ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2016
William M. Boal

# FINAL EXAMINATION ANSWER KEY

## Version A

### I. Multiple choice

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (1)b. | (2)a. | (3)c. | (4)d. | (5)c. | (6)c. | (7)a. | (8)c. | (9)c. | (10)d. |
| (11)b. | (12)c. | (13)b. | (14)b. | (15)b. | (16)a. | (17)b. | (18)b. | (19)b. | (20)d. |

### II. Short answer

| | | | |
|---|---|---|---|
| (1) | a. inelastic. | b. decrease. | c. 3%. |
| | d. increase. | e. 2%. | |
| (2) | a. \$10. | b. 4 units. | c. \$4. |
| | d. 9 units. | e. 4 units. | f. 1 unit. |
| (3) | a. import. | b. 6 thousand pounds. | c. increase. |
| | d. \$22 thousand. | e. decrease. | f. \$16 thousand. |
| | g. increase. | h. \$6 thousand. | |
| (4) | a. 2 units of food | b. 1/2 units of clothing | c. slope = -2 |
| | d. $P_{food}$ = \$6, because slope of each consumer's budget line = $-P_{clothing}/P_{food} = -2$. | | |

### III. Problems

(1) [Properties of individual demand functions]

a. Check homogeneity of the demand function:

$$\frac{(a\,I)}{5(a\,p_1)} + \frac{(a\,p_2)}{(a\,p_1)} + 3 = \frac{I}{5p_1} + \frac{p_2}{p_1} + 3 \,.$$

Note that the "a" factor cancels. So multiplying income and prices by some positive factor a *does not* change the quantity demanded. The function <u>is homogeneous of degree zero</u> in income and prices.

b. Must determine sign of partial derivative with respect to own price (or equivalently, sign of own-price elasticity of demand). Here, it is probably easier to find the partial derivative = $\frac{-I}{5\ p_1^{\,2}} - \frac{p_2}{10\ p_1^{\,2}}$ , which is negative. Since it is negative, this is an <u>ordinary good</u>, not a Giffen good.

c. Must determine sign of partial derivative with respect to income (or equivalently, sign of income elasticity of demand). Here, it is probably easier to find the partial derivative = $\frac{I}{5\ p_1}$ , which is positive. Since it is positive, this is <u>normal good</u>, not an inferior good.

d. Must determine sign of partial derivative with respect to cross price (or equivalently, sign of cross-price elasticity of demand). Here, it is probably easier to find the partial derivative = $\frac{1}{10\ p_1}$ , which is positive. Since it is positive, the goods are <u>substitutes</u>, not complements.

(2) [Finding individual demand functions]

a. MRS = $MU_2/MU_1 = 2\,q_1 / (3q_2)$ .

Solve MRS = $p_2/p_1$ jointly with $I = p_1q_1 + p_2q_2$ to get

b. $q_1^* = \frac{3\,I}{5\,p_1}$, and c. $q_2^* = \frac{2\,I}{5\,p_2}$ .

(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 = $0.2\,q^2 - 2\,q + 7$.

