ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2016
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EXAMINATION #3 ANSWER KEY

Version A

I. Multiple choice

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

II. Short answer

(1) a. 3.2 % . b. 0.8 %.
(2) a. 0 (shut down). b. 10 thousand. c. 12 thousand.
d. \$8 = min SATC. e. \$3 = min SAVC.
(3) a. import. b. 6 thousand pounds. c. increase.
d. \$22 thousand. e. decrease. f. \$16 thousand.
g. increase. h. \$6 thousand.

III. Problems

(1) [Production functions]

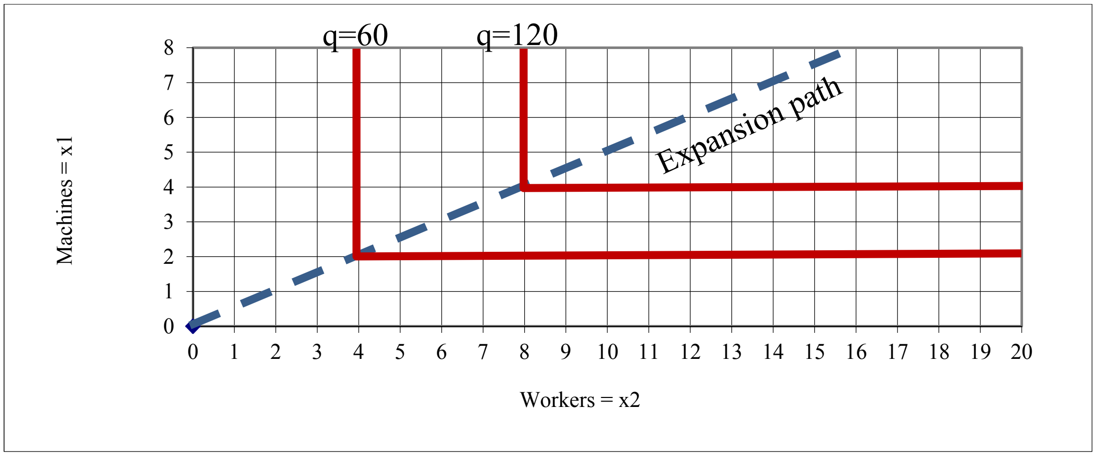
a. $MP_1 = 4\, x_1^{-0.2}\, x_2^{0.4}$. YES, there are diminishing returns to input 1, because as x_1 increases (and x_2 is held constant), MP_1 decreases.

b. $MRSP = MP_2/MP_1 = \frac{2\ x_1^{0.8} x_2^{-0.6}}{4\ x_1^{-0.2} x_2^{0.4}} = \frac{x_1}{2\, x_2}$. YES, this function has diminishing MRSP, because as x_1 decreases and x_2 increases, MRSP diminishes.

c. Check returns to scale:
$f(ax_1, ax_2) = 5\,(ax_1)^{0.8}\,(ax_2)^{0.4} = a^{0.8}\,a^{0.4}\,5\,x_1^{0.8}x_2^{0.4} = a^{1.2}\,q > a\,q$, for a>1.
So this production function has INCREASING returns to scale.

(2) [Fixed-proportions technology]

a. $x_1 = (x_2/2)$. b. $q = 30\, x_1$. c. $q = 15\, x_2$.
d. $q = \min\{30\, x_1, 15\, x_2\}$.
e.



(3) [Cost minimization]

a. $60 = x_1^{0.5}\, x_2^{0.5}$.

b. $MRSP = MP_2/MP_1 = \frac{0.5\ x_1^{0.5}\, x_2^{-0.5}}{0.5\ x_1^{-0.5}\, x_2^{0.5}} = x_1/x_2$.

c. Set MRSP = \$10/\$90 and solve jointly with $60 = x_1^{0.5}\, x_2^{0.5}$, to get x_1*=20 and x_2*=180.

d. TC(60) = 20×\$90 + 180×\$10 = \$3600.

