

AB Calculus Syllabus

Submitted to the College Board

: Advanced Placement AB Calculus

Text: Calculus

Graphical Numerical, Algebraic

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Addison Wesley 1999

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Syllabus:

I: Overview of Functions: Pgs: 9-50: 1 week

A. Functions and Graphs

i) Domain and Range

ii) Odd and Even

B. Piece-Wise Defined Functions

i) Composite functions

C. One-One Functions and Inverses

D. Trigonometric Functions

i) Inverse trig functions

II: Limits and Continuity Pgs: 55-81: 2 weeks

A. Rates of Change: Graphical and Numerical

B. Definition of a Limit (informal)

i) Properties

ii) One and Two Sided Limits

iii) The Sandwich Theorem

C. Infinite Limits

i) Properties and Sandwich Theorem

ii) Asymptotes and End Behavior

D. Continuity

i) Continuity and Discontinuity at a Point

ii) Continuous Functions

iii) Intermediate Value Theorem for Continuous Functions

III: Tangent Lines, Rates of Change, and Derivatives: Pgs: 82- 173: 4 Weeks

A. Average Rate of Change –Using Table of Values (velocity, acceleration)

i) Tangent –Line Problem

B. Finding Slope and Tangent Line

i) Slope of a Curve at a point

ii) Normal Line to a Curve

C. Derivative of a Function

i) Definitions of function and at a point

ii) Relationship between the graphs of f and f'

iii) Graphing the Derivative from Data

iv) One sided derivatives

D. Differentiability

i) Where a Function is not Differentiable

ii) Differentiability *implies* Local Linearity

iii) Derivatives on the Calculator: *nDeriv*

iv) Differentiability *implies* Continuity

v) Intermediate Value Theorem for Derivatives

E. Rules for Differentiation

i) Constant, Power, Constant multiple, Sum, Difference,
Product, Quotient, negative powers of x

ii) Higher Orders of Derivatives

F. Linear Motion

G. Derivatives of Trigonometric Functions

H. Chain Rule of a Composite Function

i) Repeated use of the Chain Rule

I. Implicit Differentiation

J. Derivatives of Inverse Functions

K. Derivative of Inverse Trig Functions

i) Derivations of formulas

L. Derivatives of Exponential (e^u, a^u) and Logarithmic ($\ln u, \log_a u$) Functions

- i) Logarithmic Differentiation
- IV Extreme Values of a Function and Curve Sketching : Pgs:177-206: 2.5 weeks
- i) The Extreme Value Theorem, Critical Values
 - ii) Absolute *max* and *min* points
 - iii) Local (relative) *max* and *min* points
 - iv) Rolle's Theorem
 - v) Mean Value Theorem
 - vi) Increasing and Decreasing Functions
 - vii) Determining Where a Graph Rises or Falls
 - viii) Connecting f' , f'' , with f
 - ix) 1st Derivative Test for Local Extrema
 - x) Concavity and Points of inflection
 - xi) 2nd Derivative Test for Local Extrema
- V. Optimization and Linearization Problems: Pgs: 206-230: 1.5 weeks
- i) Modeling: *max* and *min* problems
 - ii) Linear Approximation with Tangent Lines: $L(x) = f(a) + f'(a)(x - a)$
- VI. Related Rates Problems involving: Pgs: 232-245: 1.5 weeks
- i) Triangles and moving ladders
 - ii) Cones and cylinders
 - iii) Angles
 - iv) Shadows
- VII. The Definite Integral Pgs: 247-301: 3 weeks
- A) Estimating Finite Sums
 - i) Rectangular Approximation Method
 - B) Definite Integrals
 - i) Riemann Sums/ Numerical Approximations
 - ii) Integrals on Calculator: nINT
 - iii) Rules for Antiderivatives
 - iv) Average Value of a Function
 - v) Mean Value Theorem for Definite Integrals
 - vi) Connecting Differential and Integral Calculus
 - C) The Fundamental Theorem of Calculus Pts. I and II

D) The Trapezoidal Rule

VIII. Anti Derivatives and Integration Techniques pgs: 306- 322: 3weeks

A) Indefinite Integral

- i) Rules and Properties (power, trig, inverse trig, exponential, and logarithmic)
- ii) Using the Fundamental Theorem of Calculus
- iii) Substitution Method

