

How to Study Mathematics

Written by Paul Dawkins

Before I get into the tips for how to study math let me first say that everyone studies differently and there is no one right way to study for a math class. There are a lot of tips in this document and there is a pretty good chance that you will not agree with all of them or find that you can't do all of them due to time constraints. There is nothing wrong with that. We all study differently and all that anyone can ask of us is that we do the best that we can. It is my intent with these tips to help you do the best that you can given the time that you've got to work with.

Now, I figure that there are two groups of people here reading this document, those that are happy with their grade, but are interested in what I've got to say and those that are not happy with their grade and want some ideas on how to improve. Here are a couple of quick comments for each of these groups.

If you have a study routine that you are happy with and you are getting the grade you want from your math class you may find this an interesting read. There is, of course, no reason to change your study habits if you've been successful with them in the past. However, you might benefit from a comparison of your study habits to the tips presented here.

If you are not happy with your grade in your math class and you are looking for ways to improve your grade there are a couple of general comments that I need to get out of the way before proceeding with the tips. Most people who are doing poorly in a math class fall into three main categories.

The first category consists of the largest group of students and these are students that just do not have good study habits and/or don't really understand how to study for a math class. Students in this category should find these tips helpful and while you may not be able to follow all of them hopefully you will be able to follow enough of them to improve your study skills.

The next category is the people who spend hours each day studying and still don't do well. Most of the people in this category suffer from inefficient study habits and hopefully this set of notes will help you to study more efficiently and not waste time.

The final category is those people who simply aren't spending enough time studying. Students are in this category for a variety of reasons. Some students have job and/or family commitments that prevent them from spending the time needed to be successful in a math class. To be honest there isn't a whole lot that I can do for you if that is your case other than hopefully you will become a more efficient in your studies after you are through reading this. The vast majority of the students in this category unfortunately, don't realize that they are in this category. Many don't realize how much time you need to spend on studying in order to be successful in a math class. Hopefully reading this document will help you to realize that you do need to study more. Many simply aren't

willing to make the time to study as there are other things in their lives that are more important to them. While that is a decision that you will have to make, realize that eventually you will have to take the time if you want to pass your math course.

Now, with all of that out of the way let's get into the tips. I've tried to break down the hints and advice here into specific areas such as general study tips, doing homework,, studying for exams, *etc.* However, there are three broad, general areas that all of these tips will fall into.

Math is Not a Spectator Sport

You cannot learn mathematics by just going to class and watching the instructor lecture and work problems. In order to learn mathematics you must be actively involved in the learning process. You've got to attend class and pay attention while in class. You've got to take a good set of notes. You've got to work homework problems, even if the instructor doesn't assign any. You've got to study on a regular schedule, not just the night before exams. In other words you need to be involved in the learning process.

The reality is that most people really need to work to pass a math class, and in general they need to work harder at math classes than they do with their other classes. If all that you're willing to do is spend a couple of hours studying before each exam then you will find that passing most math classes will be very difficult.

If you aren't willing to be actively involved in the process of learning mathematics, both inside and outside of the class room, then you will have trouble passing any math class.

Work to Understand the Principles

You can pass a history class by simply memorizing a set of dates, names and events. You will find, however, that in order to pass a math class you will need to do more than just memorize a set of formulas. While there is certainly a fair amount of memorization of formulas in a math class you need to do more. You need to understand how to USE the formulas and that is often far different from just memorizing them.

Some formulas have restrictions on them that you need to know in order to correctly use them. For instance, in order to use the quadratic formula you must have the quadratic in standard form first. You need to remember this or you will often get the wrong answer!

Other formulas are very general and require you to identify the parts in the problem that correspond to parts in the formula. If you don't understand how the formula works and the principle behind it, it can often be very difficult to use the formula. For example, in a calculus course it's not terribly difficult to memorize the formula for integration by parts for integrals. However, if you don't understand how to

actually use the formula and identify the appropriate parts of the integral you will find the memorized formula worthless.

Mathematics is Cumulative

You've always got to remember that mathematics courses are cumulative. Almost everything you do in a math class will depend on subjects that you've previously learned. This goes beyond just knowing the previous sections in your current class to needing to remember material from previous classes.

You will find a college algebra class to be very difficult without the knowledge that you learned in your high school algebra class. You can't do a calculus class without first taking (and understanding) an Algebra and a Trigonometry class.

