

**EXAMINATION #2 VERSION A**  
**“Consumers and Demand”**  
**September 26, 2024**

**INSTRUCTIONS:** This exam is closed-book, closed-notes. Calculators, mobile phones, and wireless devices are NOT permitted. Point values for each question are noted in brackets.

**I. MULTIPLE CHOICE:** Circle the one best answer to each question. Use margins for scratch work. [1 pt each—10 pts total]

(1) Which utility function below violates the assumption of "monotonicity" or "more is better"?

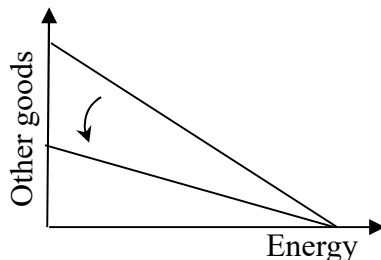
- a.  $U(q_1, q_2) = 7 q_1 q_2$ .
- b.  $U(q_1, q_2) = (4q_1) / (3q_2)$ .
- c.  $U(q_1, q_2) = 7 q_1^4 q_2^3$ .
- d.  $U(q_1, q_2) = 4 q_1^{1/2} + 3 q_2^{1/2}$ .

(2) Which utility function below violates the assumption of "diminishing marginal rate of substitution"?

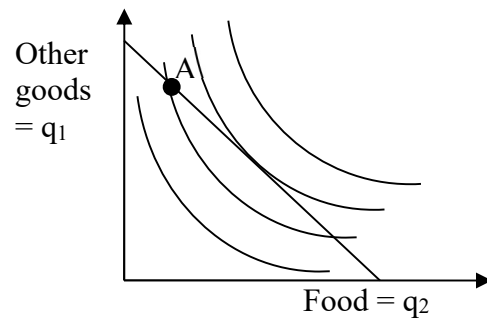
- a.  $U(q_1, q_2) = q_1^2 q_2^3$ .
- b.  $U(q_1, q_2) = (q_1+2)(q_2+3)$ .
- c.  $U(q_1, q_2) = 2q_1 + 3q_2$ .
- d.  $U(q_1, q_2) = 2 q_1^{1/2} + q_2^{1/2}$ .

(3) In the graph below, the shift in the budget line could be caused by

- a. an increase in income.
- b. a decrease in income.
- c. an increase in the price of energy.
- d. a decrease in the price of energy.
- e. an increase in the price of other goods.
- f. a decrease in the price of other goods.



The next two questions refer to the following graph of a consumer's budget line and indifference curves. Suppose the consumer is currently at bundle A for some reason.



(4) This consumer could enjoy higher utility, without increasing total spending, by

- a. purchasing less food and more other goods.
- b. purchasing more food and fewer other goods.
- c. purchasing less food and fewer other goods.
- d. any of the above.
- e. none of the above.

(5) Let  $MU_1$  denote the marginal utility of other goods and  $MU_2$  the marginal utility of food for this consumer. Let  $p_1$  denote the price of other goods and  $p_2$  denote the price of food. At bundle A,

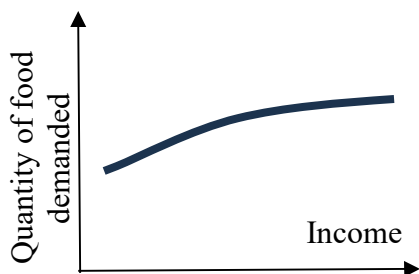
- $MU_2 = MU_1$  and  $p_2 = p_1$ .
- $MU_2/MU_1 = p_2/p_1$ .
- $MU_2/MU_1 < p_2/p_1$ .
- $MU_2/MU_1 > p_2/p_1$ .
- cannot be determined from information given.

(6) Which function is homogeneous of degree zero in income and prices?

- $q_1^* = 0.02 I + 0.7 (p_2/p_1)$ .
- $q_1^* = I/(8p_1) + 7$ .
- $q_1^* = 0.05 I - 2p_1 + 0.1 p_2$ .
- $q_1^* = 0.07 I + 0.3/p_1$ .
- All are homogeneous of degree zero.