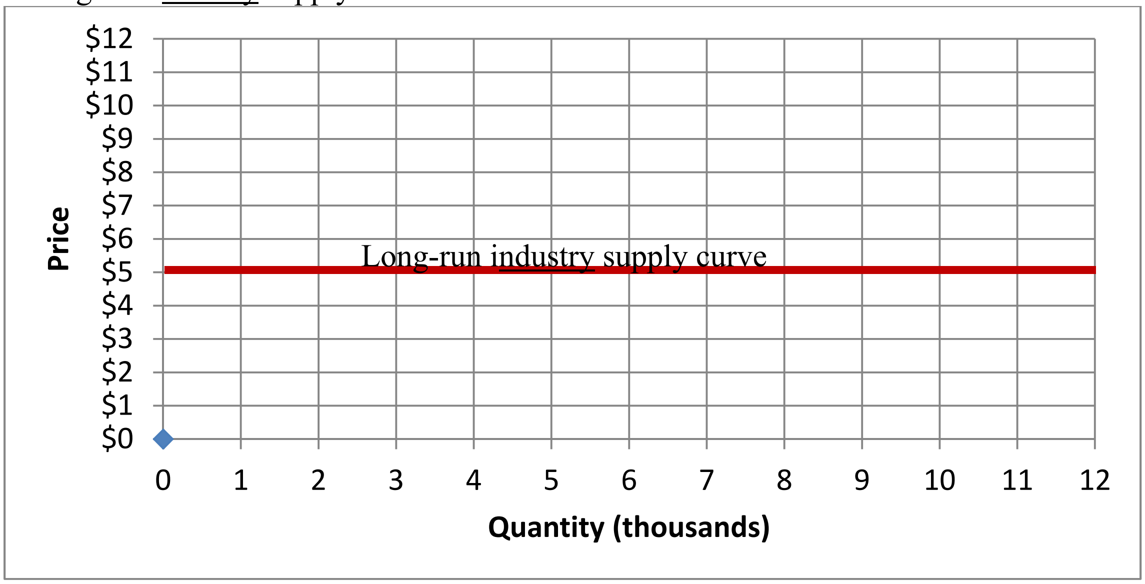
(4) [Long-run profit maximization and supply]

a. AC = TC/q = 0.1 q^2 – 2 q + 15.
Set 0 = dAC/dq = 0.2q – 2 and solve to get q_{ES} = 10.

b. Breakeven price = minimum AC = AC(q_{ES}) = \$5.

c. Firm's supply curve is as follows.
If P≥\$5, P = MC(q) = dTC/dq = 0.3q^2 – 4 q + 15.
If P≤\$5, q=0 (firm shuts down).

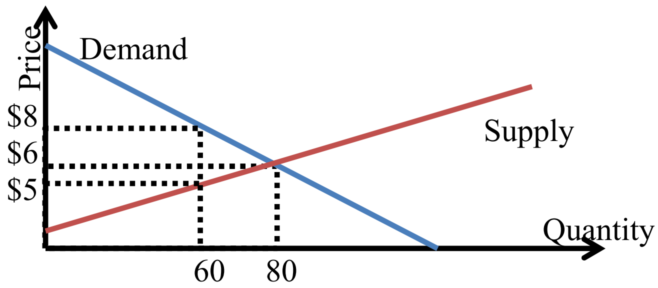
d. Long-run industry supply curve is a horizontal line at minimum AC:



(5) [Welfare effects of tax or subsidy]

a. Set $P_D = P_S$ and solve to get P* = \$6 and Q* = 80.

b. With an excise tax of \$3, $P_D = P_S + 3$. Substituting and solving gives Q = 60. It is useful to also compute the new total price paid by buyers, including the tax (P_D = \$8), and the new net price received by sellers, excluding the tax (P_S = \$5).



c. Consumer surplus decreases by \$140, the area of the trapezoid between \$6 and \$8.
d. Producer surplus decreases by \$70, the area of the trapezoid between \$6 and \$5.
e. Although the government collects \$180 in tax revenue, this is less than the combined decreases of consumer and producer surplus. The net deadweight loss to society as a whole is \$30.

IV. Critical thinking

(1) To minimize total costs, the **marginal costs of the two factories must be equal.** For Factory A, $MC_A = dTC_A/q_A = q_A + 4$. For Factory B, $MC_B = dTC_B/q_B = q_B$. So we must have $q_A + 4 = q_B$. We are given that $q_A + q_B = 20$. Substituting, we have $q_A + (q_A+4) = 20$. Solving gives $\mathbf{q_A^* = 8}$ **and** $\mathbf{q_B^* = 12}$.

(2) First note that there are only two kinds of cost, fixed and variable, so STC = SFC + SVC. This implies that SFC = STC – SVC = (SATC – SAVC) × q. Now fixed cost is independent of output, so we should get the same answer regardless of what level of quantity (q) we look at on the graph.

For example, when q = 17 thousand, the graph shows that SATC ≈ \$12 and SAVC ≈ \$9. So SFC ≈ (12-9) × 17 thousand = \$51 thousand.

