ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2023
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EXAMINATION 3 VERSION B
"Firms and Competition"
October 26, 2023

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—16 pts total]

(1) A firm's *isoquants* are level curves of the firm's
a. average cost function.
b. profit function.
c. production function.
d. total cost function.

(2) Given the production function $q = x_1^{1/3} x_2^{2/3}$, the value (2/3) is
a. the marginal product of input 2.
b. the elasticity of output with respect to input 2.
c. the average product of input 2.
d. the marginal rate of substitution in production of input 2 for input 1.

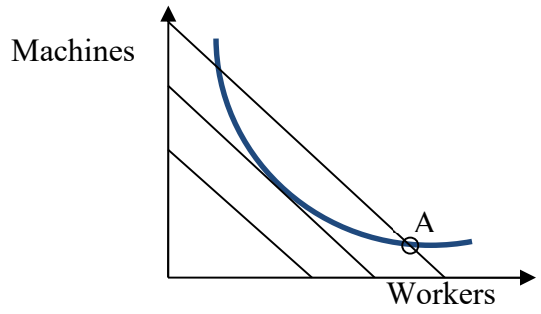
(3) Suppose that in a certain production process, doubling all inputs causes output to triple. Then the production process is characterized by
a. constant returns to scale.
b. increasing returns to scale.
c. decreasing returns to scale.
d. homogeneity of degree zero.

The next two questions refer to the following information. A certain kind of machine can produce 50 units of output if it is operated by 4 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.

(4) The equation for the firm's expansion path is
a. $50 = x_1 + 4 x_2$.
b. $50 = x_1 x_2^4$.
c. $1 = 4$.
d. $x_1 = (1/4) x_2$.
e. $x_1 = 4 x_2$.

(5) The formula for the firm's production function is
a. $q = x_1 + 4x_2$.
b. $q = x_1 + (1/4) x_2$.
c. $q = 50 \min\{x_1 , 4x_2\}$.
d. $q = 50 \min\{x_1, (x_2/4)\}$.
e. $q = 50 x_1 x_2^4$.
f. $q = 50 x_1 x_2^{1/4}$.

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.



(6) This firm could lower its total cost, without reducing output, by
a. using fewer machines and more workers.
b. using more machines and fewer workers.
c. either (a) or (b).
d. neither (a) nor (b).
e. 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,
a. $MP_2/MP_1 < w_2/w_1$.
b. $MP_2/MP_1 > w_2/w_1$.
c. $MP_2/MP_1 = w_2/w_1$.
d. $MP_2 = MP_1$ and $w_2 = w_1$.
e. cannot be determined from information given.

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(8) If a firm's average cost curve is flat then it is said to have
a. economies of scale.
b. diseconomies of scale.
c. None of the above.
d. Cannot be determined from information given.

(9) A firm's so-called "efficient scale" is the level of output where
a. average cost is minimized.
b. output is maximized.
c. marginal cost is minimized.
d. total cost is minimized.

(10) 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.

(11) 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.

(12) When firms enter 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.

(13) *Price equals marginal cost* in a competitive industry in both short-run and long-run equilibrium because
a. business owners have a sense of fairness.
b. individual firms adjust their output levels to maximize profit.
c. consumers refuse to pay more than what is reasonable.
d. positive profits encourage entry of new firms while negative profits encourage existing firms to leave the industry.
e. the threat of government regulation causes firms to hold prices down.

(14) 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.

(15) 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.

(16) 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.

