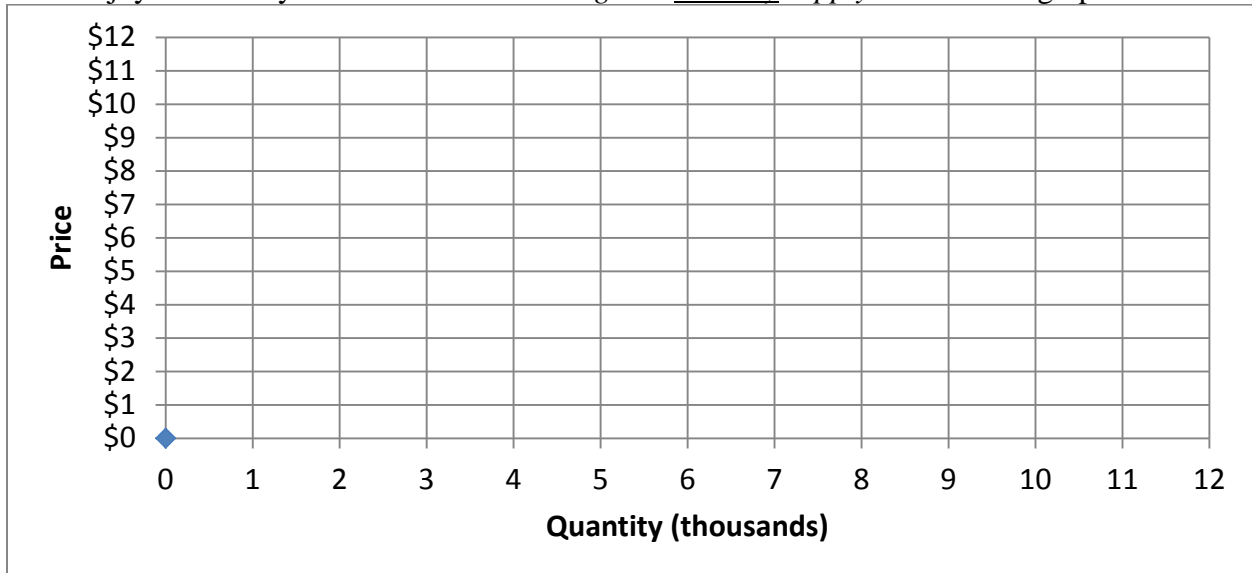
(4) [Long-run profit maximization and supply: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by  $TC(q) = 0.05q^3 - 2q^2 + 28q$ .

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 international trade: 15 pts] Suppose domestic demand and supply for a good are given by the following equations. Answer the questions below. Show your work and circle your final answers. (Use the graph at right for scratch work.)

Domestic demand:

$$Q_D = 2000 - 100 P$$

Domestic supply:

$$Q_S = 200 P - 100$$



First consider the market without international trade.

a. Compute the equilibrium price and quantity.

Now suppose the market is opened to international trade, and the world price of the good turns out to be **\$6**.

b. Will the country now *import* or *export* the good? How much?

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

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

e. Does the country as a whole *gain* or *lose* as a result of international trade? By how much?

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

(1) Suppose a competitive producer wants to maximize profit. Should it choose a level of output where average cost is lowest, regardless of price? Why or why not? Illustrate your answer with a graph of the producer's cost curves.

(2) Suppose a tax of \$3 is placed on calculators, and as a consequence, the number of calculators sold falls from 20 million to 16 million. 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 good grammar, legible writing, accurate spelling, and correct reasoning.



[end of exam]