ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2024
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EXAMINATION 3 ANSWER KEY
"Firms and Competition"

Version A

I. Multiple choice

(1)c. (2)b. (3)d. (4)b. (5)d. (6)b. (7)b. (8)b. (9)b. (10)d.
(11)c. (12)b. (13)a. (14)b. (15)b.

II. Short answer

(1) a. 6.5 percent. b. 1.5 percent.

(2) a. 3 units. b. 4 units. c. \$100.
d. 2 units. c. \$140.

(3) a. \$7 (because breakeven price = min(SATC)).
b. \$2 (because shutdown price = min(SAVC)).
c. 11 thousand (using rule P=MC to find q).
d. 12 thousand (using rule P=MC to find q).
e. 0 thousand (because price is below shutdown price).

(4) a. \$6. b. 9 thousand. c. \$4 per pumpkin.
d. \$7 per pumpkin. e. increase. f. \$8 thousand.
g. increase. h. \$16 thousand. i. \$27 thousand.
j. \$3 thousand.

III. Problems

(1) [Input substitution]

a. $MP_1 = 3\, x_1^{-1/2}$. YES, there are diminishing returns to input 1, because as x_1 increases (and x_2 is held constant), MP_1 decreases.

b. $MRSP = \frac{MP_2}{MP_1} = \frac{2\, x_2^{-1/2}}{3\, x_1^{-1/2}} = \left(\frac{2}{3}\right)\left(\frac{x_1}{x_2}\right)^{1/2}$. YES, this function has diminishing MRSP, because as x_1 decreases and x_2 increases, the numerator decreases and the denominator increases. Therefore, MRSP decreases.

c. Check returns to scale:

$f(ax_1, ax_2) = 6\,(a\,x_1)^{1/2} + 4\,(a\,x_2)^{1/2} = 6\,a^{1/2}\,x_1^{1/2} + 4\,a^{1/2}\,x_2^{1/2}$
$= a^{1/2}\left(6\;x_1^{1/2} + 4\;x_2^{1/2}\right) = a^{1/2}\,q < a\,q$, for all $a>1$.

Thus, multiplying all inputs by the same factor (a) causes output to increase by a smaller factor. So, this production function has DECREASING returns to scale.

(2) [Cost minimization]

a. Equation for isoquant: $90 = 5\, x_1^{1/2}\, x_2^{1/2} \;\; or \;\; 18 = \; x_1^{1/2}\, x_2^{1/2}$.

b. $MRSP \, = MP_2/MP_1 = \frac{(5/2)\; x_1^{1/2}\, x_2^{-1/2}}{(5/2)\; x_1^{-1/2}\, x_2^{1/2}} = x_1/x_2$.

c. Set MRSP = w_2/w_1 = \$10/\$90 (the tangency condition) and solve jointly with $90 = 5\, x_1^{1/2}\, x_2^{1/2}$ (the isoquant) to get x_1*=6 and x_2*=54.

d. TC(50) = 6×\$90 + 54×\$10 = \$1080.

(3) [Cost curves; Long-run market equilibrium]

a. AC = TC/q = 0.02 q^2 – 0.8 q + 18.

Set 0 = dAC/dq = 0.04 q – 0.8 and solve to get q_{ES} = 20.

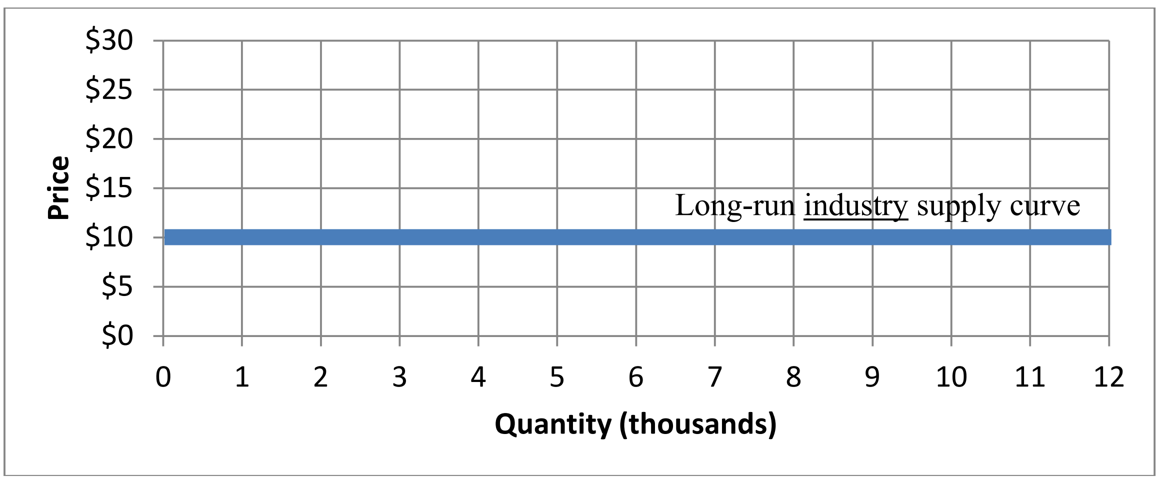
b. Breakeven price = minimum AC = AC(q_{ES}) = \$10.

c. A firm's supply curve shows how much the firm will produce for any given price. If P>minimum average cost, the profit-maximizing firm will choose an output level where P=MC(q), and if P<minimum average cost, it will produce nothing. So, this firm's supply curve is given by the following equations.