Alternatively, when q = 12 thousand, the graph shows that SATC ≈ \$8 and SAVC ≈ \$4. So SFC ≈ (8-4) × 12 thousand = \$48 thousand.

[In fact, the graph was drawn in Excel with SFC set at \$50,000.]

Version B

I. Multiple choice

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

II. Short answer

(1)	a. 1.8 % .	b. 1.2 %.	
(2)	a. 10 thousand.	b. 14 thousand.	c. zero (shut down).
	d. \$5 = min SATC.	e. \$2 = min SAVC.	
(3)	a. export.	b. 6 thousand pounds.	c. decrease.
	d. \$18 thousand.	e. increase.	f. \$24 thousand.
	g. increase.	h. \$6 thousand.	

III. Problems

(1) [Production functions]

a. $MP_1 = 3\, x_1^{-0.7}\, x_2^{0.7}$. YES, there are diminishing returns to input 1, because as x_1 increases (and x_2 is held constant), MP_1 decreases.

b. $MRSP = MP_2/MP_1 = \frac{6\ x_1^{0.3} x_2^{-0.4}}{3\ x_1^{-0.7} x_2^{0.6}} = \frac{2\, x_1}{x_2}$. YES, this function has diminishing MRSP, because as x_1 decreases and x_2 increases, MRSP diminishes.

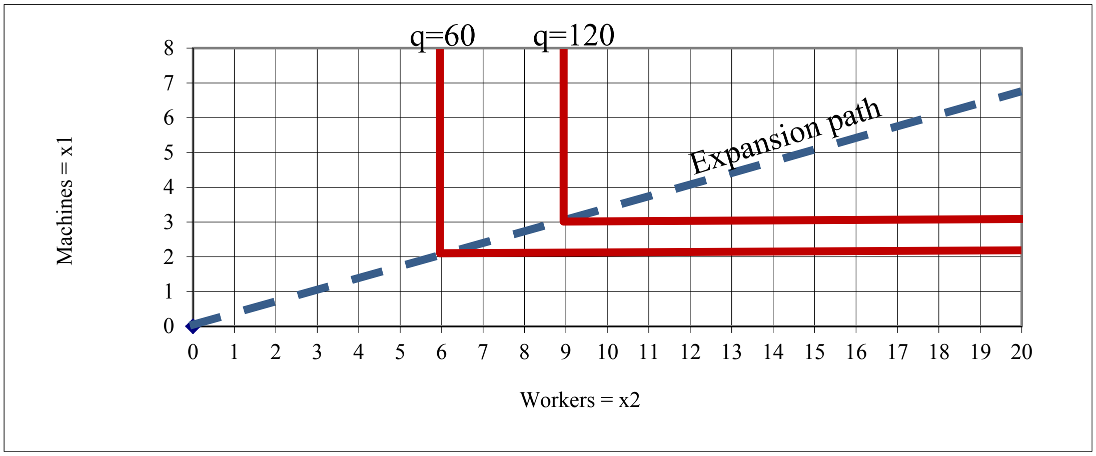
c. Check returns to scale:
$f(ax_1, ax_2) = 10\ (ax_1)^{0.3}\ (ax_2)^{0.6} = a^{0.3}\ a^{0.6}\ 10\ x_1^{0.3} x_2^{0.6} = a^{0.9}\ q < a\ q$, for a>1.
So this production function has DECREASING returns to scale.

(2) [Fixed-proportions technology]

a. $x_1 = (x_2/3)$. b. $q = 40\ x_1$. c. $q = 40\ (x_2/3)$.

d. $q = \min\{40\ x_1, 40\ (x_2/3)\}$.

e.



(3) [Cost minimization]

a. $12 = x_1^{0.5}\ x_2^{0.5}$.

b. $MRSP = MP_2/MP_1 = \frac{0.5\ \ x_1^{0.5}\ x_2^{-0.5}}{0.5\ x_1^{-0.5}\ x_2^{0.5}} = x_1/x_2$.

c. Set MRSP = \$10/\$40 and solve jointly with $12 = x_1^{0.5}\ x_2^{0.5}$, to get x_1*=6 and x_2*=24.

d. TC(12) = 6×\$40 + 24×\$10 = \$480.

(4) [Long-run profit maximization and supply]

a. $AC = TC/q = 0.2\ q^2 - 2\ q + 7$.

Set $0 = dAC/dq = 0.4q - 2$ and solve to get $q_{ES} = 5$.

