Final Exam Review
MATH 1401 - Calculus 1
Spring 2009

Instructors: Eric Sullivan and Henc Bouwmeester
The Final Exam covers Chapters 1 - 5 and 6.1 - 6.3, 6.5, & 6.6.

**Review Material:**

- Know the rules and properties of exponents
- Know the rules and properties of logarithms
- Know how to use function notation and interval notation
- Know the general shapes of all “basic” functions
- See the first day’s notes, chapter 1, and the first homework for sample problems

**Chapter 2: Limits**

- Be able to define what it means to find: \( \lim_{x \to c} f(x) \)
- Be able to find a limit using a table of numbers
- Be able to find a limit using a graph
- Be able to find a limit using factoring and dividing (long or synthetic division)
- Know how to evaluate limits at infinity (and negative infinity)
- Be able to sketch a graph of a function if you are given certain information about that function (see p111 #s 7 - 12).
- Be able to use the properties of exponents and logarithms to simplify a function before taking a limit (see page 132 #s 43 - 58)
- Know the definition of a continuous function at a point (there are three conditions that the function must satisfy (p144))
- Know the following special limits:
  \[
  \lim_{x \to 0} \frac{\sin x}{x} = 1 \\
  \lim_{x \to 0} \frac{1 - \cos x}{x} = 0
  \]
- Know the intermediate value theorem and how to use it to determine where a function has a root

**Chapter 3 (The Derivative)**

- Know the limit definition of the derivative and be able to use it.
- Know the conditions that a function must satisfy in order to be differentiable
- Know the theorem on p184, and be able to provide a counterexample of its converse
- Be able to use the definition of the derivative to find the slope of the tangent line at a point
- Be able to find the equation of a tangent line to a curve at a point
- Be able to match a graph of a function to a graph of its derivative
- Know how position, velocity, and acceleration relate in terms of derivatives
- Know the geometrical interpretation of a derivative
- Know the power, sum, difference, product, quotient, and chain rules
- Be able to use the rule for taking derivatives to take pretty much any derivative under the sun.
• Be able to provide examples and counterexamples of the product, quotient, and chain rules. (for example: provide an example of a function that shows that \( \frac{d}{dx}(f(x)g(x)) \neq f'(x)g'(x) \).)

• Know the derivatives of \( y = \sin(x) \) and \( y = \cos(x) \), and be able to derive the derivatives for the other four trigonometric functions (you will use quotient rule to derive all of them) (see section 3.5).

• Related Rates! Suggestion: work through all of the examples in the book (pp217-221) and all of the problems from the handout in class.

• Local Linear Approximation: Be able to use tangent lines to make an approximation of a function value.

• Error Propagation: Know how to use differentials to calculate the area propagated through formulas (see section 3.8)

Chapter 4 (Derivatives of Logarithmic, Exponential, and Inverse Trig Functions)

• Be able to find \( \frac{dy}{dx} \) and \( \frac{d^2y}{dx^2} \) using implicit differentiation.

• Know how to take the derivative of \( y = \ln(u) \), \( y = \log_a(u) \), \( y = e^u \), \( y = a^u \).

• Know how to take the derivatives of the inverse trig functions (using implicit differentiation and a picture).

• Know how to use logarithmic differentiation to simplify a derivative problem

• Know the different types of indeterminate forms, and be able to provide an explanation for why they are indeterminate.

• Be able to apply L’Hopital’s rule to limits of the form \( 0/0 \) and \( \infty/\infty \).

• Be able to rearrange indeterminate limit problems so that L’Hopital’s rule applies.

Chapter 5 (Graphical Analysis and Applications):

• Know how to find intervals of increasing and decreasing

• Know how to find intervals of concavity

• Know how to use the first and second derivative tests to find relative extrema

• Know how to find absolute extrema on a closed interval

• Be able to find all of the important features of a function and make a complete graph. This includes: intercepts, asymptotes, domain, range, symmetry, intervals of increase and decrease, relative extrema, inflection points, concavity, periodicity, and end behavior.

• Know Rolle’s Theorem and the Mean Value Theorem

• Be able to solve optimization problems (see section 5.5)

• Know how to analyze position, velocity, and acceleration if you are given a position function or its graph.

Chapter 6 Sections 6.1 - 6.3, 6.5, & 6.6 (Integration):

• Be able to use rectangles to estimate area under a curve. Recall that area can be found with “left rectangles”, “right rectangles”, and “middle rectangles.”

• Be able to write an area function (aka accumulation function) for a simple function (see examples 1 and 2 on pg 352-353)

• Be able to calculate anti-derivatives of basic functions (see the table on page 357)

• Know the properties of the indefinite integral (see page 358-359)

• Be able to solve a simple differential equation (see page 361)

• Know how to solve u-substitution integral problems (chain rule in reverse!).

• Know the first fundamental theorem of calculus and how to use it. (This topic was not tested on exam 3 so expect to see a few of them.)
Some suggestions:

• Check out final exams from previous semesters
  (http://www-math.cudenver.edu/undergraduate/uniformfinals/finals.shtml) Remember that Spring 2008 and before used a different text so some topics may be slightly different. I would suggest taking at least 3 of the exams!

• Take some of the review quizzes at http://www.math.sjsu.edu/ valdes/calcreview/home.html

• Do the flash cards at http://mathmistakes.info/facts/CalculusFacts/

• Take all of the web quizzes (linked off of my website)

• redo exams 1, 2, and 3 (solutions are posted)

• There is an extra study session on May 8th at 10:00 (CU building room 626). This is an optional last-minute question and answer session.