

**EXAMINATION #3 VERSION A**  
**“Firms and Competition”**  
**November 7, 2012**

**INSTRUCTIONS:** This exam is closed-book, closed-notes, and calculators are NOT permitted. Point values for each question are noted in brackets.

**I. MULTIPLE CHOICE:** Circle the one best answer to each question. Feel free to use margins for scratch work [1 pt each—10 pts total]

(1) Which production function below violates the assumption of "diminishing marginal rate of substitution"?

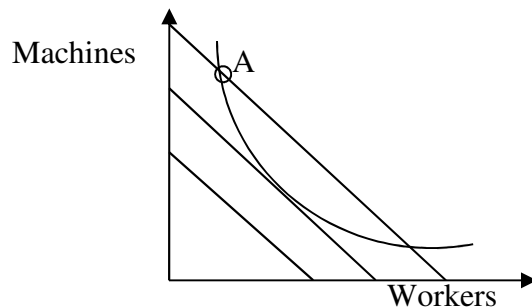
- a.  $q = 3x_1 + 2x_2$ .
- b.  $q = x_1^3 x_2^2$ .
- c.  $q = x_1^{3/5} x_2^{2/5}$ .
- d.  $q = 3x_1^{1/2} + 2x_2^{1/2}$ .
- e. All of the above functions show diminishing marginal rates of substitution.

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

- a.  $q = 20x_1 x_2^3$ .
- b.  $q = 20x_1 x_2^{1/3}$ .
- c.  $q = x_1 + 3x_2$ .
- d.  $q = x_1 + (1/3)x_2$ .
- e.  $q = 20 \min\{x_1, 3x_2\}$ .
- f.  $q = 20 \min\{x_1, (x_2/3)\}$ .

The next two questions refer to the following information. A certain kind of machine can produce 20 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.

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.



(2) The equation for the firm's expansion path is

- a.  $1 = 3$ .
- b.  $x_1 = 3x_2$ .
- c.  $20 = x_1 + 3x_2$ .
- d.  $20 = x_1 x_2^3$ .
- e.  $x_1 = (1/3)x_2$ .

(4) 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.

(5) 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.

(6) In the short run, a firm should shut down immediately if its

- a. revenue is less than fixed cost.
- b. profit is negative.
- c. revenue is less than producer surplus.
- d. revenue is less than variable cost.

(7) Price equals marginal cost in

- a. short-run competitive equilibrium.
- b. long-run competitive equilibrium.
- c. both short-run and long-run competitive equilibrium.
- d. none of the above.

(8) Suppose the demand for argyle socks abruptly and permanently shifts to the *left* because of a permanent change in preferences. The price of argyle socks 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.

(9) Suppose the price of corn rises. The increase in long-run producer surplus goes to farmers and

- a. all corn buyers.
- b. farmland owners.
- c. food processing companies that use corn to make other products.
- d. ultimate consumers of corn-based products.

(10) A *Pareto improvement* 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.

