

EXAMINATION #4 ANSWER KEY

Version A

I. Multiple choice

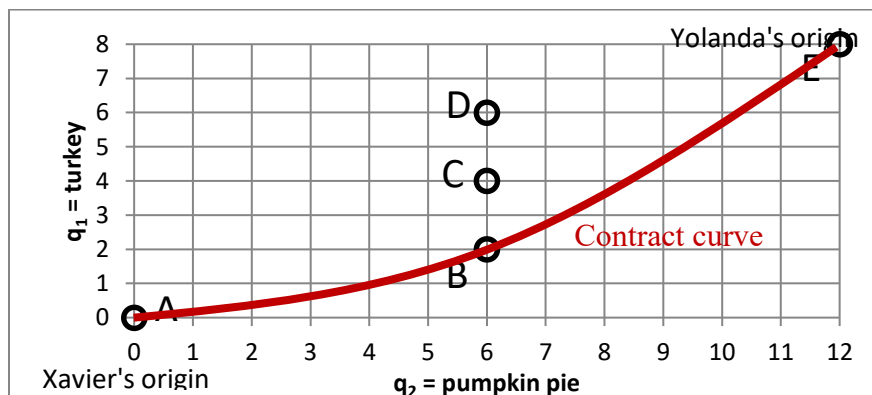
(1)e. (2)c. (3)c. (4)b. (5)d. (6)b. (7)b. (8)c. (9)a. (10)b.

II. Short answer

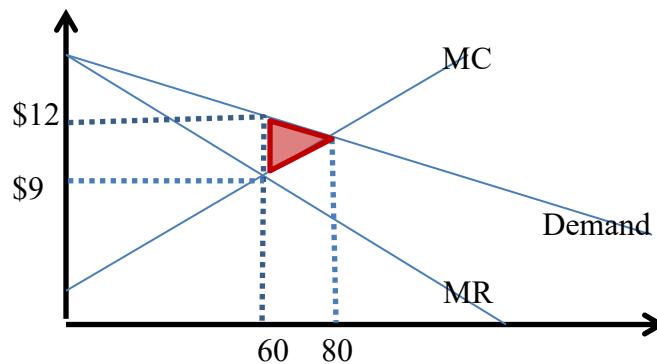
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|-----|---|-------------------|----------------------|
| (1) | a. 1/4 pizzas | b. 4 soft drinks | c. slope = -4 |
| | d. \$3, because slope of each consumer's budget line = $-P_{\text{pizza}}/P_{\text{drinks}} = -4$. | | |
| (2) | a. \$24 | b. \$10. | |
| (3) | a. 1/2 | b. 1/20 | c. 1/100. |
| (4) | a. $MR = 16 - 2Q$ | | |
| | b. MR is straight line with P-intercept = \$16, slope = -2/thousand | | |
| | c. \$10 | d. 6 thousand | e. \$12 thousand |
| | f. \$6 | g. 10 thousand | h. \$0 thousand. |
| (5) | a. yes, no, no, yes | b. no, no, no, no | c. yes, no, no, yes. |