So, with these three main ideas in mind let's proceed with some more specific tips to studying for a math class. Note as well that several of the tips show up in multiple sections since they are either super important tips or simply can fall under several general topics.

General Tips for Studying Mathematics

These are some general tips that were either important enough to single out or just didn't seem to fit into any of the other sections.

- **Go To Class.** Remember that math is cumulative. If you don't go to class you will miss important material that will be used in later sections and/or important announcements.
- **Get to Class On Time.** Sometime important announcements are only given during the first few minutes of a class.
- **LISTEN During Class.** In order to get something out of the class you need to listen while in class. Often this can be difficult to do but it is very important. Sometimes important ideas will not be written down on the board, but instead just spoken by the instructor.

Watch for things the instructor emphasizes, even if just in words. This often means the instructor thinks it's important. The more important that an instructor thinks a topic is, the more likely that it will show up on the exam!

- **Take Good Notes.** Try to write down everything that instructor puts on board. It may seem easy when watching the instructor, but it often is not so easy when it comes time for you to do it. A good set of notes will help remind you how to do these problems. For some instructors writing down everything may be difficult. In these cases you should try to write down as much as possible.

Note as well that this seems to contradict the previous tip. It is often hard to both listen and take a good set of notes. This is something that one often only gains with practice. You need to be able to listen while you are writing down the important parts of the lecture.

- If you find that you are having trouble both listening and taking good notes then you might consider bringing in a tape recorder and record the lecture.

Note however that prior to doing this you should first speak with your instructor. There are a few instructors out there in the world that do not like to have their lectures recorded.

- **Ask Questions.** If you don't understand something then ask your instructor. Chances are you are not the only one who doesn't understand.
- **Listen When Others Ask Questions.** When other students ask questions make sure you listen to both the question and the answer. It may be that the student asking the question thought of something that you didn't think of.
- **Review Notes After Class.** After each class you should review your notes. Note the topics that you found confusing and formulate questions that you can ask your instructor or tutor to help you understand the topic.
- **Make a Set of Index Cards.** Make a set of index cards with important formulas and concepts on them. You can carry these around with you to look over when you've got a few spare minutes. Use them to help you memorize the important formulas and concepts.
- **Learn The (Proper) Notation.** Instructors will assume you know it so you'll need to and many instructors will take points off for bad notation.
- **Get Into A Study Group.** It is often helpful to study in groups. People often look at things differently so someone else may see how to solve a problem that can't do or understand a topic that you find confusing.
- **Note Due Dates.** Write down the due dates for homework and dates for exams someplace you'll see them so you don't forget about them.
- **Budget Adequate Time For Studying/Homework.** It often takes more time studying mathematics to learn the subject than you may require in other classes.

Homework will often take more time than you had originally thought it would. Keep this in mind as you budget time.

- **Do Homework After Each Class.** At the end of each class budget some time to look over the homework from that days lecture and attempt to do it. Doing this will allow you time to really work at understanding the concepts covered that day. Do not wait until the last minute to do the homework as this often results in an incomplete homework set and/or an incomplete understanding of the concept.
- **Do Homework Without Notes and Book.** After the first few homework problems, put your notes and book up and try to do the remaining problems without referring to your notes and/or book. In most cases you will not have these during your exams so get used to doing problems without them.
- **Do More Homework.** Do not limit yourself to just the homework that your instructor assigns. The more problems that you work the better off you'll be.
- **Practice, Practice, Practice.** Practice as much as possible. The only way to really learn how to do problems is work lots of them. The more you work, the better prepared you will be come exam time.
- **Persevere.** You will not just instantly get every topic that is covered in a math class. There will be some topics that you will have to work at before you

completely understand. The only way to really grasp some topics is to go home and think about it and work some problems. You will often find that after a little work a topic that initially baffled you will all of a sudden make sense.

- **Keep Old Homework and Exams.** Do not throw away homework and exams once you get them back. The homework is a good source of study material for exams and both the homework and exams is a good source of study material for comprehensive final exams (if you've got one).
- **Don't Forget Your Textbook.** If you get stuck on a topic that was discussed in class do not forget that you do have a textbook. Often the text book will contain examples not worked in class and/or a different approach to a problem.
- **Seek Help If You Need It.** If you are having trouble with your math class you have many options open to you and you should take advantage of them. You can go to your instructor's office hours, go to the tutoring room or hire a tutor to get help.

