

Advanced Placement Calculus AB

AP Calculus AB course covers topics typically found in a first-year college Calculus I course and advances the student's understanding of concepts normally covered in high school Calculus. Major themes include differential calculus. Topics include functions, graphs, limits and continuity, derivatives of basic functions, applications of the derivative, implicit differentiation, curve sketching, related rates, implicit differentiation to find the derivative of an inverse function, integration, applications of integration, geometric interpretation of differential equations via slope fields, and L'Hopital's rule. This course prepares students to succeed in Advanced Placement (AP) Calculus AB exam and the subsequent courses.
Recommended School Credit: 1.0 credit

The Basics

Prerequisites for Calculus: Precalculus Review
Average rate of change
Elementary functions and graphs
Function arithmetic and composition

Limits

Concept of limit
Finding limit graphically and numerically
Properties of limits
Intermediate theorem
Squeeze theorem

Introduction to Derivative

Concepts and types of continuity and discontinuity
Average and instantaneous rate of change
Definition of derivative
Computing derivative function from the definition
Local linearity
Derivative at a given point
Secant and tangent line at a given point
Derivative as a rate of change
Estimating the average and instantaneous rate of change from data and its graphs
Motion, position, velocity and acceleration functions
Differentiability and continuity
Power rule
Product rule
Quotient rule
Chain rule

Special Functions

Trigonometric function, exponential functions, and logarithmic functions
Graphs of trigonometric function, exponential functions, and logarithmic functions
Derivatives of trigonometric Functions, exponential functions, and logarithmic functions
Derivative of $\ln x$ and e^x

Implicit Differentiation and Calculus of Inverse Function

Finding derivative implicitly
Differentiation notation
Inverse functions: exponential and logarithmic functions
Calculus of Inverse functions
Inverse trigonometric functions
Calculus of Inverse trigonometric functions
Calculus of Hyperbolic functions
Comparing graphs of f and f'

Practical Application of the Derivative

Position, velocity, and acceleration
Critical points

Finding extrema and increasing and decreasing behavior of a curve
Local and absolute extreme values
Higher derivative and linear approximation
Newton's method
Related rates
Optimization

Curve Sketching

Finding critical points, local minimum and maximum on a curve
Comparing the graphs of f , f' and f''
The first and second derivative tests
Concavity and inflection points
Estimating derivative from data and graphs
Asymptotes and infinite limits
Intermediate value theorem
Mean value theorem
Rolle's theorem

The Basics of Integration

Antidifferentiation
Antiderivatives of Powers of x
Antiderivatives of Trigonometric and Exponential Functions
Undoing the Chain Rule
Integrating Polynomials by Substitution
Integrating Composite Trigonometric Functions by Substitution
Integrating Composite Exponential and Rational Functions by Substitution
More Integrating Trigonometric Functions by Substitution
Choosing Effective Function Decompositions
Approximating Areas of Plane Regions
Areas, Riemann Sums, and Definite Integrals
The Fundamental Theorem of Calculus, Part II
Illustrating the Fundamental Theorem of Calculus
Evaluating Definite Integrals
An Introduction to the Integral Table
Deriving the Trapezoidal Rule
An Example of the Trapezoidal Rule

Applications of Integration

Motion of a particle: net and total distance traveled
Gravity and vertical motion
Area bounded by curves
Average value of a function
Volume using cross-section
Disk method
Washer method
Shell method
Arch length
Work and Hooke's Law
Moments and center of mass

Chapter 11: Differential Equations: Part I (1 week)

Separable differential equations

Direction fields

Growth and decay problems

Logistic growth

Exponential growth and radioactive decay

L'Hopital's Rule and Improper Integral

Indeterminate forms: $\left(\frac{0}{0}, \frac{\infty}{\infty}, \infty - \infty, 1^\infty, 0^\infty, \infty^0 \right)$

Use of L'Hopital's rule

Type of improper integrals

Infinite limits of integration, convergence and divergence

The Close of Calculus I

An Introduction to Paradoxes

Paradoxes and Air Safety

Newcomb's Paradox

Zeno's Paradox

Fibonacci Numbers

The Golden Ratio