

Final Projects (500 points), Due: August 3rd

The final project is a way for you to dive deeper in a topic that you're interested in. It can be something related to how calculus is related to your life or the world. Or how calculus is related to some part of science or history. Another option is to learn about the proofs of calculus. You will need to do research on the internet for these projects and you need to cite your sources. Wikipedia is an acceptable citation. There is no format required for your citations, the urls of the websites is sufficient. You will submit a short project proposal on July 28th which I will discuss with you and approve in class. The main part of this project is a written component which is to be handwritten on notebook paper. It should be 2 to 4 double spaced pages long (Or 1 to 2 single spaced pages). If your project includes diagrams or graphs this does not count towards the page count. Also your citations do not count towards the page length. On August 3rd you will have 6 minutes to present your project to the class. Your presentation will not have enough time to discuss all the material in your project but should explain the main thing you did. You should practice doing your presentation.

Rubric

Section	Points	Bonus Points Available
Proposal	25	5
Mathematical Content	250	50
Writing Quality	100	25
Spelling and Grammar	25	0
Format and Citations	25	0
Presentation	75	20

Suggested Topics

You can choose your own project. The best project is one you want to do. Here are some ideas if you don't have any. Everyone has to have a different project.

Calculus in the Sciences

- Uses of calculus in chemistry: Specifically you should focus on the rate of reaction. Some search terms you might want are "rate laws" and "rate constants," and "reaction order." You should solve the rate equation for various reaction orders and show how to get the half life formulas.
- Uses of calculus in biology: Specifically you should focus on population growth and the population growth differential equation. You may also want to look into predator-prey models such as the Lotka-Volterra model.

- Newton's law of cooling: explain Newton's law of cooling and how to solve the differential equation. Give some applications to cooking. You may want to also discuss carryover cooking.
- The harmonic oscillator: you should explain the differential equation. You should also discuss modifications such as a damping force or a driving force.
- Uses of calculus in electricity and magnetism: Find out what quantities are related by derivative relationships. Possibly find a differential equation in electricity and magnetism and show how to solve it. You can either focus on the electrical engineering perspective and use circuit diagrams or you can do more physics. If you do more physics you may want to look into Maxwell's equations.
- Computer integration: You may discuss how computers symbolically integrate. You can also discuss other ways of approximating integrals such as the trapezoid rule, the midpoint rule, and Simpson's rule.

Further topics

- Infinitesimals (Fluxions) and a discussion of the invention of calculus by Newton.
- Volume: learn the washer and shell method. Discuss finding the volume of a unit sphere. Show some example problems.
- Taylor's theorem and the radius of convergence.
- The mean value theorem. You may want to briefly discuss its proof. You should also look at some applications.
- Curvature (see mini-project A on Problem Set 5). Your project needs to be longer than what mini-project A asked for.
- The delta-epsilon definition of limits. You should include some examples of computing limits using the delta-epsilon definition.

Proofs

- Proof of the fundamental theorem of calculus.
- Proof of derivative rules using the limit definition of the derivative (sum rule, product rule, chain rule).

Project Proposal, Due: July 28th

You can write your project proposal here: