

What you need to know for Exam 1

You should know Section 5.5 and Reviewed and New Sections of Chapter 7, as well as Sections 8.1, 8.2, and 8.3. The test will not explicitly cover material from Sections 1.1–5.4 (or from Appendix D), but of course it will be assumed that you know what limits, derivatives, and integrals are, that you know how to use differentiation rules, and that you know some trigonometry. 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.

- 5.5: The Substitution Rule, for both indefinite and definite integrals.
- 7.1: Know what one-to-one means and what an inverse function is. Know how the domain and range of f relate to the domain and range of f^{-1} .
- 7.2: Know the algebraic properties and limit properties of exponentials. The graph, derivative, and antiderivative of e^x . The chain rule with e^u .
- 7.3: Algebraic properties of logarithms. The notion of $\ln(x)$ as the inverse function of e^x . The fact that $\ln e = 1$ and $\ln 1 = 0$. The graph and the limit properties of $\ln(x)$.
- 7.4: Derivative of $\ln(x)$ and antiderivative of $1/x$. The chain rule with $\ln(u)$. Know that $a^b = e^{b \ln a}$. See the Review Handout on e^x and $\ln x$. If you no longer have that, see our course web page to find a copy.
- 7.6: The definition of inverse sine, cosine, tangent, and secant. The limit properties of $\arctan x$. The derivatives of $\arcsin x$, $\arctan x$, and $\sec^{-1} x$. Know the corresponding antiderivative formulas.
- 7.7: The definition of $\sinh x$ and $\cosh x$, and the identity $\cosh^2 x - \sinh^2 x = 1$. The graphs of $\cosh x$ and $\sinh x$. The derivatives of $\sinh x$ and $\cosh x$. Have a sense of their inverses $\sinh^{-1} x$ and $\cosh^{-1} x$, their graphs, and their derivatives. Know what $\sinh 0$ and $\cosh 0$ equal.
- 7.8: L'Hôpital's Rule. Know the key hypothesis (that the original limit is one of the indeterminate forms $0/0$ or ∞/∞). Know how to apply it. Know how to use it to attack other indeterminate limits, like $0 \cdot \infty$, $\infty - \infty$, 0^0 , ∞^0 , and 1^∞ . Know NOT to apply it to NON-indeterminate forms (like $\infty/0$, $\infty \cdot \infty$, ∞^∞ , 0^∞ , and so on).
- Appendix D: This is just basic trig, so we didn't cover it in class, but you of course need to know all the fundamentals here.
- 8.1: Know the Integration by Parts rule, both for indefinite and for definite integrals, and be able to use it. The LIPET mnemonic may help in choosing your u . Be able to apply Parts two or more times in a row, including things like the special trick of cycling through twice with say $\int e^x \sin x \, dx$.
- 8.2: Trig Integrals. Know how to integrate products of sines and cosines, like $\sin^5 x \cos^4 x$. See the book for a summary. Also know how to integrate products of tangents and secants, when Secant is Even or Tangent is Odd. Know the relevant trig identities for each case.

- 8.3: Trig substitution. Know what substitution to make given the forms shown in the box. Triangle arguments (and trig identities, like $\sin(2x) = 2 \sin x \cos x$, if needed) to convert the final answer back to the original variable. Really practice here. Most of these integrals reduce at some point to integrals from above sections.

Some things you **Don't** need to know

- Section 5.5: The stuff about symmetry (page 364).
- Section 7.1: The *explicit* definitions of one-to-one and of inverse function. That is, you don't need to memorize those definitions. But you DO need to know the ideas of the definitions, including (but not limited to) stuff like the horizontal line test and the idea that the graph of f^{-1} is the mirror image of that of f across the line $y = x$.
- Section 7.2: Official definition of a^x for x irrational. The derivative of a^x for $a \neq e$. The official definition of the number e .
- Section 7.3: Logarithms to any base other than e .
- Section 7.4: Derivatives of logarithms to any base other than e . Logarithmic differentiation. The number e as a limit.
- All of Sections 7.2*, 7.3*, 7.4*.
- Section 7.6: The derivative or anything about \csc^{-1} and \cot^{-1} .
- Section 7.7: Hyperbolic functions other than $\sinh x$, $\cosh x$, or $\tanh x$. All the hyperbolic trig identities *besides* $\cosh^2 x - \sinh^2 x = 1$. Inverse hyperbolic functions other than $\sinh^{-1} x$ and $\cosh^{-1} x$. The formulas for inverse hyperbolic functions in terms of $\ln x$.
- Section 7.8: Cauchy's Mean Value Theorem and the proof of L'Hôpital's Rule.
- Section 8.2: Integrating $\tan^m x \sec^n x$ if m is even and n is odd. Also, integrating products of $\sin A$ and $\cos B$. (Sine and cosine of *different* things.)
- Section 8.3: Completing the square (for now anyways).

Tips

- Study the Integration Reference Sheet carefully; know all of your basic integrals. No hesitation allowed!!! Know your trigonometric identities.
- Precisely learn each integration technique. Using these techniques, practice turning complicated integrals into the more basic ones on the Reference Sheet.
- Practice enough in order to *immediately* recognize which technique of integration is needed. There may be some flexibility here.
- For definite integrals, make sure to change your limits of integration **every** time you make a substitution. They could be layered with multi-subst in a single problem, so be careful. Otherwise, mark the limits correctly.
- Know when ... and when **not** to apply L'H Rule.
- Know how to recognize all indeterminate forms, as well as how to transition them into an indeterminate form $\left(\frac{\infty}{\infty}\right)$ or $\left(\frac{0}{0}\right)$ so you can then apply L'Hôpital's Rule.