Show all of your work.

1. (8 points) Suppose the benefits of taking an action $x$ are given by a linear function $B(x) = px$, where $p$ is a constant, while costs are given by a general function $C(x)$. The problem is to maximize net benefits. What are the first-order and second-order conditions for a maximum? Draw a graph to show how the optimal amount of $x$ is determined, and explain how you used both the first-order and second-order conditions in drawing your graph. How does your answer differ if the solution is at the boundary (i.e., $x^* = 0$)?

b. (8 points) Suppose that the benefit function is $B(x) = 20x$ and the cost function is $C(x) = x^3 - 5x^2 + 25x + 10$. Find the value of $x$ that maximizes net benefits. Check both the first-order and second-order conditions, and check for the possibility of a boundary solution.

2. (6 points) What does it mean for two goods to be substitutes in consumption? What does it mean for two goods to be substitutes in production? Suppose, in a competitive market for a good, there is simultaneously an increase in the price of a substitute in consumption and a decrease in the price of a substitute in production. Use words and graphs to discuss the effects on price and quantity. Can you say for sure whether price increases or decreases? Can you say for sure whether quantity increases or decreases? Explain.

3. (5 points) Let $P$ be price and let $Q$ be quantity demanded. Under what conditions will a decrease in price increase total expenditure (i.e., $PQ$), and under what conditions will a decrease in price decrease total expenditure. Give a convincing argument as to why your answer holds.

4. Consider the demand function $Q = 240 - 6P$.

a. (4 points) Calculate $|E_d|$ when $Q = 120$.

b. (4 points) Find the price at which total revenue is maximized.

5. (4 points) If the supply curve is linear and goes through the origin (say $Q = aP$ where $a > 0$), is the price elasticity of supply the same at every point or different at different points? Explain your answer.

6. (4 points) If the absolute value of the price elasticity of demand for shoes is .75, what price change would be necessary to increase quantity demanded by 12%? Would price have to increase or decrease? Explain.

7. (4 points) If 62 units of a good are demanded when the price is $12 and 74 units are demanded when the price is $9, what is the price elasticity of demand between the two points?

8. (3 points) Does the law of demand hold for both elastic and inelastic demand? Explain.