ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2024
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Signature: _____

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EXAMINATION 3 VERSION B
"Firms and Competition"
October 24, 2024

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—15 pts total]

(1) Suppose a firm produces an output using capital and labor. The increase in output from a one-unit increase in labor input, while holding capital input constant, is called
a. the marginal rate of substitution in production of labor for capital.
b. the average product of labor.
c. the price of labor.
d. the marginal product of labor.

(2) Suppose a firm has *decreasing returns to scale*. Then if all inputs are doubled, output
a. less than doubles.
b. more than doubles.
c. exactly doubles.
d. remains exactly constant.
e. decreases.

(3) Suppose a firm uses both labor and capital to produce some output. Along the firm's *isoquant*, what is held constant?
a. the firm's quantity of capital input.
b. the firm's marginal rate of substitution in production.
c. the firm's quantity of output.
d. the firm's quantity of labor input.

The next two questions refer to the following information. A certain kind of machine can produce 20 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. $20 = x_1 + 4\,x_2$.
b. $20 = x_1\,x_2^4$.
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. $q = 20\,x_1\,x_2^4$.
b. $q = 20\,x_1\,x_2^{1/4}$.
c. $q = x_1 + 4x_2$.
d. $q = x_1 + (1/4)\,x_2$.
e. $q = 20 \min\{x_1 , 4x_2\}$.
f. $q = 20 \min\{x_1, (x_2/4)\}$.

(6) The increase in total cost from a one-unit increase in output is called
a. average cost.
b. sunk cost.
c. unit cost.
d. marginal cost.

(7) 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.

(8) *Diseconomies of scale* mean that the firm's average cost curve
a. slopes up.
b. slopes down.
c. is horizontal.
d. is vertical.

(9) Suppose a firm is now producing 1000 units of output per day. Its marginal cost is $5, its average cost is $2, and it can sell its output at a price of $3. If it increases its output to 1001 units, its profit will
a. increase by $1.
b. increase by $3.
c. increase by $2.
d. decrease by $1.
e. decrease by $3.
f. decrease by $2.

(10) 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.

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

(12) *Price equals average cost* in a competitive industry in long-run equilibrium because
a. business owners have a sense of fairness.
b. individual firms adjust their output levels using the rule "price equals average cost" 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.

(13) Suppose there is a change in government policy affecting the automobile industry. Which of the following outcomes would be a *potential Pareto improvement*?
a. Producers gain $5 billion while consumers are unaffected.
b. Producers gain $5 billion while consumers lose $10 billion.
c. Producers gain $10 billion while consumers lose $5 billion.
d. Both (a) and (c).
e. All of the above.

(14) Suppose the price of oil rises. The increase in long-run producer surplus goes to oil producers and
a. owners of land where oil can be drilled.
b. purchasers of products made from oil, such as gasoline.
c. companies that refine oil into products such as gasoline.
d. all of the above.

(15) Suppose the price elasticity of demand for hotel rooms in a small city is -5.0 and the price elasticity of supply is 1.5. If a tax is imposed on hotel rooms in this city,

a. sellers (hotel operators) will pay most of the tax.
b. buyers (guests) will pay most of the tax.
c. sellers and buyers will each pay half of the tax.
d. Answer depends on which side is legally required to remit the tax to the government.