Here at Lamar University we have a free math tutoring room located in Lucas 209. You can get a current list of tutors for hire at <http://www.math.lamar.edu/tutorlist.asp> or by visiting the departmental office in Lucas 200.

- **Have the Proper Attitude.** Always do the best that you can. Do not do try to do just enough to get by. Doing this can lead to major problems if you aren't careful. If you are trying to do just enough to get by then all it takes is one bad exam and you are now failing the course.

You should always do the best that you can and strive for the best grade that you can possible get.

Taking Notes

Here are a couple of tips for taking notes in the class.

- **Listen in Class.** Do not just write down what you see on the board. No instructor is going to write down every word they say and sometimes the important ideas won't get written down.
- **Write Down Explanatory Remarks.** Make sure you write down any explanatory remarks the instructor makes. These often won't get written down by the instructor, but can tell you how to work a particular kind of problem or why the instructor used one formula/method over another for a given problem.
- **Note Important Formulas/Concepts.** If an instructor emphasizes a particular formula or concept then make note of it. This probably means the instructor feels that it's important and important formulas and concepts are much more likely to show up on an exam.
- **Question Your Instructor.** If you are unclear on something ask questions.
- **Note Topics You Don't Understand.** If you are having trouble understanding something being presented note that in the margin and at least write down the key words. Leave yourself a couple of lines so you can fill in the missing details later once you've gotten help to understand the concept.

- **Review/Edit Your Notes.** As soon you can after class go back over your notes. Look for any errors and/or omissions. Fill in any information you didn't have time to write down in class.
- **Review Regularly.** At regular intervals sit down and review your notes so that you can learn and retain the information. Remember, that this information will probably be required down the road so it's best to learn it as soon as possible.

Getting Help

Getting help when you are in trouble is one of the most important things that you can do in a math class. Here are a couple of things that you can do to get help.

- **Get Help When You Need It.** Do not wait until the last minute to get help. When you start running into problems it is time to get help. Remember that math is cumulative. If you don't get help right away you will only be making it all that more difficult to understand future material.
- **Ask Questions in Class.** This way you get the help you need AND stay actively involved in the class.
- **Visit the Instructor's Office Hours.** The instructor has office hours for a reason, so use them!
- **Form a Study Group.** Many people find it convenient to study in a group. Different people will see things differently and may see a way to work a problem that you don't know how to do.
- **Go to the Tutor Lab.** If your school has a free math tutoring lab (many do and many don't) then make use of it! That's what it's there for.

Here at Lamar University the free math tutoring lab located in Lucas 209.

- **Get a Private Tutor.** You can always hire a private tutor for some help. In almost every school you will find people who are willing to tutor you for a fee. Most math departments keep a list of tutors or can tell you where you might be able to find one.

If you are here at Lamar University you can access a list of current tutors at <http://www.math.lamar.edu/TutorList.aspx> or stop by the Math Departments office in Lucas 200 for a list.

- **Ask Good Questions.** Saying "I don't understand this section." or "I don't get it." is not the best way to seek help. It just doesn't imply what you're having trouble with and so will probably not get your questions answered. Be specific with your questions. What exactly is it about this section don't you understand?

Many instructors won't help you unless you do have specific questions and/or can articulate exactly what it is that you don't understand and/or "get". If you really don't understand a given section that is okay, but be prepared to tell your instructor just what is causing the problems. Do you not understand the concept? Are you having trouble getting the problems started? Are you having trouble identifying how the problems use the ideas in the given section?

- **Have Attempted Work With You.** When you get help make sure and bring the attempts that you've made on the problem. This will help the person helping you to understand just where you're having problem.

Again, many instructors won't help you unless you've got something to show that you've at least attempted a problem. If you really don't understand how to even start the problem then bring in work for other problems in that section that you have done. This accomplishes two things. First, it shows the instructor that you have been working and second, it gives the instructor something to look at to see just where you're having trouble understanding the problem you're trying to work.

Homework

Note that this section contains some general tips on making the most out of your homework. The next section contains tips on actually working homework problems.

- **Understand the Purpose of Homework.** Instructors do not give you homework assignments to make your life miserable (well some might, but most don't!). Homework assignments are given to help you to learn the material in the class and to develop good reasoning and problems solving skills.

