ECON 173 - Intermediate Microeconomic Analysis
Drake University, Fall 2025
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FINAL EXAMINATION ANSWER KEY

Version A

I. Multiple choice

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

II. Short answer

(1) a. elastic. b. decrease. c. 6 %.
d. decrease. e. 2 %.

(2) Note: This graph is based on Slutsky's approach to income and substitution effects, not Hicks's approach.
a. \$2. b. 10 units of food. c. \$8.
d. 2 units of food. e. -6 units of food. f. -2 units of food.

(3) a. 0 thousand (because price is below shutdown price).
b. 10 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. \$3 (because shutdown price = min(SAVC)).

(4) a. import. b. 4 million. c. increase.
d. \$7 million. e. decrease. f. \$5 million.
g. increase. h. \$2 million.

(5) a. 7 percent. b. 1 percent.

(6) a. 4 units of other goods. b. 1/4 energy. c. slope = -4.
d. P_{energy} = \$32, because slope of each consumer's budget line = $-P_{energy}/P_{other} = -4$.

(7) a. 2 units, found by setting the household's MB = MC.
b. MSB = 1200 – 100 Q, found by multiplying the number of households × MB.
c. 11 units, found by setting MSB = MC.

(8) a. \$5. b. 7 thousand. c. \$0 because P=MC.
d. MR = 12 – 2Q ("Same intercept, twice the slope as demand").
e. Plot MR as a straight line with P-intercept = \$12, slope = -2/thousand.
f. \$8. g. 4 thousand. h. \$6 thousand.

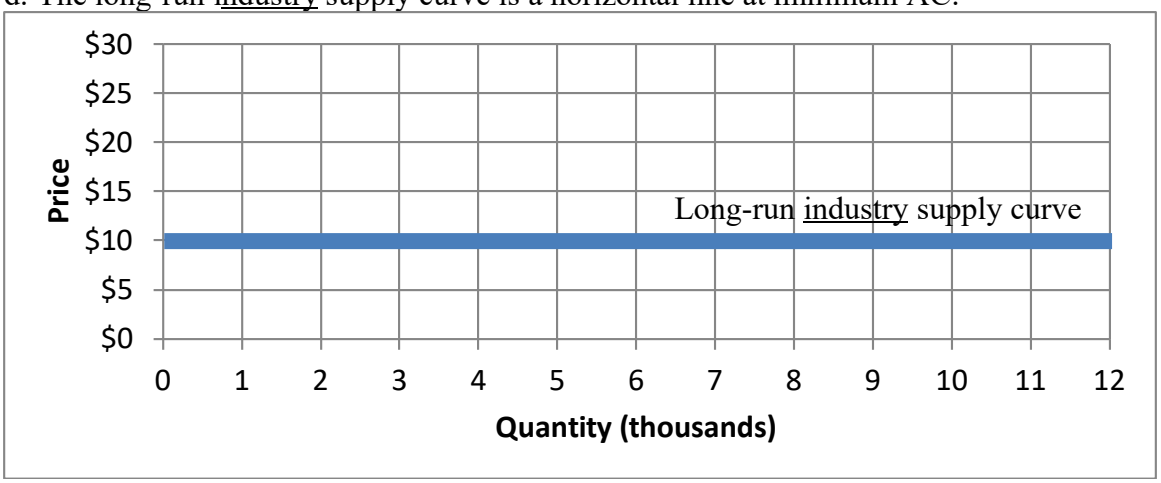
(9) The vaccine evidently provides an external benefit, or positive externality.
a. \$4 per tree, at intersection of demand and supply.
b. 6 million, at intersection of demand and supply.
c. 12 million, at intersection of marginal social benefit and supply.

d. $12 million, the area of the triangle between marginal social benefit, supply, and a vertical line at 12 million, the unregulated quantity. Deadweight loss is the gap between the benefit to society and the cost of all those units that *should* have been produced.
e. subsidy, to increase the quantity to the socially-optimal quantity.
f. $3 per vaccination, which equals the vertical gap between demand and supply at the socially-optimal quantity.