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

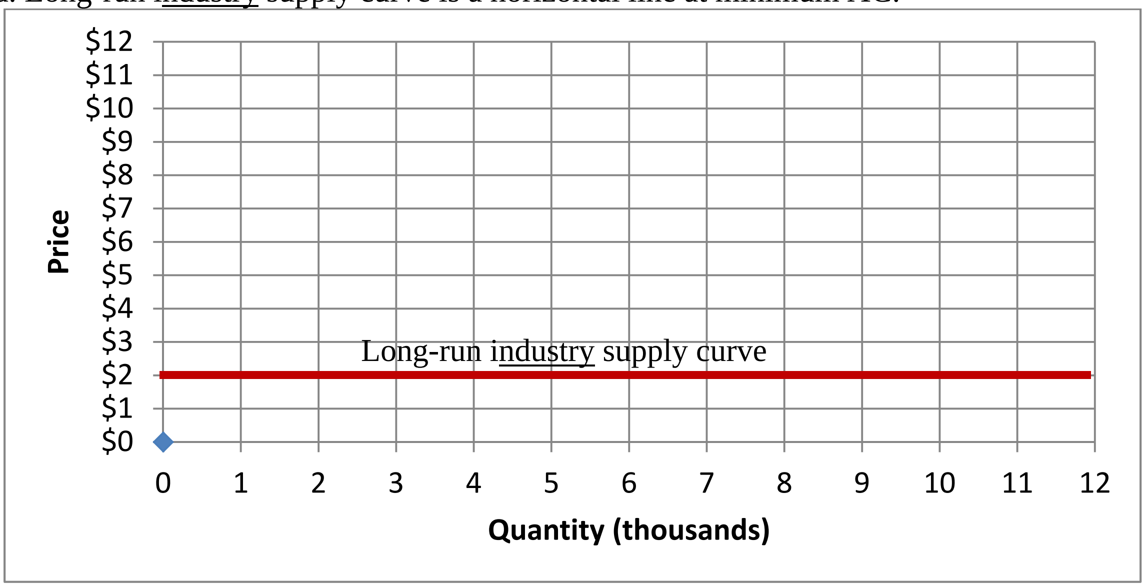
b. Breakeven price = minimum AC = AC($q_{ES}$) = \$2.

c. Firm's supply curve is as follows.

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

If P≤\$2, q=0 (firm shuts down).

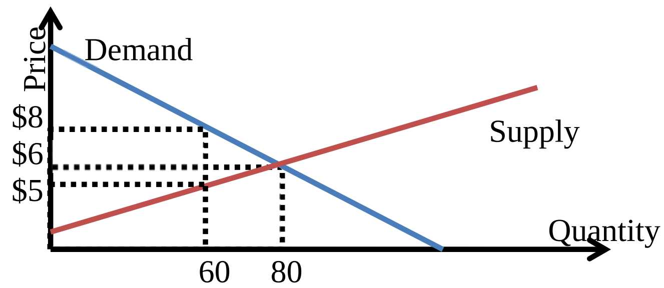
d. Long-run industry supply curve is a horizontal line at minimum AC:




(5) [Welfare effects of tax or subsidy]

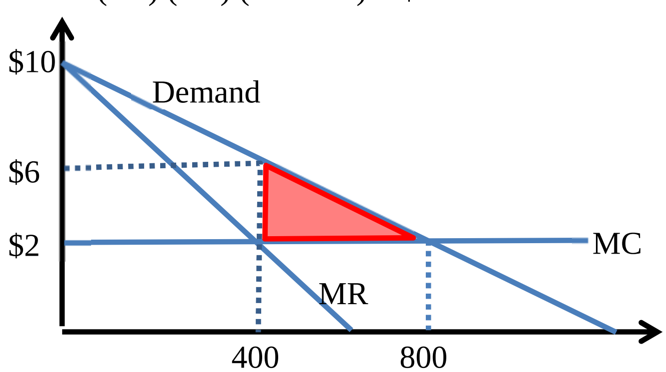
a. Set $P_D = P_S$ and solve to get P* = \$6 and Q* = 80.

b. With 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.

(6) [Monopoly pricing, deadweight loss]
a. First find MR. Total revenue = TR = P×Q = 10Q – ($Q^2$/100). MR = dTR/dQ = 10 – (2Q/100). Now set MR equal to MC=2, and solve to get **$Q_M$=400**. Insert this value into the demand equation to get **$P_M$=\$6**.
b. Maximum up-front cost that the firm would be willing to pay for developing and patenting the chip = TR – production cost = (P×Q) – (2×Q) = **\$1600**.
c. When the market is competitive, **$P_C$=MC=\$2**. Insert this value into the demand equation to get **$Q_C$=800**.
d. Deadweight loss is the area of a triangle bounded by the demand curve, a vertical line at the monopoly quantity, and a horizontal line at the competitive price (see below). So deadweight loss = (1/2) (6-2) (800-400) = **\$800**.