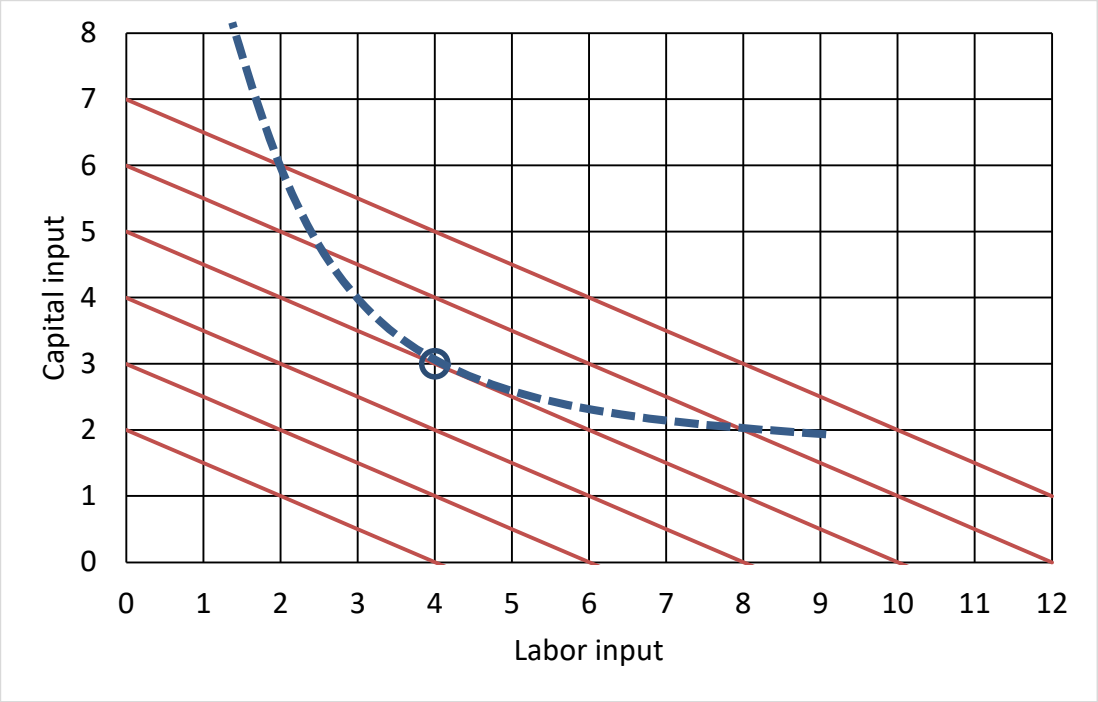
II. SHORT ANSWER: Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(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 5% and capital input increases by 10%.

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

b. Suppose output in fact increases by 10%. 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 500 units of output at lowest cost. This firm must pay \$10 per hour for labor and \$20 per hour for capital. The graph below shows the firm's isoquant for 500 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

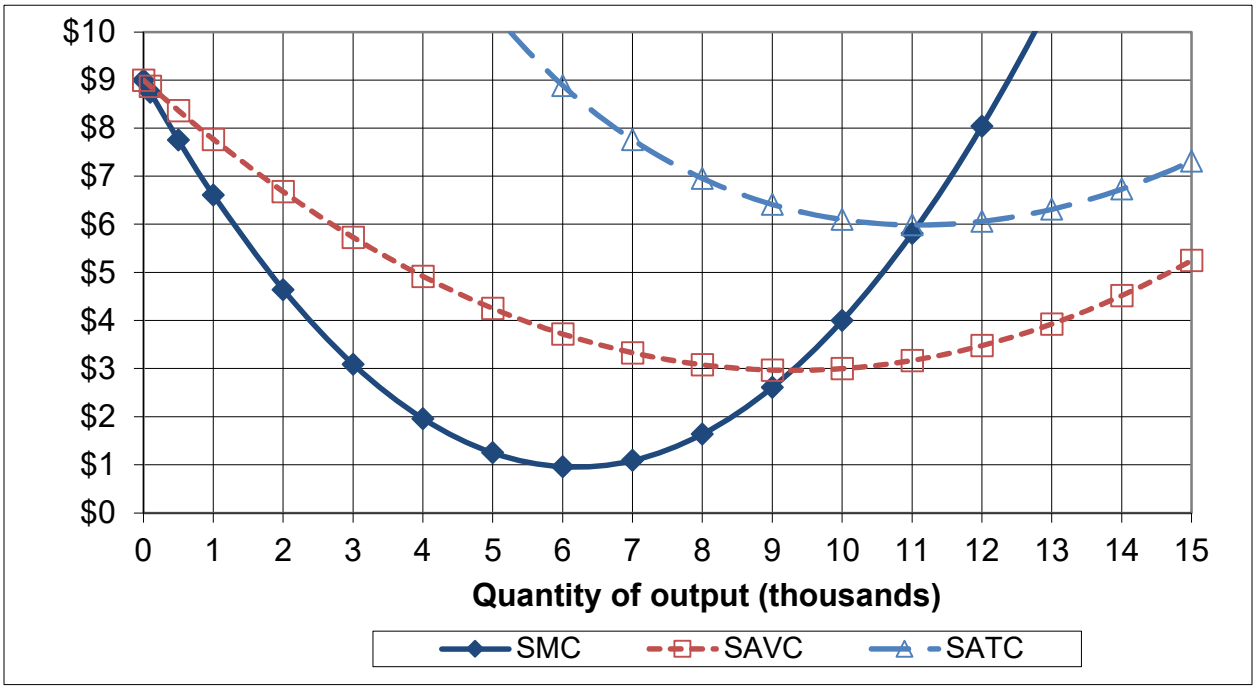
c. Compute the firm's total cost. \$ _____

