

# Math 331 Homework: Day 20

Review Section 3.2 and Read 3.3. The exam will cover material through the Mean Value Theorem (if we get this far).

## Material to Review for the In-Class Exam

In-class format: Definitions, theorems, examples, simple limit, continuity, and derivative proofs; simple results that follow from theorems.

1. You should know the definitions of the following terms and how to use these definitions in problems:
  - a) polynomial, rational function
  - b) the variations on the limit definition, e.g.:  $\lim_{x \rightarrow a^+} f(x)$ ,  $\lim_{x \rightarrow a^-} f(x)$ ,  $\lim_{x \rightarrow +\infty} f(x)$ . You will also still need to use the basic limit definition:  $\lim_{x \rightarrow a} f(x)$ .
  - c) continuity (various forms of the definition), continuity on a closed interval, uniform continuity
  - d) extreme points and values and corresponding theorems for continuous functions and for differentiable functions
  - e) differentiability (definition of  $f'(a)$  including the fact that  $f$  must be defined in an interval containing  $a$ ), critical points and values. You should be able to use the definition of the derivative to calculate the derivatives of particular functions.
2. You should know the following theorems and how to use them. The ones in bold should be memorized.
  - a) The basic limit theorems (Thms 2.3.1–2.3.6): uniqueness, sum, constant multiple, product, quotient, polynomial and the squeeze theorems.
  - b) The basic continuity theorems: **Theorem 2.5.2–3**, the **IVT**.
  - c) The uniform continuity theorems: “**Continuous functions on closed bounded intervals are uniformly continuous**” **Thm 2.6.4**. **The Boundedness Theorem**, **The Max-Min Theorem**.
  - d) The basic differentiability theorems: **differentiability implies continuity**, **Theorem 3.1.2**. Theorem 3.1.3, **Theorem 3.1.5**, and if we get this far: **The Mean Value Theorem**.
  - e) The basic derivative rules Theorems 3.2.1–7 (which you should already know).
  - f) I might take a proof of a theorem and have you justify the steps.
  - g) If we get this far: **Know the proof** of the Mean Value Theorem (using Rolle’s Theorem).
3. You should be able to give examples of various sorts of functions (or know why such examples do NOT exist). For instance:
  - a) A function that is continuous at a point but not differentiable there.
  - b) A function that is differentiable at a point but not continuous there.
  - c) A function continuous at no point; a function continuous only at one point.
4.
  - a) You haven’t had a chance to do many problems involving derivatives. Here are some elementary ones that should be doable using the definition of derivative (some are easier with the  $x \rightarrow a$  version of the definition). Page 99ff #1, 3, 7, 8(a), 9,
  - b) Think about how you would modify the derivative definition to do “one-sided” derivatives page 99 #6. Also look at 7, 8(a), 9, 10 (a,b) should sound familiar.
  - c) Page 104ff #1, 2, 3, 4 (this type of short answer question is would be good on the in-class portion), 5 (which is similar)
  - d) Here are a couple of pairs of problems that go together. Page 64 #2.2.5 and page 99 #4. Page 63 #2.2.2 and then page 105 #3.2.7. A bit harder: Page 80 #2.5.7 (we did this in class) and page 99 #3.1.10 (a,b).
5. From Sections 2.5 and 2.6 to try: 2.5.1, 2.5.8, 2.5.9, 2.6.3, 2.6.4, 2.6.5, 2.6.6, 2.6.11.