

EXAMINATION #3 VERSION B
“Firms and Competition”
October 25, 2018

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—14 pts total]

(1) Suppose a production function is given by $q = 30 x_1^{1/3} x_2^{2/3}$. Then the average product of input #2 is given by

- a. $20 x_1^{1/3} x_2^{-1/3}$.
- b. $30 x_1^{1/3} x_2^{-1/3}$.
- c. $10 x_1^{-2/3} x_2^{2/3}$.
- d. $30 x_1^{-2/3} x_2^{2/3}$.

(2) The production function

$$q = 2 x_1^{1/3} x_2^{1/3}$$

shows

- a. constant returns to scale.
- b. decreasing returns to scale.
- c. increasing returns to scale.
- d. cannot be determined from the information given.

(3) Without any technical change, one would expect output to increase by

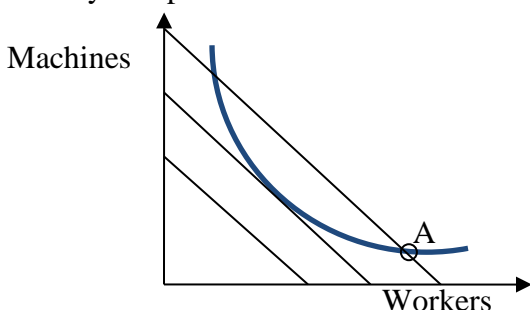
- a. 0%.
- b. 1%.
- c. 2%.
- d. 3%.
- e. 4%.
- f. 5%.
- g. 6%.
- h. 7%.

(4) If in fact output increases by 5%, then the Solow residual (that is, the increase in multifactor productivity) is

- a. 0%.
- b. 1%.
- c. 2%.
- d. 3%.
- e. 4%.
- f. 5%.
- g. 6%.
- h. 7%.

The next two questions refer to the following information. The elasticity of output with respect to labor for the US economy as a whole is about $2/3$. The elasticity of output with respect to capital is about $1/3$. Suppose labor input increases by 2% and capital input increases by 5%.

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
- using fewer machines and more workers.
 - using more machines and fewer workers.
 - either (a) or (b).
 - neither (a) nor (b).
 - 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,
- $MP_2/MP_1 < w_2/w_1$.
 - $MP_2/MP_1 > w_2/w_1$.
 - $MP_2/MP_1 = w_2/w_1$.
 - $MP_2 = MP_1$ and $w_2 = w_1$.
 - cannot be determined from information given.

- (7) If a firm has decreasing returns to scale in production, then its average cost curve will show
- economies of scale.
 - diseconomies of scale.
 - constant average cost.
 - cannot be determined from information given.

- (8) Suppose at 100 units of output, Acme Company's marginal cost is \$4 and its average cost is \$3. Then at this level of output, Acme's average cost curve
- slopes up.
 - slopes down.
 - is horizontal.
 - cannot be determined from information given.

- (9) In the short run, a firm should continue to operate only if its revenue is greater than its
- total cost.
 - producer surplus.
 - fixed cost.
 - variable cost.

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

- (11) Price equals *marginal* cost in markets which are in
- short-run competitive equilibrium.
 - long-run competitive equilibrium.
 - either short-run or long-run competitive equilibrium.
 - none of the above.

- (12) 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
- is horizontal (zero slope).
 - is vertical (infinite slope).
 - slopes up (positive slope).
 - slopes down (negative slope).
 - cannot be determined from information given.

(13) A *potential Pareto improvement* (also called an *economically efficient change*) is defined as a change in the economy where

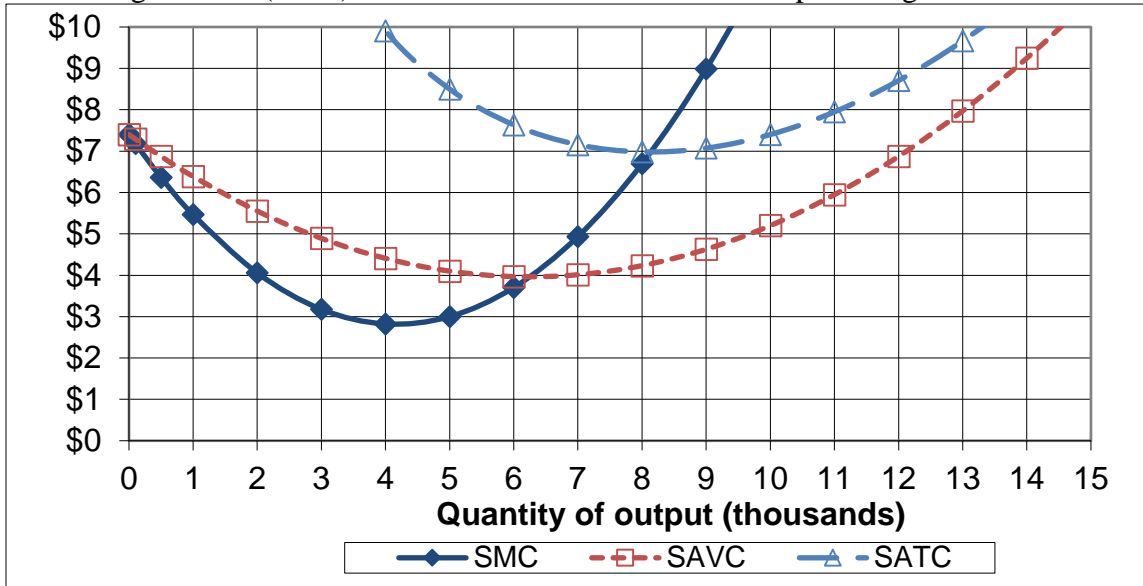
- a. everyone gains.
- b. at least one person gains.
- c. at least one person gains and no one loses.
- d. the gains to the winners exceed the losses to the losers.

