Online Courses for High School Students
1-888-972-6237

AP® Calculus AB

Course Description:

AP Calculus AB is a two-semester course in which students study functions, limits, derivatives and integrals. This document outlines the topics and subtopics that are covered in each chapter/unit.

Throughout the course, students write and work with functions represented by written descriptions, mathematical rules, graphs and tabular data. Students develop and practice skills using a graphing calculator to solve problems, experiment, interpret results, and support their conclusions. Students learn the meaning of the derivative and apply it to a variety of problems while developing a deeper understanding of the meaning of the solutions to those problems. Students study integrals and learn about the relationship between the derivative and the definite integral, using written work and graphing technology to explore and interpret this relationship. Students discover how calculus is used to model real-world phenomena by using functions, differential equations, integrals, and graphing technology to solve problems, support solutions, and interpret findings.

The content of this course aligns with College Board frameworks and College Board approved textbooks.

Prerequisites: Algebra II, Geometry, Pre-Calculus with Trigonometry
Course Length: Two Semesters

Required Text:
The required virtual content for this course is covered in:

- Thomas, Paul et al. (editors). AP Calculus AB, K12 digital edition. Herndon, VA: 2012.

In addition, students should have this required (printed) textbook:

- Larson, Ron, and Bruce H. Edwards. Calculus of a Single Variable, AP Edition (9th ed.), Belmont, CA: Brooks/Cole, Cengage Learning, 2010. [ISBN: 0547212909]

The following additional textbooks **(optional)** may be used to supplement the material presented in this course:

- Finney, Ross L., Franklin Demana, Bert Waits, and Daniel Kennedy. Calculus: Graphical, Numerical, Algebraic (3rd ed.), Boston: Pearson Addison Wesley, 2007. [ISBN: 0132014084]
- Stewart, James. Single Variable Calculus (7th ed.), Belmont, CA: Brooks/Cole, Cengage Learning, 2011. [ISBN: 0538497831]

Course Outline:

Semester A

Unit 1: The Basics
Students prepare to study calculus by reviewing basic pre-calculus concepts from algebra and trigonometry. They learn what calculus is, why it was invented, and what it is used for.

Pre-Calculus Review Introduction to Calculus

- Video Lectures: The Study of Change, History of Calculus, Calculus Today, The Study of Calculus

Using a Graphing Calculator
- Graphing Calculator: Finding Zeros of Functions

Combining Functions
- Video Lectures: Sums, Differences, Products, Quotients

Composite and Inverse Functions
- Video Lectures: Composite Functions, Composite Domains, Inverse Functions, Domains of Inverse Functions
- Graphing Calculator: Exploring Functions Graphically and Numerically

Graphical Symmetry
- Video Lectures: Symmetry, Even and Odd Functions, Inverse Is Reflection of Original

Patterns in Graphs
- Video Lectures: Function Families, Rules, Absolute Value
- Graphing Calculator: Shifting and Exploring Function Graphs

Unit Review Unit Test

Unit 2: Limits and Continuity
This unit addresses Topic I: Functions, Graphs, and Limits of the College Board's Calculus AB topic outline. Students learn two important concepts that underlie all of calculus: limits and continuity. Limits help students understand differentiation (the slope of a curve) and integration (the area inside a curved shape). Continuity is an important property of functions.

Introduction
- Video Lectures: Limits, Unequal Limits, Ways to Find Limits

Finding Limits Analytically
- Video Lectures: Identities, Factoring and Rationalizing, Trigonometric

Asymptotes as Limits

- Video Lectures: Asymptotes Revisited, Horizontal Asymptotes, Vertical Asymptotes, Drawing a Graph with Asymptote Information

Relative Magnitudes for Limits

- Video Lectures: Comparing Algebraic Functions, Comparing Exponential Functions, Comparing 5 Exponential Functions to Algebraic Polynomials and Power Functions

When Limits Do and Don't Exist

- Video Lectures: Vertical Asymptotes, Left-and-Right Hand Limits Don't Match, Oscillating Limits

Continuity

- Video Lectures: What Is Continuity? Discontinuity Types: Jump, Discontinuity Types: Infinite, Discontinuity Types: Removable, All Together

Intermediate and Extreme Value Theorems

- Video Lectures: The Intermediate Value Theorem, The Extreme Value Theorem

Unit Review Unit Test

Unit 3: The Derivative

This unit addresses Topic II: Derivatives of the Calculus AB topic outline from the College Board. Students learn how to calculate a derivative, the slope of a curve at a specific point. They learn techniques for finding derivatives of algebraic functions (such as y = x2) and trigonometric functions (such as y = sin x). Students also interpret the derivative as a rate of change and move fluidly between multiple representations including graphs, tables, and equations.