(7) [External benefit and Pigou subsidy]
a. Set $P_D$ = $P_S$ and solve to get Q** = 800, P = \$7.
b. MSB = $P_D$ + MEB = 28 – (Q/50).
c. Set MSB = $P_S$ and solve to get Q* = 1000.
d. DWL = (1/2) × (1000-800) × (12-7) = \$500.
e. Pigou subsidy rate = MEB(1000) = \$3.

(8) [Uncertainty, risk aversion, demand for insurance.]
[This question assumes ridiculously small dollar values to make calculations easier.]
a. E(I) = (0.5 × 25) + (0.5 × 9) = \$17 .
b. E(U) = (0.5 × $25^{1/2}$ ) + (0.5 × $9^{1/2}$ ) = 4 utils.

c. Set $U(I) = I^{1/2} = 4$ and solve to get $I^* = \$16$.
d. Willing to pay \$25 - \$16 = \$9.
e. 0.50 × \$16 = \$8 .

(9) [Hidden characteristics and adverse selection]
a. $P_D = 60 + EL = 260 – 0.4 Q$.
b. $MC = EL = 200 – 0.4 Q$.
c. If the market were efficient, everyone (Q=400) would get insurance because everyone is willing to pay more than the marginal cost of insurance: $P_D > MC$ for all values of Q.
d. $AC = 200 – 0.2 Q$.
e. Set $P_D = AC$ and solve to get Q = 300. P = AC = \$140.

**IV. Critical thinking**

A good answer should begin by defining what you think people mean by "free markets." A plausible definition is "markets unhindered by government interference," but one might argue that free markets also means "unhindered by monopoly."

Then one should acknowledge that markets unhindered by government interference will indeed be efficient if they do not suffer from market failure. One should then explain why such markets are efficient, emphasizing that they generate prices equal to marginal cost, or that the demand curve represents marginal benefit and the supply curve represents marginal cost. A supply-and-demand diagram showing absence of deadweight loss would support the argument.

Finally, one should demonstrate that "free markets" can nonetheless be inefficient if they are plagued by market failure—such as market power (including monopoly, oligopoly, cartels, or monopolistic competition), externalities, or asymmetric information (including adverse selection or moral hazard). Picking one example, one should then explain why such an apparently "free" market is inefficient, showing how prices give the wrong signal. Again, a supply-and-demand diagram showing deadweight loss would support the argument.

## Version B

**I. Multiple choice**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| (1)d. | (2)b. | (3)d. | (4)b. | (5)c. | (6)a. | (7)b. | (8)b. | (9)d. | (10)b. |
| (11)a. | (12)a. | (13)c. | (14)a. | (15)c. | (16)b. | (17)a. | (18)c. | (19)b. | (20)d. |

**II. Short answer**

| | | | |
|---|---|---|---|
| (1) | a. elastic. | b. increase. | c. 6%. |
| | d. increase. | e. 1%. | |
| (2) | a. \$3. | b. 12 units. | c. \$6. |
| | d. 4 units. | e. -6 units. | f. -2 units. |
| (3) | a. export. | b. 6 thousand pounds. | c. decrease. |
| | d. \$18 thousand. | e. increase. | f. \$24 thousand. |
| | g. increase. | h. \$6 thousand. | |
| (4) | a. 3 units of food | b. 1/3 units of clothing | c. slope = -3 |

d. $P_{food}$ = \$4, because slope of each consumer's budget line = $-P_{clothing}/P_{food} = -3$.