(7) The curve in the graph below is called

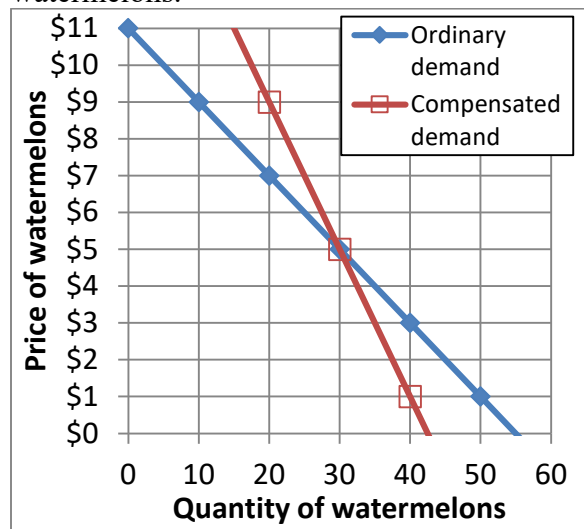
- an indifference curve.
- a demand curve.
- an Engel curve.
- an income expansion path.



(8) Which price index tends to underestimate the rate of inflation?

- Laspeyres price index.
- Paasche price index.
- Fisher price index.
- All of the above.
- None of the above.

The next two questions refer to the following graph of ordinary and compensated demand curves for watermelons.



(9) The increase in income that would exactly compensate consumers for a rise in price from \$5 to \$9, leaving consumers just as well off as before the price change, would be

- \$4.
- \$80.
- \$100.
- \$120.
- none of the above.

(10) If the price rises from \$5 to \$9, then consumer surplus decreases by

- \$4.
- \$80.
- \$100.
- \$120.
- none of the above.

**II. SHORT ANSWER:** Please write your answers in the boxes on this question sheet. Use margins for scratch work.

(1) [Price elasticity of demand: 10 pts] Suppose the price elasticity of demand for water is  $-0.6$ , and water utility raises the price of water rises by 5 %.

- a. Is the demand for water *elastic* or *inelastic* ?
- b. Will the quantity demanded of water *increase* or *decrease*?
- c. By about how much?
- d. Will consumers' total spending on water *increase* or *decrease*?
- e. By about how much?

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(2) [Income elasticity of demand: 10 pts] Suppose that a consumer's income rises by 5%, and the income elasticity of demand for gasoline is 0.4 .

- a. Does the income elasticity indicate that gasoline is an *inferior* good, a *necessary* good, or a *luxury or superior* good?
- b. Will the quantity demanded of gasoline *increase* or *decrease*?
- c. By about how much?
- d. Will the share of the consumer's budget devoted to water *increase* or *decrease*?
- e. By about how much?

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(3) [Substitution and income effects: 12 pts] Consider the indifference-curve diagram below. Assume the consumer has **\$60 income**.



- What was the price of ice cream cones on the old budget line?
- Given the old budget line, how many ice cream cones does the consumer demand?
- What is the price of ice cream cones on the new budget line?
- Given the new budget line, how many ice cream cones does the consumer demand?
- Compute the *change* in quantity of ice cream cones demanded due to the substitution effect:  $\Delta q^{\text{sub}}$ .
- Compute the *change* in quantity of ice cream cones demanded due to the income effect:  $\Delta q^{\text{inc}}$ .

\$	
	ice cream cones
\$	
	ice cream cones
	ice cream cones
	ice cream cones

(4) [Slutsky equation: 10 pts] The Slutsky equation in elasticity form is given by

$$\varepsilon = -S \eta + \varepsilon^{\text{comp}}$$

where, as usual,  $\varepsilon$  denotes the own-price elasticity of demand,  $S$  denotes the share of total consumer spending devoted to the good (a fraction),  $\eta$  denotes the income elasticity of demand, and  $\varepsilon^{\text{comp}}$  denotes the compensated demand elasticity. Suppose that for electricity,  $\varepsilon = -0.8$ ,  $S = 0.1$ , and  $\eta = 0.4$ .

- a. Compute the compensated elasticity of demand for electricity ( $\varepsilon^{\text{comp}}$ ).

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First, suppose the price of electricity rises by 10%, but the consumer's income does *not* change.

- b. Does the quantity demanded of electricity *increase* or *decrease*?  
 c. By about how much?

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Alternatively, assume that the price of electricity rises by 10%, but now suppose the government helps the consumer by giving them a cash transfer equal to 10% of last year's spending on electricity.

- d. Does the quantity demanded of electricity *increase* or *decrease*?  
 e. By about how much?

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(5) [Cost-of-living indexes: 6 pts] Suppose we are given the following data on prices and quantities consumed of food and clothing.

