

Exam 1 Study Sheet

Exam 1 is scheduled for Tuesday, February 19, during class. The exam will cover Chapter 5, Chapter 6, and Sections 7.1–7.3. Most of the exam questions should be quite predictable. Here are some obvious things you should certainly be prepared for:

- Anti-derivatives/definite integrals

This includes using the substitution method and integration by parts and the methods related to these, like trig substitution. **You will not be allowed to use a calculator for this portion of the test since some calculators can evaluate integrals for you.**

- Applications of integration
 - area and volume, especially volumes of shapes formed by revolution and the area between curves
 - motion (displacement, velocity, acceleration)
 - work
 - average value of function
- Understanding what integration is all about
 - relationship to area
 - Riemann sums

Everything on the exam will fit under those categories, but here is some additional detail:

1. Terms you should be familiar with:

- definition of logarithm in terms of an integral,
- Riemann sum,
- cross-section (including non-circular),
- disk, washer, shell, cylinder in context of finding volumes,
- reduction formula (things like 73–78 of integral table),
- work, Newtons, Joules, and foot-pounds, density of water (metric)
- g , the gravitational constant, and
- Hookes law, and spring constant.

2. Things you need to know

- **Memorize the derivatives and anti-derivatives of our basic functions:** polynomials, powers, exponential and logarithmic functions (including “unnatural bases”), all six trig functions. (Don’t forget $\int \sec x \, dx = \ln |\sec x + \tan x| + C$ and $\int \tan x \, dx = \ln |\sec x| + C$. (See table of integrals, numbers 1–15 in the back of your book.)
- Be able to **recognize derivatives** when you see them. (Examples: $\sec x \tan x$, $\sec^2(x)$, $\cos(x)$, $\frac{1}{2\sqrt{x}}$, $\frac{1}{x}$, etc.)
- Know the most important **trig identities**. These include:
 - $\sin^2(x) + \cos^2(x) = 1$ (and its cousins, $1 + \tan^2(x) = \sec^2(x)$ and $\cot^2(x) + 1 = \csc^2(x)$),
 - the definitions of the 6 trig functions (triangles and unit circle forms),
 - $\sin^2(x) = \frac{1 - \cos(2x)}{2}$
 - $\cos^2(x) = \frac{1 + \cos(2x)}{2}$

– You should be able to evaluate expressions like $\sin(\arctan(x/3))$ that arise when doing trig substitutions.

- Force = Mass \times Acceleration,
- Work = Force \times Distance,
- Hooke's Law for springs (force is proportional to displacement).

3. Things you don't need to memorize.

You should know how to use these, but you don't need to memorize them. They will be provided on the test if needed. (Or you will be expected to "figure them out" from scratch.)

- $\int \sec^3(x) dx$ (But you should be able to derive it, see page 481.)
- $\int \tan^3(x) dx$ (But you should be able to derive it, see page 481.)
- $\sin(A)\cos(B) = \frac{1}{2}[\sin(A - B) + \sin(A + B)]$
- $\sin(A)\sin(B) = \frac{1}{2}[\cos(A - B) - \cos(A + B)]$
- $\cos(A)\cos(B) = \frac{1}{2}[\cos(A - B) + \cos(A + B)]$

4. Some advice

- Show your work. This includes writing down the computations that you had your calculator do, not just the results. (I should be able to easily tell where each number came from.)
- Practice, practice, practice the substitution method, including substitutions for trig integrals, and integration by parts. You need to be **confident and quick** when working these methods.
- **Look for simple things first.** Don't launch into complicated substitutions or parts until you have looked to see if something simpler is available. Leave "long" integration until the end of the exam.
- **Read the directions.** I may ask you to do only part of a problem: for example, I could ask you to set up an integral, but not evaluate it. I may require you to show certain substeps clearly: sketch a picture, write down a Riemann sum associated with an integral, or compute the volume of one "section" of a shape, etc.
- **Be NEAT.** If you keep your work neat and organized, you are less likely to make errors and more able to correct them once made.
- **Don't forget the differentials!** Don't leave off dx and its cousins in your integration.
- Be absolutely certain that you can find volumes of revolution for **any** vertical or horizontal axis of rotation, and that you know how to choose between disks/washers and shells/cylinders.
- I strongly recommend that you to **sketch a representative disk, washer, cylinder, or other cross-section** when finding volumes. I may even require it. It is very easy to make mistakes in finding radii or other dimensions. A sketch helps prevent these errors. Often just sketching the rectangle that generates the disk, washer, cylinder, etc. is just as good.
- Don't forget that we can calculate volumes even when a figure does not have circular cross-sections.
- Reread section 6.4 on calculating work. Do some of the problems from that section. Work is the hardest situation to memorize a formula for; you need to understand what is going on. **Think Riemann sums.**
- Review both parts of the Fundamental Theorem of Calculus paying particular attention to the applications of this theorem. For example, how do you calculate net distance traveled if you only know your velocity function?