Mathematics is just not a subject that most people will instantly understand every single topic after hearing the instructors lecture. Most people need to work on some problems in order to really start to understand the topic. That is the point of the homework. It gives you a set of problems that will help you to understand the topics.

Remember that it almost always seems easier to watch an instructor doing problems on the board than it actually is. You won't know if you truly understand the material and can do the problem if you don't attempt the homework.

- **Have The Actual Assignment.** This may seem like a silly tip, but make sure that you accurately write down the assignment and due date. This is one of the more common mistakes that students make with homework.
- **Do the Assignment Promptly.** You should always do the assignment as soon after the lecture as possible while the lecture is still fresh in your mind. Do not wait until the last minute to do the whole assignment when comments made by the instructor are no longer fresh in your mind. Often these little asides that an instructor makes won't seem important at the time, but when it comes time to doing the homework the reason for making the comment will become clear.
- **Be Organized.** When you start working on homework make sure that you've got all the materials that you'll need to do the homework such as notes and textbook.
- **Review.** Go back over the lecture for each section and review any examples that the instructor worked to make sure that you understand the ideas from that section. Make note of any common errors that your instructor may have mentioned. Do the same with the text book. Read the section and note examples worked and common errors mentioned in the text book.

One of the biggest roadblocks in doing homework that I've seen in many students is that they completely ignore the notes and/or text. They look at a problem and if they can't see how to do it they give up and go to the next problem. Often there will be a similar problem in the notes and/or text that can help you to get started!

- **Read/Follow the Directions.** Make sure that you read and follow all the directions for both the homework set and the individual problems.
- **Be Neat.** Make sure that you write neatly. This will help the instructor as he/she is grading the assignment and you when you are going over the assignment in preparation for an exam.
- **Show All Work.** Make sure that you show all of your work. Do not just give the answer. Many instructors will not accept homework that consists only of answers and no work. Also, do not skip large chunks of the work. Instructors aren't mind readers and so they won't know how you got from Step 1 to Step 3 unless you also show Step 2. This is also important if you made a mistake in Step 2. If the instructor can't determine how you got from Step 1 to Step 3 you're liable to lose far more points than you would have lost for the error in Step 2 had you shown it.

Showing your work will also help you when you are reviewing for the exam.

- **Check Your Work.** Always go back over your work and make sure that you've not made any simple arithmetic/sign errors.

Problem Solving

In the previous section there were some general tips in regards to homework sets as a whole. Here are some tips to help you actually work the problems. Note that some of the ideas were important enough that they are actually in both sections.

- **Read the Problem.** Read the problem to get an idea of what you're being asked to do. This one of the biggest sources of point loss that I've seen in grading. Too many students just skim the problem and assume they know what's going on and what they are being asked to do.
- **Read the Problem Again.** Now that you know what you're being asked to do, read the problem again. This time around make note of what you are given and what you need to find. Also make sure that you understand just what you're being asked to do.
- **Clearly Note What You Are Asked to Find.** Clearly write down somewhere what you're being asked to find.
- **Clearly Note What You Know.** Clearly write down somewhere all the information you've been given.
- **Draw a Diagram.** If appropriate draw a diagram and label what you know and what you need to find. Often diagrams will suggest the solution technique, so it's a good idea to get into the habit of drawing them.
- **Devise a Plan.** Try to figure out what you're going to need to work the problem. Identify formulas that may help you. See if there are any intermediate steps/answers that will be needed in order to arrive at the final answer.

- **Work a Similar Problem.** If you can't figure out how to work the problem find a similar problem that is simpler. Work this then go back and compare what you did in the simpler problem to the problem you're asked to do.
- **Work the Plan.** Once you've got the plan, work it out to get the answer.
- **Check Your Solution.** Is the answer in proper form? Does your answer make sense? If possible, plug your answer back into the original problem as a check.
- **Go Back Over the Problem.** Once you're satisfied that you've got the correct answer go back over the problem. Identify concepts/methods/formulas that were used for the problem. Try to understand why these concepts/methods/formulas were used on this problem. Look for identifying characteristics that will help you identify this kind of problem in the future.

Studying for Exams

Here are some tips on studying for exams.