III. Problems

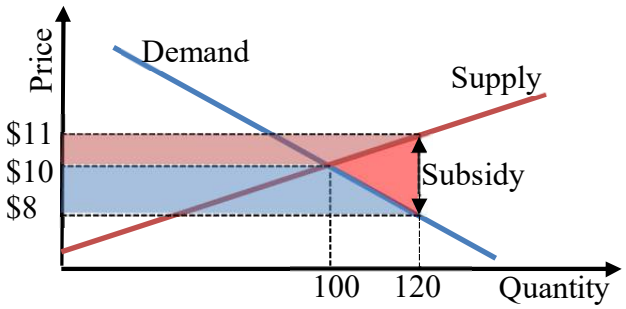
(1) [Budgets and choice]
a. Equation for budget line (income=spending): $150 = 5\ q_1 + 6\ q_2$.
b. MRSC = $MU_2/MU_1 = q_1 / (q_2\text{-}5)$.
c. Solve the tangency condition [MRSC = p_2/p_1 or $q_1 / (q_2\text{-}5) = 6/5$) jointly with equation for budget line (see part a) to get $q_1^* = 12$, $q_2^* = 15$.

(2) [Cost curves; Long-run market equilibrium]
a. $AC = TC/q = 0.01\ q^2 - 0.8\ q + 26$.
Set $0 = dAC/dq = 0.02\ q - 0.8$ and solve to get $q_{ES} = 40$.
b. Breakeven price = minimum AC = $AC(q_{ES}) = \$10$.
c. A firm's supply curve shows how much the firm will produce for any given price. If P>minimum average cost, the profit-maximizing firm will choose an output level where P=MC(q), and if P<minimum average cost, it will produce nothing. So, this firm's supply curve is given by the following equations.
If $P \geq \$10$, $P = MC(q) = dTC/dq = 0.03\ q^2 - 1.6\ q + 26$.
If $P \leq \$10$, $q = 0$ (firm shuts down).
d. The long-run industry supply curve is a horizontal line at minimum AC:

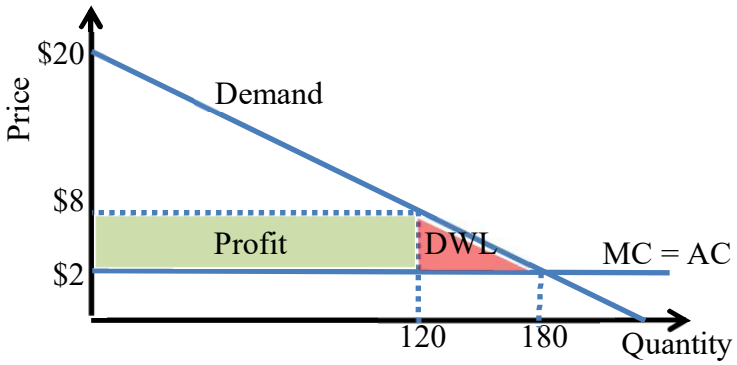


(3) [Welfare effects of tax or subsidy]
a. Set $P_D = P_S$ and solve to get $P^* = \$10$ and $Q^* = 100$.

b. With subsidy of \$3, $P_D + 3 = P_S$. Substituting and solving gives Q = 120. It is useful to also compute the new net price paid by buyers, excluding the subsidy (P_D = \$8), and the new total price received by sellers, including the subsidy (P_S = \$11).
c. Consumer surplus *increases* by \$220, the area of the trapezoid between \$10 and \$8.
d. Producer surplus increases by \$110, the area of the trapezoid between \$11 and \$10.
e. The government pays \$3×120=\$360 in direct cost, but this is greater than the combined increases of consumer and producer surplus. The loss to society as a whole (also called "deadweight loss") is \$30, the area of the red triangle in the graph below.



