ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2022
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EXAMINATION #3 ANSWER KEY
"Firms and Competition"

Version A

I. Multiple choice

(1)c. (2)d. (3)f. (4)e. (5)c. (6)a. (7)b. (8)b. (9)b. (10)a. (11)a.

II. Short answer

(1) a. 3 units. b. 4 units. c. $100.
d. 8 units. c. $120.

(2) a. 0 thousand (because price is below shutdown price).
b. 12 thousand (using rule P=MC to find q).
c. 14 thousand (using rule P=MC to find q).
d. $7 (because breakeven price = min(SATC)).
e. $2 (because shutdown price = min(SAVC)).

(3) a. $5. b. 10 thousand. c. $3 per watermelon.
d. $6 per watermelon. e. increase. f. $9 thousand.
g. increase. h. $18 thousand. i. $30 thousand.
j. $3 thousand.

III. Problems

(1) [Input substitution]

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

b. $MRSP = MP_2/MP_1 = \frac{x_1^{1/3}}{2\, x_2^{1/3}}$. YES, this function has diminishing MRSP, because as x_1 decreases and x_2 increases, MRSP decreases.

c. Check returns to scale:

$$f(ax_1, ax_2) = 6\,(a\,x_1)^{2/3} + 3\,(a\,x_2)^{2/3} = 6\,a^{2/3}\,x_1^{2/3} + 3\,a^{2/3}\,x_2^{2/3}$$
$$= a^{2/3}\,\left(6\,x_1^{2/3} + 3\,x_2^{2/3}\right) = a^{2/3}\,q < a\,q \text{ , for all a>1.}$$

Thus, multiplying all inputs by the same factor (a) causes output to increase by a smaller factor ($a^{2/3}$). So this production function has DECREASING returns to scale.

(2) [Cost minimization]

a. Equation for isoquant: $50 = 5\,x_1^{1/2}\,x_2^{1/2}$ *or* $10 = x_1^{1/2}\,x_2^{1/2}$ *or* $100 = x_1 x_2$.

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

c. Set MRSP = $10/$40 and solve jointly with $50 = 5\,x_1^{1/2}\,x_2^{1/2}$, to get x_1*=5 and x_2*=20.

d. TC(50) = 5×$40 + 20×$10 = $400.

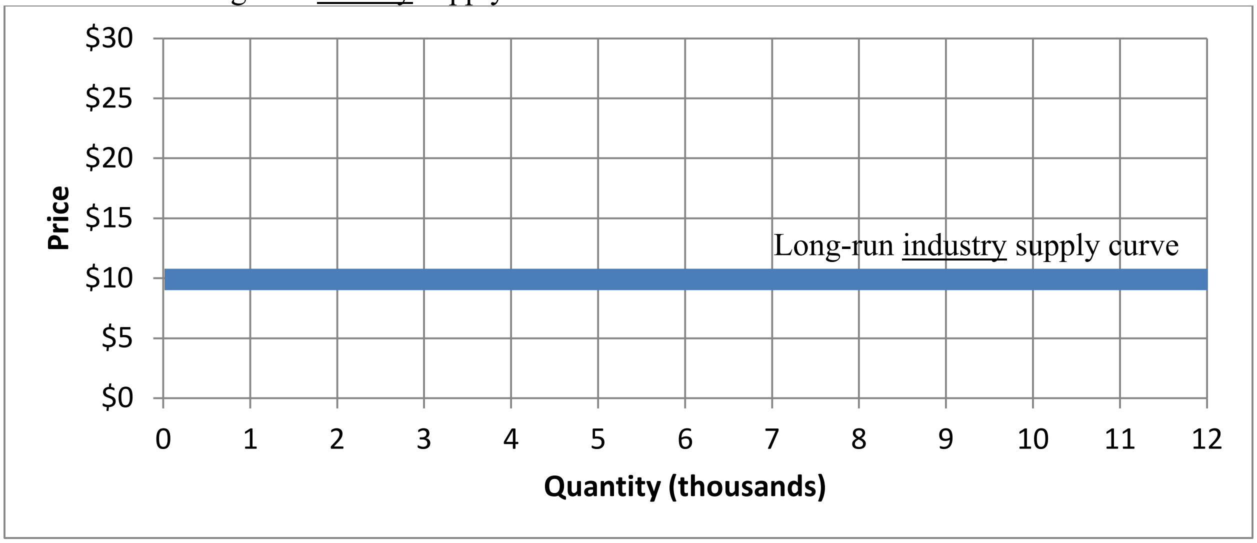
(3) [Cost curves; Long-run market equilibrium]

