Math 2413- Calculus I

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- Check CASA calendar for due dates.
- Bring "blank notes" to class. Completed notes will be posted after class.
- Do your best to attend every lecture and lab.
- Study after every lecture; work on the quiz covering the topic we cover on the lecture immediately afterwards. Retake your quizzes for more practice.
- Get help when you need help; bring your questions to the labs, or my office hours. We also have tutoring options on campus.
- Respect your friends in class; stay away from distractive behavior. Do your best to concentrate on the lecture.
- If you email me, mention the course code in the subject line. Email is the best way to communicate with me outside of class. Teams chat messages are not monitored or replied to.

Chapter 5 Applications of Derivatives

Section 5.1 – Optimization

We learned how to find the extreme values of a function in Chapter 3. In this section, we will see practical applications of those methods. Our approach is to express the quantity to be maximized or minimized as a function and find its extreme points. Most of the examples will be word problems; converting the word problem into a mathematical optimization question may be the most critical step in these problems.

Optimization problems (to maximize or minimize):

1. Draw a picture, label it.
2. Determine the primary function (what is to be a max/min)
3. Use a secondary formula if necessary to get the primary function in terms of one variable.
4. Determine a feasible domain.
5. Find the max/min.
6. SHOW that the answer is a max/min using the First or Second Derivative test.

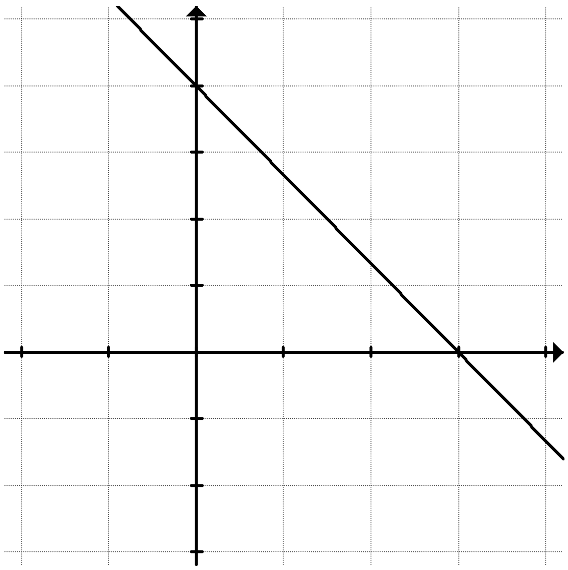
To maximize/minimize a function on a closed bounded interval, we evaluate the function at the endpoints, and then evaluate the function at any critical numbers in the interval.

Example 1: Find the dimensions to minimize the perimeter of a rectangular garden whose area is 60 square feet.

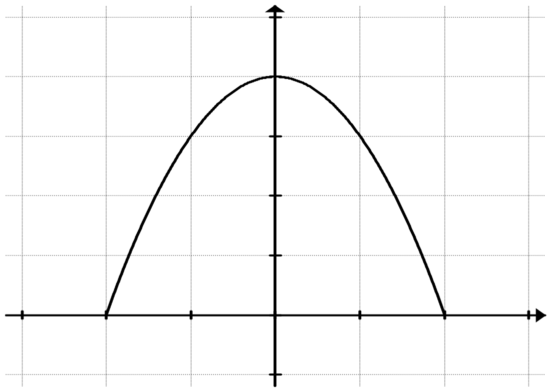
Example 2: A rectangular garden is to be fenced using 600 ft of fencing material. What are the dimensions that will maximize the area?

What is the largest possible area?

Example 3: A rectangle sits in the first quadrant with its base on the x-axis and its left side on the y-axis. Its upper righthand corner is on the line passing through the points (0, 4) and (3, 0). What is the largest possible area of this rectangle?



Example 4: Find the largest possible area for a rectangle with base on the x-axis and upper vertices on the curve $y = 4 - x^2$.

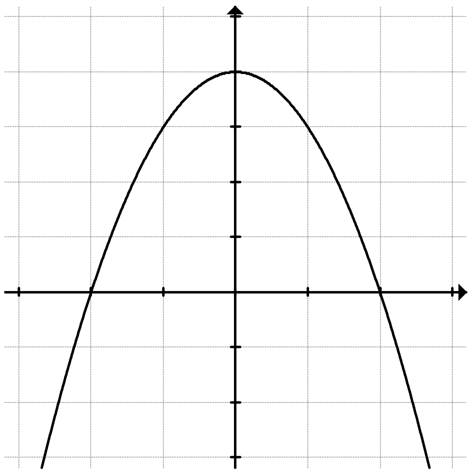


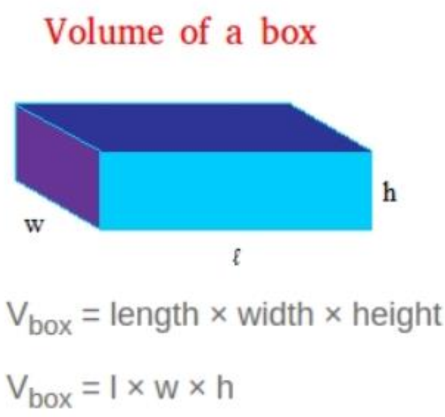
Box problem visual:

https://www.geogebra.org/m/vv65befg

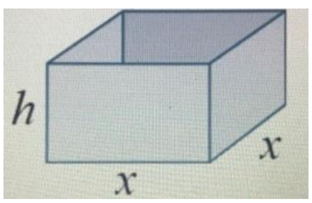
Example 5: Square corners are cut from a rectangular piece of tin that is 24 cm by 45 cm. The edges are folded up to form an open box. Find the length of the side of the square corner removed in order to have a box with a maximum volume.

Example 6: Find the point(s) on the graph of $y = 4 - x^2$ that is closest to the point (0, 2).





Example 7: An open top box with a square base is to be built to hold 32 cubic feet. What should the dimensions be in order to minimize the cost of material used to build this box?



Exercise (a typical question):

A rectangular garden will be made using fencing on 3 sides as one side of the garden will be the river (assume the side is straight). If one has 600 ft of fencing material, what are the dimensions to maximize the garden's area?

Exercise (a typical question):

A rectangular garden will be made using fencing on all sides; but some part of one side is covered by an existing building of 20 feet wide; those 20 feet will not need to be fenced. If one has 300 ft of fencing material, what are the dimensions to maximize the garden's area?

Exercise:

A rectangular playground will be made using fencing on all sides. If the playground must cover an area of 24 square feet, what are the dimensions that will **minimize** the cost of fencing the garden?

Exercise (Similar to a quiz problem):

Find A and B such that $y = \frac{A}{\sqrt{x}} + B\sqrt{x}$ has a minimum value of 6 at x=9.