Alternatively, suppose the firm's capital input is fixed in the short run at **2** units, but the firm's labor input is variable. The firm still wants to produce 500 units of output.

d. How many units of labor will it hire? _____ units

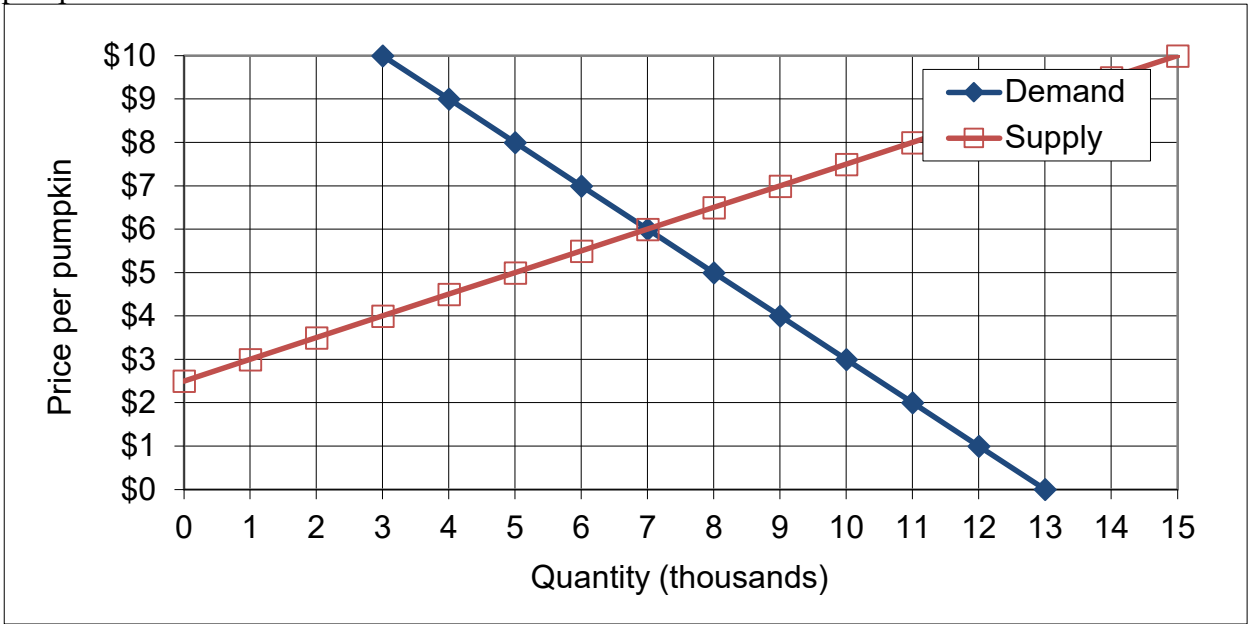
e. Compute the firm's total cost in the short run. \$ _____

(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. What is ACME's *breakeven price*—that is, the lowest price at which ACME can produce output without making losses in the short run?	$
b. What is ACME's *shutdown price*—that is, the lowest price at which ACME will continue to operate in the short run?	$
c. If the market price is \$8, about how much output will ACME try to produce (to the nearest thousand)?	thousand
d. If the market price is \$2, about how much output will ACME try to produce (to the nearest thousand)?	thousand
e. If the market price is \$4, about how much output will ACME try to produce (to the nearest thousand)?	thousand

(3) [Welfare analysis of taxes and subsidies: 20 pts] The following graph shows the market for pumpkins.



a. Find the equilibrium price without government intervention.	$

Suppose the government imposes a **tax of $ 3** per pumpkin.

b. Compute the equilibrium quantity sold.	thousand
c. Compute the equilibrium total price paid by buyers (including the tax).	$ per pumpkin
d. Compute the equilibrium net price received by sellers (excluding the tax).	$ per pumpkin
e. Does producer surplus *increase, decrease,* or *remain constant* because of the tax?	
f. By how much?	$ thousand
g. Does consumer surplus *increase, decrease,* or *remain constant* because of the tax?	
h. By how much?	$ thousand
i. Compute the total tax revenue collected by the government.	$ thousand
j. Compute the deadweight social loss caused by the tax.	$ thousand

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: 9 pts] Suppose a production function is given by

$$q = 8\, x_1^{1/4}\, x_2^{3/4}\,.$$

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 **90** 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 (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 **90** units of output, TC(**90**).