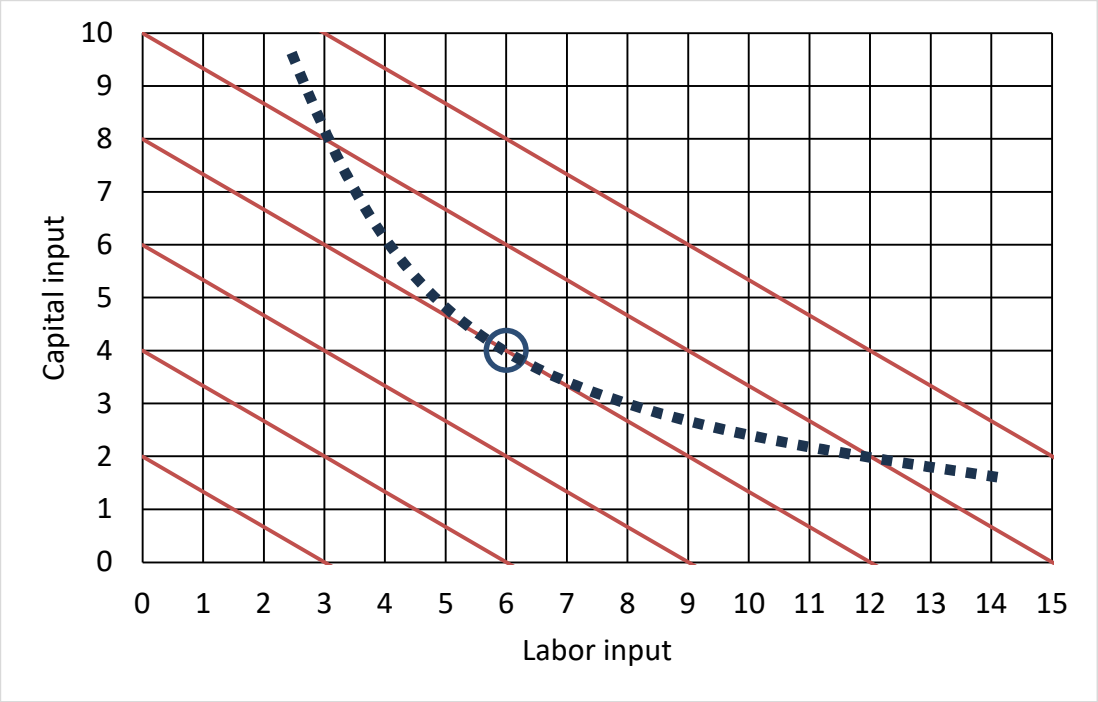
II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Technical change: 4 pts] Suppose the elasticity of output with respect to labor input for the US economy as a whole is about 0.75, and the elasticity of output with respect to capital input is about 0.25. Further suppose labor input increases by 4% and capital input increases by 8%.

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

b. Suppose output in fact increases by 8%. What is the increase in multifactor or total factor productivity (also called the Solow residual)? ____ %

(2) [Cost minimization; Cost in the short run: 10 pts] A firm wants to produce 100 units of output at lowest cost. This firm must pay \$10 per hour for labor and \$15 per hour for capital. The graph below shows the firm's isoquant for 100 units of output per hour as a dashed curve and several isocost lines as solid 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? ____ units

b. How many units of labor will it hire? ____ units

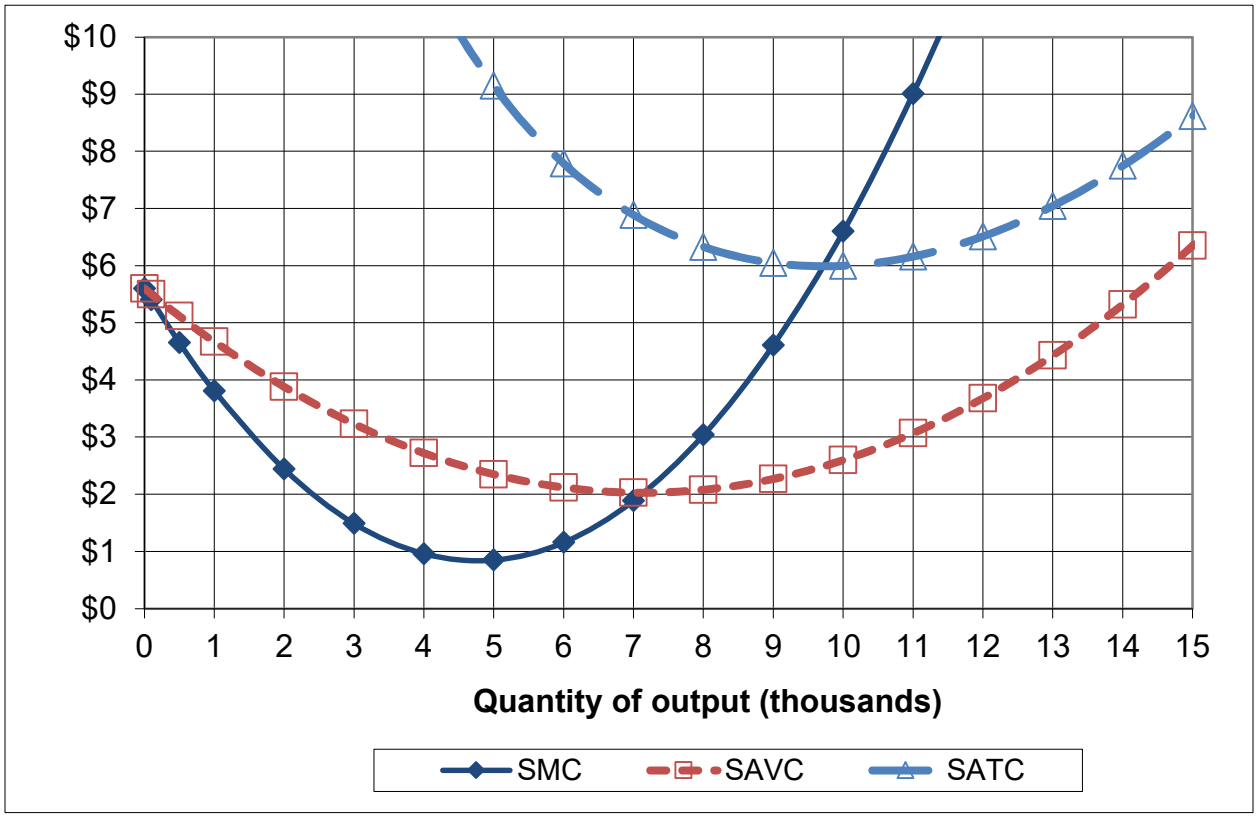
c. Compute the firm's total cost. \$ ____