**III. Problems**

(1) [Properties of individual demand functions]

a. Check homogeneity of the demand function:

$$47\,(a\,I)^{0.9}(a\,p_1)^{-0.8}(a\,p_2)^{-0.1} = (a^{0.9}a^{-0.8}a^{-0.1})(47\,I^{0.9}{p_1}^{-0.8}{p_2}^{-0.1})$$
$$= 1 \times 47\,I^{0.9}{p_1}^{-0.8}{p_2}^{-0.1} = 47\,I^{0.9}{p_1}^{-0.8}{p_2}^{-0.1} \;.$$

Note that the "a" factor cancels. So multiplying income and prices by some positive factor a *does not* change the quantity demanded. The function is homogeneous of degree zero in income and prices.

b. Must determine sign of partial derivative with respect to own price (or equivalently, sign of own-price elasticity of demand). Here, it is probably easier to find the own-price elasticity = -0.8, which is negative. Since it is negative, this is an ordinary good, not a Giffen good.

c. Must determine sign of partial derivative with respect to income (or equivalently, sign of income elasticity of demand). Here, it is probably easier to find the income elasticity = 0.9, which is positive. Since it is positive, this is normal good, not an inferior good.

d. Must determine sign of partial derivative with respect to cross price (or equivalently, sign of cross-price elasticity of demand). Here, it is probably easier to find the cross-price elasticity = -0.1, which is negative. Since it is negative, the goods are complements, not substitutes.

(2) [Finding individual demand functions]

a. $MRS = MU_2/MU_1 = 3\,q_1 / (4q_2)$ .

Solve $MRS = p_2/p_1$ jointly with $I = p_1q_1 + p_2q_2$ to get

b. $q_1^* = \frac{4\,I}{7\,p_1}$, and c. $q_2^* = \frac{3\,I}{7\,p_2}$ .

(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. $AC = TC/q = 0.1\,q^2 - 2\,q + 15$.

Set $0 = dAC/dq = 0.2q - 2$ and solve to get $q_{ES} = 10$.

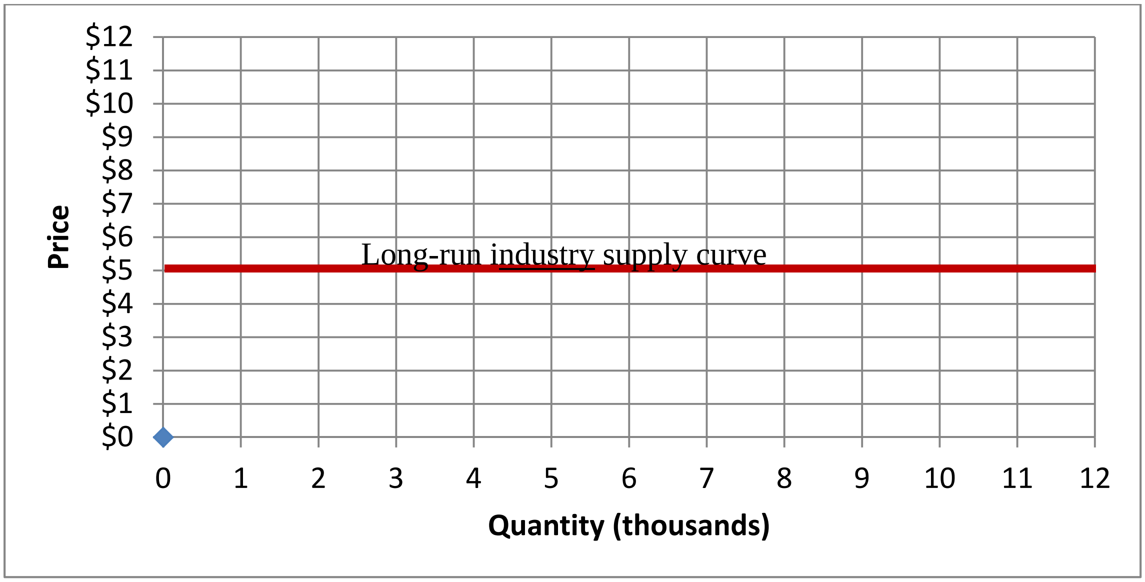
b. Breakeven price = minimum AC = $AC(q_{ES})$ = \$5.

c. Firm's supply curve is as follows.

If $P \geq \$5$, $P = MC(q) = dTC/dq = 0.3q^2 - 4\,q + 15$.

If $P \leq \$5$, q=0 (firm shuts down).