Introduction: Slope and Change

- Video Lectures: Slope, Instantaneous Rate of Change

Derivative at a Point

- Video Lectures: Slope of Curve, Differentiable, Calculating the Derivative
- Graphing Calculator: Computing the Derivative of a Function Numerically

The Derivative

- Video Lectures: Finding and Using the Derivative Function, Units, Slope, Notation

The Power Rule

- Video Lectures: The Derivative as a Function, The Power Rule, Trigonometric Derivatives

Sums, Differences, Products, and Quotients

- Video Lectures: Sums, Products, Quotients, Applying the Quotient Rule

Graphs of Functions and Derivatives

- Video Lectures: Zeros, Extreme Values, Steepness, Graphical Differentiation, Non Differentiable

Continuity and Differentiability

- Video Lectures: Review, Discontinuous, Continuous, Differentiable

Rolle's and Mean Value Theorems
- Video Lectures: Rolle's, MeanValue

Higher-Order Derivatives
- Graphing Calculator: Higher-Order Derivatives

L'Hôpital's Rule
- Video lectures, Indeterminate Quotients and L'Hôpital's Rule, Indeterminate Products, Indeterminate Differences, Indeterminate Powers

Concavity
- Video Lectures: The Second Derivative, Inflection Points

Chain Rule
- Video Lectures: Units, Chain Rule, Applying the Chain Rule, Derivatives of Complicated Functions

Implicit Differentiation
- Video Lectures: Implicit Equations and Their Derivatives, Derivative of an Ellipse, Derivative of a Circle and a Hyperbola, Tough Analytical Derivatives, Analytical

Unit Review Unit Test

Unit 4: Rates of Change

This unit focuses on Second Derivatives and Applications of Derivatives within Topic II: Derivatives of the Calculus AB topic outline. Students learn how to use calculus to model and analyze changing aspects of our world.

Introduction
- Exploration: Maximums

Extrema
- Video Lectures: Extrema, First Derivative Test, Sketching with the Second Derivative, Second Derivative Test

Optimization
- Video Lectures: Minimizing, Maximizing, Sketching with the Second Derivative, Travel Time, Travel Time 2

Tangent and Normal Lines
- Video Lectures: The Tangent Line to a Curve, Normal Line, Finding Lines

Tangent Line Approximation
- Video Lectures: Local Linearity, Approximation, Calculator

Rates and Derivatives
- Video Lectures: Rates of Change as Derivatives, Economics, Translating

Related Rates

- Video Lectures: Related Rates are Applications of the Chain Rule, Related Rates Story Problems Technique, Commonly Needed Formulas and Rules

Rectilinear Motion

- Video Lectures: Rectilinear, Speed & Velocity
- Graphing Calculator: Velocity and Acceleration

Unit Review Unit Test

Semester B

Unit 1: The Integral

This unit focuses on Topic III: Integrals in the Calculus AB topic outline. Students learn numerical approximations to definite integrals, interpretations and properties of definite integrals, the Fundamental Theorem of Calculus, and techniques of anti-differentiation. They learn how to find areas of curved shapes.

Introduction

- Graphing Calculator: Analyzing Velocity and Distance for a Car Trip

Riemann Sums

- Video Lectures: Area, Approximating Area, Inscribed and Circumscribed Rectangles, Improving the Estimate, Riemann Sums

Area Approximations

- Video Lectures: Trapezoid Rule, From a Function with a Formula, From a Function Graph, From Numerical Data, Error

The Definite Integral

- Video Lectures: Many Intervals, Definite Integral, Evaluating Definite Integrals, Approximating Numerically, Limit of Sums
- Graphing Calculator: Taking More Intervals

Properties of Integrals

- Video Lectures: Signed Area, Properties, Using Rules

Graphing Calculator: Integration

- Graphing Calculator: Using fnint ()

Applications of Accumulated Change

- Video Lectures: Accumulation, Average Value, Velocity Curves, Exercises, Accumulated Change

Antiderivatives

- Video Lectures: Going Backwards, Antiderivatives, Some Rules, Differential Equations
- Going Between Position, Velocity, and Acceleration

Composite Functions

- Video Lectures: Chain Rule, Differential Form, Substitution, Another Substitution Example, Practice, Guess & Check, Guess & Check II