- **Start on Day One.** You should always be studying for the next exam. Do a little each day, or at the very least start studying 2 – 3 days before the exam. Do NOT start studying the night before the exam. Cramming, while a time honored college tradition, just doesn't work as well as spending time each day studying, especially with a math class.
- **Get a Good Nights Sleep.** Get a good nights sleep the night before the exam. It is important to be well rested and mentally sharp when you take the exam.
- **Make a List of Important Concepts/Formulas.** Review your notes and make a concise list of important concepts and formulas. Make sure you know these formulas and more importantly how to use them!
- **Rework Homework Problems.** Do not just read over the homework problems. Actually rework them. Writing down the steps will help you to remember them. Make sure that you try to do the problems without looking at the solutions.
- **Rework Book/Notes Examples.** Cover up the solutions to book or note examples and try to rework them. When looking for problems from the book don't forget that most books have a review section at the end of each chapter that usually contains more problems.
- **Look for Identifying Characteristics in Problems.** While doing your homework you knew which section it came out of. This provided some clues as to the solution process. During an exam you won't have this to help you. So, while reviewing your homework look for identifying characteristics that will give you clues on how to identify that kind of problem.
- **Take a Practice Exam.** Find some problems and treat them a practice test. Give yourself a time limit and don't use your notes or book.

Taking an Exam

Taking exams is probably one of the most important things that you'll do in a math class and so it's important to do the best that you can. Here are some ideas that will help you while you're taking an exam.

- **RELAX!!!** This is the first step to successfully taking an exam. Unfortunately, it's also one of the hardest things to do. The more worked up and nervous you are during the exam the more likely you are to forget something or blank out. The worst thing that you can do in an exam is panic.
- **Be Smart.** By this I mean be smart as you take the exam. You should go over the exam three times. First, go over the exam and work all the problems that you KNOW you can do. Second, work all the problems that you think you can do, but aren't sure. Last, go back and work the remaining problems. In this way you will get all the points that you know you can get.
- **Be Time Efficient.** Watch the clock. Don't spend a huge amount of time trying to get the points for one problem! If you spend too much time trying to get the points for one problem, you may not be able to finish the exam and lose more points than you gained by taking all that time for that one problem.
- **If You're Stuck Move On.** If you find that you're stuck on a problem, move on to a different problem and come back later to finish the problem. Don't waste time trying to get 10 points and then not be able to finish and miss 20 points because you ran out of time.

Note that is really the same as the previous tip, but it was important enough to make again and in a different way.

- **Show All Your Work.** Make it as easy as possible for the instructor to see how much you do know. Try to write a well-reasoned solution. If your answer is incorrect, the instructor will assign partial credit based on the work you show. Don't leave it to the instructor to read your mind trying to figure out if you knew what you were doing or not.
- **Never Leave a Problem Blank.** You should never leave a problem blank. Even if you don't know how to finish the problem, write down as much as you do know. The instructor can only give partial credit if there is something written down for the problem. Writing something down is not a guarantee of partial credit, but not writing anything down is a guarantee of no partial credit!
- **Read the Problem.** Make sure that you read the questions carefully and completely before you answer the question. If the instructor asks for the answer to be written in a specific form then make sure that you do that.
- **Does Your Answer Make Sense?** Make sure you've gotten an answer that makes sense.
- **Recheck Your Work.** If time permits go back over the exam and check every problem. This means completely rework the problem from scratch.

Learn From Your Errors

This is probably one of the more important sections here and also one of the most overlooked. Learning from your mistakes can only help you.

- **Review Homework.** When you get your homework back review it looking for errors that you made.
- **Review Exams.** Do the same thing with exams.
- **Understand the Error.** When you find an error in your homework or exams try to understand what the error is and just what you did wrong. Look for something about the error that you can remember to help you to avoid making it again.
- **Get Help.** If you can find the error and/or don't understand why it was an error then get help. Ask the instructor, your tutor, or a classmate who got the problem correct.
- **Rushed Errors.** If you find yourself continually making silly arithmetic or notational errors then slow down when you are working the problems. Most of these types of errors happen because students get in a hurry and don't pay attention to what they are doing.
- **Repeated Errors.** If you find yourself continually making errors on one particular type of problem then you probably don't have a really good grasp of the concept behind that type of problem. Go back and find more examples and really try to understand just what you are doing wrong or don't understand.
- **Keep a List of Errors.** Put errors that you keep making in a "list of errors". With each error write down the correct method/solution. Review the list after you complete a problem and see if you've made any of your "common" errors.