

A. Conceptual Questions

1. Why is the value of slope equal to 0 at turning point? Use diagram(s) to explain your answer.
2. What does second-order derivative measure? Explain the following behavior using appropriate graphs:
 - Increasing at an increasing rate
 - Increasing at a decreasing rate
 - Decreasing at an increasing rate
 - Decreasing at a decreasing rate
3. What is the difference between concavity/convexity and strict concavity/strict convexity? Use graphs to explain the differences.

B. Optimization with sketching

Use optimization to sketch the following quadratic functions:

1. $y = 6x^2 + 19x + 10$

2. $y = 6x^2 - 13x + 6$

3. $y = 5x^2 + 3x - 2$

4. $y = 14x^2 + 9x + 1$

5. $q = 6p^2 + 11p - 10$

6. $y = x^2 - 4x - 12$

7. $y = 2x^2 + 5x - 3$

C. Optimization problems

1. A manufacturer of men's shirts determines that her costs will be 500 dollars for overhead plus 9 dollars for each shirt made. Her accountant has estimated that her selling price p should be determined by:
 $p = 30 - 0.2\sqrt{x}$ where x is the number of shirts sold.
Maximize their profit function.

- It is estimated that the cost of constructing an office building that is n floors high is $c(n) = 2n^2 + 500n + 600$ thousand dollars. How many floors should the building have in order to minimize the **average cost** per floor? (*Answer: 17 floors*)
- Maximize the profit function for Firm A where the total revenue is $R(q) = 5q - 0.003q^2$ and $C(q) = 300 + 1.1q$. Sketch the profit function clearly identifying the turning point.
- HARD: A farmer has 2400 ft of fencing and wants to fence off a rectangular field that borders a straight river. He needs no fence along the river. What are the dimensions of the field that has the largest area? (Hint: Sketch a picture of the fence.)
- HARD: We have a piece of cardboard that is 14 in by 10 in and we're going to cut out the corners as shown below and fold up the sides to form a box, also shown below. Determine the height of the box that will give a maximum volume.

