

1. Thomas has a quasi-linear utility function of the form

$$U(x, y) = x^3 + 2y.$$

- a) What are Thomas's marginal utility functions, MU_x and MU_y ?
- b) Suppose $I = 30$, $P_x = 12$, and $P_y = 2$. What is utility maximizing basket?
- c) Derive Thomas's demand curve for x (in terms of exogenous variables I , P_x and P_y).
- d) Derive Thomas's demand curve for y (in terms of exogenous variables I , P_x and P_y).

2. Frank's preferences over oranges (x) and other goods (y) are given by $U(x, y) = \sqrt{xy}$, and he has an income of $I = \$120$. (Hint: Might need calculator)

- a) What are his marginal utility functions MU_x & MU_y ?
- b) Calculate the optimal basket when $P_x = 6$ & $P_y = 3$.
- c) Suppose P_x decreases to $P_x = 1$, find the new optimal basket.
- d) Calculate the income and substitution effects when P_x decreases to $P_x = 1$.
- e) What is the compensating variation of the price change.
- f) What is the equivalent variation of the price change.

3. Suppose the market for cars has two segments, businesses and home users. The demand curve for cars by businesses is $P = 120 - 40Q_b$, where Q_b is the quantity of cars demanded by businesses with the price is P . The demand curve for cars by home users is $P = 40 - 10Q_h$, where Q_h is the quantity of cars demanded by home users when the price is P . Both businesses and home users will never demand negative amounts of cars, so for sufficiently high prices, the demand will be 0.

- a) Graph the demand curves for each segment, and draw the market demand curve for cars.
- b) Write the equation for the demand curve for all prices $P \geq 0$ (make sure that it matches with part (a)).
- c) When the price is $P = \$20$, what is the consumer surplus for businesses, home users, and the market as a whole.

4. A firm uses the inputs of fertilizer, labor, and hothouses to produce roses. Suppose that when the quantity of labor and hothouses is fixed, the relationship between the quantity of fertilizer and the number of roses produced is given by the following table:

Tons Fertilizer	0	1	2	3	4	5	6	7	8
1000's of Roses	0	0.5	1	1.7	2.2	2.5	2.6	2.5	2

- a) What is the average product of fertilizer when 4 tons are used?

- b) What is the marginal product of the sixth ton of fertilizer?
- c) Does this total product function exhibit diminishing marginal returns? If so, over what quantities of fertilizer do they occur?
- d) Does this total product function exhibit diminishing total returns? If so, over what quantities of fertilizer do they occur?

5. A firm is required to produce 50 units of output using quantities of labor and capital $(L, K) = (3, 8)$. For each of the following production functions, state whether it is possible to produce the required output with the given input combination. If it is possible, state whether producing $Q = 50$ with input combination is technically efficient or inefficient.

- a) $Q = 8L + 4K$
- b) $Q = 10\sqrt{KL}$
- c) $Q = \min\{17L, 7K\}$
- d) $Q = 2KL + L - 6$.

6. Consider the production function $Q = KL^2 - L^3$.

- a) Sketch a graph of at least 4 isoquants from this production function.
- b) Does this production function have an uneconomic region? If so, describe the region algebraically (Hint: your answer will be an inequality like this: $K < \alpha L$)?

7. A firm's production function is $Q = 3L^{1/3}K^{2/3}$.

- a) Does this production function have constant, increasing, or decreasing returns to scale?
- b) Determine $MRTS_{L,K}$ for this production function.
- c) What is the elasticity of substitution for this production function? (Hint: what type of production function is this?)

8. A firm's production function is initially $Q_1 = K^{1/3}L^{2/3}$. Over time, the production function changes to $Q_2 = KL^{2/3}$.

- a) Does this change represent technological progress?
- b) Is this change labor saving, capital saving, or neutral?