Math 111-01, Fall 2022 Professor Rob Benedetto

What you need to know for Exam 1

The exam (in class, Friday, September 30) will cover everything from the beginning of the course up to (and including) Section 2.1. (Note: we skipped Sections 1.4 and 1.7.) The following is a list of most of the topics covered. **THIS IS NOT A COMPREHENSIVE LIST, BUT MERELY AN AID.** Remember, no calculators in any exams.

You may bring one standard size (8.5x11") "cheat sheet" of notes to the exam

- 1.1: What is a function? (Vertical line test.) Domain of a function. Piecewise-defined functions, including $|x|$.
- 1.2: Standard functions: polynomials (including constant and linear), power functions (including root functions and things like $1/x$), rational functions, trig functions. You need to be familiar with the graphs of $y = \sin x$ and $y = \cos x$, and know values of sine and cosine at all multiples of $\pi/2$.
- 1.3: Adding, subtracting, multiplying, and dividing functions. Composition of functions. Given the graph of $y = f(x)$, what do $y = f(x) + c$, $y = f(x) - c$, $y = f(x + c)$, $y = f(x - c)$, $y = cf(x)$, $y = f(cx)$, $y = -f(x)$, and $y = f(-x)$ look like?
- 1.5: Limits. Intuitive idea of what a limit is. Estimating limits using tables and computations. Be familiar with the various ways a limit can fail to exist. Right- and left-hand limits; and Box 3, page 56. Infinite limits. Vertical asymptotes.
- 1.6: Limit laws: sum, difference, constant multiple, product, quotient, power, root laws. Computing limits of polynomials, rational functions, and other functions. Computing harder limits, i.e., things that start out as $0/0$, using algebraic strategies.
- 1.8: Continuity: at a number a, or on an interval I. Know both the official definition ($\lim_{x\to a} f(x) = f(a)$) and the intuitive idea (you can draw it without lifting your pencil off the paper). The three ways continuity can fail ($f(a)$ not defined, or $\lim_{x\to a} f(x)$ not defined, or both defined, but not equal). Continuity from the right or left. Theorems 4–9 (for continuity of sums, differences, products, and quotients, not to mention polynomials, rational functions, trig functions, and root functions, as well as compositions).
- 2.1: Limit definition of derivatives. (Use either box 4 or box 5 on page 109; but don't mix-and-match parts of one with the other. I generally used the box 4 definition.) Computing derivatives from the limit definition. Understanding derivatives as slopes of tangent lines or instantaneous velocities or rates of change.

Some Things You Don't Need to Know

- 1.1: Symmetry. Increasing and Decreasing.
- 1.2: Trig values at $\pi/6$, $\pi/4$, and $\pi/3$. (But you *will* need to know these on future exams.)
- 1.2: Algebraic functions. (That is, you don't need to know the definition of the phrase "algebraic function," but you **do** need to be able to deal with functions like $f(x) = \sqrt{x^2 - 3}$.)
- 1.2: Exponential and logarithmic functions.
- 1.6: The identifying numbers of all the limit laws. The greatest integer function. The Squeeze Theorem.
- 1.8: The Intermediate Value Theorem.

Tips

- Spend some time writing your "cheat sheet" that you can bring to the exam. Don't type it or photocopy something someone else did; there's something about physically handwriting that helps burn things into one's brain better than anything else.
- I'll give you tons of practice problems in a separate handout, and you should do a lot of those. I'll also give you some practice exams that you should try taking under test conditions (closed book, timed) for further practice. And of course, I'll provide solutions so that you can check your answers after you're done.
- For the Exam Day itself, I'll give you a printed exam packet, stapled together, where you'll write your solutions on the exam paper itself (usually one or two problems per page). You can use the backs of pages OR scratch paper from the pile at the front if you need more space to write.
- If you get stuck on a problem, just move on and come back to it later. (But **make sure to actually come back** to any problems you skipped!)
- Make sure you know how to manipulate functions. If any of the problems from Sections 1.1–1.3 gave you serious trouble, make sure you've got things cleared up.
- Limit computations will figure prominently. Know how to use DSP, when to check RHL and LHL separately, when and how to use the conjugate trick, how to deal with fractions inside fractions, etc.
- Know the limit definition of the derivative, and be able to use it. (Hmm, some of these things sound like they might be good to put on your cheat sheet...)
- If I give you the formula for a function $f(x)$, make sure you can quickly and correctly write down the formulas for things like $f(1 + h)$ and $f(x + 2)$.