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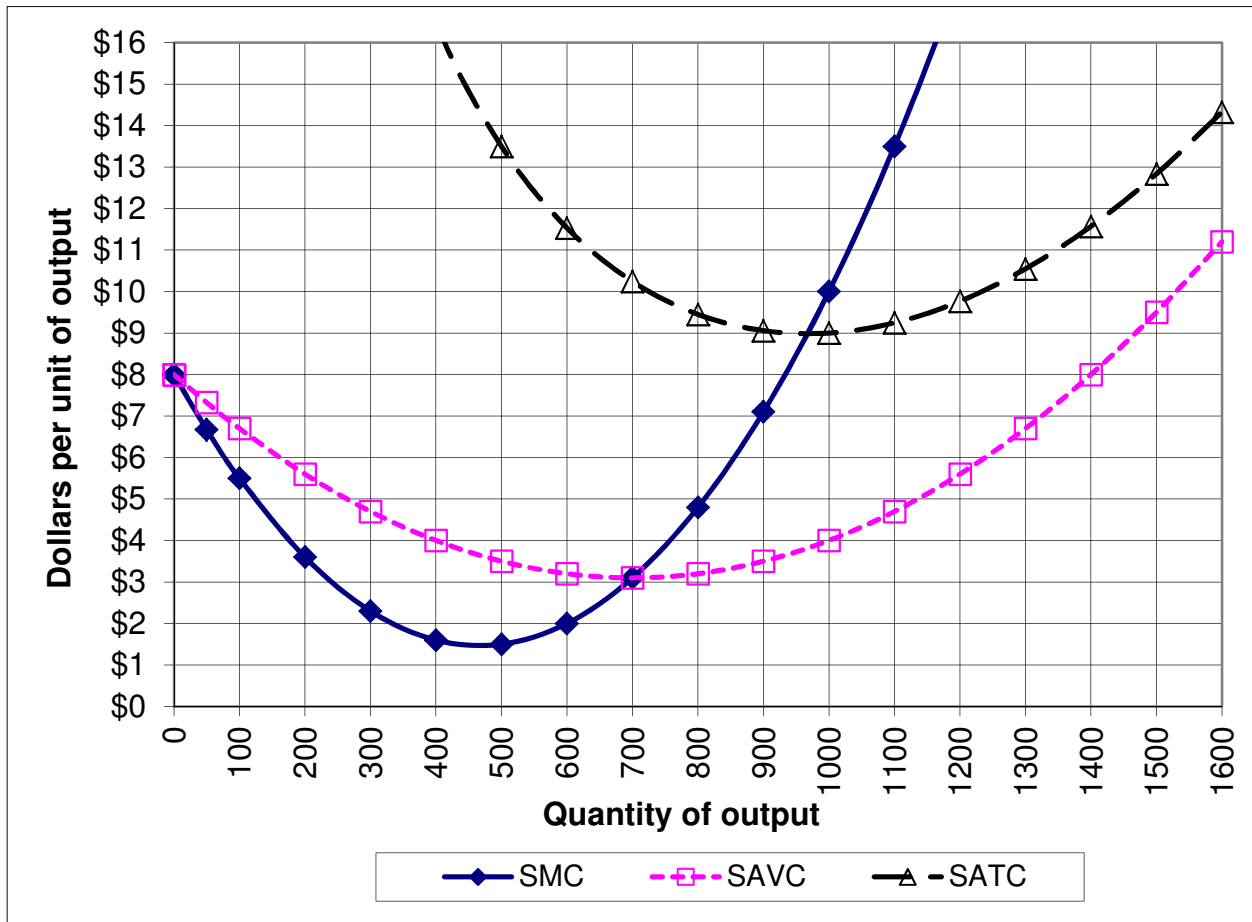
**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Technical change: 4 pts] The elasticity of output with respect to labor input for the US economy as a whole is about  $2/3$ . The elasticity of output with respect to capital input is about  $1/3$ . Suppose labor input increases by 2.1% and capital input increases by 3.0%.

- a. By how much would output increase, without any technical change?
- b. Suppose output in fact increases by 4.0%. What is the increase in multifactor or total factor productivity (also called the Solow residual)?

	%
	%

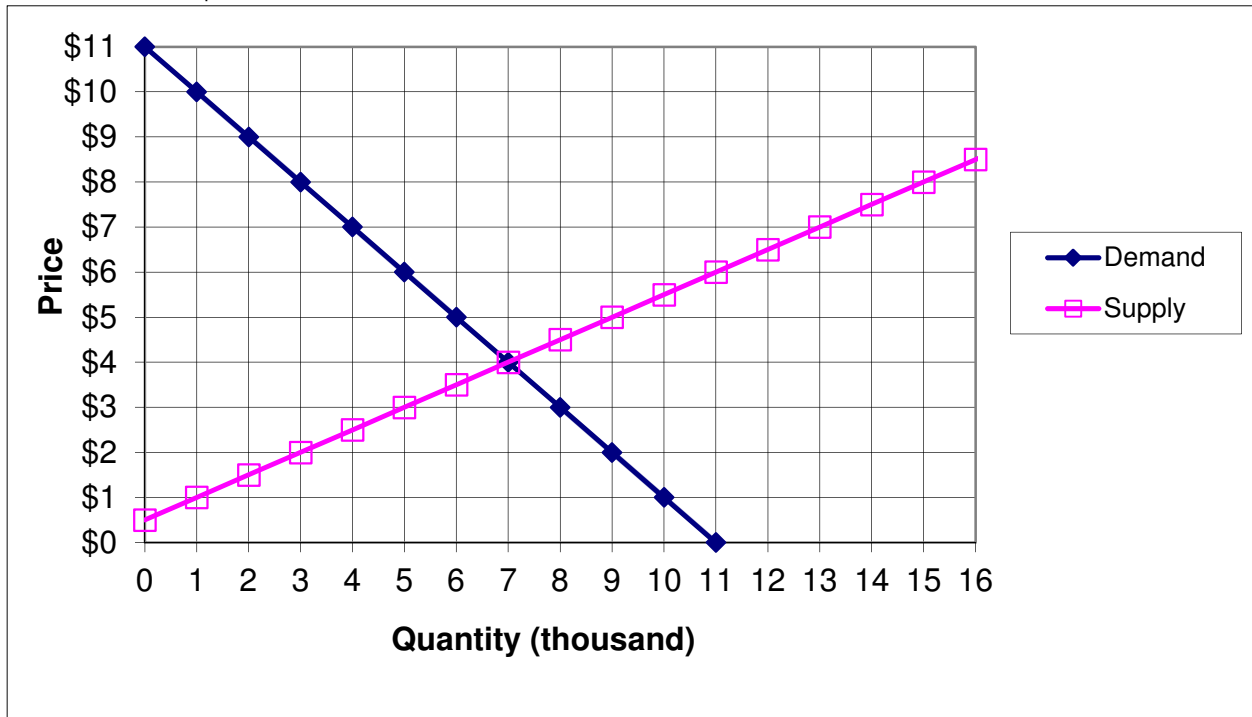
(2) [Short-run cost curves and supply: 10 pts] The following graph shows Acme Manufacturing Company's short-run average total cost (SATC), short-run average variable cost (SAVC), and short-run marginal cost (SMC). Assume Acme takes its market price as given.



