Math 111-01, Fall 2022 Professor Rob Benedetto

What you need to know for Exam 3

The exam (in class, Friday, December 2) will cover Sections 3.3, 3.4, 3.5, 3.7, 3.9, and 4.1–4.4. The test will not explicitly cover material from Chapters 1–2, but of course it will be assumed that you know that material. (For example, there will be no related rates problems, but of course a lot of the same geometric skills come up in Section 3.7). The following is a list of most of the topics covered. **THIS IS NOT A COMPREHENSIVE LIST, BUT MERELY AN AID.** Remember, no calculators, cell phones, etc. in any exams.

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

- 3.3: Derivatives and graphs. Definitions of increasing, decreasing, and inflection points. Intuitive definition of concavity. The Increasing/Decreasing Test, the Concavity Test, the First Derivative Test, and the Second Derivative Test.
- 3.4: Limits at $\pm\infty$; Horizontal Asymptotes. Know what they are, and how to compute them.
- 3.5: Summary of Curve Sketching. Be able to combine all the information (incr/decr, concavity, local extrema, inflection points, asymptotes) from Sections 3.3 and 3.4 to draw accurate pictures of the graph of a curve.
- 3.7: Optimization. Given a word problem asking you to minimize or maximize a given quantity, be able to convert the problem to the problem of finding extreme values of a function on an interval. (Don't forget to **explicitly** write down both the **function** and the **interval**.) Then use calculus to find the extremum. The closed interval method is sometimes useful, but not always; sometimes you need the First Derivative Test for Absolute Extrema.
- 3.9: Antiderivatives. Given a function f, know the definition of *an* antiderivative of f, and know the definition of *the* (most general) antiderivative of f. Be able to compute some antiderivatives.
- 4.1: Areas and Distances. Know the idea of the Riemann sum as a way to approximate area or distance. Know how to compute R_n (right endpoint) Riemann sums using n equal-width intervals. Sigma notation.
- 4.2: The Definite Integral. The definition of the definite integral as a limit of Riemann sums. Notation for the definite integral. Evaluating definite integrals using Sigma identities (equations 5–11, p. 309) and limit laws. Properties of the definite integral (page 313).
- 4.3: The Fundamental Theorem of Calculus, Part II. Know how to use it to compute definite integrals.
- 4.4: Indefinite Integrals. Know the definition of indefinite integrals, and don't confuse them with definite integrals. Know the table of indefinite integrals on page 331. Be able to evaluate some integrals, sometimes using algebra.

Some Things You Don't Need to Know

- Official definition of concavity (middle of Section 3.3), although you DO need to know what concavity means intuitively.
- Precise definitions (i.e., ε and all that) for limits at ∞ (end of Section 3.4).
- Slant asymptotes (end of Section 3.5).
- Use of antiderivatives for rectilinear motion (end of Section 3.9).
- Riemann sums using unequal width intervals; or choosing x_i^* to be something besides the right endpoint; or the midpoint rule (page 312).
- Computing certain integrals by geometric tricks, like Example 4, page 312.
- Comparison properties of integrals (boxed items 6–8 on page 315).
- Part I of the Fundamental Theorem (page 322).
- The Net Change Theorem and Applications (pages 333–336).

Tips

- As on Exams 1 and 2, spend time preparing your "cheat sheet" and do lots of practice problems, and try the practice exams.
- 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!)
- Always take a moment to look for simplifications **before** you start wildly differentiating.
- Don't forget that there are **two** kinds of critical points; the oft-forgotten type is when $f(c)$ is defined but $f'(c)$ isn't. Even if f' is defined everywhere, you need to **write** that fact on your paper to get full credit.
- With the closed interval method in Section 3.1 and all the tests in Section 3.3, there are a lot of similar **but not quite the same** tests running around. Mixing and matching pieces of one with another leads to disaster. So make sure you know **exactly** what situations to use each of these tests in, and **exactly** what to do (and **what not to do**) to execute each one.
- Practice sketching graphs. It's easy to make a mistake computing all those derivatives and second derivatives. Even if you get the derivatives right, it's all too easy to make a mistake finding the critical points or deciding the derivatives are positive and negative. One little mistake on a sign can multiply to a whole huge mess of horror. So **be careful** and **check your work AS YOU GO**. The asymptotes can also be a little tricky sometimes.
- When making your f' chart, remember that you need to chop the domain up not just at critical points but also at any vertical asymptotes. That is, chop anywhere f' is zero or undefined, even if f was also undefined. Same for f'': chop anywhere f'' is zero or undefined.
- For optimization problems, **draw pictures**. And practice, practice, practice. Don't forget to read the problem carefully and label your picture clearly. Make sure to say **clearly** what interval the domain of your function is. Then, decide whether you will use the closed interval method or the first derivative test for absolute extrema; and **don't use the closed interval method unless your interval is actually closed**.
- Make sure you know the distinction between definite and indefinite integrals. They are **not** the same thing. For example, When you're doing an **indefinite integral**, you need the $+C$. When you're doing a **definite integral**, you need to **not** have the $+C$.
- Know how to compute an integral from the limit definition (i.e., chop up the interval, make the Riemann sum, use Sigma identities, and take the limit). I might not make you do a whole problem like that from scratch, but I *will* ask you to do at least some pieces of it.