IX. A) Differential Equations pgs: 303-312, 320-322, 330-340, 363-73: 2.5 weeks

- i) Initial Value Problems
- ii) Separable Differential Equations
- iii) Slope Fields
- iv) Exponential Growth and Decay
 - a) Real Life Applications:
Interest, Population, Radioactivity and Newton's Law of Cooling
- v) Linear Motion

X. Area and Volume Pgs: 374-394: 2 weeks

A) Area

- i) Area under a curve
- ii) Area between 2 curves

B) Volume: Solids of Revolution

- i) Disk Method
- ii) Washer Method
- iii) Cross Sections

XI: Review 2.5 -3 weeks

While no one text can be a panacea in the study of calculus the following is also used:

Supplementation:

1. Calculus 8th edition: Anton, Bivens, and Davis Early Transcendentals
John Wiley & Sons, Inc. ISBN: 0-471-47244-1
2. Calculus 6th Edition: Larson, Hosteller, and Edwards
Houghton Mifflin ISBN: 0-395-86974-9
3. Calculus: Single Variable 2nd Edition: Stewart
Brooks/Cole ISBN: 0-534-37862-5

4. Multiple Choice and Free Response Questions in
Preparation for the AP (AB) Calculus Exam 8th Edition: Lederman and McMullin
5. AP Calculus (AB) Released Multiple Choice Question Collection: 1969-1998, 2003
The College Board (Educational Testing Service)
6. AP Calculus (AB) Free Response Questions: 1969-2007
The College Board (Educational Testing Service)
7. Supplement for **Students ONLY**:
Preparing For the (AB) Calculus Examination: Best and Lux
Venture Publishing

Throughout this course students will encounter the above topics in an “*explore and discover*” scenario wherever possible in conjunction with the time constraints of this course. The above mentioned texts have a wealth of *exploration* exercises that enable the student to work independently and collaboratively in groups to *experience* the concepts of calculus in an informal as well as formal manner. The student will do this verbally and in writing, employing the usage of the graphical calculator as a tool where necessary.

Some examples are:

Composing functions (Finney: pg.16). Students will make up functions as independent variables of other functions and use the graphical calculator to compose them. EX:
 $y_1 = x^3 - 1$, $y_2 = \sqrt[3]{x}$, $y_3 = y_2(y_1(x))$, $y_4 = y_1(y_2(x))$ make conjectures of their domain and range.

Which functions represent $f \circ g$, $g \circ f$?

Discovering the limit of a function graphically using a table of values (Larson: pg.47)

Explaining if points of discontinuity are removeable (Finney pg 81 / ex 45)

Students will identify a Tangent line of a function using a graphical calculator.

Ex: Which line best represents a tangent line to $f(x) = x^3 - 1$ at $x = 1$: $y = x - 3$, $y = 2x - 3$, $y = 3x - 3$?

Applications of the Derivative:

Rectilinear Motion: (Anton: pgs:336-345)

Concepts of “speeding up” and “slowing Down”

Using a graphical calculator to see a particle change direction

Motion along a Line (Finney: Pg 127 Explorations #2,3 :Modeling Horizontal Motion, Seeing Motion On a Graphing Calculator)

Rectangular Approximation Method

(Finney: pg. 257/ex.2: Prove or disprove:

$MRAM_n$ is always the average of $LRAM_n$ and $RRAM_n$

Showing Graphically: Area under a curve

These are just some examples where students will be asked to experiment with some of the ideas and concepts using the graphical calculator and express their results numerically, verbally and in writing.

Throughout this course students will be given topic related AP Questions.

Students will justify their answers and conclusions in writing complete mathematical sentences or ideas where appropriate.

For example the explanation of i) sign charts and derivative tests in finding a:

max or

min.

ii) concavity to determine if Riemann sums or linearizations are over or under in estimating .

iii) Using the IVT and MVT to prove or disprove the existence of values of functions and their derivatives in defined intervals.

The graphing calculator will be used to emphasize: nderiv, nint, zoom, intersection of 2 curves, and finding the zero of a function.

Some examples of these calculator functions are illustrated by the free response questions on the following AP exams:

AB 2005:ex 1, 2 , AB 2004: ex 3, and AB 2002 Form B: ex 3.

There will be an exam every 2 weeks.

The review sessions will consists of students practicing released AP exams in class and *simulated exams* such as the ones provided by Lederman and Best **see supplementation**.

Weekend practice sessions will be provided.

Students are encouraged to visit the AP Central website and other pertinent sites.