

## FINAL EXAMINATION ANSWER KEY

---

### Version A

---

#### I. Multiple choice

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

#### II. Short answer

- (1) Note: This graph is based on Slutsky's interpretation of income and substitution effects, which was emphasized in class, not Hicks's interpretation, which is often presented in textbooks.
- |                   |                   |                   |
|-------------------|-------------------|-------------------|
| a. \$10.          | b. 3 mini-pizzas. | c. \$3.           |
| d. 9 mini-pizzas. | e. 4 mini-pizzas. | f. 2 mini-pizzas. |
- (2) a. elastic.                      b. decrease.                      c. 6 %.  
d. decrease.                      e. 2 %.
- (3) a. 0 thousand (because price is below shutdown price).  
b. 8 thousand (using rule  $P=MC$  to find  $q$ ).  
c. 11 thousand (using rule  $P=MC$  to find  $q$ ).  
d. \$6 (because breakeven price =  $\min(SATC)$ ).  
e. \$2 (because shutdown price =  $\min(SAVC)$ ).
- |                   |                       |                  |
|-------------------|-----------------------|------------------|
| (4) a. export.    | b. 5 million gallons. | c. decrease.     |
| d. \$7.5 million. | e. increase.          | f. \$10 million. |
| g. increase.      | h. \$2.5 million.     |                  |
- (5) a. \$6                                  b. 10 thousand                      c. \$0  
d.  $MR = 16 - 2Q$   
e. MR is straight line with P-intercept = \$16, slope =  $-2/\text{thousand}$
- |         |               |                   |
|---------|---------------|-------------------|
| f. \$10 | g. 6 thousand | h. \$12 thousand. |
|---------|---------------|-------------------|
- (6) a. 2 units of food                  b. 1/2 units of health care        c. slope =  $-1/2$   
d.  $P_{\text{food}} = \$15$ , because slope of each consumer's budget line =  $-P_{\text{food}}/P_{\text{health}} = -1/2$ .
- (7) a. 150 units, because with no penalty, factories pollute until  $MB=0$ .  
b. \$8. Set demand =  $Q_{\text{old}}+Q_{\text{new}} = 30$ , substitute P for MB, and solve for P.  
c. 20 permits, substituting \$8 for MB in  $Q_{\text{old}} = 100 - 10 MB$ .  
d. 10 permits, substituting \$8 for MB in  $Q_{\text{new}} = 50 - 5 MB$ .  
e. \$8. Again, set demand =  $Q_{\text{old}}+Q_{\text{new}} = 30$ , substitute P for MB, and solve for P.

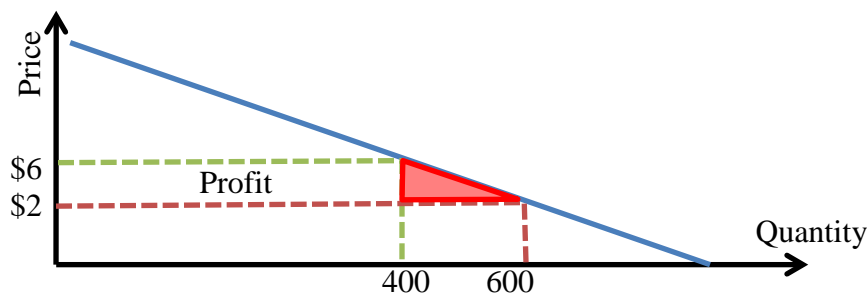
#### III. Problems

- (1) [Budgets and choice]
- a. Equation for budget line:  $75 = 6 q_1 + 3 q_2$ .
- b.  $MRSC = MU_2/MU_1 = \frac{q_1}{2(q_2-10)}$ .

- c. Solve the tangency condition ( $MRSC = p_2/p_1 = 2/1$ ) jointly with equation for budget line (see part a) to get  $q_1^* = 5$ ,  $q_2^* = 15$ .
- (2) [Production functions]
- a.  $MP_1 = \frac{1}{2}(x_1 + x_2)^{-1/2} = \frac{1}{2(x_1+x_2)^{1/2}}$ . YES, there are diminishing returns to input 1, because as  $x_1$  increases (and  $x_2$  is held constant),  $MP_1$  decreases.
- b.  $MRSP = MP_2/MP_1 = \frac{\frac{1}{2}(x_1+x_2)^{-1/2}}{\frac{1}{2}(x_1+x_2)^{-1/2}} = 1$ . 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:
- $$f(ax_1, ax_2) = (ax_1 + ax_2)^{1/2} = (a(x_1 + x_2))^{1/2} = a^{1/2}(x_1 + x_2)^{1/2},$$
- $$= a^{1/2} q < a q, \text{ for all } a > 1.$$

So this production function has DECREASING returns to scale.