Exploring the Derivative and Antiderivative

- Graphing Calculator: Derivatives and Antiderivatives

The Fundamental Theorems of Calculus

- Video Lectures: Area Functions, The First Fundamental Theorem, The Second Fundamental Theorem, Units, Names

Definite Integrals of Composite Functions

- Video Lectures: Fundamental Theorems, Definite Integrals, Area, Upper Limits, Strange Substitutions, When to Substitute

Analyzing Functions and Integrals

- Video Lectures: Leibniz's Rule, Leibniz's Rule II, Area Functions, Analyzing Functions, One More Analyzing Functions Example

Unit Review Unit Test

Unit 2: Applications of Integrals

This unit focuses on Topic III: Integrals in the College Board's Calculus AB topic outline. Students learn to use integrals and antiderivativesto solve problems.

Introduction and Area Between Curves

- Video Lectures: Accumulation, Two Curves, Multiple Curves, Cutting Area Horizontally

More Areas and Averages

- Video Lectures: Area Problems, No Formula? Working Backwards

Volumes of Revolution

- Video Lectures: Principles, A Calculus View of Volume, Solids of Revolution

Cross Sections

- Video Lectures: Cross Sections, Other Shapes for Cross-Sections, Finding Dimensions of Solids

More Rectilinear Motion

- Video Lectures: Total vs. Net, Velocity vs. Speed, Putting It All Together, Other Accumulated Changes

Other Applications of the Definite Integral

- Video Lectures: Geometry, Surface Area, Applications from Physics, Nifty Application, Connections

Unit Review Unit Test

Unit 3: Inverse and Transcendental Functions
This unit focuses on Topic II: Derivatives and Topic III: Integrals in the College Board's Calculus AB topic outline. Students learn to calculate and use derivatives, antiderivatives, and integrals of exponential functions (such as y = 3x where the input variable is an exponent), logarithmic functions (the inverses of exponential functions), and trigonometric functions (such as y = secant x).

Introduction and Derivatives of Inverses

- Video Lectures: Inverse Functions, Derivatives of Inverse Functions, The Graphical View, Inverse Trig Functions

Inverse Trigonometric Functions

- Video Lectures: Domain Restrictions, Derivatives of Arctan and Arccos, Complicated Examples,Using Derivatives

Logarithmic and Exponential Review

- Video Lectures: Exponential Growth and Decay Functions, Logarithms, Slope,Applications
- Graphing Calculator: Derivatives of Exponential Functions

Transcendentals and 1/x

- Graphing Calculator: Explore transcendentals and 1/x

Derivatives of Logarithms and Exponentials

- Video Lectures: Definition, Laws, Logarithmic Differentiation, Exponential Function, Other Bases

Analysis of Transcendental Curves

- Video Lectures: Curve Analysis, Tangent and Normal Lines, Optimization, Rates of Change, Related Rates

Integrating Transcendental Functions

- Video Lectures: Recap Rules, Practice, Strategies, Applications

Applications of Transcendental Integrals

- Video Lectures: Area and Averages, Volume, Motion, Accumulations

Unit Review Unit Test

Unit 4: Separable Differential Equations and Slope Fields
This unit focuses on Topic II: Derivatives of the College Board's Calculus AB topic outline, and specifically, on Equations Involving Derivatives. Students investigate differential equations and solve the equations using a technique called "separating the variables."

Slope Fields

- Video Lectures: What is a Differential Equation?, Slope Fields, Conic Sections, Solving Some Simple Differential Equations, Separating Isn't Always the Answer

Differential Equations as Models

- Video Lectures: A Field Guide to Differential Equations, English to Math, Separating the Variables, Solving Separable Differential Equations

Exponential Growth and Decay

- Video Lectures: A Family of Exponential Functions, Modeling Exponential Growth, Modeling Exponential Decay, Modified Growth and Decay

More Applications of Differential Equations

- Video Lectures: Law of Cooling, Falling Bodies, Mixing Problems, Logistic Growth, Connections

Unit Review Unit Test

Unit 5: AP Exam Prep

Students review what they have learned and become more familiar with AP-type questions in preparation for the AP Exam. Students are also provided with access to previously released AP Exams for practice.

Exam Strategies

- Video Lectures: T-Minus, One Day, Calculators, Multiple Choice, Free Response, Do's and Don'ts

Review of Topics Practice Exams

- Video Lectures: How an AP Exam Score is Calculated, Rubrics, Strategies, What will be on the Exam

Final Exam