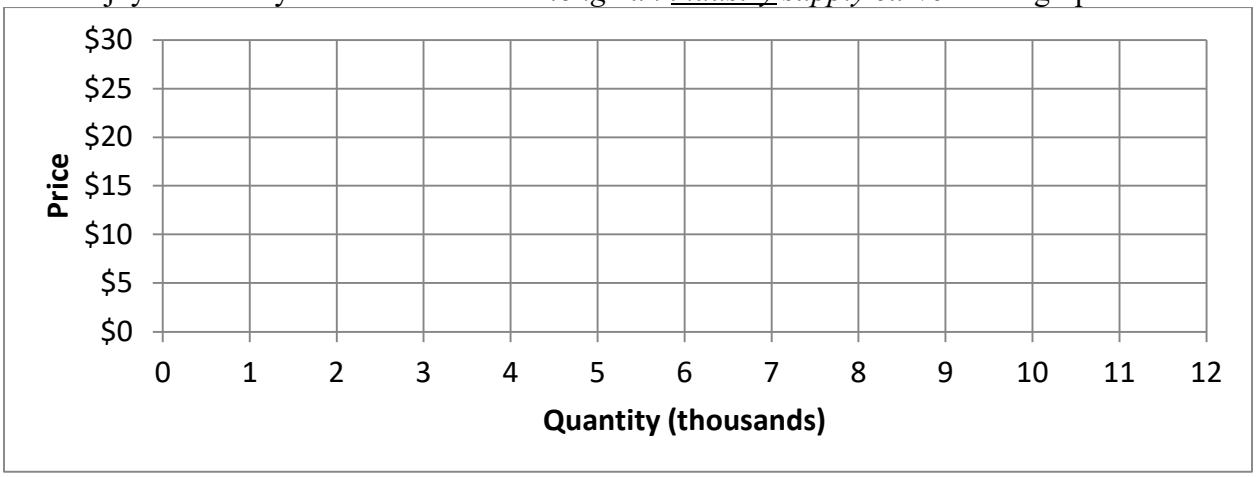
(3) [Cost curves; Long-run market equilibrium: 8 pts] Suppose a typical firm faces a (long-run) total cost function given by $TC(q) = 0.05\,q^3 - q^2 + 20\,q$.

a. Compute the typical firm's so-called 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?

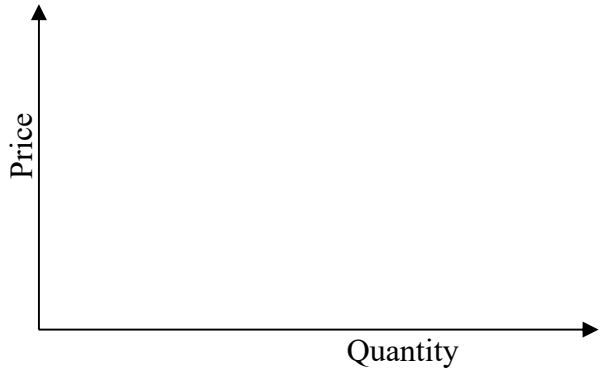
d. Suppose all firms in this industry have the same costs, and these costs are not affected by other firms in the same industry or by total industry output. Further assume the industry enjoys free entry and exit. Draw the *long-run industry supply curve* in the graph below.



(4) [Welfare analysis of international trade: 10 pts] Suppose domestic demand and supply for a good are given by the following equations. (Use the graph at right for scratch work.)

Demand: $Q_D = 50 - 5\,P$

Supply: $Q_S = 10\,P - 10$



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 **$8** .

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) experience an *increase* or *decrease* in economic efficiency as a result of international trade? How much?

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

(1) If a production function has diminishing returns to each input separately, can it still have *increasing returns to scale*? If you answer "no," explain your reasoning. If you answer "yes," give an example production function and prove that it has diminishing returns to each input and that it still has increasing returns to scale.

(2) 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.

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]