(14) The number of lawnmowers actually sold would *decrease* if the government enacted a

- a. a price ceiling (or legal maximum price) for lawnmowers.
- b. a price floor (or legal minimum price) for lawnmowers.
- c. a quota on sellers of lawnmowers.
- d. a tax on lawnmowers.
- 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) [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 \$9, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$3, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$5, about how much output will ACME try to produce (to the nearest thousand)?
- What is ACME's *shutdown price*—that is, the lowest price at which ACME will continue to operate in the short run?
- What is ACME's *breakeven price*—that is, the lowest price at which ACME can produce output without making losses in the short run?

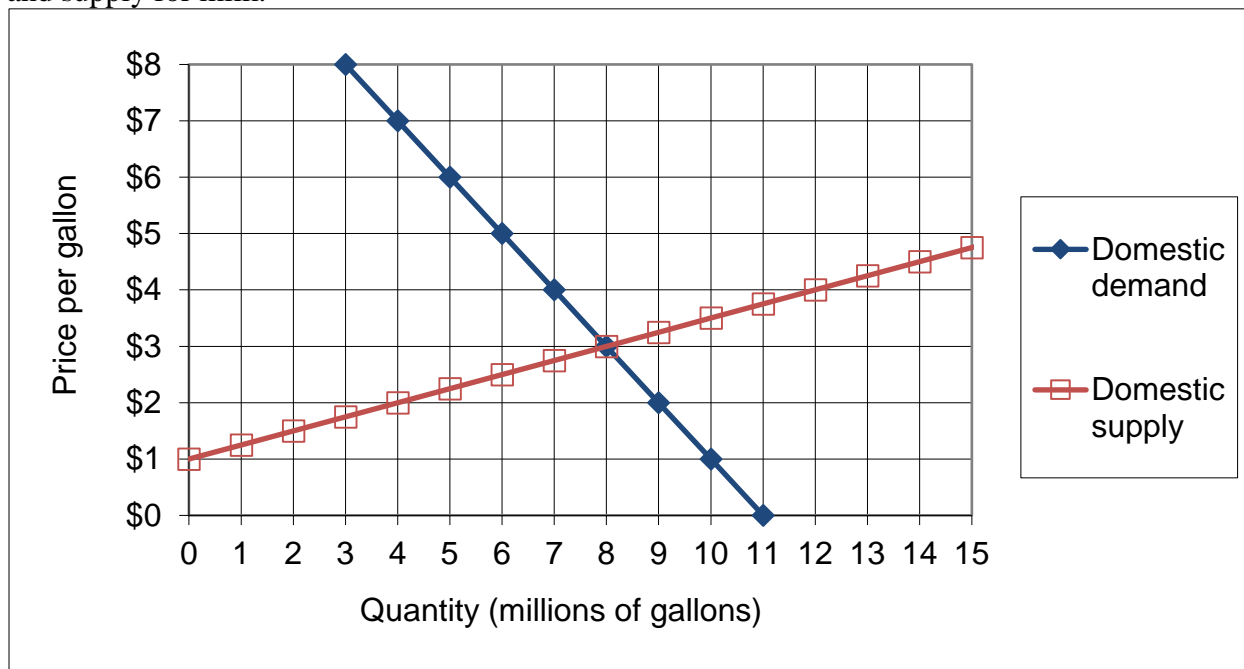
thousand
thousand
thousand
\$
\$

(2) [Cost minimization across firms: 6 pts] Firm A and Firm B must together produce a total of 100 units of output at *minimum total cost*. Firm A's marginal cost is given by $MC_A = 5 + (q_A/10)$, where q_A denotes Firm A's output level. Firm B's marginal cost is given by $MC_B = 3 + (q_B/20)$, where q_B denotes Firm B's output level.

- What output level q_A should be produced by Firm A?
- What output level q_B should be produced by Firm B?
- Suppose Firm A and Firm B are competitive firms, taking price as given. What market price would motivate Firm A and Firm B to produce these output levels?

\$

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



At first, international trade in milk is not permitted. Then this industry is opened to international trade and the international price of milk turns out to be \$ 4.

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

	million gallons
\$	million
\$	million
\$	million

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 $q = (x_1 + x_2)^2$.

- 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) [Fixed-proportions technology: 11 pts] Suppose a particular machine can produce 40 units of output per hour if it is operated by four workers. This machine cannot be operated by fewer than four 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 four 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.