Alternatively, suppose the firm's capital input is fixed in the short run at 8 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? ____ units

e. Compute the firm's total cost in the short run. \$ ____

(3) [Profit maximization in the short run: 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.



a. If the market price is \$1, about how much output will ACME try to produce (to the nearest thousand)? ____ thousand

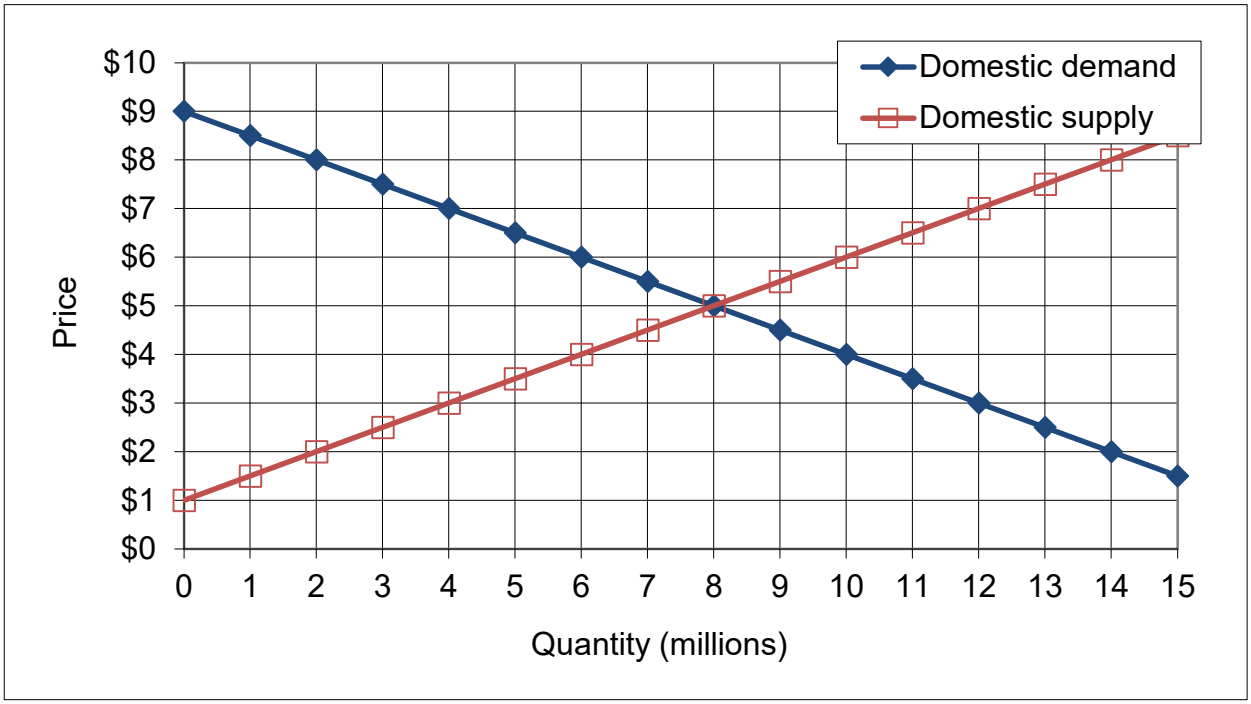
b. If the market price is \$3, about how much output will ACME try to produce (to the nearest thousand)? ____ thousand

c. If the market price is \$9, about how much output will ACME try to produce (to the nearest thousand)? ____ thousand

d. What is ACME's *breakeven price*—that is, the lowest price at which ACME can produce output without making losses in the short run? \$ ____

e. What is ACME's *shutdown price*—that is, the lowest price at which ACME will continue to operate in the short run? \$ ____

(4) [Welfare effects of international trade: 16 pts] The following graph shows domestic demand and supply for stocking caps in some country.



