

Introduction to Calculus

Instructor: Anton Levonian

Classes every weekday (Monday through Friday) from 5:30 PM to 6:15 PM (EST)

Course from 7/17/22 to 8/9/22

Course Description

This course is made for high school and middle school students who are new to calculus but who want to get a head start in this subject. Students will be introduced to topics typically covered in a non-AP calculus course such as limits, derivatives, integrals, and real-world calculus applications. Throughout the course, visualizations and proofs will be emphasized to help students build an intuitive foundation for calculus. By taking this course, students will gain a strong foundation for calculus and will be ready to succeed in more advanced areas of math.

Unit Outline

Unit 1: Foundational topics in calculus

Unit 2: Differential calculus

Unit 3: Integral calculus

Unit 4: Beyond calculus: applications of calculus to advanced math

Meeting Schedule (subject to change)

7/17 Meeting 1 (Unit 1): What is calculus?

- Brief introduction to the course
- Visualizing derivatives, integrals, and the fundamental theorem

7/18 Meeting 2 (Unit 1): Limits

- Introduction to limits and basic limit rules
- Squeeze Theorem

7/19 Meeting 3 (Unit 1): Continuity

- Introduction to continuity
- Types of discontinuity
- Limit definition of continuity
- Intermediate Value Theorem

7/20 Meeting 4 (Unit 2): Intro to derivatives

- Instantaneous rates of change: what does this mean?

- Tangent lines to a graph
- Limit definition of a derivative

7/21 Meeting 5 (Unit 2): Introductory derivatives

- Warm up: Derivative of constant and linear functions
- Derivatives of sums, differences, and constant multiples of functions
- Power rule and differentiation of polynomials

7/24 Meeting 6 (Unit 2): Intermediate derivatives

- Differentiation of $\sin(x)$, $\cos(x)$, and exponential functions
- Product rule
- Chain rule

7/25 Meeting 7 (Unit 2): Harder derivative rules

- Quotient rule
- Derivatives of other trig functions and $\ln(x)$
- Derivatives of inverse functions and inverse trig functions

7/26 Meeting 8 (Unit 2): Derivatives of curves that are not functions

- Implicit differentiation
- Related rates

7/27 Meeting 9 (Unit 2): Analyzing functions using calculus

- Mean Value Theorem
- Increasing and decreasing functions
- Extreme Value Theorem, critical points, and extrema

7/28 Meeting 10 (Unit 2): Maxima and minima

- Concavity, inflection points, and second derivative test
- Maximization and minimization problems

7/31 Meeting 11 (Unit 2): Applications of derivatives

- Position, velocity and acceleration
- L'Hôpital's Rule
- Approximating values of functions with local linearity

8/1 Meeting 12 (Unit 3): Introduction to integrals

- Accumulation of change
- Riemann sums

- Defining and evaluating integrals using the fundamental theorem

8/2 Meeting 13 (Unit 3): Integration techniques

- Properties of definite and indefinite integrals
- Reverse power rule
- U-substitution

8/3 Meeting 14 (Unit 3): Advanced integration techniques

- Long division and completing the square
- Integration by parts
- Partial fraction decomposition

8/4 Meeting 15 (Unit 3): Applications of integration

- Acceleration, velocity, and position
- Average value
- Integration with respect to different axes

8/7 Meeting 16 (Unit 3): Using integrals to find area and volume

- Area between two curves
- Finding volume: cross-sections, disc, and washer methods

8/8 Meeting 17 (Unit 4): Taylor polynomials and series

8/9 Meeting 18 (Unit 4): Review and final comments