AP Calculus AB

Prerequisites:

Calculus AB course is intended to develop students' understanding of the concepts of calculus and provide experience with its methods and applications. The course will emphasize a multirepresentational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally, and the connections among these representations will be highlighted.

Before studying calculus, students should complete four years of secondary mathematics designed for collegebound
students: courses in which they study
algebra, geometry, trigonometry, analytic geometry, and elementary functions. These functions include those that are linear, polynomial, rational, exponential, logarithmic, trigonometric, inverse trigonometric, and piecewise defined. In particular, before studying calculus, students must be familiar with the properties of functions, the algebra of functions, and the graphs of functions. Students must also understand the language of functions (domain and range, odd and even, periodic, symmetry, zeros, intercepts, and so on) and know the values of the trigonometric functions of the numbers 0, /6, /4, /3, /2, and π π π π their multiples.

Basic course information:

1. Our classes meet once a day for 53 minutes.

2. The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline in the *AP Calculus Course Description*.

3. The course provides students with the opportunity to work with functions represented in a variety of ways graphically,
numerically,
analytically, and verbally and
emphasizes the connections among
these representations.

4. The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences.

5. Each student has a graphing calculator of his/her own and is expected to bring it to class each day. If a student does not have a calculator, one may be provided for him/her for class use or to check out and take home. We mainly use the TI83
plus, but students are also allowed to
use any calculator accepted on the AP Calculus test. The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.

Semester 1:

Chapter 1: Introduction to Limits (Functions, Graphs, and Limits)

23

weeks, approximately August 18September

• Analysis of graphs—using calculators as well as pictures of graphs, students will analyze local and overall behavior of a function.

o **Limits**—onesided limits included

☐ Students will learn what the limit process entails, and how the limit process works.

☐ Students will calculate limits numerically, analytically, and graphically.

o **Asymptotes and unbounded behavior**

☐ Students will understand asymptotes in terms of graphical behavior.

☐ Students will discover the relationship between asymptotic behavior and limits involving infinity.

☐ Students will compare/contrast the relative magnitudes of functions and their rates of change (polynomials, exponential and logarithmic functions, for example).

o **Continuity**

☐ Students will understand the concept of continuity—in terms of limits (function values can be made as close as desired by taking sufficiently close values of the domain).

☐ Students will also understand continuity visually/graphically and will learn how the Intermediate and Extreme Value Theorems apply.

Chapter 1 Test at the end of the chapter (approx. Sept. 8)

Chapters 2 and 3: Derivatives (and their applications)

1014

weeks, September 9December

• **The concept of "derivative"**

o Graphically, analytically, and numerically

o As an instantaneous rate of change

o Derivative defined as the limit of the difference quotient (beginning of chapter 2)

o Relationship between continuity and derivative

• **Derivative at a point**

o Slope of a curve at a point, including vertical tangents and points with no tangents

o Tangent line to a curve at a point and local linear approximation

o Instantaneous rate of change, as the limit of average rate of change o Approximate rate of change from graphs and tables of values

- **Derivative as a function**

o Relationships between *f* and *f'*

o Relationship between increasing and decreasing behavior of *f* and the sign of *f'*

o The Mean Value Theorem and its geometric consequences

o Equations involving derivatives (verbal descriptions are translated into equations involving derivatives and vice versa; including related rates/optimization problems)

- **Second Derivatives**

o Corresponding characteristics between *f, f',* and *f''*

o Relationship between concavity and the sign of *f''*

o Points of inflection as the place where concavity changes

- **Application of Derivatives**

o Analysis of curves, including notions of monontonicity and concavity

o Optimization, both absolute and relative/local extrema

o Modeling rates of change, including related rates problems

o Use of implicit differentiation to find the derivative of an inverse function

o Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration

o Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations

- **Computation of derivatives**

o Knowledge of derivatives of basic function, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions

o Basic rules for the derivative of sums, products, and quotients of functions

o Chain rule and implicit differentiation

Chapter tests given at the end of chapter 2 and at the end of chapter 3 (approximately October 13 (ch. 2) and Dec. 9 (ch. 3))