	Food		Clothing	
	Price	Quantity	Price	Quantity
Old period	\$3	20 units	\$5	8 units
New period	\$6	25 units	\$5	15 units

Assume that all cost-of-living indexes equal 100 in the old period.

- a. Compute the *value* of the Laspeyres cost-of-living index in the new period.  
 b. Compute the *value* of the Paasche cost-of-living index in the new period.  
 c. Give a *formula* for the Fisher cost-of-living index in the new period. The formula should include numbers but no variables.


**III. PROBLEMS:** Please write your answers in the boxes on this question sheet. Show your work and circle your final answers.

(1) [Budgets and choice: 14 pts] A consumer has the following utility function:

$U(q_1, q_2) = (q_1 + 3) q_2$ , where  $q_1$  denotes the quantity of food and  $q_2$  denotes the quantity of other goods. The price of food is \$10 and the price of other goods is \$6. The consumer has \$150 in income to spend on these items.

- a. [4 pts] Give an equation for the consumer's budget line. The variables  $q_1$  and  $q_2$  should be the only unknowns.

- b. [4 pts] Find a formula for the consumer's marginal rate of substitution in consumption of other goods for food—that is, the |slope| of the consumer's indifference curve with food on the vertical axis and other goods on the horizontal axis. The variables  $q_1$  and  $q_2$  should be the only unknowns. Circle your final answer.

- c. [6 pts] Solve for the quantities of food ( $q_1^*$ ) and other goods ( $q_2^*$ ) that this consumer will choose. Circle your final answers.

(2) [Properties of individual demand functions: 12 pts] Suppose an alleged demand function is  $q_1^* = (I + 3p_2)p_1^{-1} + 5$ , where  $I$  denotes the consumer's income,  $p_1$  denotes the price of good #1, and  $p_2$  denotes the price of good #2.

- a. Is this function homogeneous of degree zero in income and prices? Justify your answer.

- b. Find the partial derivative  $\partial q_1^*/\partial p_1$ . Is good #1 an ordinary good or a Giffen good? Justify your answer.

- c. Find the partial derivative  $\partial q_1^*/\partial I$ . Is good #1 an inferior good or a normal good? Justify your answer.

- d. Find the partial derivative  $\partial q_1^*/\partial p_2$ . Are goods #1 and #2 substitutes, complements, or unrelated in demand? Justify your answer.

(3) [Finding individual demand functions: 12 pts] A consumer has the following utility function:  $U(q_1, q_2) = q_1^2 q_2^4$ , where  $q_1$  denotes the quantity of entertainment and  $q_2$  denotes the quantity of other goods.

- a. Find a formula for the consumer's marginal rate of substitution in consumption of other goods for entertainment—that is, the  $|\text{slope}|$  of the consumer's indifference curve with entertainment on the vertical axis and other goods on the horizontal axis. The variables  $q_1$  and  $q_2$  should be the only unknowns. Circle your final answer.

Let  $p_1$  denote the price of entertainment and let  $p_2$  denote the price of other goods. Let  $I$  denote the consumer's income.

- b. Solve for the consumer's demand function for entertainment—that is, the formula showing  $q_1^*$  as a function of  $p_1$ ,  $p_2$ , and  $I$  (but not  $q_2$ ). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]

- c. Solve for the consumer's demand function for other goods—that is, the formula showing  $q_2^*$  as a function of  $p_1$ ,  $p_2$ , and  $I$  (but not  $q_1$ ). Show your work and circle your final answer. [Hint: check that your answer is homogeneous of degree zero.]



**IV. CRITICAL THINKING:** Answer just *one* of the questions below (your choice). [4 pts]

- (1) Suppose Abby initially buys 20 gallons of gasoline per month. Now suppose that the price of gasoline rises from \$3 per gallon to \$4 per gallon. Fortunately, at the same time, Abby's income rises by \$20 per month. Will Abby buy *more gasoline*, *less gasoline*, or the *same amount of gasoline* as before? Justify your answer with an indifference-curve diagram.
- (2) Suppose all prices faced by a consumer *exactly double*. Thus all prices increase *at the same rate*. Consider three alternative formulas for the increase in the cost of living: the Laspeyres price index, the Paasche price index, and the Fisher price index. Which price index shows the greatest increase in the cost of living? Which price index shows the smallest increase in the cost of living? Justify your answer with algebra. (Ignore the graph.)

Circle the question you are answering and write your answer below. Full credit requires good grammar, legible writing, accurate spelling, and correct reasoning.



[end of exam]