III. Problems

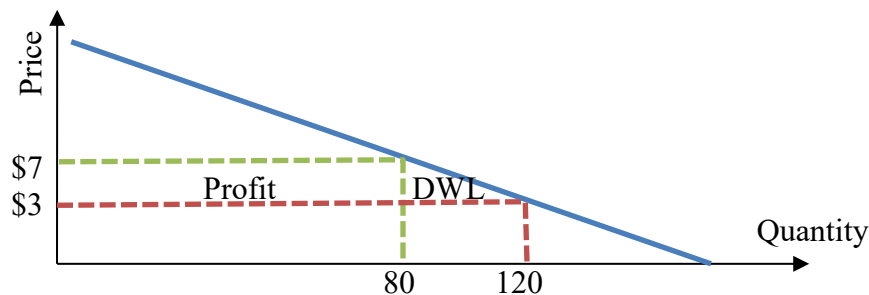
- (1) Note that Xavier's $MRS_X = 3q_1 / q_2$ and Yolanda's $MRS_Y = q_1 / q_2$.
- Yes**, A is Pareto-efficient, because no one can be made better off without someone else being made worse off. Yolanda has everything, so she cannot be made better off. Xavier has nothing, so he cannot be made better off without taking some of Yolanda's turkey or pumpkin pie, which would make Yolanda worse off.
 - Yes**, B is Pareto-efficient, because $MRS_X = 1 = MRS_Y$.
 - No**, C is not Pareto-efficient, because $MRS_X = 2 \neq MRS_Y = 2/3$.
 - No**, D is not Pareto-efficient, because $MRS_X = 3 \neq MRS_Y = 1/3$.
 - Yes**, E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Xavier has everything, so he cannot be made better off. Yolanda has nothing, so she cannot be made better off without taking some of Xavier's turkey or pumpkin pie, which would make Xavier worse off.
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- (2) a. $MC(Q) = dTC/dQ = 3 + (Q/10)$.
 b. $AC(Q) = TC/Q = 3 + (Q/20)$.
 c. $Rev(Q) = P \times Q = 15Q - (Q^2/20)$, so $MR = dRev/dQ = 15 - (Q/10)$.
 d. Set $MC(Q) = MR(Q)$ and solve to find $Q^* = 60$.
 e. Substitute into demand curve: $P^* = 15 - (60/20) = \$12$.
 f. Profit = $Rev(Q) - TC(Q) = \$360$.
 g. The efficient level of output is where the marginal cost curve intersects the demand curve, that is, where $MC=P$. Set $3 + (Q/10) = 15 - (Q/20)$ and solve to find $Q = 80$. Deadweight loss is the area of the triangle bounded by the demand curve, the marginal cost curve, and a vertical line at the monopolist's quantity, 60. So $DWL = \$30$, the area of the red triangle below.



- (3) a. $Rev_1 = P q_1 = 15q_1 - (q_1^2/10) - (q_1q_2/10)$.
 b. $MR_1 = \partial Rev_1(q_1, q_2) / \partial q_1 = 15 - 2q_1/10 - q_2/10$.
 c. Set $MR_1 = MC = \$3$ and solve to get $q_1^* = 60 - q_2/2$.
 d. Since $q_1^* = q_2^*$, $q_1^* = 60 - q_1^*/2$. Solving yields $q_1^* = 40 = q_2^*$.
 e. $Q = q_1^* + q_2^* = 80$. Substituting into demand equation: $P^* = 14 - (80/10) = \$7$.
 f. Total revenue = $P^* \times Q^* = \$560$. Total cost = $AC \times Q^* = \$240$. Total profit = total revenue - total cost = $\$320$.
 g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting $MC = \$3 = P = 15 - (Q/10)$ and solving to get $Q = 120$. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity $Q^*=80$ to the efficient quantity = 120. This is the area of a triangle, equal to $\$80$.



IV. Critical thinking

(1) Cournot triopoly

Firm #1's revenue = $Rev_1 = P q_1 = 15q_1 - (q_1^2 + q_1q_2 + q_1q_3)/100$.

$MR_1 = \partial Rev_1 / \partial q_1$. Set this equal to $MC=3$. Use symmetry ($q_1=q_2=q_3$) to solve.

Solution is $q_1 = 300$, $Q = 900$, $P = 15 - (Q/100) = \$6$.

(2) Bertrand price competition

a. Firm B's best reply is to undercut Firm A's price very slightly, setting a price just less than \$10. Firm B will take the entire market, enjoying a profit of nearly $(\$10-\$5) \times Q$. If Firm B instead were to match Firm A's price, Firm B will have a profit of only $(\$10-\$5) \times (Q/2)$. If Firm B were to exceed Firm A's price, Firm B will have zero profit.

b. Firm A's best reply is to undercut Firm B's price very slightly. Same reasoning applies.

c. The Nash equilibrium is for both firms to set price equal to marginal cost (\$5).

Although they enjoy zero profit in this solution, if either firm were to cut price below marginal cost, it would make losses. If either firm were to increase price by itself, it would lose all its customers and again enjoy zero profit.

