

Math 116 Student Guide

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Welcome to Michigan Mathematics!

In the mid-1990s, as part of a nationwide reform movement, the University of Michigan changed its introductory math program (105/115/116) to move away from the traditional emphasis on rote memorization, and instead focus on conceptual understanding, real-world applications, and collaborative learning. Since then, Michigan has been recognized nationally as a model program. We're proud of the program we've developed, and look forward to working with you in this course to broaden and deepen your mathematical knowledge.

We set high standards in our courses because we know what University of Michigan students are capable of achieving, and we want to help all of our students grow and learn as much as possible. That means there will be times when you struggle with the material, are confused or frustrated, make mistakes, and do things incorrectly. When you feel that way, remember that this is something everyone experiences as they learn and grow. We've seen students succeed in these courses semester after semester, and we want to help you succeed too.

This guide serves as an introduction to the program, letting you know what you can expect, what we expect of you, some important course policies, and some suggestions to help you succeed. Please read this entire document carefully; you are expected to know the information provided here.

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Course structure

You should expect this course to be different from other math courses you have taken. Many math courses are taught in a very formulaic way: students are given an example of a particular kind of problem and shown a step-by-step approach to solving such a problem, spend time practicing these steps on twenty or so nearly identical problems, and then repeat with the next skill. Our courses do not work that way, which can be disconcerting to students who arrive expecting more of the same. Here are some of the key features emphasized in our courses.

Conceptual understanding. We want students to learn not only how to “get the right answer”, but also how to choose an appropriate approach, why the approach works, how to decide whether your answer is correct or even reasonable, and what your answer means.	Collaboration. You'll be expected to work with classmates during class and on homework. Working in groups gives you the opportunity to share ideas and see different approaches. Explaining mathematics to your classmates will also improve your own understanding of the material.
Interpretations. You'll be asked to think about mathematical topics in a variety of real-world contexts, to explain what the math means in that context, and to translate between mathematical expressions and English sentences.	Multiple representations. When you hear the word “function”, you likely think of a symbolic representation, like $f(x) = 5x - 2$. In these courses, we'll also be representing functions graphically, numerically (with tables of data), and

These skills are part of what it means to have a deep conceptual understanding of the content.	verbally. Taking these different approaches deepens your understanding of the material.
Explanations. As you are solving problems in this course, remember that “getting the answer” is only one of the steps. You’ll be asked to explain your mathematical ideas, both verbally and in writing. The more carefully and clearly you explain your ideas, the more likely they are to be correct, and the more likely you will be to remember them.	Problem solving. Figuring out how to approach a problem is an important part of the problem-solving process, and not all problems can be solved in only one way or with just a few minutes of thought. You’ll be given many non-routine problems in this course, and have to think carefully about how you’ll solve them.

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Course assignments and tasks

Task	Purpose	Evaluation
Reading the textbook and watching videos	<ul style="list-style-type: none"> • Foundational introduction to topics • Preparation for class 	<ul style="list-style-type: none"> • Needed to complete prepwork assignments
Reading assignments (online)	<ul style="list-style-type: none"> • Check understanding from textbook reading and videos • Preparation for class 	<ul style="list-style-type: none"> • Graded by computer • The prepwork and homework online assignments are together worth 5% of your grade • 6 attempts per problem
In-class groupwork	<ul style="list-style-type: none"> • Practice with concepts and explanations • Get feedback from instructor early in the learning process 	<ul style="list-style-type: none"> • Failure to complete class activities can lead to a penalty in your course grade
Homework assignments (online)	<ul style="list-style-type: none"> • Further practice with concepts already covered in class, especially computations • Similar to textbook problems 	<ul style="list-style-type: none"> • Graded by computer • The prepwork and homework online assignments are together worth 10% of your grade • 6 attempts per problem

Team Homework	<ul style="list-style-type: none"> • Further in-depth practice with concepts already covered in class • Requires collaboration and deeper conceptual understanding 	<ul style="list-style-type: none"> • Graded on explanations as well as correctness • Part of the 5% of your grade from section work • Failure to participate in team homework can lead to an additional penalty in your course grade
Quizzes	<ul style="list-style-type: none"> • Evaluates individual mastery of concepts that have been covered in past classes • Practice for exams 	<ul style="list-style-type: none"> • Part of the 5% of your grade from section work • Graded by instructor
Gateway	<ul style="list-style-type: none"> • Evaluates mastery of derivative and integral skills • Take on your own and upload your written work on Gradescope when you pass 	<ul style="list-style-type: none"> • Graded instantly by webwork system • Entrance gateway: lose $\frac{1}{3}$ of a letter grade in the course if you don't pass • Integral gateway: 5% of course grade
2 Midterm Exams	<ul style="list-style-type: none"> • Evaluates mastery of concepts. • All students take the same exam at the same time. 	<ul style="list-style-type: none"> • Graded by teams of course instructors • 45% of grade in total • Partial credit often awarded for correct work • Scale for letter grades determined by course coordinator
Final Exam	<ul style="list-style-type: none"> • Evaluates mastery of concepts. • All students take the same exam at the same time. • Cumulative 	<ul style="list-style-type: none"> • 30% of grade in total • Graded like midterm exams

