



FAST FACTS

How to Succeed in Calculus

“Dedicated to the memory of Dale Winter — student success was foremost in his thoughts.”

“Mathematics is not a spectator sport.”
—Paul Halmos (1916–2006),
American mathematician

“If you do the work, you get rewarded. There are no short-cuts in life.”
—Michael Jordan (1963–),
retired NBA star

“Determination. Plus discipline. Plus hard work. That is the path.”
—Jaime Escalante (1930–2010),
mathematics teacher and
hero of the movie “Stand and Deliver”

Calculus plays an important part in the curriculum of students across the university in disciplines like engineering, science, business, economics, computer science and information systems.

But for many it may also be perceived as a barrier. The purpose of this handout is to help students soar over that barrier.

Calculus rests on only one big idea—the limit. Master that and all its big applications, and you have made a major step toward success. There are four essential varieties of the limit:

- The derivative (the slope of the tangent line)
- The definite integral (the area under a curve)
- Asymptotes (how graphs behave)
- The sum of an infinite series

Mastering the concept of the limit—in its various forms—involves building multiple layers/levels of knowledge. First, you have to learn the basic concepts (i.e., be able to define limits and use them in simple situations). Then you have to learn to apply the concepts to more complex problems (i.e., recognize how and when the integral applies to particular word problems). And throughout this process, it’s important to increase your accuracy and efficiency in using the concepts (i.e., be able to take derivatives accurately and easily so you have mental energy left to focus on more difficult aspects). All of this can be done, but it takes time and perseverance in building your knowledge and skills. The plan/steps/strategies outlined in the following pages will help you spend that time more efficiently so you can achieve success.



How to Succeed in Calculus

“Don’t blow off the class because it seems fairly straightforward. No matter how manageable a class is, if you don’t put in work and time, you’ll never perform as well as you can—and should.”

Always attend recitation. Even if you think you know everything, you should still go to recitation. And if you’re not a morning person, don’t pick an early-morning recitation—it will be hard to get up for something that starts at 9:30 a.m., especially since you may not feel that attending recitation is as necessary as going to lecture.

Nothing will guarantee success on a test as much as solving all of the problems in the book. Practice is key – you develop speed and intuition only by going through lots of problems.”

— Dina, Economics and Math

“The biggest challenge I faced in calculus was not so much one of grasping the new material, as one of when and where to apply it. I would blindly attack the problem and get lost in the math, leaving me frustrated and tired. After meeting with the professor and spending time with the helpful tutors at the academic success center, I came to realize where I was going wrong.

Don’t use the answer key as a crutch. The answer key can be helpful if used correctly to check your work after you’ve done the problem on your own. Using it to complete homework, however, will work against you. You could be tricked into thinking you get it, but when faced with the problem on an exam, you could draw a blank if you haven’t practiced it enough.”

— Mridula, Biological Sciences

Prepare for class. Don’t walk into class without preparing yourself for that particular lecture. Prior to class, read all assignments, look over the previous lecture notes and print out any available webnotes. Be sure you can do the assigned practice problems. When you go over the material prior to class, the lecture will serve to clarify and reinforce ideas with which you have some familiarity. After lecture, be sure to review your notes within 24 hours to optimize recall.

Go to class. Many professors give clear hints on what is important—and what may show up on the test. Knowing what happened in class enhances your studying and reduces the study time you need. Take the word “choice” out of going to class...just make the decision to attend each and every class. Think of going to class as your job, being accountable to yourself for those five hours each week. Some courses will have both lecture and recitation. In lecture, the professor will discuss concepts or theories. However, in recitation you will practice and apply those concepts to problems or ideas.

Think in class. During lecture, you should not just be transcribing—you should be actively thinking and learning the material. You might try to figure out the main ideas of a lecture as you listen while jotting down key ideas. Always ask yourself if you are following what the instructor is saying, and if you’re confused or unsure, make a note of your question(s) and be sure to find an answer (either by reviewing the material yourself or asking your instructor or a TA). Lastly, take appropriate lecture notes (see the Fast Fact entitled, “Taking Lecture Notes”).

Polish your pre-calculus. You can’t build a house—or calculus—on shifting sand. Go for bedrock! If you don’t have the simplifications of $e^{2\ln(x)}$ and $\sin(2\theta)$ on the tip of your tongue, and can’t factor and graph $y = 2x^2 - 5x - 12$ quickly, you may be in trouble. So, practice these prerequisite skills enough that you can apply them quickly and accurately, *and still have some mental energy left over for new material.* This is a case where drilling yourself a bit every day—and pushing yourself to be faster and more accurate—can really pay off in the long run. Some textbooks offer online supplements that will help you review your pre-calculus.