- If the market price is \$10, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$2, about how much output will Acme try to produce? Give an answer to the nearest 100.
- If the market price is \$5, about how much output will Acme try to produce? Give an answer to the nearest 100.
- What is Acme's *breakeven price*—that is, the lowest price at which Acme will avoid losses in the short run? Give an answer to the nearest dollar.
- What is Acme's *shutdown price*—that is, the lowest price at which Acme will continue to operate in the short run? Give an answer to the nearest dollar.

	units
	units
	units
\$	
\$	

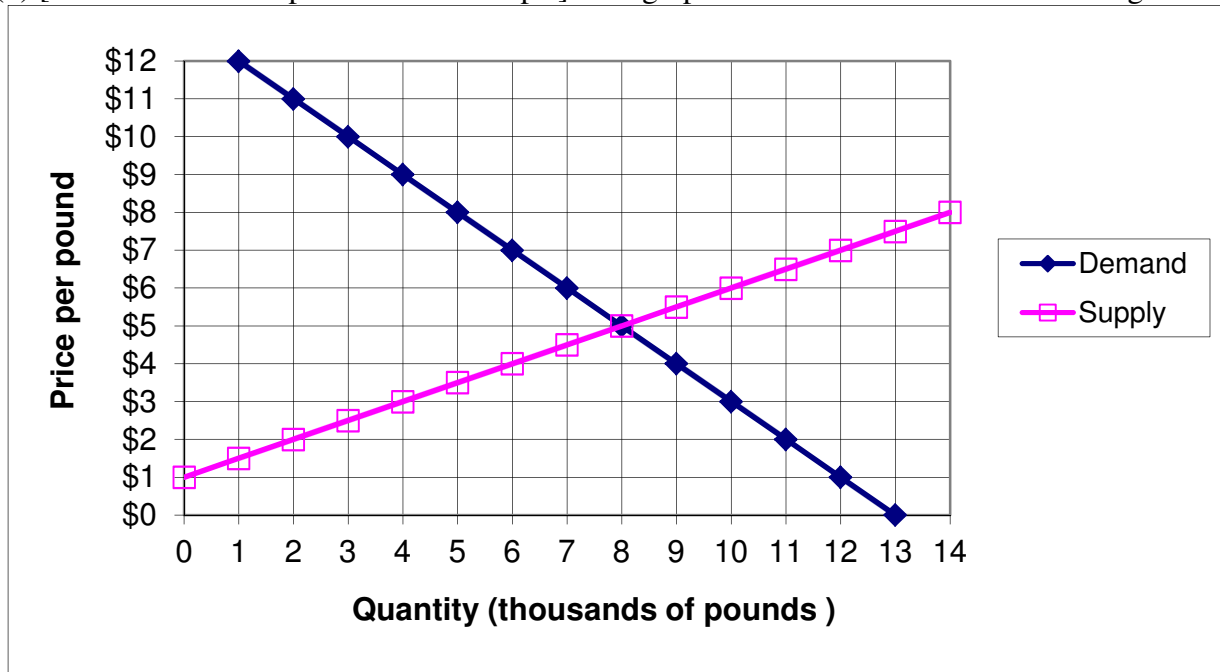
(3) [Welfare analysis of international trade: 16 pts] The graph below shows domestic demand and supply for a good. Suppose this market is opened to international trade and the world price turns out to be \$2.



