

Week 9 Overview

My reviews and review sheets are not meant to be your only form of studying. It is vital to your success on the exams that you carefully go through and understand ALL the homework problems, worksheets and lecture material. Hopefully this review sheet will remind you of some of the key ideas of these sections.

4.7: Optimization

- Using our methods from 4.1-4.3, we now can find absolute maximum and minimum values of a function over an interval. In 4.7, we applied these methods to real problems where optimization is needed. Thus, this section really doesn't introduce any new methods, instead it is an opportunity to work on setting up problems from a description so that calculus can be applied.
- Here is one approach to setting up these problems (sometimes you may do these steps out of order, that is fine, this is just one template to organize your thinking):
 - VISUALIZE:** Draw a good picture and label everything with variables. Label lengths, label angles, *etc.* It doesn't hurt to over-label.
 - WHAT IS GIVEN?:** Write down all given facts and connections between the labels and unknowns. Of course, if you can think ahead to the next steps you really only need to write down what will be useful to you later.
 - WHAT TO OPTIMIZE?:** It is important to identify what quantity is to be optimized. Write down a formula for that quantity. Then, using the given facts, find a one variable function for the quantity that you want to optimize.
 - DOMAIN:** Find any restrictions on the domain of the function. Do negatives make sense? Are there any common sense restriction?
 - USE CALCULUS:** Find the critical numbers.
 - JUSTIFY:** There are a few different ways to verify your answer and each may be appropriate in varying situations (choose whichever is fastest and most clear to you):
 - Option 1 (The Closed Interval Abs Max/Min Method):** If the restricted domain is a closed interval, then find the value of the quantity at all critical points AND the endpoints. The biggest output value is the absolute max and the smallest output value is the absolute min. I often try this approach first and only use another approach if the evaluation is tedious or if the interval is not closed.
 - Option 2 (2nd Derivative Test):** Find the second derivative of the function. Determine if the function is concave up or concave down at the critical number. This will classify the critical numbers as locations of local max or local min points (or will be inconclusive). This in itself does not always tell us about absolute max/min points. However, we use the following logical deduction: *If there is only one critical point and it is a local max/min on the domain, then it is an absolute max/min as well.*
 - Option 3 (1st Derivative Test):** If the 2nd derivative test is inconclusive or if the 2nd derivative is messy to find, you may want to use the first derivative test. That is, figure out if the function is increasing or decreasing near the critical numbers and use the same logical deduction mentioned above.
- The most challenging steps are often the first two. Things we often use are:
 - Area, volume and surface area of know solids: cones, cylinders, spheres, and cubes (See the front flap of your book).
 - Similar Triangles and other triangle facts (ratio of sides are equal)
 - Distance between two points ($\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$)
 - Trigonometry (basic facts about sin, cos, tan, or more advanced facts like the law of cosines).