Use your resources. There are lots of resources available: your professor, your TA, your classmates, tutoring, and Supplemental Instruction (SI) can all help. Ask your professor or TA to thoroughly check your solutions to a few problems. You can’t ask them to check every problem, but getting a few problems graded could really help you to understand the level of detail that is expected. Plus, it will give you a chance to visit their office hours—which never hurts. Learn how the text is organized and take advantage of features like the true and false concept checks in the review sections.

Do it now. Don’t wait to study until just before a test. Begin studying for tests on the first day of class by keeping up with assignments and readings, attending class and taking notes, and using available help regularly. Memorize theorems, rules and formulas as they appear in the course, and test yourself on them.



How to Succeed in Calculus

“Doing practice problems by yourself is important; but it is not just doing them, it’s how you do them. Think about each step that you take to solve the problem. Why did you do that and would you be able to do the same thing with other problems? If so, which ones? You might think you shouldn’t even bother doing easy problems because they are just a waste of time. But unless you can do them like adding 2+2, you should still practice them!”

When you take exams (which are typically long, it’s about accuracy and speed. You can’t afford to ponder over the easier problems too much, plus they are easy points if you can do away with them quickly. Then you can spare yourself more time for harder problems.

There are a good number of formulas in calculus but it shouldn’t be hard to memorize if you’ve done enough practice problems. You should have done so many you can’t get the formulas out of your head. If this is not the case, do more!”

— Stephanie, Biological Sciences

“Seek help early and often. There are many resources here at CMU (professors, TA’s, tutors, etc) that will help you succeed. There’s no shame in getting additional help.

For later courses, it’s almost impossible to do all of the work on your own. Working in groups also helps you meet people you might not have known otherwise.

I remember after the Calc final that my teeth were hurting from clenching my teeth throughout the exam, though I didn’t realize I was doing it. Now for most of my exams, I chew gum to help my nerves.”

— Ben, Computer Science

Read the text. Mark it up. Write in the margins. You paid for it, so get your money’s worth out of it. Yes, you could re-sell it, but it is better to know what is in it and how to find it. Furthermore, reading the book/webnotes before class makes the lecture more useful.

Do lots of problems and practice “good practice.” Someone who wants to be a champion golfer would hire a coach to make sure they are practicing their swing correctly, because practicing a bad swing can actually make you a worse golfer. The same principle applies to learning calculus. You need to practice solving problems in the right way. Try to solve problems in front of the professor, TA, tutor or even peers. This way, you can get immediate feedback and the practice is much more likely to be “good” practice. You cannot master calculus by looking at other people’s work—or the solutions manual. Always do more problems than are assigned. And be certain before the test rolls around that you can do problems with the book closed.

Work with others. Your fellow students have varied and interesting backgrounds. You can learn a lot from them—including calculus. You’ve probably noticed at one time or another that two heads are better than one. And, you’ve also probably noticed that when you can teach something...then you really know it. Form a study group that will be serious but enjoy being together.

Study Group Tips

- Be sure that the time spent with your group is productive.
- Don’t make the group too large; four to six students is the ideal size.
- Come prepared: Do the readings and homework, and review the lecture notes. Don’t come just looking for answers. One way to share the work is to ask each member of the group to be responsible for explaining certain problems or sections of the chapter. Another idea is to ask each member to bring along 5 questions that are unclear to them.
- If your group is not helpful/productive, switch to a more responsible group.
- Structure the time to avoid turning study time into a social hour. It’s likely that you will become friendly with members of your study group, and it’s certainly okay to chat a bit, but be sure you get some work done, too.
- Either periodically throughout the study group session or immediately afterwards, make sure that everyone can do the work on their own and is able to articulate the concepts independent of the group.

Remember, talking about calculus helps understanding.



How to Succeed in Calculus

Learn to judge your work.

A solutions manual is just an aid, not a crutch. You must do the problems. Include enough steps that you can justify each one, so that you can have confidence in the whole solution. Remember to take time to have your professor/TA check some of your work.

Be neat. Organize your work. Note how your professor and TA organize theirs. Mathematics cannot be done randomly on the page—especially on a test. And take that test with a good pencil, have a spare, and an eraser.

Test yourself. After mastering problems with your textbook closed, move on to the next level by testing yourself. You and a friend/study group could make practice tests for each other to do under time constraints. Discuss your answers and straighten out any errors. If practice exams are available, do them under a time limitation either alone or with a friend/study group. These exercises will give you an indication as to whether you are ready for an exam.

Read the test questions carefully.

Many points are lost by the failure to read carefully. What are the units? Is a method suggested? What is really asked for? Some of the best students underline the key phrases of a test problem.

Our thanks to Russ Walker, teaching professor, Department of Mathematical Sciences, for his contribution toward this Fast Fact.

Carnegie Mellon University
Student Academic Success

cmu.edu/student-success