

EXAMINATION #4 ANSWER KEY

Version A

I. Multiple choice

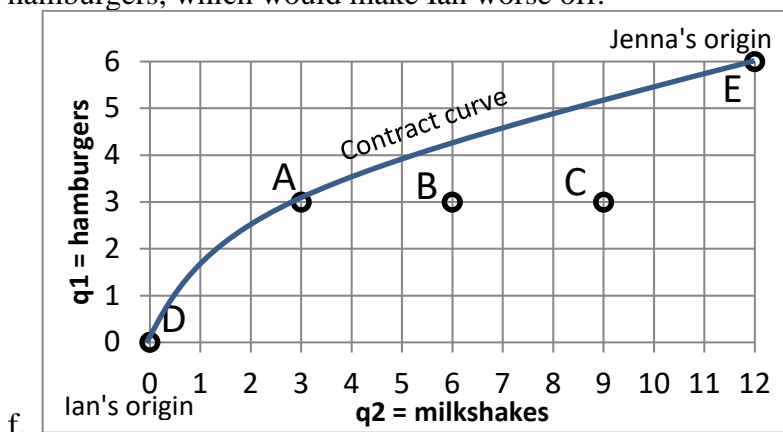
(1)a. (2)e. (3)b. (4)b. (5)d. (6)c. (7)b. (8)b. (9)c. (10)b. (11)b.

II. Short answer

- (1) a. 4 units of food b. 1/4 units of clothing c. slope = -4
 d. $P_{\text{food}} = \$2$, because slope of each consumer's budget line = $-P_{\text{clothing}}/P_{\text{food}} = -4$.
- (2) a. \$6.00 b. \$4.50.
- (3) a. 0.25 b. 0.05. c. zero.
- (4) a. \$11 b. 8 thousand c. \$0
 d. $MR = 15 - Q$
 e. MR is straight line with P-intercept = \$15, slope = -1/thousand
 f. \$12 g. 6 thousand h. \$3 thousand.
- (5) a. no, yes, yes, yes b. yes, no, no, no c. yes, no, no, no.

III. Problems

- (1) [Exchange efficiency] Note that Ian's $MRS_I = q_1 / (3q_2)$ and Jenna's $MRS_J = q_1 / q_2$.
- a. **Yes**, A is Pareto-efficient, because $MRS_I = 1/3 = MRS_J$.
- b. **No**, B is not Pareto-efficient, because $MRS_I = 1/6 \neq MRS_J = 1/2$.
- c. **No**, C is not Pareto-efficient, because $MRS_I = 1/9 \neq MRS_J = 1$.
- d. **Yes**, D is Pareto-efficient, because no one can be made better off without someone else being made worse off. Jenna has everything, so she cannot be made better off. Ian has nothing, so he cannot be made better off without taking some of Jenna's milkshakes or hamburgers, which would make Jenna worse off.
- e. **Yes**, E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Ian has everything, so he cannot be made better off. Jenna has nothing, so she cannot be made better off without taking some of Ian's milkshakes or hamburgers, which would make Ian worse off.



(2) [Monopoly, profit maximization]

a. $MC = dTC/dQ = 1 + (Q/10)$.

b. $AC = TC/Q = 1 + (Q/20)$.

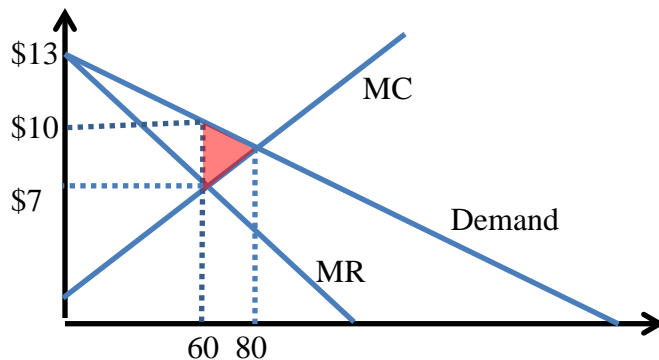
c. First find total revenue = $P \times Q = 13Q - (Q^2/20)$. So $MR = dTR/dQ = 13 - (Q/10)$.

d. Set $MC = MR$ and solve to get $Q^* = 60$.

e. Substitute into demand function: $P = 13 - (60/20) = \$10$.

f. Profit = $TR - TC = (60 \times 10) - (60 + 60^2/20) = \360 .

g. First find the efficient quantity, where demand = MC: $13 - (Q/20) = 1 + (Q/10)$, which yields $Q=80$. Then find $MC(60) = 1 + (60/10) = \$7$. Then evaluate DWL as the area of a triangle: **\$30**.



(3) [Cournot duopoly]

a. $Rev_1 = P q_1 = 14q_1 - (q_1^2/20) - (q_1q_2/20)$.

b. $MR_1 = \partial Rev_1(q_1, q_2) / \partial q_1 = 14 - 2q_1/20 - q_2/20$.

