

Course organization

My name is Oliver Knill ("Oliver"). Office hours are Tuesdays and Thursdays 4-5. Good times for short meetings are also in the morning before class, shortly before noon or Tuesday and Thursday from 3-4.

Lectures

Lectures take place Monday Wednesday and Friday from 10 AM to 11 AM in SC 309. Come to lectures. It will save you time.

Course assistant

Cody Kiechle (ckiechle@college.harvard.edu)
Emma Rausch (erauscha@college.harvard.edu)

Problem Sessions

Weekly problem section will be arranged by the course assistants.

Exam Group

This course is in the exam group 1. You need only to know this if you should need check about possible final exam conflicts.

General Education

When taken for a letter grade, this course meets the General Education requirement for **Empirical and Mathematical Reasoning** or the Core Area requirement for **Quantitative Reasoning**. It can be taken for graduate credit. Talk to me about special requirements in that respect.

Prerequisites

A solid pre-calculus background is required. This course is recommended for students who score 18 or higher on the first part of the Harvard Math Placement Test. You are not expected to have taken calculus in high school. Even if you have seen some calculus, we expect that Math 1a will provide you with a deeper, more conceptual understanding of the subject.

Synopsis

Calculus can be traced back to Archimedes who was born 2300 years ago. It became a powerful tool with work done by Newton and Leibniz. Calculus can be considered one of the biggest achievements of the past two millennia. The core of the course introduces differential and integral

calculus. Differential calculus studies "rate of change", integral calculus treats "accumulation". The fundamental theorem of calculus links the two. The subject will be applied to problems from other scientific disciplines in homework as well as in lectures. Calculus is not only important because of its content and applications which currently make billions in medicine (example: tomography), internet (example: complex network analysis with calculus methods), geography (example: google earth, location based services), movie industry (animated or CGI enhanced pictures), game development (also under the hood like in artificial intelligence agents). Your phone uses tons of calculus when recognizing voice commands or faces in images). Often, the ideas of calculus only enter in disguised form. One point I want to make in this course is that calculus can appear in different forms. Actually, in the first lecture we look at calculus on integers and prove the fundamental theorem of calculus in a form which the Egyptians already could have done.

Course Policies

Class attendance is expected. In case of religious holidays, conflicts like a sports competitions or concert, please send me a brief email before.

Computers

The use of computers and computer algebra systems or online tools to experiment with the mathematical structures is encouraged. We do not have a lab component in this course. The use of laptops or tablets in class to take notes is fine. No computer, phone or tablet of any type is permitted however during exams. If you get computer assistance for homework, acknowledge it in the paper. I do recommend that you work out most of the work on paper. The material sticks better when you write things up by hand. It will also prepare you better for exams.

Pass Fail

The course may be taken pass/fail or for graduate credit after talking to Oliver. Note that there is **no** GenEd credit for Pass/Fail.

Textbook

I do not follow a particular book. A popular choice is "Single Variable Calculus: Concepts and Contexts, 4th Edition" by James Stewart (ISBN-10: 0495559725 ISBN-13: 9780495559726). The Cabot library has a desk copy available. It is recommended to read in some book but course material and homework is posted on the website <http://www.math.harvard.edu/~knill/teaching/math1a.2012/>

Grades

- 20 percent midterm 1
- 20 percent midterm 2
- 20 percent homework
- 40 percent final exam

As in every course, the numerical score needs to be converted to a letter grade. The cutoffs are determined when the final distribution is known. We will say more about this in the first lecture.

Math Question Center

The mathematics question center MQC is open from Sunday through Thursday in SC 309a, 8:30-10:30 PM. The rooms are reserved from 7:30 PM on. This drop-in help service is staffed by calculus course assistants who can answer questions for homework. You may also stop by the MQC to find other students in the course. While staffed from 8:30 on, the room should be available from 7:30 PM on in the spring.

Bureau of Study Counsel BSC

The bureau of Study council at 5 Linden Street is a resource outside the math department. The BSC offers one-on-one peer tutoring for a minimal fee study skills and test-taking workshops, counseling, and many other services. I recommend however to make use first of our resources. The website of the BSC is <http://bsc.harvard.edu>.

Exams

We have 2 midterm exams and one final exam. You can already mark the calendars for the exam dates:

- 1. Midterm: Tuesday, March 4: 7-8:30, Hall C
- 2. Midterm: Tuesday, April 8: 7-8:30, Hall D

Exams focus on the mathematics done in the course. Calculus is a large area. The syllabus will walk along an efficient and interesting path, which focuses on stuff which is really needed in the sciences. Many calculus books can be overwhelming in this respect.

Homework

Homework is due at the beginning of **every** class. This is easy to remember. Bring every time some homework to class. This course has a "no late homework policy". This makes it possible for the course assistants to return the homework in a timely manner. We will discard the least 3 homework scores.

Academic Integrity

Collaboration policies are the ones established by FAS. Collaboration is permitted or even encouraged for homework but not in exams. Homework needs to be written down individually however. I recommend to attack each homework problem first on your own. This helps you to develop independent thinking and problem solving skills and prepares you for the exams.

Accessible education:

Students who need academic adjustments or accommodations because of a documented disability should provide me with a letter from the Accessible Education Office (AEO). Please talk to me about it also.

Hour by hour syllabus

1. What is calculus?	Date	Day

1. What is Calculus?	Jan 27	Mon
2. Functions	Jan 29	Wed
3. Limits	Jan 31	Fri
4. Continuity	Feb 3	Mon
5. Intermediate value theorem	Feb 5	Wed
6. A fundamental theorem	Feb 7	Fri
7. Rate of Change, tangent	Feb 10	Mon
8. Derivative as a function	Feb 12	Wed
9. Product and Quotient rules	Feb 14	Fri
2. The derivative		

Presidents day, no class	Feb 17	Mon
1. Chain rule	Feb 19	Mon
2. Critical points and extrema	Feb 21	Wed
3. Optimization problems	Feb 24	Fri
4. L'Hopital rule	Feb 26	Wed
5. Newton method	Feb 28	Fri
6. Review for first midterm	Mar 3	Mon
7. Rolles theorem	Mar 5	Wed
8. Castastrophe theory	Mar 7	Fri
3. The integral		

1. From sums to integrals	Mar 10	Mon
2. The fundamental theorem	Mar 12	Wed
3. Antiderivatives	Mar 14	Fri
4. Computing areas	Mar 24	Mon
5. Volume of solids	Mar 26	Wed
6. Improper integrals	Mar 28	Fri
7. Applications of integration	Apr 1	Mon
4. Calculus Techniques		

1. Related rates	Apr 2	Wed
2. Implicit differentiation	Apr 4	Fri
3. Review for second midterm	Apr 7	Mon
4. Substitution	Apr 9	Wed
5. Integration by parts	Apr 11	Fri
6. Numerical integration	Apr 14	Mon
7. Partial fractions	Apr 16	Wed
8. Trig substitutions	Apr 18	Fri
5. Calculus and the world		

1. Calculus and music	Apr 21	Mon
2. Calculus and statistics	Apr 23	Wed
3. Calculus and economics	Apr 25	Fri
1. Calculus and Computing	Apr 28	Mon
2. Outlook and review	Apr 30	Wed