If P≥\$10, P = MC(q) = dTC/dq = 0.06 q^2 – 0.8 q + 18.

If P≤\$10, q = 0 (firm shuts down).

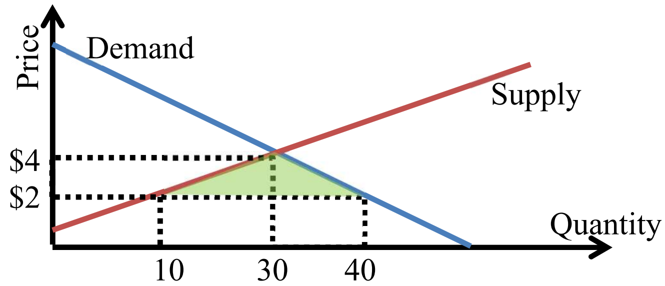
d. The long-run industry supply curve is a horizontal line at minimum AC:



(4) [Welfare effects of international trade]

a. Set $Q_D = Q_S$ and solve to get P* = \$4 and Q* = 30.

b. With international trade, P_W = \$2. Substituting into demand and supply gives Q_D = 40 and Q_S = 10, so the country IMPORTS 40-10=30 units.



c. Consumer surplus increases by \$70, the area of the large trapezoid bounded by the two prices and the demand curve.
d. Producer surplus decreases by \$40, the area of the small trapezoid, the area of the small trapezoid bounded by the two prices and the supply curve..
e. Economic efficiency increases by \$70-\$40 = \$30, the area of the green triangle.

IV. Critical thinking

(1) Yes! Example production function: $q = x_1^{2/3} x_2^{2/3}$.

Marginal products are $MP_1 = (2/3)\, x_1^{-1/3}\, x2^{2/3}$ and $MP_2 = (2/3)\, x_1^{2/3}\, x_2^{-1/3}$. MP_1 evidently decreases as x_1 increases and x_2 is held constant. MP_2 evidently decreases as x_2 increases and x_1 is held constant. So this production function has *diminishing returns* to each input separately.

Returns to scale can be checked as follows.
$(a\, x_1)^{2/3}\ (a\, x_2)^{2/3} = a^{2/3}\, x_1^{2/3}\, a^{2/3}\, x_2^{2/3} = a^{4/3}\, x_1^{2/3}\, x_2^{2/3} = a^{4/3}\, q > a\, q$, for $a > 1$, so this production function has *increasing returns to scale*.

Another example production function might be $q = x_1^{3/4}\, x_2^{3/4}$.

(2) Competition with free entry drives *economic* profits to zero, but that does not mean all firms fail. Zero *economic* profit means that investors are earning the same rate of return as their next best alternative, so there is no reason for the firm to exit the industry.

Version B

I. Multiple choice

(1)d. (2)a. (3)c. (4)d. (5)f. (6)d. (7)a. (8)a. (9)f. (10)b.
(11)d. (12)d. (13)d. (14)a. (15)a.

II. Short answer

(1) a. 7 percent. b. 3 percent.
(2) a. 3 units. b. 4 units. c. \$100.
d. 8 units. c. \$120.
(3) a. \$6 (because breakeven price = min(SATC)).
b. \$3 (because shutdown price = min(SAVC)).
c. 12 thousand (using rule P=MC to find q).
d. 0 thousand (because price is below shutdown price).
e. 10 thousand (using rule P=MC to find q).

(4) a. \$6. b. 5 thousand. c. \$8 per pumpkin.
d. \$5 per pumpkin. e. decrease. f. \$6 thousand.
g. decrease. h. \$12 thousand. i. \$15 thousand.
j. \$3 thousand.

III. Problems

(1) [Input substitution]

a. $MP_1 = 2\,x_1^{-3/4}\,x_2^{-3/4}$. YES, there are diminishing returns to input 1, because as x_1 increases (and x_2 is held constant), MP_1 decreases.

b. $MRSP = \frac{MP_2}{MP_1} = \frac{6\,x_1^{1/4}\,x_2^{-1/4}}{2\,x_1^{-3/4}\,x_2^{-3/4}} = 3\left(\frac{x_1}{x_2}\right)$. YES, this function has diminishing MRSP, because as x_1 decreases and x_2 increases, the numerator decreases and the denominator increases. Therefore, MRSP decreases.

c. Check returns to scale:

$f(ax_1, ax_2) = 8\,(a\,x_1)^{1/4}\,(a\,x_2)^{3/4} = 8\,a^{1/4}\,x_1^{1/4}\;a^{3/4}\,x_2^{3/4}$

$= a^{1/4}\,a^{3/4}\left(8\,x_1^{1/4}\;x_2^{1/2}\right) = a\,q$, for all a>1.

