

EXAMINATION #3 VERSION A
“Firms and Competition”
October 24, 2019

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—11 pts total]

- (1) Suppose a production function is given by $q = 30 x_1^{1/3} x_2^{2/3}$. The number $(1/3)$ equals the
- marginal product of input #1.
 - marginal rate of substitution in production.
 - returns to scale.
 - elasticity of output with respect to input #1.
 - average product of input #1.

The next two questions refer to the following information. A certain kind of machine can produce 50 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
- $1 = 3$.
 - $x_1 = (1/3) x_2$.
 - $x_1 = 3 x_2$.
 - $50 = x_1 + 3 x_2$.
 - $50 = x_1 x_2^3$.

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

- $q = x_1 + 3x_2$.
- $q = x_1 + (1/3) x_2$.
- $q = 50 \min\{x_1, 3x_2\}$.
- $q = 50 \min\{x_1, (x_2/3)\}$.
- $q = 50 x_1 x_2^3$.
- $q = 50 x_1 x_2^{1/3}$.

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 3% and capital input increases by 6%.

- (4) Without any technical change, one would expect output to increase by
- 0%.
 - 1%.
 - 2%.
 - 3%.
 - 4%.
 - 5%.
 - 6%.
 - 7%.

(5) If in fact output increases by 6%, 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%.

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

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

(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) Price equals average 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.

(9) 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 horizontal (zero slope).
- b. is vertical (infinite slope).
- c. slopes up (positive slope).
- d. slopes down (negative slope).
- e. cannot be determined from information given.

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

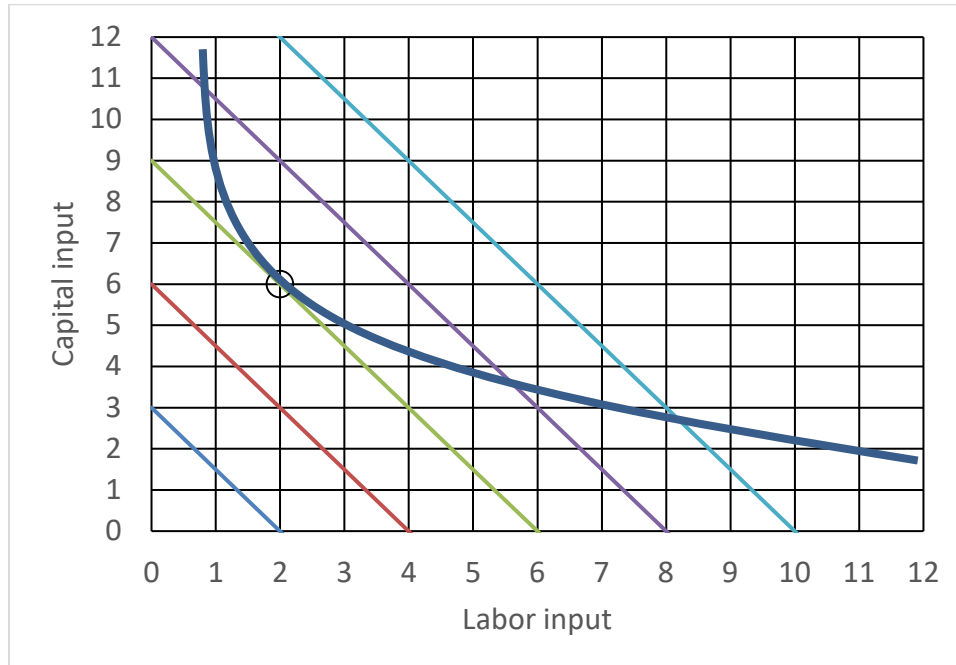
- a. everyone gains.
- b. at least one person gains.
- c. at least one person gains and no one loses.
- d. the gains to the winners exceed the losses to the losers.

(11) A quota on *buyers* of tropical fish would have basically the same effect on the market for tropical fish as

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

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

(1) [LR versus SR cost: 10 pts] Firm ABC wants to produce 100 units of output at lowest cost. This firm must pay \$15 per hour for labor and \$10 per hour for capital. The graph below shows the firm's isoquant for 100 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 capital will it hire?
- b. How many units of labor will it hire?
- c. Compute Firm X's total cost.