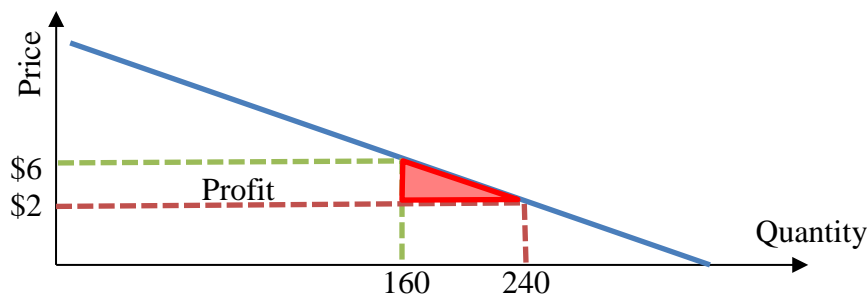
c. Set $MR_1 = MC = \$2$ and solve to get $q_1^* = 120 - q_2/2$.

d. Since $q_1^* = q_2^*$, $q_1^* = 120 - q_1^*/2$. Solving yields $q_1^* = 80 = q_2^*$.

e. $Q^* = q_1^* + q_2^* = 160$. Substituting into demand equation: $P^* = 14 - (160/20) = \$6$.

f. Profit = $(P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (6 - 2) \times 160 = \640 .

g. The efficient level of output lies where marginal cost intersects demand (“marginal cost pricing”). Find this quantity by setting $MC = \$2 = P = 14 - (Q/20)$ and solving to get $Q = 240$. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity $Q^*=160$ to the efficient quantity = 240 (see below). This is the area of a triangle, equal to **\$160**.



IV. Critical thinking

(1) Perfect price discrimination

To maximize profit, choose quantity where MC = demand: $Q = 80$.

Revenue = area of trapezoid: $\left(\frac{13+9}{2}\right) \times 80 = \880 .

Profit = Revenue – TC = $880 - (80 + [80^2/20]) = \480 .

(2) Collusion

To maximize the sum of profits, choose quantity where joint marginal cost equals MR:
 $MC_J = 2 = 14 - (Q/10)$, giving $Q = 120$.

Find price from the demand curve: $P = 14 - (120/20) = \$6$.

Profit = $(P-AC) \times Q = (8-2) \times 120 = \720 .

Version B

I. Multiple choice

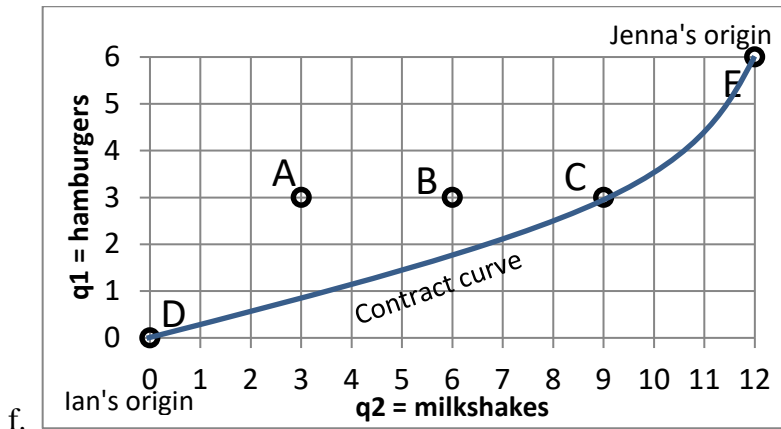
(1)e. (2)b. (3)c. (4)c. (5)c. (6)b. (7)c. (8)a. (9)b. (10)d. (11)d.

II. Short answer

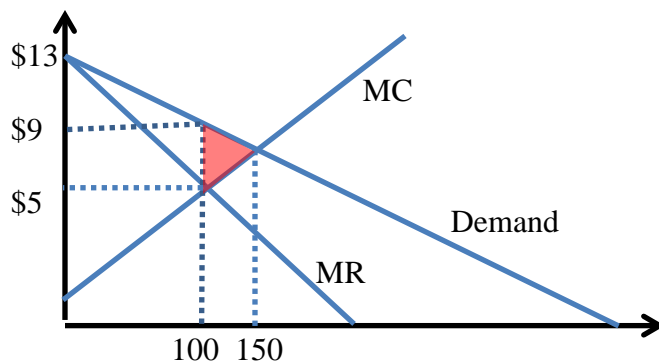
- (1) a. 2 units of food b. 1/2 units of clothing c. slope = -2
d. $P_{\text{food}} = \$4$, because slope of each consumer's budget line = $-P_{\text{clothing}}/P_{\text{food}} = -2$.
- (2) a. \$10.00 b. \$6.00.
- (3) a. 0.5 b. 0.1. c. zero.
- (4) a. \$8 b. 6 thousand c. \$0
d. $MR = 14 - 2Q$
e. MR is straight line with P-intercept = \$14, slope = -2/thousand
f. \$10 g. 4 thousand h. \$4 thousand.
- (5) a. no, yes, no, yes b. no, no, no, no (New Firm has no dominant strategy)
c. no, no, no, yes.