- Will the country *import* or *export* the good?
- How many units?
- Will consumer surplus *increase* or *decrease*?
- By how much?
- Will producer surplus *increase* or *decrease*?
- By how much?
- Will the country as a whole *lose* or *gain* from international trade?
- By how much?

thousand
\$ thousand
\$ thousand
\$ thousand

(4) [Welfare effects of price controls: 16 pts] The graph below shows the market for arugula.



Suppose a **price ceiling (or legal maximum price)** of \$4 is imposed on the market for arugula. No arugula may be sold for more than the price ceiling.

- Compute the quantity traded with the price ceiling.
- Does the price ceiling create *excess demand*, *excess supply*, or *neither*?
- How much?
- Does producer surplus *increase* or *decrease* because of the price ceiling, as compared to the market without government intervention?
- By how much?
- Does consumer surplus *increase* or *decrease* because of the price ceiling, as compared to the market without government intervention? (Assume optimistically that arugula is actually purchased by those buyers who value arugula the most.)
- By how much?
- Compute the deadweight social loss caused by the price ceiling.

	thousand pounds
	thousand pounds
\$	thousand
\$	thousand
\$	thousand

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

(1) [Production functions: 10 pts] Suppose a production function is given by  $q = 20 x_1^{2/5} x_2^{4/5}$ .

a. Find an expression in terms of  $x_1$  and  $x_2$  for the *average product of input 1*.

b. Find an expression in terms of  $x_1$  and  $x_2$  for the *marginal product of input 2*.

c. Are there diminishing returns to input 2? Why or why not?

d. Find an expression in terms of  $x_1$  and  $x_2$  for the marginal rate of substitution 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. Circle your final answer.

e. Does this production function have *constant* returns to scale, *increasing* returns to scale, or *decreasing* returns to scale? Justify your answer.

(2) [Cost minimization: 12 pts] Suppose a firm wishes to produce 60 units of output per hour at minimum cost. Machines cost \$4 per hour to rent and workers must be paid \$9 per hour. The firm's hourly production function is given by  $q = 5(x_1^{-1} + x_2^{-1})^{-1}$  where  $x_1$  denotes the number of machines and  $x_2$  denotes the number of workers.

- a. [2 pts] Give an equation for the firm's target isoquant. The variables  $x_1$  and  $x_2$  should be the only unknowns.

- b. [4 pts] 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. [2 pts] Compute the total cost to produce 60 units of output,  $TC(60)$ .

(3) [Short-run profit maximization and supply: 6 pts] Suppose a firm faces short-run fixed cost of \$8 and short-run variable cost given by  $SVC(q) = 0.5q^2 + q$ , where  $q$  denotes the number of units of output. Suppose the market price is \$11.

- a. How much output  $q$  will the firm produce in order to maximize profit? Show your work and circle your final answer.

- b. Compute the firm's profit at this price.

- c. Compute the firm's breakeven price—the minimum price at which it will avoid losses. Show your work and circle your final answer.



(4) [Welfare analysis of tax or subsidy: 12 pts] Suppose demand and supply for a good are given by the following equations.

Demand:  $P_D = 14 - (Q/10)$

Supply:  $P_S = 2 + (Q/20)$ .

First consider the unregulated market.

a. Compute the equilibrium quantity.

units
\$

b. Compute the equilibrium price.

Now suppose a **tax of \$3** per unit is imposed on this market. (Use the space and graph below for scratch work.)

c. Compute the new equilibrium quantity.

units
\$
\$
\$

d. Compute the total price (including the tax) paid by demanders.

e. Compute the net price (excluding the tax) received by suppliers.