(4) [Cournot duopoly]
a. $TR_1 = P\ q_1 =$ **$20q_1 - (q_1^2/10) - (q_1q_2/10)$.**
b. $MR_1 = \partial TR_1(q_1,q_2) / \partial q_1 =$ **$20 - (2q_1/10) - (q_2/10)$.**
c. Set $MR_1 = MC =$ \$2 and solve to get **$q_1^* = 90 - (q_2/2)$.**
d. Since $q_1^* = q_2^*$, $q_1^* = 90 - (q_1^*/2)$. Solving yields **$q_1^* = 60 = q_2^*$**.
e. $Q^* = q_1^* + q_2^* =$ **120**. Substituting into demand equation: $P^* = 20 - (120/10) =$ **\$8.**
f. Profit = $(P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (11-2) \times 90 =$ **\$810** (see green rectangle below.).
g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting P = MC, or $P = 20 - (Q/10) = 2$ and solving to get Q = 180. Deadweight loss is the area between demand and marginal cost, from the Cournot equilibrium quantity Q*=120 to the efficient quantity = 180 (see below). This is the area of a triangle, equal to **\$405** (see red triangle below).



(5) Note: this game is similar to a "Prisoner's Dilemma."
a. Pareto optimal: yes, yes, yes, no.

b. Dominant-strategy equilibria: no, no, no, yes.
c. Nash equilibria in pure strategies: no, no, no, yes.

IV. Critical thinking

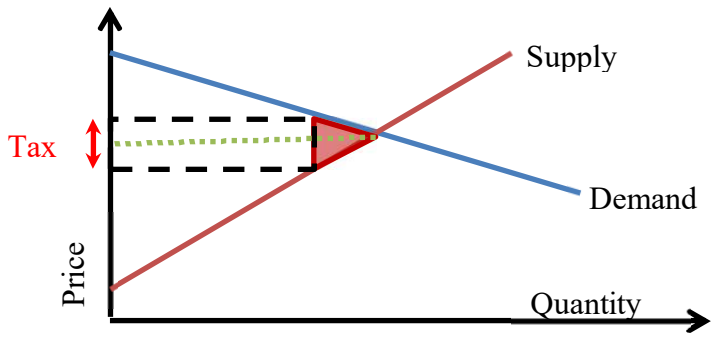
(1) Taxes and subsidies

One should *disagree* with this statement. Economic efficiency is *not* maximized when production is maximized. Instead, economic efficiency is maximized when the **marginal benefit to consumers of the last unit produced equals the marginal cost of producing that unit.**

In an unregulated competitive market, assuming no externalities, marginal benefit is represented by the demand curve and marginal cost is represented by the supply curve. Equilibrium therefore occurs where the two are equal—at the economically efficient level of production.

When a tax is imposed on a competitive market, demanders pay more in total than suppliers receive—the difference is paid to the government. A tax therefore creates a wedge between marginal benefit and marginal cost, causing *too little* to be produced. **A tax therefore reduces economic efficiency**. There are at least two ways to show this.

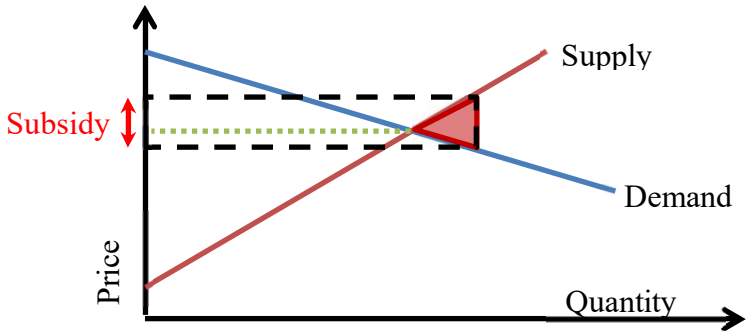
1. With a tax, some demanders who are willing to pay the marginal cost of production choose not to buy the product, because the tax raises the price that demanders must pay to a level above the marginal cost of production. So taxes do indeed discourage production and reduce economic efficiency. The loss of efficiency from too little production is measured by deadweight loss, shown as the area of the red triangle in the graph below.
2. A tax creates losses for consumers and producers that are greater than the tax revenue collected by the government. In the graph below, consumer surplus decreases by the area of the upper trapezoid, producer surplus decreases by the area of the lower trapezoid, and the government collects tax revenue equal to the area of the dashed rectangle. Clearly, the revenue collected by the government is less than the loss of consumer and producer surplus. The difference is the loss of economic efficiency, called deadweight loss, measured by the area of the red triangle.