- (3) [Cournot duopoly]
- a.  $TR_1 = P q_1 = 14q_1 - (q_1^2/50) - (q_1q_2/50)$ .
- b.  $MR_1 = \partial TR_1(q_1, q_2) / \partial q_1 = 14 - 2q_1/50 - q_2/50$ .
- c. Set  $MR_1 = MC = \$2$  and solve to get  $q_1^* = 300 - q_2/2$ .
- d. Since  $q_1^* = q_2^*$ ,  $q_1^* = 300 - q_1^*/2$ . Solving yields  $q_1^* = 200 = q_2^*$ .
- e.  $Q^* = q_1^* + q_2^* = 400$ . Substituting into demand equation:  $P^* = 14 - (400/50) = \$6$ .
- f. Profit =  $(P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (6 - 2) \times 400 = \$1600$ .
- g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting  $MC = \$2 = P = 14 - (Q/50)$  and solving to get  $Q = 600$ . Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity  $Q^* = 400$  to the efficient quantity = 600 (see below). This is the area of a triangle, equal to **\$400**.



- (4) [External cost and Pigou tax]
- a. Set  $P_D = P_S$  and solve to get  $Q^{**} = 1000$ ,  $P = \$6$ .
- b.  $MSC = P_S + MEC = 2 + (2Q/200)$ .
- c. Set  $MSC = P_D$  and solve to get  $Q^* = 600$ .
- d.  $DWL = (1/2) \times (1000 - 600) \times 6 = \$1200$ .
- e. Pigou tax rate =  $MEC(600) = \$4$ .
- (5) [Uncertainty, risk aversion, demand for insurance.]
- a.  $E(I) = (0.75 \times 120) + (0.25 \times 40) = \$100$ .
- b.  $E(U) = 0.75 \times (10 - (240/120)) + 0.25 \times (10 - (240/40)) = 7$  utils.
- c. Set  $U(I) = 10 - (240/I) = 7$  and solve to get  $I^* = \$80$ .
- d. Willing to pay  $\$120 - \$80 = \$40$ .

- e. Fair insurance premium =  $0.25 \times \$80 = \$20$  .
- (6) [Hidden characteristics and adverse selection]
- $P_D = 40 + EL = 340 - 0.2 Q$ .
  - $MC = EL = 300 - 0.2 Q$ .
  - If the market were efficient, everyone ( $Q=1000$ ) would get insurance because everyone is willing to pay more than the marginal cost of insurance:  $P_D > MC$  for all values of  $Q$ .
  - $AC = 300 - 0.1 Q$ .
  - Set  $P_D = AC$  and solve to get  $Q = 400$ .  $P = AC(400) = \$260$ .

#### IV. Essay

A good answer should first give an example of a situation in which a market produces too much output, such as a government subsidy or an external cost. The answer should explain why too much output is produced and should describe an accompanying graph. At a minimum, the graph should show supply and demand, the socially-optimal output level, the actual output level, and the deadweight loss triangle.

Then the answer should give an example of a situation in which a market produces too little output, such as monopoly, collusion, Cournot oligopoly, external benefits, or adverse selection. Again, the answer should explain why too little output is produced and should describe an accompanying graph. Again, the graph should show supply and demand, the socially-optimal output level, the actual output level, and the deadweight loss triangle.

For full credit, both graphs must be accurate and intelligible. In particular, axes and curves should be labeled. So should optimal and actual output levels, and the deadweight loss triangle.

---

### Version B

---

#### I. Multiple choice

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

#### II. Short answer

- (1) Note: This graph is based on Slutsky's interpretation of income and substitution effects, which was emphasized in class, not Hicks's interpretation, which is often presented in textbooks.
- |                  |                   |                   |
|------------------|-------------------|-------------------|
| a. \$3.          | b. 11 sandwiches. | c. \$12.          |
| d. 4 sandwiches. | e. -2 sandwiches. | f. -5 sandwiches. |
- (2) a. inelastic. b. decrease. c. 4 %.  
d. increase. e. 1 %.
- (3) a. 9 thousand (using rule  $P=MC$  to find  $q$ ).  
b. 0 thousand (because price is below shutdown price).  
c. 7 thousand (using rule  $P=MC$  to find  $q$ ).  
d. \$7 (because breakeven price =  $\min(SATC)$ ).  
e. \$4 (because shutdown price =  $\min(SAVC)$ ).

