

# MATH 10A – TECHNIQUES OF CALCULUS (A)

## SUMMER 2023

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### BIG IDEA: WHAT IS THIS COURSE ABOUT?

This course is an introduction to the theory and practice of differential calculus as well as some basic integral calculus. My hope is not just to expose you to the mathematical material and how to use it, but also to convey some appreciation for the beautiful theory underlying the subject.

At its core, the main idea of calculus is a simple one: if you want to know the exact value of something, first make an approximate guess, then improve your approximation. If you can “infinitely improve” your approximation, you get the exact answer. There are two main ways this idea is used in calculus: to find the slope of the graph of a function, called its *derivative*; and to find the area between the graph of a function and the  $x$ -axis, called an *integral*. The tool which allows us to “infinitely improve” the approximation is called the *limit*. We will spend the semester developing an understanding of these three deeply interconnected ideas.

### TEXT

We will follow *Calculus*, Volume I, by Gilbert Strang, which you can find freely online at <https://openstax.org/details/books/calculus-volume-1>. Since we only have five weeks together, we will cover material at a brisk pace. I expect you to read each day’s section of the textbook *before* you come to class, so that you at least have a general idea of the objective of each topic and the concepts involved.

Reading math is a learnable skill, but not one we are born with – you can and should ask questions, and I will provide some advice on how to get the most out of the textbook!

### PREREQUISITES

You should have a good working knowledge of precalculus. In our experience, the number one reason students struggle in Math 10a is due to a shaky foundation of precalculus mathematics. One way to check your knowledge is to use our placement exam, located at <http://www.brandeis.edu/registrar/newstudent/testing.html#mathtest>. It is OK if you’re a bit rusty on some topics – I just ask that you’re honest with yourself about skills you need to learn or brush up on and take steps to recover that knowledge, and that you ask me for help when you need it.

### TOPICS

#### Limits:

- Computing limits of functions; limit laws
- Continuity

#### Differentiation and its applications:

- Definition from first principles; the derivative as a function
- Derivative properties; power, product, quotient, and chain rules; derivatives of common functions
- Implicit differentiation; related rates
- Finding maxima and minima; concavity; sketching graphs of functions
- Optimization problems
- L’Hopital’s Rule

## Integration and its applications

- Antiderivatives and indefinite integrals; antiderivatives of common functions
- Definition of the definite integral
- Fundamental Theorem of Calculus
- Applications of definite integrals
- Substitution

## MEETING TIMES AND COURSE STRUCTURE

The course will meet 9 AM-11 AM, Monday-Thursday from June 5 to July 7. The course will be mainly lecture based, with some exercises in groups from time to time, and we will use LATTE and/or Gradescope for assignments and grades.

## GRADING

The grading for this class will be as follows:

- **Homework: 40%.** There will be four homework assignments, each worth 10% of your grade. Working examples and struggling with challenging questions is probably the most important thing you can do to develop your mathematical skills. In fact, I usually refer to these sorts of things as “exercises” rather than “problems” or “questions” because the emphasis is not on obtaining a final answer, but instead on growing stronger as a mathematician. You are encouraged to work together on homework, but everyone should submit their own paper with your own thoughts and work presented authentically.
- **Midterm quiz: 15%.** There will be an in-class quiz in the middle of the course. It will be shorter than the final exam; tentatively, I expect it to take one hour.
- **Final exam: 25%.** This will be an in-class exam on the last day of class. Tentatively, I plan to give you the entire last day of class (two hours) for this.
- **Final presentation: 10%.** During the last two weeks of the class, I will distribute a list of “interesting” calculus problems that build on the ideas we cover in class. These problems are challenging, but you will have the tools to answer them, and you’re welcome to ask me for help. You should form small groups of 2-4 people and solve one of these problems completely, and I will hold extra office hours during which you’ll come and present your solution. Although it may sound scary, I promise this is a low-pressure assignment, and will be graded leniently. The objective is simply to have you engage and struggle with challenging or interesting mathematical questions, and to gain a bit of experience talking about math.
- **Attendance/participation: 10%.** Since we are fitting a full semester of material into just five weeks, it’s really important to attend class each day in order to avoid falling behind. I’ll pass around an attendance sheet during class each day.
- **Reading: 0%.** No, that is not a typo. Although reading the textbook is *not* assessed and is instead on the honor system, it *is* required, and I hope you will reciprocate the trust I place in you by not checking your reading, by making sure you keep up with it. Again, I am here to help!

The boundaries for each letter grade are as follows, where  $G$  is your percent grade for the class:

- A-/A/A+:  $G \geq 90\%$
- B-/B/B+:  $80\% \leq G < 90\%$
- C-/C/C+:  $70\% \leq G < 80\%$
- D-/D/D+:  $60\% \leq G < 70\%$
- E:  $G < 60\%$

I reserve the right to decrease these grade boundaries (that is, to adjust them in your favor), but I will not increase them.

#### ACCOMMODATIONS

Brandeis seeks to welcome and include all students. If you are a student who needs accommodations as outlined in an accommodations letter, please talk with me and present your letter of accommodation as soon as you can. I want to support you.

In order to provide test accommodations, I need the letter more than 48 hours in advance. I want to provide your accommodations, but cannot do so retroactively. If you have questions about documenting a disability or requesting accommodations, please contact Student Accessibility Support (SAS) at (781)-736-3470 or [access@brandeis.edu](mailto:access@brandeis.edu).

#### ACADEMIC INTEGRITY

You are expected to follow the University's policy on academic integrity, which is distributed annually as section 4 of the Rights and Responsibilities Handbook (see <http://www.brandeis.edu/studentaffairs/srcs/rr/index.html>). Instances of alleged dishonesty will be forwarded to the Department of Student Development and Conduct for possible referral to the Student Judicial System. Potential sanctions include failure in the course and suspension from the University. If you have any questions about how these policies apply to your conduct in this course, please ask.

#### TIMELY COMMUNICATION

Use your Brandeis email to reach out to me. I am usually able to respond quickly to most messages, within 24 hours, although during the weekends and over holidays it could take me longer. If I reach out to you, with a query or comment or in response to an email from you, I would appreciate it if you would acknowledge receipt of my message and/or respond with 24 hours, unless it is during weekend or over a holiday. Note that we will use your Brandeis email address, so you need to check it regularly. All course announcements can be found in the Course News & Announcements page on LATTE.

#### NAME/PRONOUNS

Feel free to let me know (and/or update me on) your name and/or pronouns, either by email or in person. You should call me Kam or Kamryn and I use he/him pronouns. Thanks!

#### ABOUT ME



I'm a second-year PhD student here at Brandeis, recently coming from WPI in Worcester where I completed my undergrad degree. My research interests include geometry of Calabi-Yau spaces and variations of complex structures, mirror symmetry, and number theory. I also have some experience in numerical analysis. Outside of school, I enjoy cooking and the occasional board/card game. Lately I've also been learning how to knit. I'm eager to get to know you all and share some exciting math!