However, **a subsidy does *not* increase economic efficiency**. When a subsidy is imposed on a competitive market, demanders pay less than suppliers receive in total—the difference is paid by the government. A subsidy therefore creates a negative wedge between marginal benefit

and marginal cost, causing *too much* to be produced. A subsidy therefore also reduces economic efficiency. There are at least two ways to show this.

1. With a subsidy, some demanders who are *not* willing to pay the marginal cost of production choose to buy the product anyway, because the subsidy lowers the price that demanders pay to a level below the cost of production. So subsidies encourage production, but they nevertheless *reduce* economic efficiency, because the benefit of the last few units produced is *less* than their cost. The loss of efficiency from too much production is measured by deadweight loss, shown as the area of the triangle in the graph below.
2. A subsidy creates gains for consumers and producers that are less than the direct cost of the subsidy program to the government. In the graph below, consumer surplus increases by the area of the lower trapezoid, producer surplus decreases by the area of the upper trapezoid, and the subsidy program costs the government an amount equal to the area of the dashed rectangle. Clearly, the cost of the program is greater than the loss of consumer and producer surplus. The difference is the loss of economic efficiency, called deadweight loss, measured by the area of the red triangle.



(2) Least-cost pollution standards

To meet the target $q_A + q_B = 12$ at least cost, pollution limits q_A and q_B should be set so that

$$MB_A = MB_B ,$$
$$10 - (q_A/2) = 6 - (q_B/2) .$$
$$10 - (q_A/2) = 6 - ([12-q_A]/2) .$$

Solving gives **$q_A^* = 10$ units** and **$q_B^* = 2$ units**.

Version B

I. Multiple choice

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

II. Short answer

(1) a. inelastic. b. decrease. c. 2 %.
d. increase. e. 3 %.

(2) Note: This graph is based on Slutsky's approach to income and substitution effects, not Hicks's approach.
a. \$4. b. 10 units energy. c. \$10.
d. 3 units energy. e. -5 units energy. f. -2 units energy.

(3) a. 0 thousand (because price is below shutdown price).
b. 10 thousand (using rule P=MC to find q).
c. 7 thousand (using rule P=MC to find q).
d. \$8 (because breakeven price = min(SATC)).
e. \$2 (because shutdown price = min(SAVC)).

(4) a. export. b.8 million. c. decrease.
d. \$8 million. e. increase. f. \$16 million.
g. increase. h. \$8 million.

(5) a. 5 percent. b. 3 percent.

(6) a. 3 units of other goods. b. 1/3 energy. c. slope = -3.
d. P_{energy} = \$18, because slope of each consumer's budget line = $-P_{energy}/P_{other} = -3$.

(7) a. 3 units, found by setting the household's MB = MC.
b. MSB = 1300 – 100 Q, found by multiplying the number of households × MB.
c. 12 units, found by setting MSB = MC.

(8) a. \$4. b. 9 thousand. c. \$0 because P=MC.
d. MR = 13 – 2Q ("Same intercept, twice the slope as demand").
e. Plot MR as a straight line with P-intercept = \$13, slope = -2/thousand.
f. \$8. g. 5 thousand. h. \$10 thousand.

