ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2025
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Signature: _____

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EXAMINATION 3 VERSION B
"Firms and Competition"
October 27, 2025

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) The *marginal product of capital* is the increase in output from a one-unit increase in capital input while holding constant
a. prices of all inputs.
b. the firm's profit.
c. the output price.
d. the quantity of other inputs.

(2) The *marginal rate of substitution* of labor for capital is the additional amount of capital required when labor input is reduced by one unit, while holding constant
a. the firm's profit.
b. the output price.
c. the quantity of output.
d. prices of all inputs.

(3) By definition, total output is constant all along
a. an isoquant.
b. an expansion path.
c. a supply curve.
d. an isocost line.
e. a total cost curve.

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.

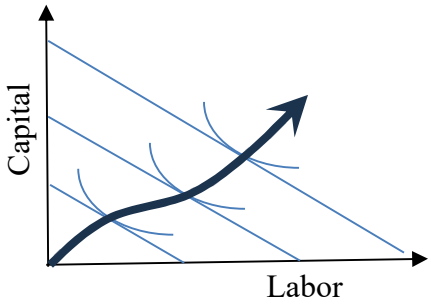
(4) The equation for the firm's expansion path is
a. $50 = x_1 + 4\,x_2$.
b. $50 = x_1\,x_2^4$.
c. $1 = 4$.
d. $x_1 = (1/4)\,x_2$.
e. $x_1 = 4\,x_2$.

(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. $q = 50\,x_1\,x_2^{1/4}$.

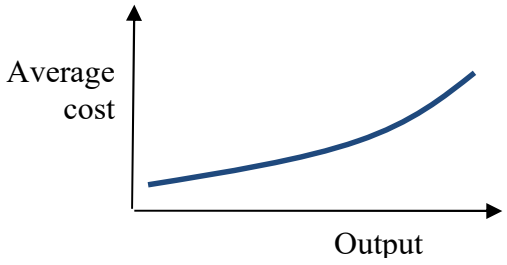
(6) Suppose that in a certain production process, doubling all inputs causes output to less than double. Then the production process is characterized by
a. constant returns to scale.
b. increasing returns to scale.
c. decreasing returns to scale.
d. homogeneity of degree zero.

(7) Suppose a firm uses both labor and capital to produce some output. Along an *isocost line*, what is held constant?
a. the firm's total cost.
b. the firm's total output.
c. the firm's average cost.
d. the firm's marginal cost.

(8) The heavy curve in the graph below is called
a. a profit function.
b. an expansion path.
c. an isoquant.
d. a total cost curve.



(9) The average cost curve below depicts
a. economies of scale.
b. diseconomies of scale.
c. economies of scale at low levels of output and diseconomies of scale at high levels of output.
d. neither economies of scale nor diseconomies of scale.



(10) If a firm's marginal cost is lower than its average cost, then the average cost curve must be
a. downward-sloping.
b. upward-sloping.
c. horizontal.
d. vertical.

(11) In the short run, a firm's so-called "shutdown price" is equal to the minimum of its
a. total cost curve.
b. average variable cost curve.
c. marginal cost curve.
d. average total cost curve.

(12) When firms exit 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) In *short-run* competitive equilibrium,
a. price equals marginal cost.
b. price equals average cost.
c. average cost equals marginal cost.
d. all of the above.

(14) Suppose the demand for pomegranate juice suddenly and permanently shifts to the *left* 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.

(15) 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.

(16) A quota on *buyers* of baseball bats would have basically the same effect on the market for baseball bats as
a. a price ceiling on baseball bats.
b. a price floor on baseball bats.
c. a tax on baseball bats.
d. a subsidy for baseball bats.
e. a free market for baseball bats.