Version B

I. Multiple choice

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

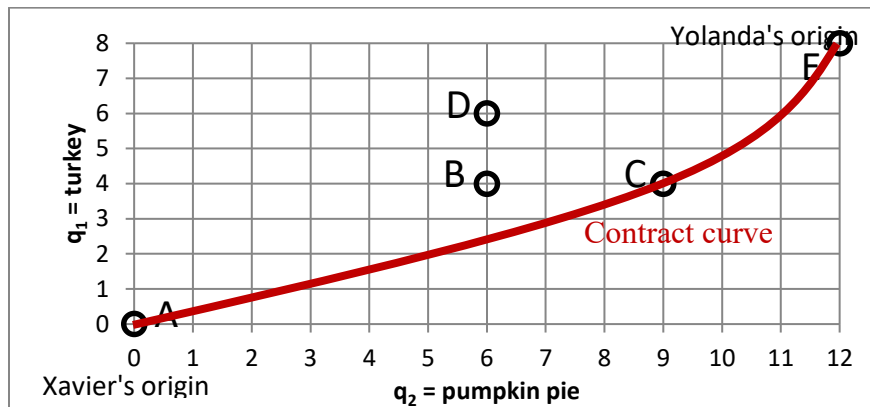
II. Short answer

- (1) a. 1/3 pizzas b. 3 soft drinks c. slope = -3
d. \$4, because slope of each consumer's budget line = $-P_{\text{pizza}}/P_{\text{drinks}} = -3$.
- (2) a. \$15 b. \$12.
- (3) a. 2/3 b. 1/3 c. 1/9.
- (4) a. $MR = 13 - Q$
b. MR is straight line with P-intercept = \$13, slope = -1/thousand
c. \$9 d. 8 thousand e. \$8 thousand
f. \$7 g. 12 thousand h. \$0 thousand.
- (5) a. no, yes, yes, yes b. yes, no, no, no c. yes, no, no, no.

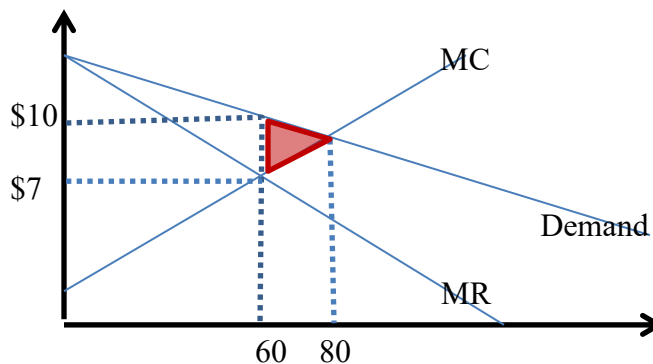
III. Problems

- (1) Note that Xavier's $MRS_X = 3q_1 / q_2$ and Yolanda's $MRS_Y = q_1 / q_2$.
- a. **Yes**, A is Pareto-efficient, because no one can be made better off without someone else being made worse off. Yolanda has everything, so she cannot be made better off. Xavier has nothing, so he cannot be made better off without taking some of Yolanda's turkey or pumpkin pie, which would make Yolanda worse off.
- b. **No**, B is not Pareto-efficient, because $MRS_X = 2 \neq MRS_Y = 2/3$.
- c. **Yes**, C is Pareto-efficient, because $MRS_X = 4/3 = MRS_Y$.
- d. **No**, D is not Pareto-efficient, because $MRS_X = 3 \neq MRS_Y = 1/3$.
- e. **Yes**, E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Xavier has everything, so he cannot be made better off. Yolanda

has nothing, so she cannot be made better off without taking some of Xavier's turkey or pumpkin pie, which would make Xavier worse off.
 f.