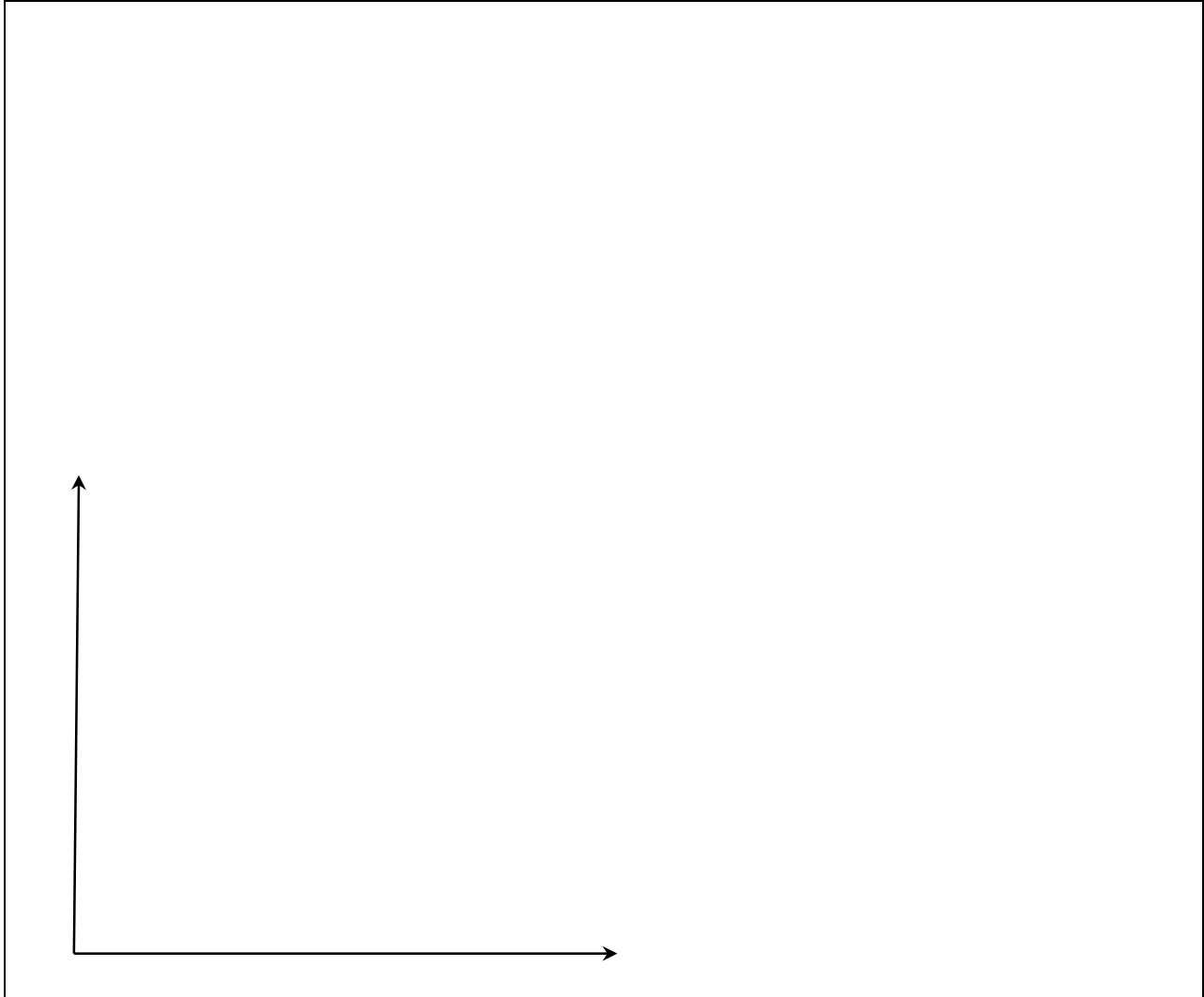
f. Compute the social deadweight loss from the tax.



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

- (1) Suppose a competitive firm wants to maximize profit. Now profit equals revenue minus cost. Should it choose a level of output where average cost is lowest? Why or why not? Illustrate your answer with a graph of the producer's cost curves.
- (2) Suppose a tax is placed on a market, but all tax revenue is returned to the people. For example, suppose tax revenue equal to \$1 billion is collected. Then the government sends each person a check for  $(\$1 \text{ billion} / N)$ , where  $N$  is the population of the country. Ignore any administrative costs of collecting the tax and sending the checks. Is the country *better off*, *worse off*, or *just as well off* as if the tax and rebate did not exist? Use the concepts of consumer and producer surplus to formulate your answer. Illustrate your answer with a supply-and-demand graph.

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]