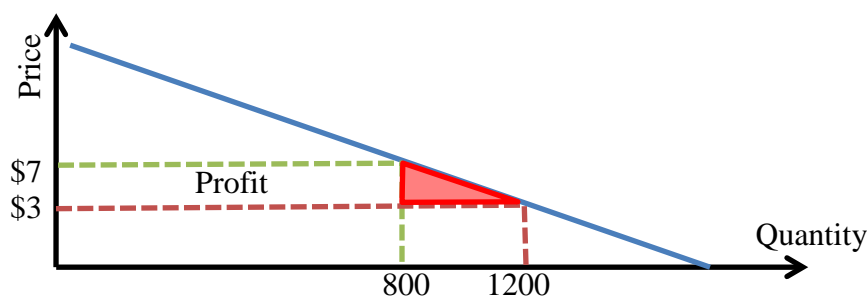
- (4) a. import. b. 5 million gallons. c. increase.  
 d. \$8.5 million. e. decrease. f. \$6 million.  
 g. increase. h. \$2.5 million.
- (5) a. \$8 b. 12 thousand c. \$0  
 d.  $MR = 14 - Q$   
 e. MR is straight line with P-intercept = \$14, slope = -1/thousand  
 f. \$10 g. 8 thousand h. \$8 thousand.
- (6) a. 3 units of food b. 1/3 units of health care c. slope = -1/3  
 d.  $P_{\text{food}} = \$10$ , because slope of each consumer's budget line =  $-P_{\text{food}}/P_{\text{health}} = -1/3$ .
- (7) a. 150 units, because with no penalty, factories pollute until  $MB=0$ .  
 b. \$6. Set demand =  $Q_{\text{old}} + Q_{\text{new}} = 60$ , substitute P for MB, and solve for P.  
 c. 40 permits, substituting \$6 for MB in  $Q_{\text{old}} = 100 - 10 MB$ .  
 d. 20 permits, substituting \$6 for MB in  $Q_{\text{new}} = 50 - 5 MB$ .  
 e. \$6. Again, set demand =  $Q_{\text{old}} + Q_{\text{new}} = 60$ , substitute P for MB, and solve for P.

### III. Problems

- (1) [Budgets and choice]  
 a. Equation for budget line:  $42 = 3 q_1 + 2 q_2$ .  
 b.  $MRSC = MU_2/MU_1 = (2 q_1^{1/2}) / q_2^{1/2}$ .  
 c. Solve the tangency condition ( $MRSC = p_2/p_1 = 2/1$ ) jointly with equation for budget line (see part a) to get  $q_1^* = 2$ ,  $q_2^* = 18$ .
- (2) [Production functions]  
 a.  $MP_1 = 2(x_1 + x_2)$ . No, there are no diminishing returns to input 1, because as  $x_1$  increases (and  $x_2$  is held constant),  $MP_1$  increases.  
 b.  $MRSP = MP_2/MP_1 = \frac{2(x_1+x_2)}{2(x_1+x_2)} = 1$ . 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:  

$$f(ax_1, ax_2) = (ax_1 + ax_2)^2 = (a(x_1 + x_2))^2 = a^2(x_1 + x_2)^2,$$

$$= a^2 q > a q, \text{ for all } a > 1.$$
 So this production function has INCREASING returns to scale.
- (3) [Cournot duopoly]  
 a.  $TR_1 = P q_1 = 15q_1 - (q_1^2/100) - (q_1q_2/100)$ .  
 b.  $MR_1 = \partial TR_1(q_1, q_2) / \partial q_1 = 15 - 2q_1/100 - q_2/100$ .  
 c. Set  $MR_1 = MC = \$3$  and solve to get  $q_1^* = 600 - q_2/2$ .  
 d. Since  $q_1^* = q_2^*$ ,  $q_1^* = 600 - q_1^*/2$ . Solving yields  $q_1^* = 400 = q_2^*$ .  
 e.  $Q^* = q_1^* + q_2^* = 800$ . Substituting into demand equation:  $P^* = 15 - (800/100) = \$7$ .  
 f. Profit =  $(P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (7 - 3) \times 800 = \$3200$ .  
 g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting  $MC = \$3 = P = 15 - (Q/100)$  and solving to get  $Q = 1200$ . Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity  $Q^* = 800$  to the efficient quantity = 1200 (see below). This is the area of a triangle, equal to \$800.



- (4) [External benefit and Pigou subsidy]
- Set  $P_D = P_S$  and solve to get  $Q^{**} = 100$ ,  $P = \$7$ .
  - $MSB = P_D + MEB = 26 - (3Q/20)$ .
  - Set  $MSB = P_S$  and solve to get  $Q^* = 120$ .
  - $DWL = (1/2) \times (120-100) \times 4 = \$40$ .
  - Pigou subsidy rate =  $MEB(120) = \$3$ .
- (5) [Uncertainty, risk aversion, demand for insurance.]  
 [This question assumes ridiculously small dollar values to make calculations easier.]
- $E(I) = (0.75 \times 40) + (0.25 \times 8) = \$32$ .
  - $E(U) = 0.75 \times (9 - (40/40)) + 0.25 \times (9 - (40/8)) = 7$  utils.
  - Set  $U(I) = 9 - (40/I) = 7$  and solve to get  $I^* = \$20$ .
  - Willing to pay  $\$40 - \$20 = \$20$ .
  - $0.25 \times \$32 = \$8$ .
- (6) [Hidden characteristics and adverse selection]
- $P_D = 60 + EL = 560 - 0.2 Q$ .
  - $MC = EL = 500 - 0.2 Q$ .
  - If the market were efficient, everyone ( $Q=1000$ ) would get insurance because everyone is willing to pay more than the marginal cost of insurance:  $P_D > MC$  for all values of  $Q$ .
  - $AC = 500 - 0.1 Q$ .
  - Set  $P_D = AC$  and solve to get  $Q = 600$ .  $P = AC(600) = \$440$ .

#### IV. Short Essay

Same as version A.

[end of answer key]