Thus, multiplying all inputs by the same factor (a) causes output to increase by the same factor. So, this production function has CONSTANT returns to scale.

(2) [Cost minimization]

a. Equation for isoquant: $90 = 5\,x_1^{1/2}\,x_2^{1/2}$ *or* $18 = x_1^{1/2}\,x_2^{1/2}$.

b. $MRSP = MP_2/MP_1 = \frac{(5/2)\;x_1^{1/2}\,x_2^{-1/2}}{(5/2)\;x_1^{-1/2}\,x_2^{1/2}} = x_1/x_2$.

c. Set MRSP = w_2/w_1 = \$10/\$40 (the tangency condition) and solve jointly with $90 = 5\,x_1^{1/2}\,x_2^{1/2}$ (the isoquant) to get $x_1^*=9$ and $x_2^*=36$.

d. TC(50) = 9×\$40 + 36×\$10 = \$720.

(3) [Cost curves; Long-run market equilibrium]

a. AC = TC/q = $0.05\,q^2 - q + 20$.

Set $0 = dAC/dq = 0.1\,q - 1$ and solve to get $q_{ES} = 10$.

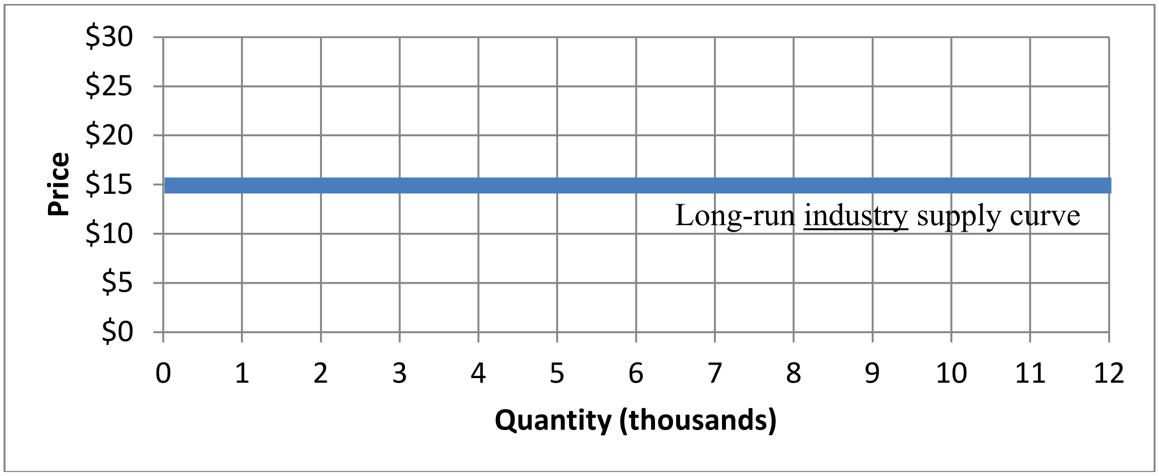
b. Breakeven price = minimum AC = AC(q_{ES}) = \$15.

c. A firm's supply curve shows how much the firm will produce for any given price. If P>minimum average cost, the profit-maximizing firm will choose an output level where P=MC(q), and if P<minimum average cost, it will produce nothing. So, this firm's supply curve is given by the following equations.

If $P \geq \$15$, $P = MC(q) = dTC/dq = 0.15\,q^2 - 2\,q + 20$.

If $P \leq \$15$, q = 0 (firm shuts down).

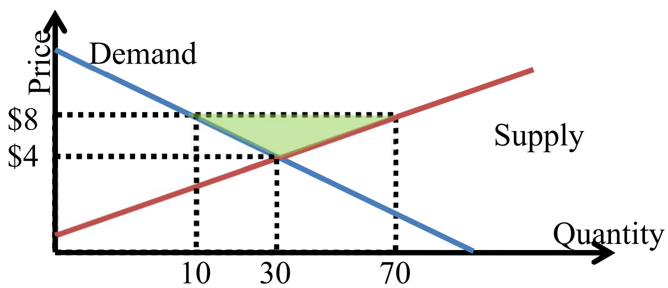
d. The long-run industry supply curve is a horizontal line at minimum AC:



(4) [Welfare effects of international trade]

a. Set $Q_D = Q_S$ and solve to get $P^* = \$4$ and $Q^* = 30$.

b. With international trade, we are given that $P_W = \$8$. Substituting into demand and supply gives $Q_D = 10$ and $Q_S = 70$, so the country EXPORTS 70-10=60 units.



c. Consumer surplus decreases by \$80, the area of the small trapezoid bounded by the two prices and the demand curve.

d. Producer surplus increases by \$200, the area of the large trapezoid bounded by the two prices and the supply curve.

e. Economic efficiency increases by \$200-\$80 = \$120, the area of the green triangle.

IV. Critical thinking

(Same as Version A above.)

[end of answer key]