a. $AC = TC/q = 0.01\ q^2 - 0.8\ q + 26$.
Set $0 = dAC/dq = 0.02\ q - 0.8$ and solve to get $q_{ES} = 40$.

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 the <u>firm's</u> supply curve is given by the following equations.
If $P \geq \$10$, $P = MC(q) = dTC/dq = 0.03\ q^2 - 1.6\ q + 26$.
If $P \leq \$10$, $q=0$ (firm shuts down).

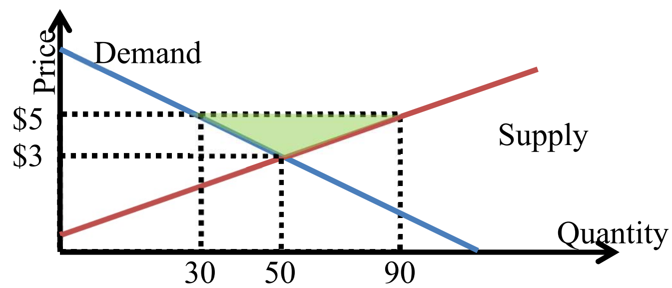
d. The long-run <u>industry</u> supply curve is a horizontal line at minimum AC:



(4) [Welfare effects of international trade]

a. Set $Q_D = Q_S$ and solve to get $P^* = \$3$ and $Q^* = 50$.

b. With international trade, we are given that $P_W = \$5$. Substituting into demand and supply gives $Q_D = 30$ and $Q_S = 90$, so the country EXPORTS 90-30=60 units.



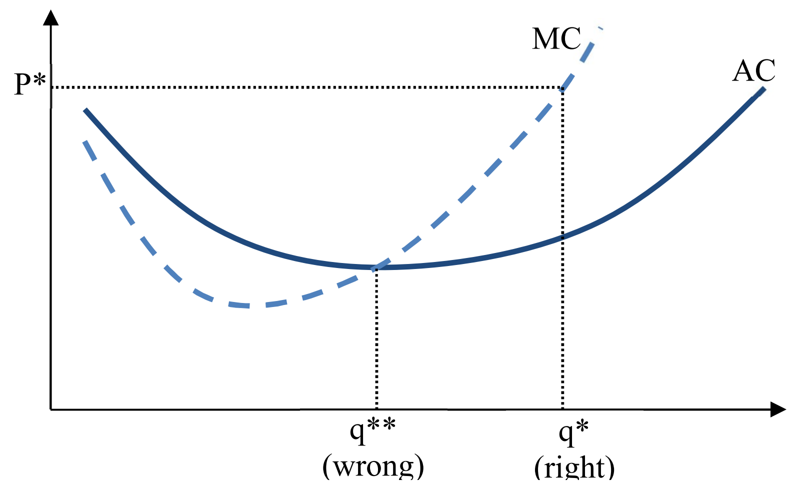
c. Consumer surplus decreases by \$80, the area of the small trapezoid bounded by the two prices and the demand curve.

d. Producer surplus increases by \$140, the area of the large trapezoid bounded by the two prices and the supply curve.