At first, international trade in stocking caps is not permitted. Then this industry is opened to international trade and the international price of stocking caps turns out to be **$ 7.**

a. Will this country now *export* or *import* stocking caps?	
b. How much?	million
c. Does consumer surplus in this country *increase* or *decrease* from international trade in stocking caps?	
d. By how much?	$ million
e. Does producer surplus in this country *increase* or *decrease* from international trade in stocking caps?	
f. By how much?	$ million
g. Does total social welfare in this country *increase* or *decrease* from international trade in stocking caps?	
h. By how much?	$ million

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

(1) [Input substitution; Returns to scale: 12 pts] Suppose a production function is given by

$$q = 3\, x_1^{2/3}\, x_2^{2/3}\,.$$

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 30 units of output per hour at minimum cost. The firm's hourly production function is given by $q = 2\, x_1^{1/2}\, x_2^{1/2}$, where x_1 denotes the number of machines and x_2 denotes the number of workers (measured in hours of service). Machines cost \$90 per hour to rent and workers must be paid \$10 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).

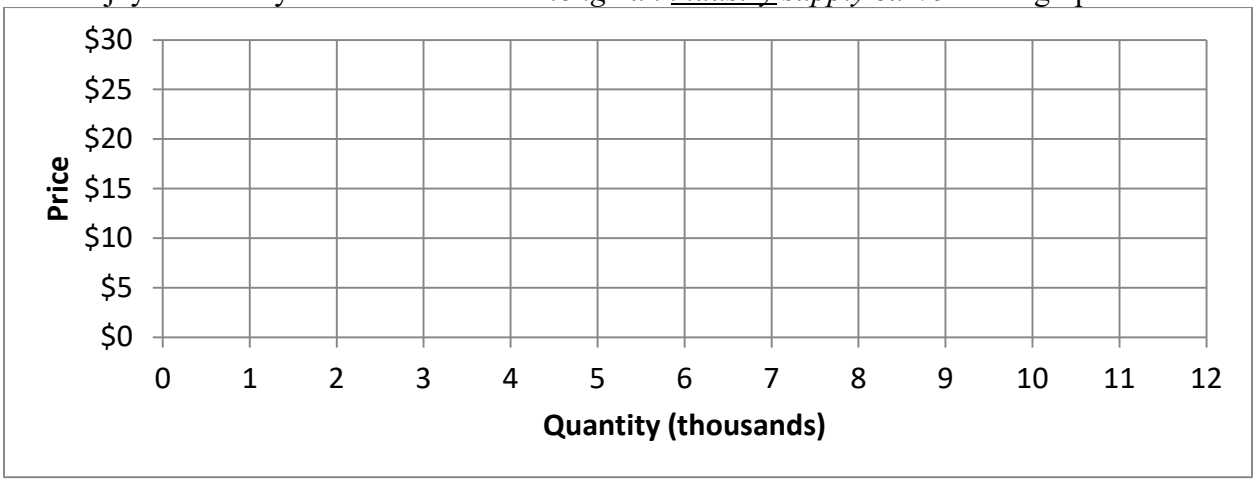
(3) [Cost curves; Long-run market equilibrium: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.01\,q^3 - q^2 + 35\,q$.

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. Describe with equations the *firm's supply curve*. What happens when the market price is above the breakeven price? When the market price is below the breakeven price?

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.



(4) [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 imposes an **excise tax of $3 per unit.**

b. Compute the new equilibrium quantity.

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

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

e. Does society as a whole (including the government) *gain* or *lose* as a result of the tax? By how much?

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

(1) When a firm goes bankrupt under chapter 7, its creditors (banks and suppliers) can take control of the firm. Usually, the creditors are anxious to keep the firm operating in the short run, even though it is losing money. Why? (Ignore the graph.)

(2) Suppose supply of a good is *perfectly **in**elastic*. If the good is taxed, who bears the burden of the tax—buyers, sellers, or both? Justify your answer with a supply-and-demand graph. Label all axes and curves.

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]