III. Problems

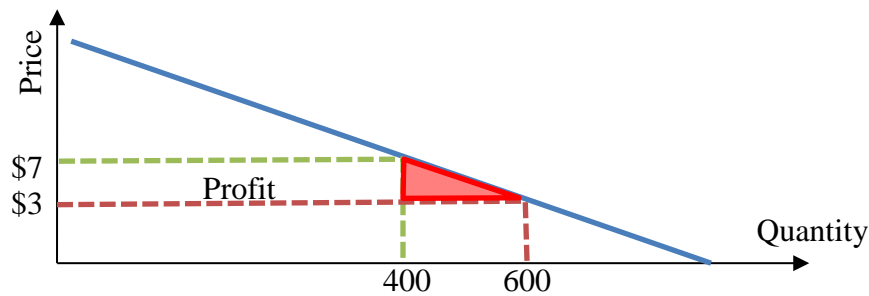
- (1) [Exchange efficiency] Note that Ian's $MRS_I = 2q_1 / q_2$ and Jenna's $MRS_J = 2q_1 / (3q_2)$.
- b. **No**, A is not Pareto-efficient, because $MRS_I = 2 \neq MRS_J = 2/9$.
- c. **No**, B is not Pareto-efficient, because $MRS_I = 1 \neq MRS_J = 1/3$.
- a. **Yes**, C is Pareto-efficient, because $MRS_I = 2/3 = MRS_J$.
- d. **Yes**, D is Pareto-efficient, because no one can be made better off without someone else being made worse off. Jenna has everything, so she cannot be made better off. Ian has nothing, so he cannot be made better off without taking some of Jenna's milkshakes or hamburgers, which would make Jenna worse off.
- e. **Yes**, E is Pareto-efficient, because no one can be made better off without someone else being made worse off. Ian has everything, so he cannot be made better off. Jenna has nothing, so she cannot be made better off without taking some of Ian's milkshakes or hamburgers, which would make Ian worse off.



- (2) [Monopoly, profit maximization]
- $MC = dTC/dQ = 1 + (Q/25)$.
 - $AC = TC/Q = 1 + (Q/50)$.
 - First find total revenue $= P \times Q = 13Q - (Q^2/25)$. So $MR = dTR/dQ = 13 - (2Q/25)$.
 - Set $MC = MR$ and solve to get $Q^* = 100$.
 - Substitute into demand function: $P = 13 - (100/25) = \$9$.
 - Profit $= TR - TC = (100 \times 9) - (100 + 100^2/50) = \600 .
 - First find the efficient quantity, where demand $= MC$: $13 - (Q/25) = 1 + (Q/25)$, which yields $Q=150$. Then find $MC(100) = 1 + (100/25) = \5 . Then evaluate DWL as the area of a triangle: **\$100**.



- (3) [Cournot duopoly]
- $Rev_1 = P q_1 = 15q_1 - (q_1^2/50) - (q_1q_2/50)$.
 - $MR_1 = \partial Rev_1(q_1, q_2) / \partial q_1 = 15 - 2q_1/50 - q_2/50$.
 - Set $MR_1 = MC = \$3$ and solve to get $q_1^* = 300 - q_2/2$.
 - Since $q_1^* = q_2^*$, $q_1^* = 300 - q_1^*/2$. Solving yields $q_1^* = 200 = q_2^*$.
 - $Q^* = q_1^* + q_2^* = 400$. Substituting into demand equation: $P^* = 15 - (400/50) = \$7$.
 - Profit $= (P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (7 - 3) \times 400 = \160 .
 - The efficient level of output lies where marginal cost intersects demand (“marginal cost pricing”). Find this quantity by setting $MC = \$3 = P = 15 - (Q/50)$ 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**.



IV. Critical thinking

(1) Perfect price discrimination

To maximize profit, choose quantity where $MC = \text{demand}$: $Q = 150$.

Revenue = area of trapezoid: $\left(\frac{13+7}{2}\right) \times 150 = \1500 .

Profit = Revenue - TC = $1500 - (150 + [150^2/50]) = \900 .

(2) Collusion

To maximize the sum of profits, choose quantity where joint marginal cost equals MR:

$MC_J = 3 = 15 - (Q/25)$, giving $Q = 300$.

Find price from the demand curve: $P = 15 - (300/50) = \$9$.

Profit = $(P-AC) \times Q = (9-3) \times 300 = \1800 .

[end of answer key]e