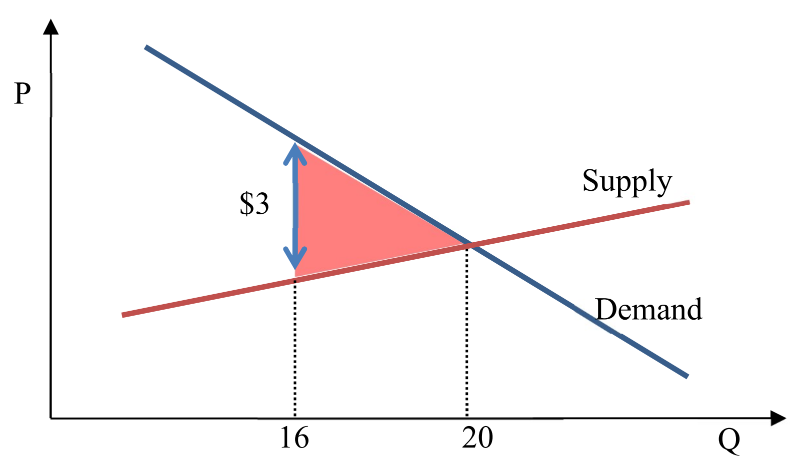
e. The country as a whole gains \$140-\$80 = \$60, the area of the green triangle.

IV. Critical thinking

(1) [The following answer uses a long-run framework, where there are no fixed costs. A similar answer in a short-run framework would be acceptable.] Profit is maximized when the firm operates at the output level where *market price equals marginal cost*, provided price is greater than minimum average cost. (If price is less than average cost, total profit is maximized when the output level is zero.) Thus, the total-profit-maximizing level of output *depends on the market price*. In general, the two output levels will be different, as shown in the graph below. Here, P* is the market price, q* is the output level that maximizes total profit, and q** is the output level where average cost is lowest.



(2) Construct the graph as follows. We are given that the initial quantity is 20 million, so demand and supply intersecting at that quantity. We are given that the $3 tax causes quantity to fall to 16 million, which implies that demand is higher than supply by $3 (the amount of the tax) at 16 million. The area of the deadweight loss triangle is therefore $6 million, assuming demand and supply are approximately linear. So as a result of the tax, the country's overall welfare *decreases by $6 million*. (Note that with the information given in this question, it is not possible to compute separately the loss of consumer surplus or the loss of producer surplus.)



Version B

I. Multiple choice

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

II. Short answer

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

(2) a. 10 thousand (using rule P=MC to find q).
b. 8 thousand (using rule P=MC to find q).
c. 0 thousand (because price is below shutdown price).
d. $6 (because breakeven price = min(SATC)).
e. $3 (because shutdown price = min(SAVC)).

(3) a. $5. b. 5 thousand. c. $9 per watermelon.
d. $3 per watermelon. e. decrease. f. $14 thousand.
g. decrease. h. $28 thousand. i. $30 thousand.
j. $12 thousand.

