

The midterm will mostly cover Chapter 2. Chapter 1 skills are needed in many places but the questions will be Chapter 2. We are skipping section 2.4.

Here are some important topics which you should understand, with the sections where they appear. It would be wise to find at least one example problem from each of these categories, and to do multiple examples from the “\*” categories:

- average velocity and secant line slope §2.1
- definition of the basic two-sided limit  $\lim_{x \rightarrow a} f(x)$  as a sentence §2.2
- one-sided limits §2.2
- infinite limits §2.2
- limits at infinity §2.6
- vertical and horizontal asymptotes (as limits) §2.2 and 2.6
- using values close to the limit to estimate the limit §2.2
- \* using algebra and limit laws to compute limits §2.3, 2.6
- \* getting limits from a given graph *or* using given limits and values to generate (sketch) a graph §2.2, 2.3, 2.5, 2.6
- definition of continuity §2.5
- common functions are continuous on their domains §2.5
- using Intermediate Value Theorem §2.5
- definition of the derivative as a limit §2.7
- tangent line slope and instantaneous velocity are derivatives §2.7
- find equation of a tangent lines §2.7
- the derivative as a new function derived from  $f(x)$  §2.8
- sketching  $f'(x)$  based on  $f(x)$  §2.8
- notation:  $f'(x) = y' = \frac{df}{dx} = \frac{dy}{dx}$  §2.8
- higher derivatives (and notation for them) §2.8

The reverse side has a few example problems.

1. (§2.6 #9) Sketch the graph of a function that satisfies all these conditions:

$$f(0) = 3, \lim_{x \rightarrow 0^-} f(x) = 4, \lim_{x \rightarrow 0^+} f(x) = 2, \lim_{x \rightarrow -\infty} f(x) = -\infty, \lim_{x \rightarrow 4^-} f(x) = -\infty, \lim_{x \rightarrow 4^+} f(x) = \infty, \lim_{x \rightarrow \infty} f(x) = 3$$

2. Find  $f'(x)$  using the definition if  $f(x) = \sqrt{x}$ .

3. (§2.7 #7) Using the result of the last problem, find an equation of the tangent line to  $y = \sqrt{x}$  at the point  $(1, 1)$ .

4. (§2.6 #50) Find the horizontal and vertical asymptotes of the curve, and state the limits which justify these asymptotes:

$$y = \frac{1 + x^4}{x^2 - x^4}$$

5. (§2.3 #49) Let  $g(x) = \frac{x^2 + x - 6}{|x - 2|}$ . (a) Find  $\lim_{x \rightarrow 2^-} g(x)$  and  $\lim_{x \rightarrow 2^+} g(x)$ . (b) Does  $\lim_{x \rightarrow 2} g(x)$  exist?