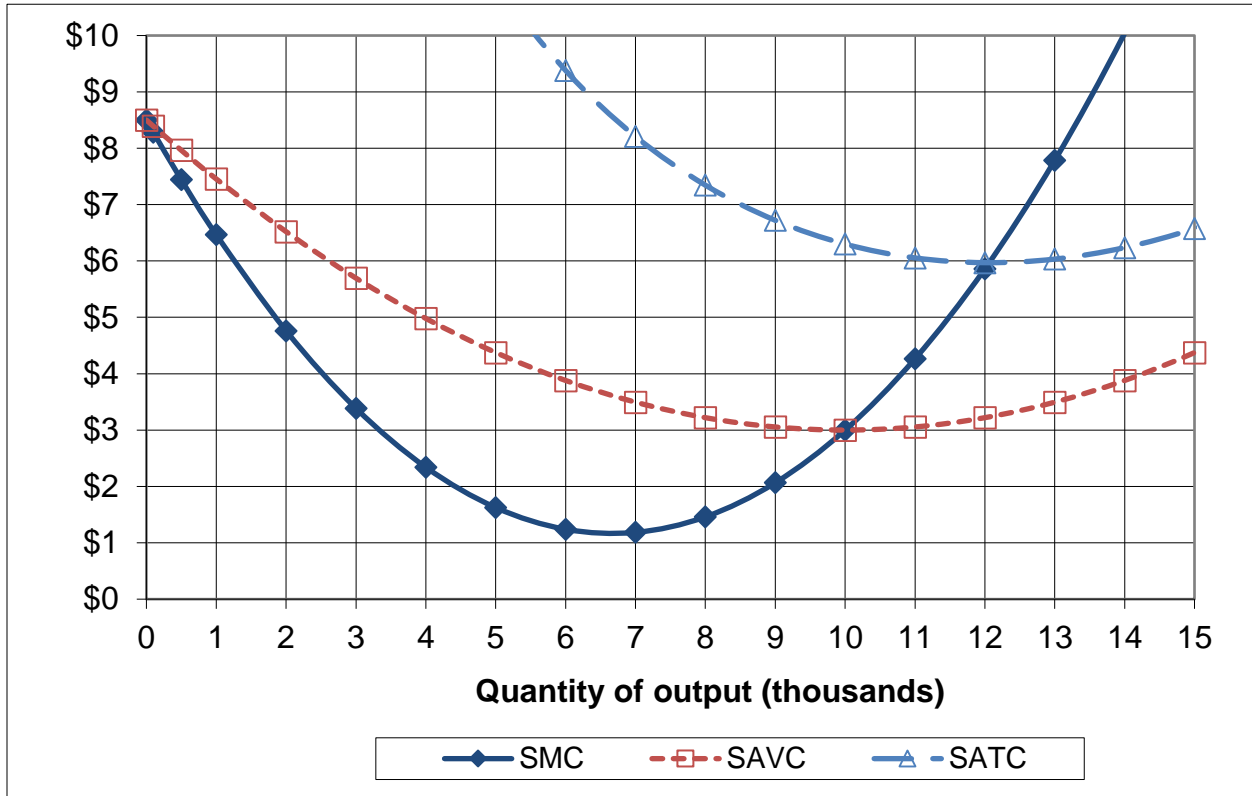
units
units
\$

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 100 units of output.

- d. How many units of labor will it hire?
- e. Compute Firm ABC's total cost in the short run.

units
\$

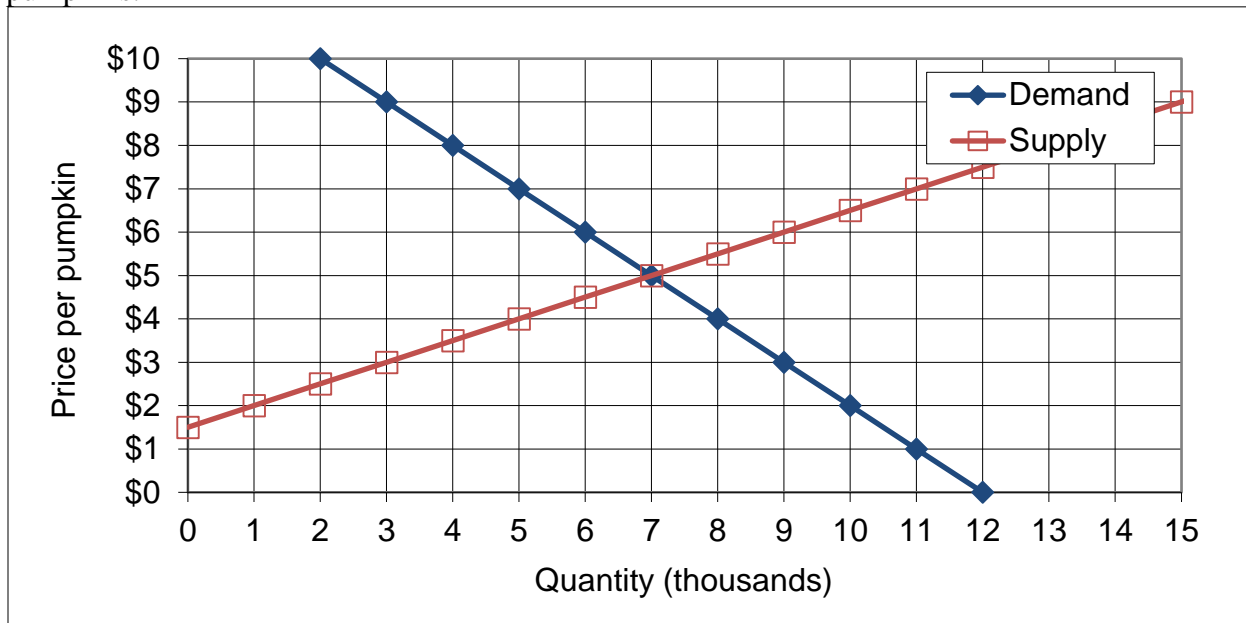
(2) [Short-run cost curves and supply: 10 pts] The following graph shows ACME Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume ACME maximizes its profit while taking the market price as given.