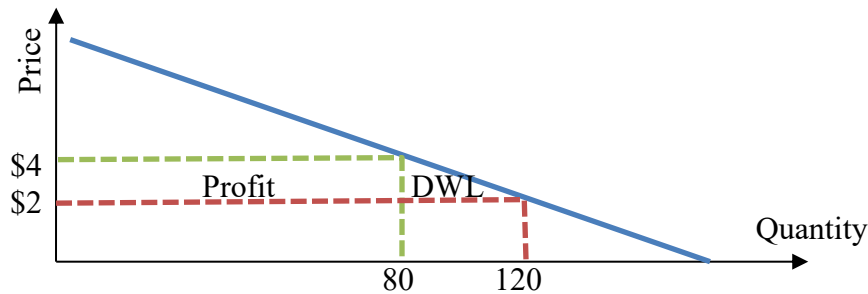


- (2) a. $MC(Q) = dTC/dQ = 1 + (Q/10)$.
 b. $AC(Q) = TC/Q = 1 + (Q/20)$.
 c. $Rev(Q) = P \times Q = 13Q - (Q^2/20)$, so $MR = dRev/dQ = 13 - (Q/10)$.
 d. Set $MC(Q) = MR(Q)$ and solve to find $Q^* = 60$.
 e. Substitute into demand curve: $P^* = 15 - (60/20) = \$10$.
 f. Profit = $Rev(Q) - TC(Q) = \$360$.
 g. The efficient level of output is where the marginal cost curve intersects the demand curve, that is, where $MC=P$. Set $1 + (Q/10) = 13 - (Q/20)$ and solve to find $Q = 80$.
 Deadweight loss is the area of the triangle bounded by the demand curve, the marginal cost curve, and a vertical line at the monopolist's quantity, 60. So $DWL = \$30$, the area of the red triangle below.



- (3) a. $Rev_1 = P q_1 = 8q_1 - (q_1^2/20) - (q_1q_2/20)$.
 b. $MR_1 = \partial Rev_1(q_1, q_2) / \partial q_1 = 8 - 2q_1/20 - q_2/20$.
 c. Set $MR_1 = MC = \$2$ and solve to get $q_1^* = 60 - q_2/2$.
 d. Since $q_1^* = q_2^*$, $q_1^* = 60 - q_1^*/2$. Solving yields $q_1^* = 40 = q_2^*$.
 e. $Q = q_1^* + q_2^* = 80$. Substituting into demand equation: $P^* = 8 - (80/20) = \$4$.
 f. Total revenue = $P^* \times Q^* = \$320$. Total cost = $AC \times Q^* = \$160$. Total profit = total revenue - total cost = **$\$160$** .
 g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting $MC = \$2 = P = 8 - (Q/20)$ and solving to get

$Q = 120$. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity $Q^*=80$ to the efficient quantity = 120. This is the area of a triangle, equal to **\$40**.



IV. Critical thinking

Same as Version A.

Version C

I. Multiple choice

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

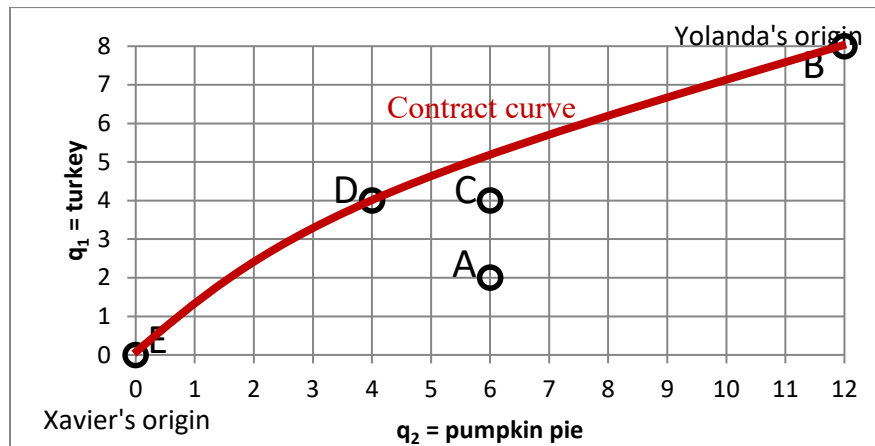
II. Short answer

- (1) a. 1/2 pizzas b. 2 soft drinks c. slope = -2
 d. \$6, because slope of each consumer's budget line = $-P_{\text{pizza}}/P_{\text{drinks}} = -2$.
- (2) a. \$24 b. \$14.
- (3) a. 1/3 b. 1/9 c. 1/30.
- (4) a. $MR = 15 - 2Q$
 b. MR is straight line with P-intercept = \$15, slope = $-2/\text{thousand}$
 c. \$11 d. 4 thousand e. \$4 thousand
 f. \$9 g. 6 thousand h. \$0 thousand.
- (5) a. no, yes, no, yes b. no, no, no, no c. no, no, no, yes.