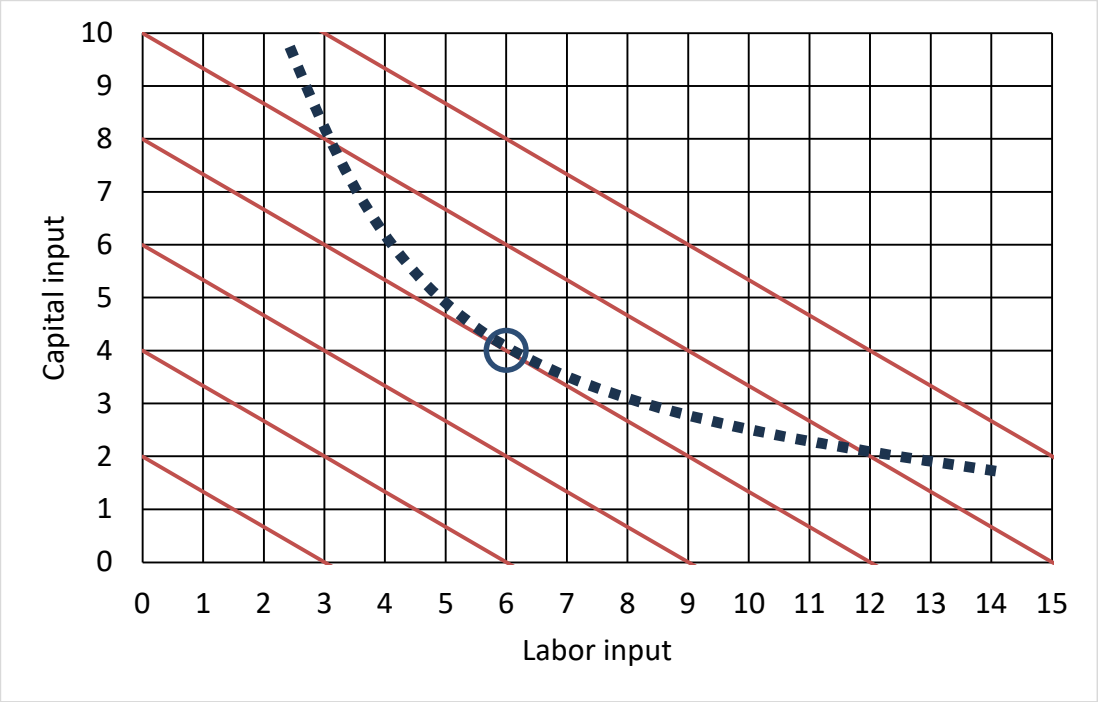
II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Technical change: 4 pts] Suppose the elasticity of output with respect to labor input for the US economy as a whole is about 0.6, and the elasticity of output with respect to capital input is about 0.4. Further suppose labor input increases by 3% 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 \$20 per hour for labor and \$30 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

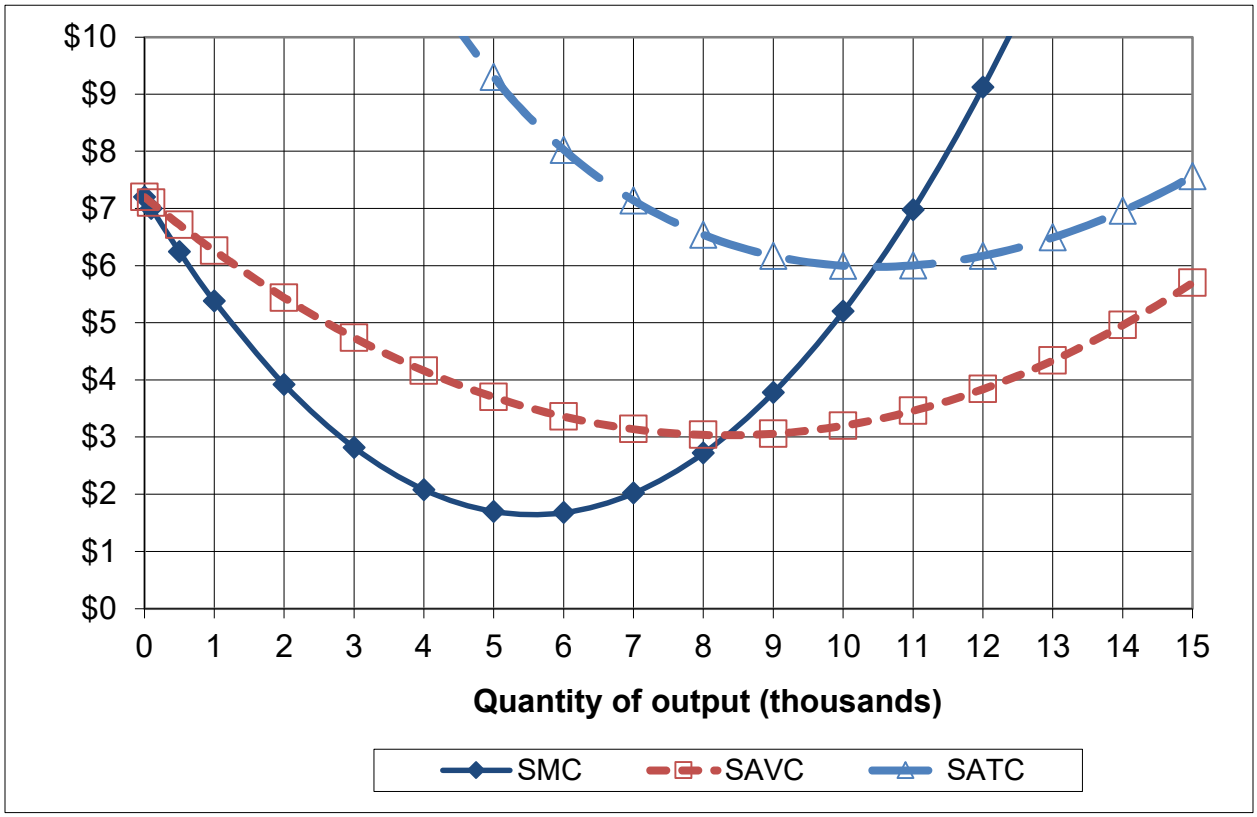
c. Compute the firm's total cost. \$ ____