(9) The chemical evidently creates an external cost, or negative externality.
a. \$4 per liter, at intersection of demand and supply.
b. 7 million liters, at intersection of demand and supply.
c. 5 million liters, at intersection of marginal social cost and demand.
d. \$4 million, the area of the triangle between marginal social cost, demand, and a vertical line at 7 million, the unregulated quantity. Deadweight loss is the gap between the benefit to consumers and the cost to society of all those units that should *not* have been produced.
e. tax, to decrease the quantity to the social optimum.
f. \$5 per liter, which equals the vertical gap between demand and supply at the socially-optimal quantity.

III. Problems

(1) [Budgets and choice]
a. Equation for budget line (income=spending): $160 = 5\,q_1 + 4\,q_2$.
b. $MRSC = MU_2/MU_1 = (q_1-8) / q_2$.
c. Solve the tangency condition [$MRSC = p_2/p_1$ or $(q_1-8) / q_2 = 4/5$] jointly with equation for budget line (see part a) to get $q_1^* = 20$, $q_2^* = 15$.

(2) [Cost curves; Long-run market equilibrium]

a. $AC = TC/q = 0.01\ q^2 - q + 40$.

Set $0 = dAC/dq = 0.02\ q - 1$ and solve to get $q_{ES} = 50$.

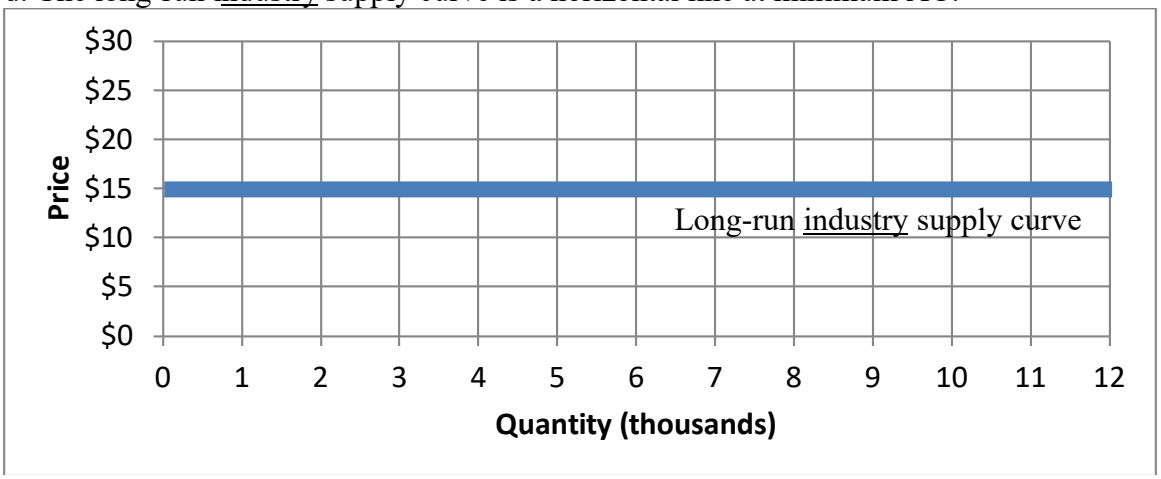
b. Breakeven price = minimum AC = $AC(q_{ES}) = \$15$.

c. A firm's supply curve shows how much the firm will produce for any given price. If P>minimum average cost, the profit-maximizing firm will choose an output level where P=MC(q), and if P<minimum average cost, it will produce nothing. So, this firm's supply curve is given by the following equations.

If $P \geq \$15$, $P = MC(q) = dTC/dq = 0.15\ q^2 - 2\ q + 20$.

If $P \leq \$15$, $q = 0$ (firm shuts down).