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Why we teach this way

- One of our goals is to ensure that **you're gaining skills that will be valuable to you in the future**. Even if you never have to work with a trigonometric function again, you probably will have to work with other people, persevere in solving difficult problems, and clearly communicate your ideas.
- Students arrive with a variety of backgrounds and strengths. You may be better at coming up with new ideas, carefully performing calculations, drawing excellent

diagrams, explaining ideas to classmates, finding flaws in others' reasoning, or asking the important questions that get everyone thinking. Our emphasis on collaboration and looking at problems from multiple perspectives means that **everyone plays an important role in class.**

- Our program was reformed based in part of the principle that **the only way to really learn math is by doing math.** Extensive research into teaching and learning has supported this principle by demonstrating that passively sitting through a lecture is simply not as effective for learning as active, collaborative engagement with the material.

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Expectations

You should expect to be challenged. Our courses set expectations that are high but achievable for University of Michigan students like you. If you never feel challenged, you're not learning as much as you could be. When you're not sure how to solve a problem, or when you get something wrong, remind yourself that this is normal and to be expected, and a sign that you are stretching yourself to learn and grow as much as possible. In fact, any mathematician or scientist will tell you that we spend a lot of time feeling "stuck" when doing our own work, and often learn more from our errors than from getting things right!

We expect you to be an active participant in your own learning.

- The general expectation at the University of Michigan is that students will spend a minimum of two hours outside class for each credit hour, which means that you should expect to spend **at least eight hours a week outside of class** working on mathematics.
- **You must read textbook assignments before coming to class.** We know that you may not have had to do this before, so we include some tips on how to do this productively later in this guide. Class time will be spent building beyond the basics, focusing on the more challenging aspects of each topic. This is only possible if you come to class already having some familiarity with the topics being covered. In addition, not every small point on which you will be tested will be covered by in-class examples.
- You will be expected to spend time in class **working on problems in small groups.** This gives you a chance to practice and deepen your mathematical understanding. Discussing the mathematics with your classmates and explaining

the concepts to one another will help you to learn the math better than you would working on your own.

- You should be sure to **communicate with your instructor** if you need to miss class, are dealing with ongoing illness, are feeling lost, or have other concerns.

Expect to receive support. We want you to succeed in this course. Here are some of the resources that are available to help you succeed.

- **Your instructor** is one of your most important resources, and they are the first person you should go to for help and to get answers to any questions you have. You should think of your instructor as a coach. Their job is to provide you with guidance, assign work that will help strengthen your skills, and give you feedback on your work that will identify and focus your attention on the things you especially need to work on improving.
- **Office Hours.** Your instructor will hold three weekly office hours, one of which will be in the Math Lab. High school may have accustomed you to the idea that going to the office is something students do when they're in trouble, but college office hours are different. These are times instructors have set aside specifically to meet with students from their classes, and you can come to part or all of these hours without making an appointment. (If you cannot attend office hours, you should talk to your instructor about scheduling an appointment for another time.) Office hours are an opportunity to talk about many things:
 - Ask questions about homework.
 - Discuss any questions you have about material covered in class (or go over it again).
 - Go over graded work to discuss what you got wrong.
 - Talk about related topics you are interested in but were not able to discuss during class.
 - Get advice on things like study skills and how to prepare for exams.
 - Get to know your instructor a little more. For example, you could ask: Why did they decide to pursue an advanced degree in math? Where did they go to college, and what was it like? What were their favorite courses? What did they find most difficult?
- **Math Lab.** This is a free drop-in tutoring center for students in Math 105, 115, 116, 215, and 216, ~~in the basement of East Hall~~ held mostly or completely online for the 2020-2021 academic year. It is staffed in part by instructors of these courses. You can use this for the same sorts of questions you might ask at office hours. You can find hours and additional information at the Math Lab website:

<https://lsa.umich.edu/math/undergraduates/course-resources/math-lab.html>

- If you have a problem or concern that you do not feel comfortable discussing with your instructor, talk to the **course coordinator** or your **advisor**.