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 Bulldog Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume Bulldog maximizes its profit while taking the market price as given.



a. If the market price is \$2, about how much output will Bulldog try to produce (to the nearest thousand)? ____ thousand

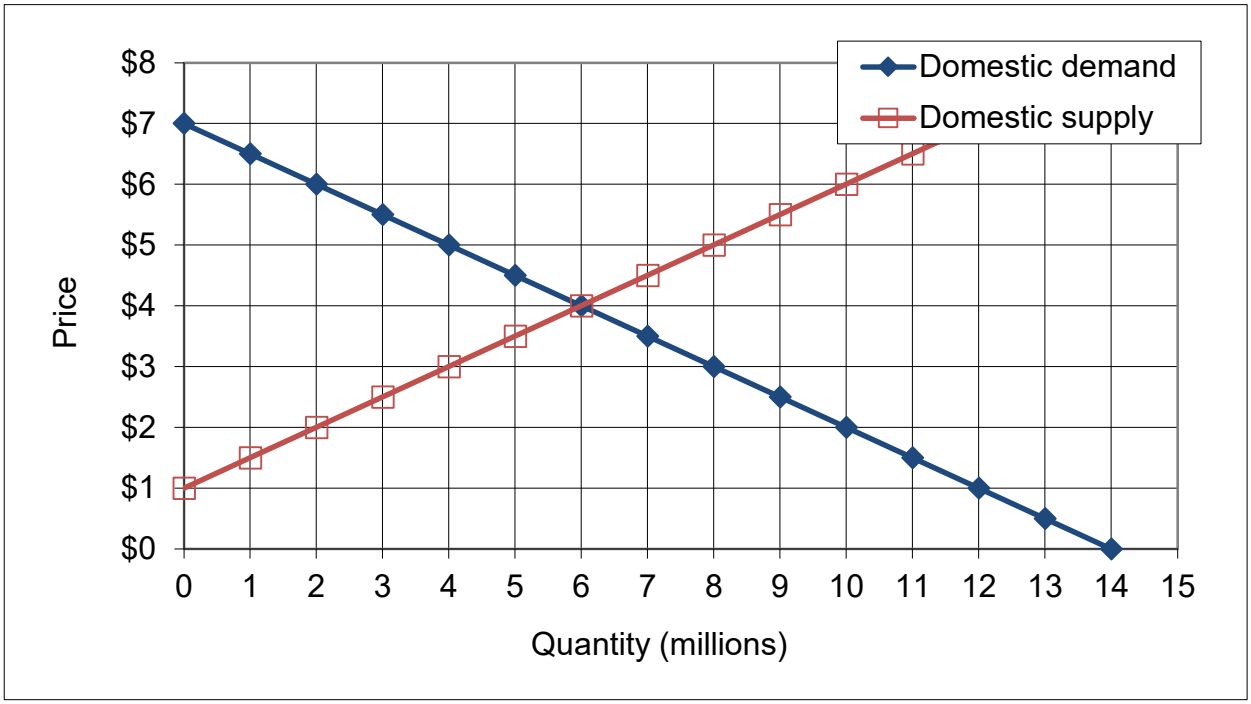
b. If the market price is \$5, about how much output will Bulldog try to produce (to the nearest thousand)? ____ thousand

c. If the market price is \$7, about how much output will Bulldog try to produce (to the nearest thousand)? ____ thousand