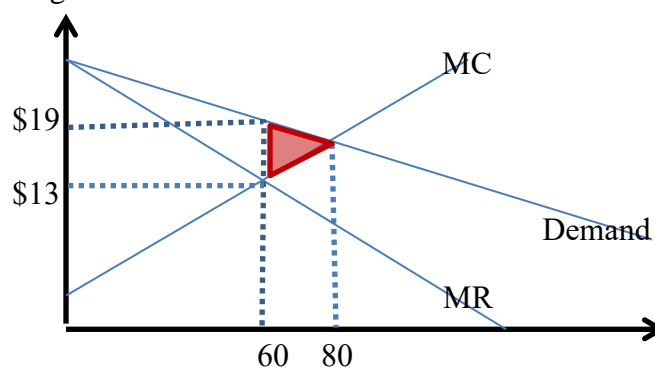
III. Problems

- (1) Note that Xavier's $MRS_X = q_1 / q_2$ and Yolanda's $MRS_Y = 2q_1 / q_2$.
- a. **No**, A is not Pareto-efficient, because $MRS_X = 1/3 \neq MRS_Y = 2$.
- b. **Yes**, B is Pareto-efficient, because no one can be made better off without someone else being made worse off. Xavier has everything, so he cannot be made better off. Yolanda has nothing, so she cannot be made better off without taking some of Xavier's turkey or pumpkin pie, which would make Xavier worse off.
- c. **No**, C is not Pareto-efficient, because $MRS_X = 2/3 \neq MRS_Y = 4/3$.
- d. **Yes**, D is Pareto-efficient, because $MRS_X = 1 = MRS_Y$.
- e. **Yes**, E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Yolanda has everything, so she cannot be made better off. Xavier has nothing, so he cannot be made better off without taking some of Yolanda's turkey or pumpkin pie, which would make Yolanda worse off.

f.

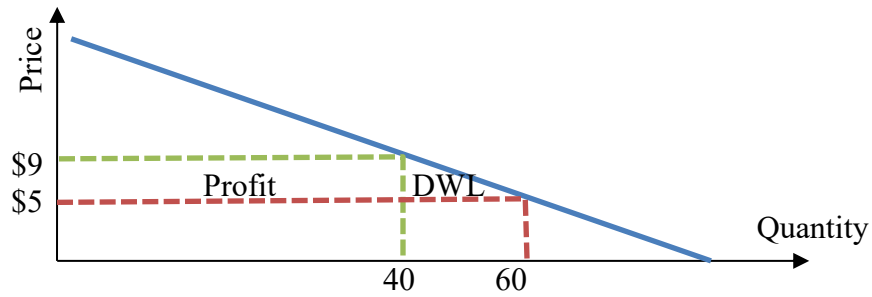


- (2)
- $MC(Q) = dTC/dQ = 1 + (Q/5)$.
 - $AC(Q) = TC/Q = 1 + (Q/10)$.
 - $Rev(Q) = P \times Q = 25Q - (Q^2/10)$, so $MR = dRev/dQ = 25 - (Q/5)$.
 - Set $MC(Q) = MR(Q)$ and solve to find $Q^* = 60$.
 - Substitute into demand curve: $P^* = 15 - (60/20) = \$19$.
 - $Profit = Rev(Q) - TC(Q) = \720 .
 - The efficient level of output is where the marginal cost curve intersects the demand curve, that is, where $MC=P$. Set $1 + (Q/5) = 25 - (Q/10)$ and solve to find $Q = 80$. Deadweight loss is the area of the triangle bounded by the demand curve, the marginal cost curve, and a vertical line at the monopolist's quantity, 60. So $DWL = \$60$, the area of the red triangle below.



- (3)
- $Rev_1 = P q_1 = 17q_1 - (q_1^2/5) - (q_1q_2/5)$.
 - $MR_1 = \partial Rev_1(q_1, q_2) / \partial q_1 = 17 - 2q_1/5 - q_2/5$.
 - Set $MR_1 = MC = \$5$ and solve to get $q_1^* = 30 - q_2/2$.
 - Since $q_1^* = q_2^*$, $q_1^* = 30 - q_1^*/2$. Solving yields $q_1^* = 20 = q_2^*$.
 - $Q = q_1^* + q_2^* = 40$. Substituting into demand equation: $P^* = 17 - (40/5) = \$9$.
 - Total revenue = $P^* \times Q^* = \$360$. Total cost = $AC \times Q^* = \$200$. Total profit = total revenue - total cost = **$\$160$** .
 - The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting $MC = \$5 = P = 17 - (Q/5)$ and solving to get $Q = 60$. Deadweight loss is the area between demand and marginal cost, from the

Cournot equilibrium quantity $Q^*=40$ to the efficient quantity = 60. This is the area of a triangle, equal to **\$40**.



IV. Critical thinking

Same as Version A.

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