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The grading system

Grades in this math course. All sections of this course use the same grading guidelines to ensure a fair, standardized evaluation process. See the Course Syllabus for detailed information. Don't ignore the assignments in the Learning Component! Many students will receive most of the points for this part of their grade, so failing to do so puts you at a significant disadvantage, and can easily cost you a third of a letter grade.

Grades at the university. Many students who come to the University of Michigan have to adjust themselves to college grading standards. You may have been accustomed to getting "straight A's" in high school. Students' first reaction to college grades is often, "I've never gotten grades like these." However, in many classes at the University of Michigan the majority of students are getting grades lower than those they got in high school. (Many students at Michigan did really well in high school!) Another adjustment is in how work is graded at the University. Here, a grade of 11/15 on a team homework assignment (which you might previously have converted to a high school C) may well be a great score. Your own instructor grades assignments to give you feedback on what you understand and what you can improve on, and is your best source of information on your progress in the class.

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Course policies

Calculators: Calculators will not be allowed on exams, and you are not required to purchase one for this course. You may want to take advantage of the [Desmos online graphing calculator](#) for homework and study purposes.

Attendance & Student Absences. Since much of the learning in this course occurs interactively during class time, participation in class is essential. For that reason, the instructor is allowed to reduce the student's course grade if they fail to participate in class activities.

Conflicts With Uniform Exams. The two uniform midterm exams during the course of the semester are scheduled in the evenings to make it possible for all students to

attend, but we are aware that there can be conflicts with other scheduled academic activities such as a class or another evening test. If this happens, notify your instructor **immediately**--we need to know about such conflicts at least **two weeks** in advance--so that we can clear up the problem. The final exam is at a specific time reserved for Math classes. Conflicts with this exam are rare, but please also report these conflicts to your instructor as soon as possible.

Accommodations for Students with Disabilities. If you need an accommodation for a disability, please let your instructor know as soon as possible. Accommodations are possible once you have registered with the Services for Students with Disabilities (SSD) Office (<http://ssd.umich.edu>). They have the expertise to determine appropriate accommodations for a wide range of temporary or ongoing disabilities. The SSD Office will provide you with a Verified Individualized Services and Accommodations (VISA) form detailing the accommodations that are appropriate in your case. You must provide a VISA form to your instructor at least two weeks prior to the need for a test/quiz accommodation. Since the process of establishing appropriate accommodations can take some time, it is very important not to leave it until the last minute. If you think you have an undiagnosed disability, the SSD office can advise you on where you can go for a diagnosis, including low-cost options.

Mental Health. If you are (or someone you know is) feeling overwhelmed, anxious, depressed, and/or in need of support, you should talk to someone. The University of Michigan has a free, confidential counseling center just for students. Counseling and Psychological Services (CAPS, <https://caps.umich.edu/>) is currently located in the Tappan Street Auxiliary Building (609 Tappan), and provides services for many things, including academic concerns like test anxiety. In a crisis situation, you'll be able to see someone quickly even without an appointment. You can also call them at any time at (734) 764-8312.

Academic Dishonesty. Students at the University of Michigan are expected to exhibit academic integrity. Each College has its own standards for treating cases of academic misconduct, but in all Colleges there can be serious consequences for academic misconduct. Sanctions can include: *suspension, disciplinary probation, and receiving a failing grade*. Some examples of cheating, as stated in the LSA Community Standards of Academic Integrity, include:

- Obtaining work or information from someone else and submitting it under one's own name.
- Using, or attempting to use, unauthorized notes, or study aids, or information from another student or student's paper on an examination.

- Altering graded work after it has been returned, and then submitting the work for regrading.

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Strategies for success

During class

- Every student's presence in class is important. You should be attending class every day, arriving on time and remaining until class is over.
- If you must miss a class, stay in touch with your instructor and find someone who can share their notes with you. Class moves quickly, with each lesson building on previous ones, and it can be very difficult to get caught up if you fall behind.
- The classroom is a place where all students need to be engaged in learning. This means that it cannot be a place for casual conversations, texting, doing homework for other classes, etc. Remember that your doing these things can be distracting for classmates who are trying to focus on class. When class starts, it's time to put away your phone and other distractions, and be ready to concentrate on math and discuss the day's material.
- Be respectful and polite. Listen to your instructor and your fellow students when they are talking.
- You'll be learning new material during class. That means that there will be times when you're not sure what to do, or you get things wrong. These things can be frustrating and uncomfortable, and make you feel vulnerable. This is one reason it's so important to be respectful of your classmates, who will be feeling the same way. Remember that you're there to learn, so you shouldn't go in already knowing everything, and making mistakes is part of how we learn.