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

e. What is Bulldog's *shutdown price*—that is, the lowest price at which Bulldog 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 screwdrivers in some country.



At first, international trade in screwdrivers is not permitted. Then this industry is opened to international trade and the international price of screwdrivers turns out to be **$ 6.**

a. Will this country now *export* or *import* screwdrivers?	
b. How much?	million
c. Does consumer surplus in this country *increase* or *decrease* from international trade in screwdrivers?	
d. By how much?	$ million
e. Does producer surplus in this country *increase* or *decrease* from international trade in screwdrivers?	
f. By how much?	$ million
g. Does total social welfare in this country *increase* or *decrease* from international trade in screwdrivers?	
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 100 units of output per hour at minimum cost. The firm's hourly production function is given by $q = 10\, x_1^{1/2}\, x_2^{1/2}$, where x_1 denotes the number of machines and x_2 denotes the number of workers (measured in hours of service). Machines cost \$40 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 100 units of output, TC(100).

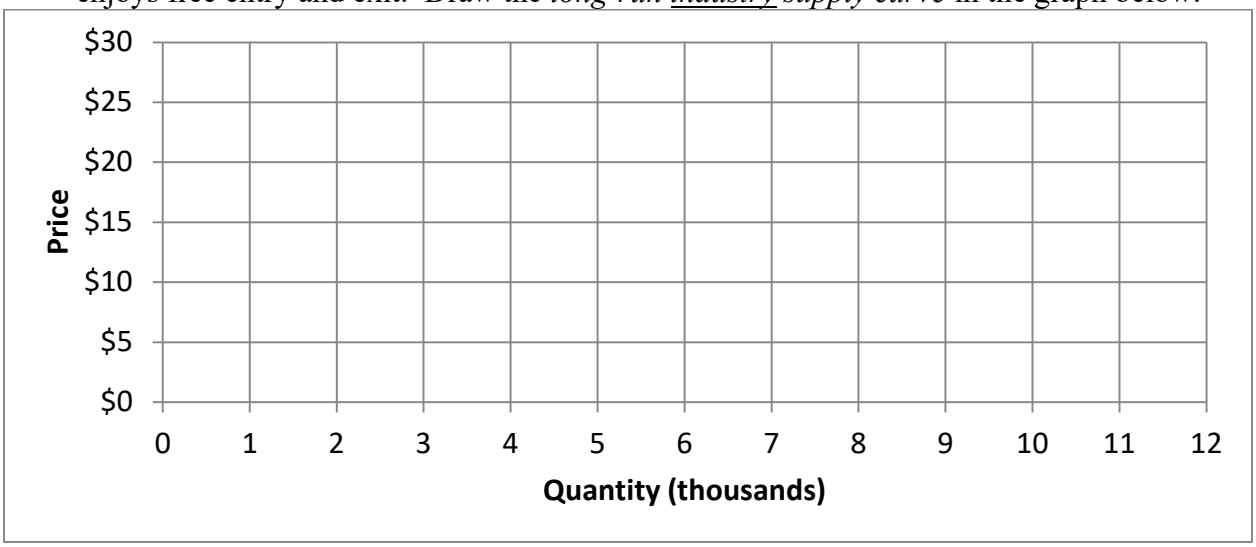
(3) [Cost curves; Long-run market equilibrium: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.01\,q^3 - q^2 + 40\,q$.

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*. [Hint: 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:
$P_S = 5 + (Q/20)$

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 (including the government) *gain* or *lose* as a result of the subsidy? By how much?

IV. CRITICAL THINKING: Answer just *one* question 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. Label all axes and curves.

(2) Suppose supply of a good is *perfectly 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]