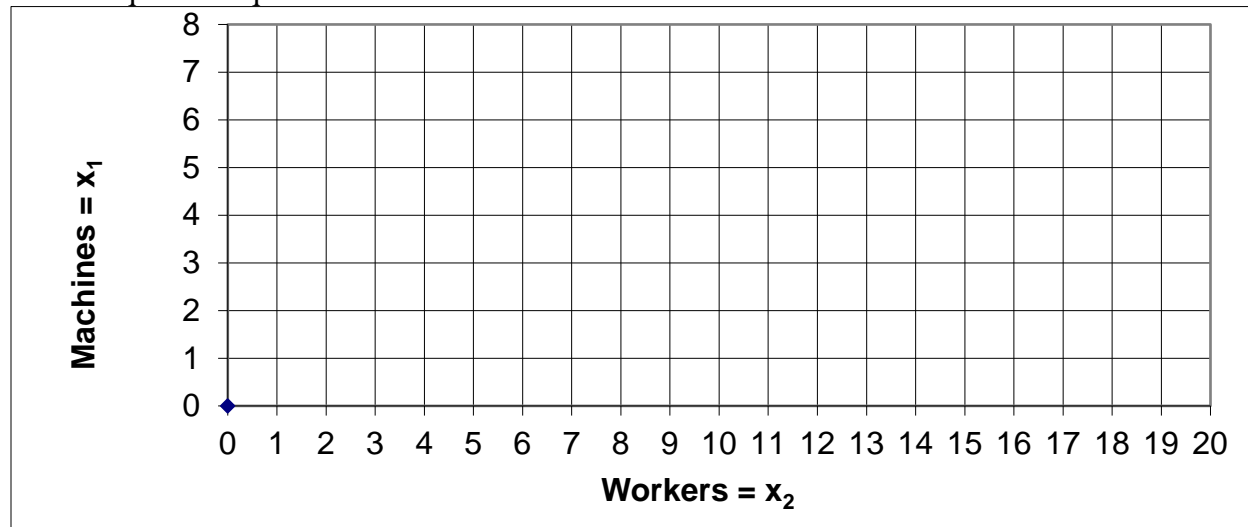
a. Give an equation for the firm's so-called "expansion path"—that is, the efficient relationship between x_1 and x_2 .

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 (i) the firm's expansion path, (ii) the isoquant for $q=40$, and (iii) the isoquant for $q=160$.



(3) [Cost minimization: 10 pts]] Suppose a firm wishes to produce 30 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 \$1 per hour to rent and workers must be paid \$9 per hour.

- 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 30 units of output, $TC(30)$.

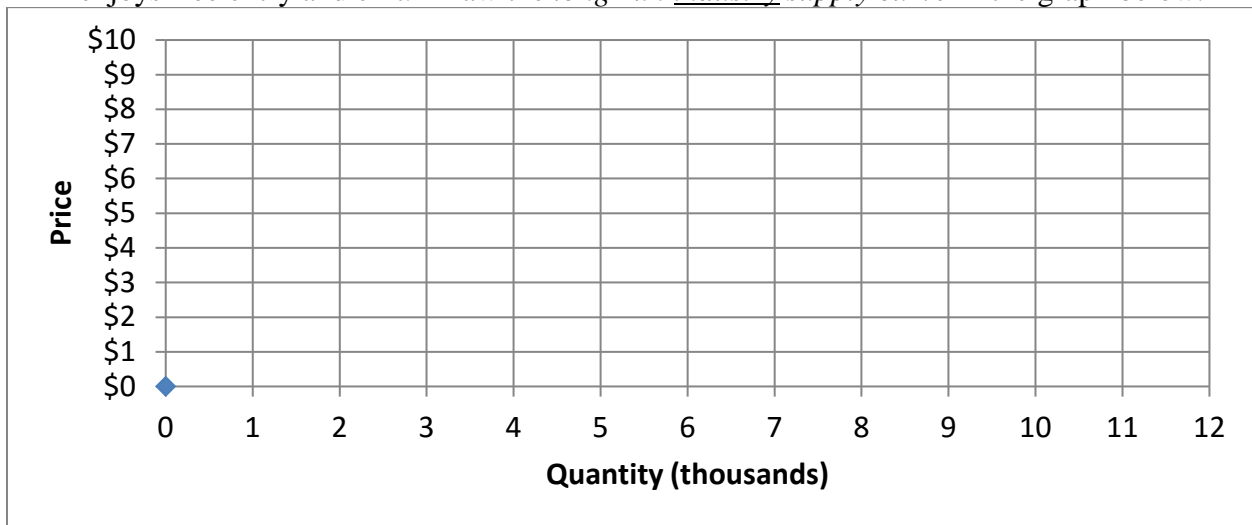
(4) [Long-run profit maximization and supply: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.01q^3 - 0.4q^2 + 8q$.

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: 10 pts] Suppose demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

Demand:

$$P_D = 20 - (Q/10)$$

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**.

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). [3 pts]

(1) A good that is manufactured for a national market (such as automobiles, electronics, etc.) may have a perfectly elastic 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.

(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 good grammar, legible writing, accurate spelling, and correct reasoning.



[end of exam]