Math 111, Fall 2011: Final Exam Study Guide

The final exam will take place on Monday 19 December at 2:00pm in Seeley Mudd 206. It will be 3 hours long. You will not be allowed to use notes, books or calculators of any kind. The exam will cover material from the whole semester.

Format of the exam

There will be approximately 12-15 questions, each about the same length and difficulty as the midterm questions. You should do as many of the questions as fully as possible. You will get partial credit if you have the right idea for a question, even if you do not get it completely correct. You should also explain your answers fully, to an amount of detail appropriate to the question. The rule of thumb is that you should explain the key steps needed to solve the problem, but do not have to explain minor steps that you use along the way.

Syllabus

The syllabus for the final includes all the material from the three midterms. You should look at each of the midterm study guides to review what was covered there. In addition you need to know the following topics. You should

- integration by substitution (4.5)
  - be able to calculate an indefinite integral (that is, find an antiderivative) by substituting for a new variable
  - be able to calculate a definite integral by substituting for a new variable, changing the limits of integration and evaluating the integral in terms of the new variable
  - be able to realize without being told that substitution is an appropriate method and be able to choose an appropriate form for the new variable (note: you will only be expected to carry out this method in cases where it is fairly clear what the new variable should be, specifically, when you are asked to integrate a function that includes part of the form $f(g(x))$ you should take $u = g(x)$: e.g. to integrate $(\sin x)\ln(\cos x)$ take $u = \cos x$.
- finding areas between curves (5.1)
  - be able to use integration to find the area of a region bounded by given curves or lines, including calculating points of intersection to find the correct limits of integration
- calculating volumes (5.2)
  - be able to find the volume of a solid region by integrating a formula for the cross-sectional area as a function of x

  - be able to calculate the cross-sectional area in the cases that the cross-section is a triangle, rectangle, disk, or 'washer'
  - be able to find the volume of a solid of revolution, formed by rotating a given region around the x- or y-axis

- average value of a function (5.5)
  - be able to find the average value of a function $f(x)$ over an interval $[a, b]$

- exponential functions (6.2)
  - be able to sketch a graph of the exponential function a^x when $a > 0$ and $a \neq 1$
  - know the definition of the number e
  - know what is meant by the natural exponential function
  - know how to find the derivative of the exponential function a^x using the limit definition of derivative
  - know the derivative of a^x and, in particular, of e^x
  - be able to calculate derivatives of functions involving exponentials using the usual rules for derivatives, in particular, the chain rule
  - know the antiderivative of e^x and be able to find antiderivatives (and calculate definite integrals) for functions involving exponentials, including using the substitution method

- logarithm functions (6.3)
  - know what is meant by the logarithm function $\log_a(x)$ and be able to sketch a graph of $\log_a(x)$ for $a > 0, a \neq 1$
  - know what is meant by the natural logarithm function ln
  - know and be able to use the basic properties of logarithms as described in class

- derivatives of logarithm functions (6.4)
  - know the derivative of the natural logarithm function $\ln(x)$ and be able to explain why it is what it is
  - know the derivative of $\log_a(x)$ for any $a > 0, a \neq 1$
  - be able to find the derivative of functions involving logarithms using the usual rules for derivatives, in particular, the chain rule
  - know how to integrate the function $\frac{1}{x}$ and similar functions, possibly using the substitution method
  - be able to solve problems based on material from the rest of the semester that involve exponentials and logarithms such as: implicit differentiation, related rates problems, finding maxima and minima, curve sketching, optimization problems, finding areas and volumes

(Note: there will no questions on exponential growth or decay on the exam.) This is not a complete list of what you might have to do on the test but it covers most of the ideas involved. In particular, you may have to combine several of these ideas or techniques, and you may need to think to decide what to use to solve a problem.

Preparing for the final

The best way to prepare for the final is to do old exams from previous semesters. These are on the Math Department web site and I'll provide a link from the course web site.

This means you should sit down, without a textbook or your notes, and try to do part of one of the old exams in the appropriate amount of time, as though it were the real thing. If you don't have 3 hours to spend on it, then do a third of the test in 1 hour, or something like that.

You should also go back over past homework problems, especially those for which the grader has written a comment or deducted points and make sure you understand the comment or why you lost points. If you can't work this out or have any other questions about the grading, please come and ask me about it. I'll have office hours all day on Thursday or Friday.

You should also just work through more practice problems. If you didn't do the practice problems assigned for the homeworks, now would be a good time to do those. If you did, you can make up some more problems on your own (which is also a good exercise to see if you understand the material) and try to solve them. You can always ask me if you are unsure of something.

Beyond that, please let me know how else I can help you prepare, and good luck!