- If the market price is \$2, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$8, about how much output will ACME try to produce (to the nearest thousand)?
- If the market price is \$4, 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 taxes or subsidies: 20 pts] The following graph shows the market for pumpkins.



a. Find the equilibrium price without government intervention.

\$

Suppose the government imposes an excise **tax of \$ 3** per pumpkin.

b. Compute the equilibrium quantity sold.

thousand

c. Compute the equilibrium net price received by sellers (excluding the tax).

\$	per pumpkin
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d. Compute the equilibrium total price paid by buyers (including the tax).

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

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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 tax?

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h. By how much?

\$	thousand
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i. Compute the total tax revenue collected by the government.

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

\$	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: 12 pts] Suppose a production function is given by $q = 3x_1 + 2x_2 - 5$.

- 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 60 units of output per hour at minimum cost. 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. Machines cost \$2 per hour to rent and workers must be paid \$18 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 60 units of output, $TC(60)$.

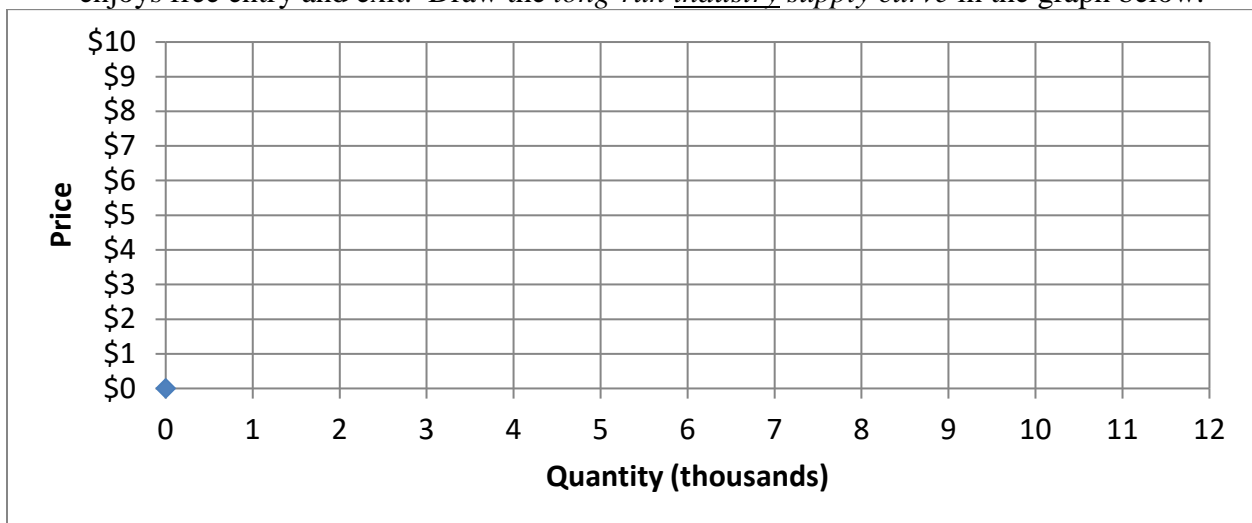
(4) [Long-run profit maximization and supply: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.01q^3 - 0.4q^2 + 10q$.

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. (Use the graph at right for scratch work.)

Demand: $Q_D = 100 - 10 P$

Supply: $Q_S = 20 P - 20$



First consider the domestic market without international trade.

- a. Compute the equilibrium price and quantity without international trade.

Now suppose the market is opened to international trade, and the world price turns out to be \$2 .

- b. Does the country *import* or *export* this 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 (consumers plus 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). [4 pts]

(1) Consider the following claim: “Unfettered competition destroys industries. When firms compete and there are no limits to entry, profits are driven to zero and all firms in the industry fail.” Do you agree or disagree? Justify your answer.

(2) Suppose a firm has a production function with three inputs: $q = x_L^{0.5} x_K^{0.25} x_E^{0.25}$, where x_L denotes labor, x_K denote capital, and x_E denotes energy. The price of labor is \$16. The price of capital is \$4. The price of energy is \$1. Suppose the firm wants to produce 100 units of output at least possible cost. *What equations must be solved* to find the required values of x_L , x_K , and x_E ? (No need to solve these equations.) [Hint: there must be at least three equations for three unknowns.]

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]