Productive collaboration

You'll be asked to work with your classmates, both in class and on homework assignments.

- Get to know the students you're working with: What are their names? What other courses are they taking? Taking a little time to get to know one another and discuss group expectations can help lead to better interactions in the long run.
- Make sure you come to meetings and class prepared so you are able to have productive conversations about the material with your classmates.

- Remember that your classmates have varied backgrounds and experiences. Material that is review to you may be new to a classmate. You may struggle with a topic that a classmate finds straightforward, or vice versa. Be respectful of these differences.
- Explaining a subject to others is an excellent way to solidify your knowledge and make sure you understand it as well as you think you do. Make sure you can explain not just the procedure for solving a problem, but why that procedure works.
- Don't hesitate to ask your classmates to explain things; doing so will be beneficial to them too, and at some point your roles will likely be reversed.
- Make sure everyone in your group is involved in solving and discussing the problems, and that everyone understands the work done so far before moving on.
- Listen to each other's ideas without interrupting or tuning them out.
- When you disagree about how to approach a problem, keep the discussion friendly and positive.

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Reading the textbook

In this course, it is absolutely essential that you read the textbook sections as assigned, before they are covered in class. Your experience with previous math courses may make this seem unlikely; many students are used to being able to do each homework problem by scanning for the appropriately similar example in the textbook (or their notes) to use as a template. This is a reasonable way to learn to do a very specific sort of problem, but does not give you the conceptual understanding necessary to solve similar problems with even small changes, which is what we ultimately want you to be able to do.

Your instructor will be counting on you to read the text, since they may not be lecturing very much, and will be assuming you have spent some time thinking about the material before you work with it in class. Further, not every small point on which you may be tested will be covered by in-class examples.

As we said earlier, you have to do math to learn math. This is true even when it comes to reading the textbook. You will likely get very little out of just passively reading through the words as you would a novel. Instead, you'll need to take the time to actively engage with the content as you read. This means that it can take a long time to read just a few

pages. Investing this time early on will pay off later, making classtime more productive and later homework assignments go much faster.

While you read, make sure to repeatedly think about the big picture. What is the main topic of this section? How does the part you're reading now connect to that topic? To previous material in this section? To previous material in the course? Try to predict what will come next.

You should have paper and a pencil out as you read. Use this to:

- **Write down key concepts (such as definitions).** Mathematics writing can be denser than other writing, with each word conveying a very specific and important meaning. Be sure to look up any words that are unfamiliar to you (or make a note of them, to ask your instructor later).
- **Draw pictures and diagrams.** Pictures can often help you understand and remember concepts, and diagrams may allow you to make connections between important concepts in ways that are harder to convey via text. Even if the textbook provides a figure, drawing it yourself, from scratch, can help you to understand it better.
- **Work through the given examples.** This will likely take up much of the time you spend reading the text. A good way to do this is to read the problem and then attempt to work through a solution yourself, turning to the book only when you get stuck. You might even use paper to cover the solution, only revealing enough of it to get yourself unstuck before continuing to do it on your own. As you read a step that you didn't come up with yourself, ask yourself: What are they doing to get from the previous step to this one? Why do they do this step? If you had to look at the solution repeatedly in order to solve the problem, you should try working through the problem a second time without looking at the textbook.
- **Note any questions you have,** making them as specific as possible. It's okay if you don't understand everything you read immediately (in fact, you should expect this to happen sometimes), but it is important to make sure you understand it eventually. Noting questions like "What are they doing in this step?" or "What does this notation mean?" or "Why do they make this comment?" will help you and your instructor to focus on parts you find most difficult.

After you finish reading a section, take some time to review. Can you state the most important topics without looking back through your notes?

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Team Homework

You will have a number of team homework assignments, which you will be asked to complete with a team of classmates.

The team homework problems are intended to be challenging, requiring you to think deeply and carefully about the concepts. When writing exams, the coordinators take what was on the team homework into consideration, so making sure you understand how to do all of the problems is an important part of preparing for exams. Your team will need to write up and submit full, carefully written explanations for how you went about solving the problems. When the work is completed and submitted, every member of the group should be able to explain how to solve all the problems.

