What you need to know for Exam 1

The exam will cover "review" material from Sections 4.5 and 6.2–6.4, and then Sections 6.6, 6.8, and 7.1–7.3. (And of course you are expected to know basic facts that we have used from trigonometry (see the Quick Reference Sheet for Trig) and from Math 111.) 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

No worked-out problems are allowed on your cheat sheet.

You must hand-write your own cheat sheet directly on the paper. No printouts.

At the end of the exam, you must hand in your cheat-sheet with your exam paper.

- 4.5: The Substitution Rule, for both indefinite and definite integrals.

- 6.2: Know the algebraic properties and limit properties of the exponentials, especially e^x. The graph, derivative, and antiderivative of e^x. The chain rule with $e^{u(x)}$.

- 6.3: Algebraic properties of the natural logarithm $\ln x$. 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 $\ln(x)$.

- 6.4: Derivative of $\ln(x)$ and antiderivative of $1/x$. The chain rule with $\ln(u(x))$. Know that $a^b = e^{b \ln a}$. (See the Quick Reference Sheet on e^x and $\ln x$.)

- 6.6: The definition of inverse sine and tangent (not cosine or secant). The graphs, limit properties, and derivatives of $\sin^{-1}(x) = \arcsin x$ and $\tan^{-1}(x) = \arctan x$. Know the corresponding antiderivative formulas.

- 6.8: 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 $0 \cdot \infty$, 0^0, ∞^0, and 1^∞. Know NOT to apply it to NON-indeterminate forms (like $\infty/0$, $\infty \cdot \infty$, ∞^∞, 0^∞, etc.)

- 7.1: Know the Integration by Parts rule (IBP), both for indefinite and for definite integrals. The LIPET mnemonic may help in choosing your u. Be able to apply IBP two or more times in a row.

- 7.2: Trig Integrals. Know how to integrate products of sines and cosines, like $\sin^5 x \cos^4 x$. Know the relevant trig identities for each case, including the half-angle identities.

- 7.3: Trig substitution. Know what substitution to make for the forms $a^2 - x^2$ (use $x = a \sin \theta$) and $a^2 + x^2$ (use $x = a \tan \theta$). 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 previous sections, especially Trig Integrals, i.e., products of powers of sines and cosines.

Some things from the book that you don't need to know

- Section 4.5: The stuff about symmetry

- Section 6.2: The 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 6.3: Logarithms to any base other than e.

- Section 6.4: Derivatives of logarithms to any base other than e. Logarithmic differentiation.

- Section 6.6: Everything about $\cos^{-1}$ and $\csc^{-1}$ and $\cot^{-1}$.

- Section 6.8: Cauchy's Mean Value Theorem and the proof of L'Hôpital's Rule.

- Section 7.1: Looping case $\int e^x \sin x \, dx$

- Section 7.2: Integrating products of $\tan x$ and $\sec x$. Integrating products of sine and cosine of *different* things.

- Section 7.3: Completing the square (for Exam 1, anyhow).

Tips

- Use $=$ signs when you mean "equals." Know when there needs to be dx or du and when there needs to be a $+C$, and **don't forget to write them** when they need to be there.

- Mark L'H application clearly each time you use L'Hôpital's rule, as well as marking $0/0$ or ∞/∞ to show that it's allowed.

- Clearly show your side work for u and du etc. **every time** you do a substitution or IBP.

- Study the Integration Reference Sheet carefully; know all of your basic integrals. Don't forget the dx or the $+C$!!

- Know your trig identities and trig values.

- 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 that you change your limits of integration **every** time you make a substitution. (Either that, or mark your limits via "$x =$" until you back-substitute.)

- Know **when** and when **not** to apply L'Hôpital's Rule. Be careful when differentiating, too. And also be careful when converting other indeterminate forms to $0/0$ or ∞/∞.

- For integrals, if you don't immediately see what to do, try to have different ideas for how to approach it (substitution, IBP, algebra, etc.), and then start trying those ideas out one at a time.