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



(3) [Welfare effects of tax or subsidy]

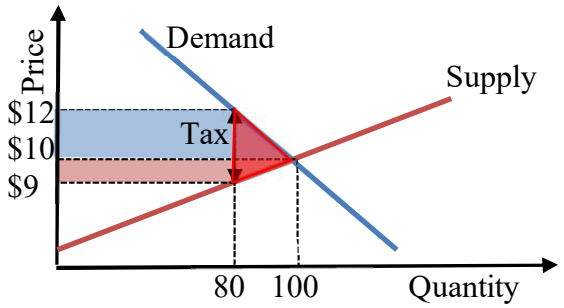
a. Set $P_D = P_S$ and solve to get $P^* = \$10$ and $Q^* = 100$.

b. With an excise tax of \$3, $P_D = P_S + 3$. Substituting and solving gives $Q = 80$. It is useful to also compute the new total price paid by buyers, including the tax ($P_D = \$12$), and the new net price received by sellers, excluding the tax ($P_S = \$9$).

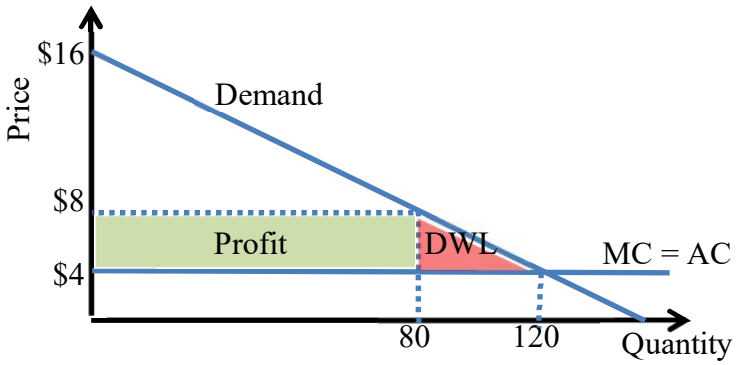
c. Consumer surplus decreases by \$180, the area of the trapezoid between \$12 and \$10.

d. Producer surplus decreases by \$90, the area of the trapezoid between \$10 and \$9.

e. Although the government collects $\$3 \times 80 = \$240$ in tax revenue, this is less than the combined decreases of consumer and producer surplus. The loss to society as a whole (also called "deadweight loss" or "excess burden of the tax") is \$30, the area of the red triangle in the graph below.



(4) [Cournot duopoly]
a. $TR_1 = P\ q_1 = \mathbf{16q_1 - (q_1^2/10) - (q_1q_2/10)}$.
b. $MR_1 = \partial TR_1(q_1,q_2) / \partial q_1 = \mathbf{16 - (2q_1/10) - (q_2/10)}$.
c. Set $MR_1 = MC = \$4$ and solve to get $\mathbf{q_1^* = 60 - (q_2/2)}$.
d. Since $q_1^* = q_2^*$, $q_1^* = 60 - (q_1^*/2)$. Solving yields $\mathbf{q_1^* = 40} = q_2^*$.
e. $Q^* = q_1^* + q_2^* = \mathbf{80}$. Substituting into demand equation: $P^* = 16 - (80/10) = \mathbf{\$8.}$
f. Profit = $(P^* \times Q^*) - (AC \times Q^*) = (P^* - AC) \times Q^* = (8-4) \times 80 = \mathbf{\$320}$ (see green rectangle below.).
g. The efficient level of output lies where marginal cost intersects demand ("marginal cost pricing"). Find this quantity by setting P = MC, or $P = 16 - (Q/10) = 4$ 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 (see below). This is the area of a triangle, equal to **\$180** (see red triangle below).



(5) Note: this game is similar to a "Prisoner's Dilemma."
a. Pareto optimal: no, yes, yes, yes.
b. Dominant-strategy equilibria: yes, no, no, no.
c. Nash equilibria in pure strategies: yes, no, no, no.

IV. Critical thinking
Same as Version A.

[end of answer key]