Team Homework roles

Teams are expected to jointly create a Google Doc or other document to submit, with every student contributing. Google Docs allow text, equations, tables, and images, for example to include any handwritten calculations or graphs, or graphs from [Desmos.com](https://www.desmos.com).

In addition, each member of the team has an important role. Take your roles seriously -- group work goes much better when everyone has a particular task to do and specific way to contribute! You should rotate roles each assignment so that everyone has the opportunity to try each role.

- **Editor:** The editor is responsible for ensuring that the document is complete, well-explained, and proofread, delegating tasks as appropriate, and for submitting the single final version of the homework to be handed in. This is the only set of solutions which will be accepted or graded. Each member of the group will receive the same grade as long as they work with the team. Students who do NOT participate will receive a zero.
- **Clarifier:** During the team meeting the clarifier assists the group by paraphrasing the ideas presented by other group members, e.g. "Let me make sure I understand, the graph goes up ...". The clarifier is responsible for making sure that everyone in the group understands the solutions to the problems and is prepared to present the problems to the class if the team is called on.
- **Reporter:** The reporter writes a record of how the homework sessions went, how long the team met, what difficulties or successes the team may have had (with math or otherwise). If there is disagreement about the solution of a problem, the reporter should present sketches of alternate solutions and explain the difference

of opinion. The report should list the members of the team who attended the meetings and their roles. The report should be on a separate sheet of paper and the first page of the team's homework solutions. You may use a copy of the sample cover sheet for this purpose, if you like.

- **Manager:** The manager is responsible for arranging and running the meetings. If the team has only three members, or if one of the four members cannot attend, the manager should also take one of the other roles. When the homework is returned, the manager ensures that each team member possesses a copy of the corrected solutions.

Meetings

- Communicate with your teammates in a timely manner in order to arrange meetings and let them know if an emergency comes up that will prevent you from attending.
- Come to meetings on time, and prepared to work. That means **reading and working on the problems in advance**. You don't have to have complete solutions to every problem by the time you meet, but it is important that you're familiar enough with the problems that you're able to have a productive discussion about them. We know it can be hard to find time to schedule meetings that work for everyone. Please respect your classmates and their time by preparing for meetings in advance.
- You will usually have a week to work on the problems, come to consensus about solutions, and write up solutions to turn in. Problems are often complex and require much careful thought, so it's important not to put off meeting until the last minute.
- We recommend meeting at least twice: first, work on solutions and identify any problems for which you need to seek out additional help. Take these solutions and jointly write up a draft, which the team goes over in the second meeting to ensure the solutions are complete and correct.
- If you go to the Math Lab for assistance, at least two team members must be present to receive help from a Math Lab tutor.

Writing up solutions.

- The goal of the solutions is not merely to demonstrate to your instructor that you "got the right answer", but to communicate to your reader the process you used to arrive at that answer.
- It might be helpful to think of your audience as another team member reading back over these solutions several weeks from now in preparation for an exam.

Will they be able to understand the explanation for how to go about solving this problem well enough that they could apply the same reasoning to solve a similar problem on the exam?

- Start each solution with a paraphrasing of the problem (e.g. "We are to find..."). Define your variables and functions precisely (with units where appropriate), and write the algebra and precalculus in complete (mathematical) sentences. Include neat, clearly labeled graphs whenever you possibly can, even if the problem does not specifically ask for them. Finally, think back on the main idea of the problem and state a summary of your conclusions.
- Your solutions should include diagrams, graphs, and tables where appropriate, and intersperse calculations and exposition. Look at how your textbook gives solutions to its examples to get a sense of what that should look like.
- When you're given a problem in context and asked to make calculations, make sure to connect the calculations to the context. If you set up an equation, what does that equation represent? How did you know to set up that equation? Why did you set up that equation--what do you intend to do with it? When you reach an answer, make sure to think about the units associated to your answer.
- When the homework is due, one set of the solutions should be submitted by the Editor, accompanied by a cover sheet written by the Reporter.
- The reporter's cover sheet should list each person's role and include: (1) Dates, times, and location of your meetings; (2) Each member's participation (you may give names or not, as you choose); (3) Comments on how the group worked together; (4) Comments you may want to include regarding the course or assignment in general.

We recommend that all students go through the team homework tutorial at <http://instruct.math.lsa.umich.edu/support/teamhomework/> . This page is also linked from the course web page for your convenience.

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Forms and Links

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[Math Team Homework Cover Sheet](#)