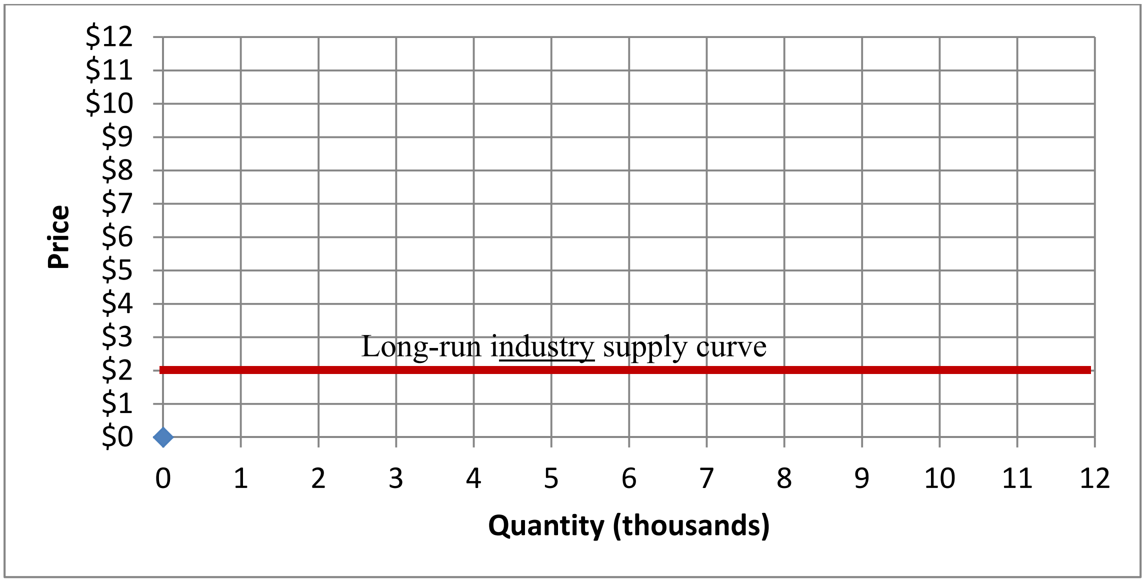
b. Breakeven price = minimum AC = $AC(q_{ES})$ = \$2.

c. Firm's supply curve is as follows.

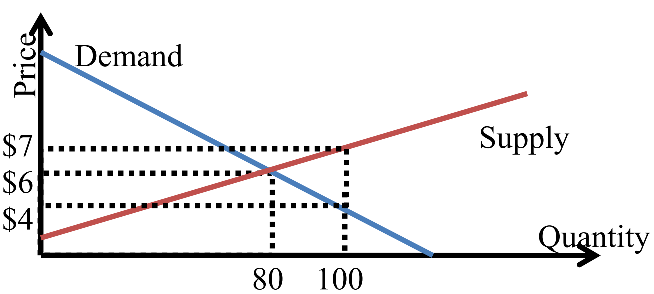
If $P \geq \$2$, $P = MC(q) = dTC/dq = 0.6q^2 - 4\ q + 7$.

If $P \leq \$2$, q=0 (firm shuts down).

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



(5) [Welfare effects of tax or subsidy]
a. Set $P_D = P_S$ and solve to get $P^* = \$6$ and $Q^* = 80$.
b. With a subsidy of $3, $P_D + 3 = P_S$. Substituting and solving gives Q = 100. It is useful to also compute the new net price paid by buyers, excluding the subsidy ($P_D = \$4$), and the new total price received by sellers, including the subsidy ($P_S = \$7$).



c. Consumer surplus increases by $180, the area of the trapezoid between $6 and $4.
d. Producer surplus increases by $90, the area of the trapezoid between $6 and $7.
e. The government pays $300 to consumers and producers. This is greater than the combined increases in consumer and producer surplus. The net deadweight loss to society as a whole is $30.

IV. Critical thinking

(1) (Same as Version A above.)

(2) First note that there are only two kinds of cost, fixed and variable, so STC = SFC + SVC. This implies that SFC = STC – SVC = (SATC – SAVC) × q. Now fixed cost is independent of output, so we should get the same answer regardless of what level of quantity (q) we look at on the graph.

For example, when q = 10 thousand, the graph shows that SATC ≈ $5.2 and SAVC ≈ $2.2. So SFC ≈ (5.2-2.2) × 10 thousand = $30 thousand.

Alternatively, when q = 15 thousand, the graph shows that SATC ≈ \$6 and SAVC ≈ \$4. So SFC ≈ (6-4) × 15 thousand = \$30 thousand.

[In fact, the graph was drawn in Excel with SFC set at \$30,000.]

[end of answer key]