Dec. 1119:

Chapters 13

review; December 2021st:

: Semester Test

Semester 2:

11 weeks; January 4March

30

Chapters 46

Integrals

• **Interpretations and properties of definite integrals**

o Definite integral as a limit of Riemann sums (left, right, trapezoidal, and midpoint sums)

o Definite integral as the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval (Fundamental Theorem of Calculus)

o Basic properties of definite integrals (examples including additivity and linearity)

• **Fundamental Theorem of Calculus**

o Use of the Fundamental Theorem to evaluate definite integrals

o Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined

• **Applications of integrals**

o Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to take their knowledge and techniques and apply them to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. Specific applications will include using the integral of a rate of change to give accumulated change, finding the area of a region, the volume of a solid with known cross sections (by use of the sums of discs, washers, cylindrical shells and other crosssectional slices), the average value of a function, and the distance traveled by a particle along a line.

• **Techniques of antidifferentiation**

o Antiderivatives following directly from derivatives of basic functions

o Antiderivatives by substitution of variables (including change of limits for definite integrals)

• **Applications of antidifferentiation**

o Finding specific antiderivatives using initial conditions, including applications to motion along a line

o Solving separable differential equations and using them in modeling (in particular, studying the equation $y' = ky$ and exponential growth)

• **Numerical approximations to define integrals**

o Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by table of values

Chapter tests at the end of chapter 4, chapter 5, and chapter 6. Approximate dates: January 30 (ch. 4), March 1 (ch. 5), March 30 (ch. 6).

April 2May

8: Review for AP Calculus Test, including taking an old exam and scoring it according to AP Scoring Guidelines (approximately May 1st4th).

May 10May

24: Yearend

review and semester tests (test: May 23 and 24).

Assignments

Students will have daily assignments covering all topics discussed for that day. These assignments will include work from the text usually, but are not limited to that work. Relevant work found in other texts may also be assigned. Alan Lipp's text (listed below) will be used extensively for work involving slope fields. Students will take a quiz regularly covering the topics discussed. Fridays will be quiz days, and students will be quizzed over any topics discussed that week. Each chapter a test will be given (a test will follow chapter 1, chapter 2, chapter 3, chapter 4, chapter 5, and chapter 6). Should scheduling fall at an inopportune time, we may take a midchapter

test (if we are midchapter

around the time of a

holiday/break, we will test at that time instead of waiting until after the holiday). Projects to be completed could include (and are not limited to): writing related rates problems (complete with some form of illustration), creating a visual aid for a volume of a solid with known cross sections problem, working in small groups to pair up matches of graphs of *f, f' and f''*.

Texts and Resources

Finney, Ross L., et al. *Calculus: Graphical, Numerical, Algebraic: AP Edition*. Boston: Addison Wesley.

HughesHallet,

Deborah, et al. *Calculus Single*

Variable. New York: John Wiley

& Sons.

Larson, Hostetler, and Edwards. *Calculus of a Single Variable, Seventh Edition.* Houghton Mifflin Company, Boston, 2002.

Lederman, David. *Multiple Choice and Free Response Questions in Preparation for the AP Calculus (AB) Examination, Eighth Edition.* D & S Marketing Systems, Brooklyn, NY, 2004.

Lipp, Alan. *Little Books of BIG IDEAS: Calculus; Visualizing Differential Equations with Slope Fields.* The Peoples Publishing Groups, Saddle Brook, NJ, 2006.

Mueller, Eleanor. *AP Summer Institute at University of Oklahoma.* Works adapted from various sources combined into an AP Conference Notebook. eleanormueller@aol.com, 2005.

Stewart, James. ***Single Variable Calculus: Concepts and Contexts.*** Belmont, CA: Brookes/Cole.
20042005
Professional Development for AP Calculus. Special Topic: Differential Equations. The College Board, 2005.
Resource: TI83
graphing calculator (Texas Instruments)