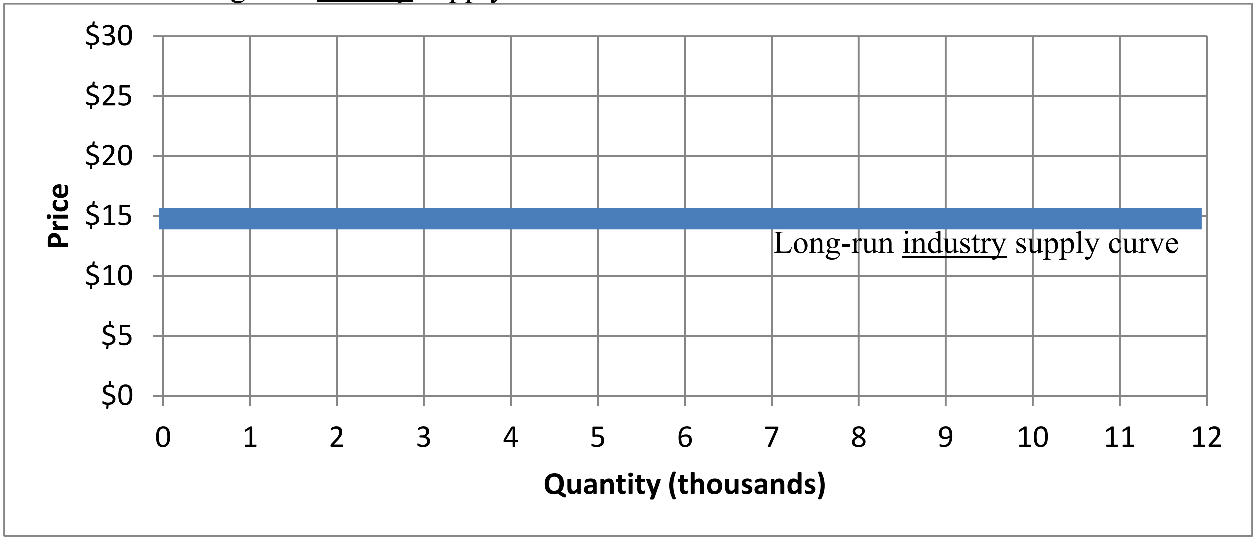
III. Problems

(1) [Input substitution; Returns to scale]
a. $MP_1 = 3$. No, there are NO diminishing returns to input 1, because as x_1 increases (and x_2 is held constant), MP_1 remains constant.
b. $MRSP = MP_2/MP_1 = \frac{3}{6} = \frac{1}{2}$. No, this function does NOT have diminishing MRSP, because as x_1 decreases and x_2 increases, MRSP remains constant.
c. Check returns to scale:
$f(ax_1, ax_2) = 6(ax_1) + 3(ax_2) - 2 > 6ax_1 + 3ax_2 - a2 = aq$, for all a>1.
Thus, multiplying all inputs by the same factor (a) causes output to increase by a (slightly) larger factor. So this production function has INCREASING returns to scale.

(2) [Cost minimization]
a. Equation for isoquant: $60 = 10\, x_1^{1/2}\, x_2^{1/2}$ *or* $6 = x_1^{1/2}\, x_2^{1/2}$ *or* $36 = x_1 x_2$.
b. $MRSP = MP_2/MP_1 = \frac{10\,(1/2)\ x_1^{1/2}\, x_2^{-1/2}}{10\,(1/2)\ x_1^{-1/2}\, x_2^{1/2}} = x_1/x_2$.
c. Set MRSP = $12/$3 and solve jointly with $60 = 10\, x_1^{1/2}\, x_2^{1/2}$, to get x_1*=3 and x_2*=12.
d. TC(60) = 3×$20 + 12×$5 = $120.

(3) [Cost curves; Long-run market equilibrium]
a. AC = TC/q = 0.01 q^2 –q + 40.
Set 0 = dAC/dq = 0.02 q – 1 and solve to get q_{ES} = 50.
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 the firm's supply curve is given by the following equations.
If P≥$15, P = MC(q) = dTC/dq = 0.03 q^2 – 2 q + 40.
If P≤$15, q=0 (firm shuts down).

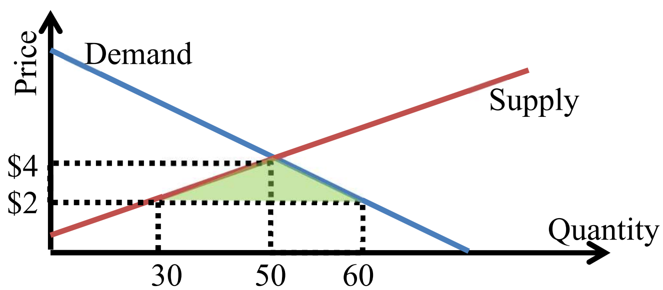
d. The long-run industry supply curve is a horizontal line at minimum AC:



(4) [Welfare effects of international trade]

a. Set $Q_D = Q_S$ and solve to get $P^* = \$3$ and $Q^* = 50$.

b. With international trade, $P_W = \$2$. Substituting into demand and supply gives $Q_D = 60$ and $Q_S = 30$, so the country IMPORTS 60-30=30 units.



c. Consumer surplus increases by $55, 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. The country as a whole gains $55-$40 = $15, the area of the green triangle.

IV. Critical thinking

(Same as Version A above.)

[end of answer key]