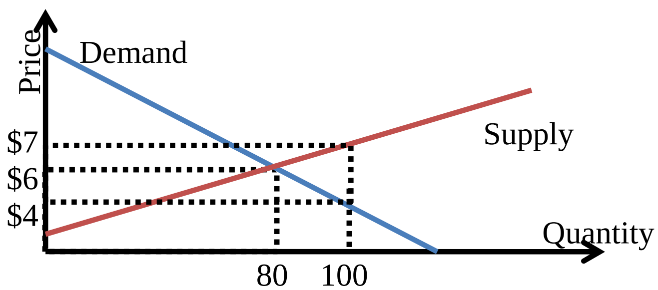
d. Long-run industry supply curve is a horizontal line at minimum AC:




(5) [Welfare effects of tax or subsidy]

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

b. With 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.

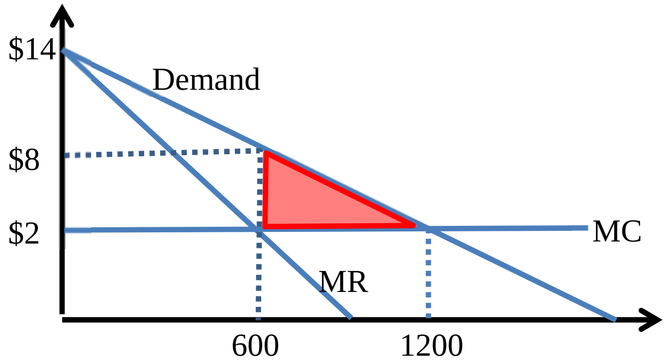
(6) [Monopoly pricing, deadweight loss]

a. First find MR. Total revenue = TR = P×Q = $14Q - (Q^2/100)$. MR = dTR/dQ = $14 - (2Q/100)$. Now set MR equal to MC=2, and solve to get $\mathbf{Q_M=600}$. Insert this value into the demand equation to get $\mathbf{P_M=\$8}$.

b. Maximum up-front cost that the firm would be willing to pay for developing and patenting the chip = TR – production cost = (P×Q) – (2×Q) = **\$3600**.

c. When the market is competitive, $\mathbf{P_C=MC=\$2}$. Insert this value into the demand equation to get $\mathbf{Q_C=1200}$.

d. Deadweight loss is the area of a triangle bounded by the demand curve, a vertical line at the monopoly quantity, and a horizontal line at the competitive price (see below). So deadweight loss = (1/2) (8-2) (1200-600) = **$1800**.




(7) [External cost and Pigou tax]
a. Set $P_D = P_S$ and solve to get Q** = 500, P = $7.
b. MSC = $P_S$ + MEC = 3 + (2Q/100).
c. Set MSC = $P_D$ and solve to get Q* = 300.
d. DWL = (1/2) × (500-300) × (13-7) = $1200.
e. Pigou tax rate = MEC(600) = $4.

(8) [Uncertainty, risk aversion, demand for insurance.]
[This question assumes ridiculously small dollar values to make calculations easier.]
a. E(I) = (0.5 × 16) + (0.5 × 4) = $10 .
b. E(U) = $(0.5 \times 16^{1/2}) + (0.5 \times 4^{1/2})$ = 3 utils.
c. Set U(I) = $I^{1/2}$ = 3 and solve to get I* = $9 .
d. Willing to pay $16 - $9 = $7.
e. 0.50 × $12 = $6 .

(9) [Hidden characteristics and adverse selection]
a. $P_D$ = 50 + EL = 300 – 0.4 Q.
b. MC = EL = 250 – 0.4 Q.
c. If the market were efficient, everyone (Q=400) would get insurance because everyone is willing to pay more than the marginal cost of insurance: $P_D$ > MC for all values of Q.
d. AC = 250 – 0.2 Q.
e. Set $P_D$ = AC and solve to get Q = 250. P = AC = $200.

**IV. Critical thinking**
Same as Version A.

[end of answer key]