

Introduction to Calculus

Instructor: Anton Levonian

Classes on Fridays and Saturdays from 5:00 PM to 5:45 PM EST (9 weeks)

From 7/22/22 to 8/13/22 and from 9/2/22 to 10/1/22

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. After each lesson, students will be provided with questions to reinforce their understanding of the topics learned in class. By taking this course, students will gain a strong foundation for calculus and will be ready to succeed in more advanced areas of math.

Meeting Schedule (subject to change)

Meeting 1 (7/22): What is calculus?

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

Meeting 2 (7/23): Limits

- Introduction to limits and basic limit rules
- Squeeze Theorem

Meeting 3 (7/29): Continuity

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

Meeting 4 (7/30): Intro to derivatives

- Instantaneous rates of change: what does this mean?
- Tangent lines to a graph
- Limit definition of a derivative

Meeting 5 (8/5): 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

Meeting 6 (8/6): Intermediate derivatives

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

Meeting 7 (8/12): Harder derivative rules

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

Meeting 8 (8/13): Derivatives of curves that are not functions

- Implicit differentiation
- Related rates

Break

Meeting 9 (9/2): Analyzing functions using calculus

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

Meeting 10 (9/3): Maxima and minima

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

Meeting 11 (9/9): Applications of derivatives

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

Meeting 12 (9/10): Introduction to integrals

- Accumulation of change
- Riemann sums
- Defining and evaluating integrals using the fundamental theorem

Meeting 13 (9/16): Integration techniques

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

Meeting 14 (9/17): Advanced integration techniques

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

Meeting 15 (9/23): Applications of integration

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

Meeting 16 (9/24): Using integrals to find area and volume

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

Meeting 17 (9/30): Taylor polynomials and series

Meeting 18 (10/1): Review and final comments