AP® Calculus AB

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Mathematics is not about numbers, equations, computations, or algorithms.
It is about Understanding.

Course Overview

The objective in teaching AP® Calculus AB is to provide students with an opportunity to explore higher levels of mathematics. Through this exploration and interaction with mathematics I hope to enable students to appreciate the higher intricacies of problems, and develop a solid foundation in the Calculus AB topic outline as it appears in the *AP® Calculus Course Description*, which they can take with them into their higher level math classes. I expect a lot of my students, whether that is in class in discussion and group work time, or at home writing up assignments and AP sample problems. AP Calculus AB is approximately equivalent to a one-semester Calculus course at the university level.

Teaching Strategies

During the course, I strive to present topics in many different ways. Emphasis is placed on investigating ideas graphically, numerically and verbally. Students are expected to relate these various representations to each other and be able to switch among methods dependent upon the problem.

I use various methods in class to give students an idea of the big picture of a topic or problem.

- TI programs (showing a graphing calculator screen through the LCD projector)
- Desmos is used often to answer graphical problems in a more intuitive way than is possible on a graphing calculator.
- Wolfram Demonstrations is used to show animations of various Calculus topics.
- Youtube.com (and other video sites) to again show visual demonstrations of various topics.

During the course, students have the opportunity to answer questions using only graphs or numerical data to determine their answers. It is critical that the students realize that a graph or a table is not sufficient to prove an answer but that a analytical justification must also be provided. Verbal and written communication of ideas is also a major goal of the course. Students are expected to be able to use proper vocabulary and terms for both questions and answers and to be able to justify their conclusions in writing.

Various sources are used for higher level analysis problems including the Problem Solving questions provided for each chapter of our text and AP released test questions. Once a concept has been taught, students may work in groups to determine problem solutions and correct and complete justification. As the instructor, I find group work on a challenging problem to be an excellent way for students to increase their knowledge and their ability to communicate what they know successfully to other students and the class.

Textbooks

Larson, Roland E., Hostetler, Robert P., and Edwards, Bruce H. *Calculus with Analytic Geometry*. 4th edition. Lexington, Mass: DC Heath and Company. 1990.

Supplemental Resources:

Wolfram Demonstrations Project; *demonstrations.wolfram.com*
Desmos Graphing Calculator; *www.desmos.com/calculator*
Youtube Calculus and other Video Demonstrations; *www.youtube.com*
Garner Chuck. *The AP Calculus Problem Book.* 4th edition. Self-published PDF
The College Board, Various AP Calculus Resources such as released test questions.

Example Problem Solving Activities

Activity 1: Find the following limits both algebraically and numerically.

- $\lim_{x\to 0} \frac{x^2+4}{x-2}$, $\lim_{x\to 2} \frac{x^2+4}{x-2}$, and $\lim_{x\to 0} \frac{\ln(x+5)-\ln(5)}{x}$

Activity 2: The speed of a car in mph and its stopping distance are recorded.

Speed (mph)	20	30	40	50	60
Distance (ft)	25	55	105	188	300

- Use the graph of the points to determine a model this data.
- Use the regression capabilities of a graphing calculator to find a quadratic model.
- Use the graphing utility to graph the derivative.

Questions to Answer:

What would your estimate of the stopping distance be at 45 mph? 65 mph?

Using the graph of the model and the graph of the derivative analyze and justify the change in the stopping distance as the speed of the car increases.

Activity 3: Graph the function $y = \sin(x)$. Use the graphing calculator to determine the slope of the tangent line at various points and determine where the tangent line has a slope of 0. Zooming in on various points of thee sine function will demonstrate local linearity and graphing the slope points on a separate graph will allow students to be able to use this graphical analysis to determine that $y' = \cos(x)$.

Course Outline:

All timelines are approximate and may be changed based on student comprehension.

1st Semester	2nd Semester
Unit 1 – Preparation for the Course (Pre-Calculus Review) 1.1 Real Numbers and the Real Line 1.2 The Cartesian Plane 1.3 Graphs of Equations 1.4 Lines in the Plane 1.5 Functions 1.6 Review of Trigonometric Functions **Unit 2 – Limits and Their Properties** 2.1 Introduction to Limits 2.2 Properties of Limits 2.3 Evaluating Limits 2.4 Continuity and One-Sided Limits 2.5 Infinite Limits **Unit 3 – Differentiation** 3.1 The Derivative and the Tangent Line Problem 3.2 Velocity, Acceleration and Other Rates of Change 3.3 Basic Differentiation: Sums and Powers 3.4 More Differentiation: Products and Quotients 3.5 The Chain Rule 3.6 Implicit Differentiation 3.7 Related Rates **Unit 4 – Graphical Analysis** 4.1 Extrema on an Interval 4.2 Rolle's Theorem and the Mean Value Theorem 4.3 Increasing/Decreasing Functions, The First Derivative Test 4.4 Concavity and the Second Derivative Test 4.5 Limits at Infinity 4.7 Optimization Problems	**Unit 5 – Integration** 5.1 Antiderivatives and Indefinite Integrals 5.2 Area 5.3 Riemann Sums and Definite Integrals 5.4 The Fundamental Theorem of Calculus 5.5 Integration by Substitution 5.6 Trapezoidal Rule 5.7 The Natural Log Function: Integration 5.8 Inverse Trigonometric Functions: Integration **Unit 6 – Differential Equations** 6.1 Slope Fields 6.2 Differential Equations: Growth and Decay 6.3 Differential Equations: Separation of Variables **Unit 7 – Application of Integration** 7.1 Area of a Region Between Two Curves 7.2 Volume: The Disk Method 7.3 Volume: The Shell Method 8.1 Basic Integration Rules 8.2 Integration by Parts **Unit 8 – AP Exam Review** Students are the major drivers in review. We spend time on each major topic with sample questions given to students for practice. AP released test questions are used heavily with Free Response questions being scored according to the AP rubric. Group and class dialog is encouraged to help students reinforce the knowledge that they have gained throughout the course. Written answers are required with students analyzing the responses. **Unit 9 – Post AP Exam** 7.4 Arc Length and Surfaces of Revolution 7.5 Work 8.3 Trigonometric Integrals

	8.4 Trigonometric Substitution

Final Course Project:

Students choose from a variety of options to demonstration the knowledge they have gained from the course. Possible options: Build a model for a Solid of Revolution; Present an in-depth problem and solution using Calculus; Present a History of Calculus Topic.

Required Materials

WiFi	– Class information, schedules, etc. will be on Google Classroom, WiFi access will be extremely helpful.
Graph Paper	– All work MUST be done on graph paper for this course. Work will be handed in to be graded. 8 ½ x 11 paper is preferred.
3-Ring Binder	– There WILL be handouts and other materials. You will need a 3-ring binder to keep your materials organized. Ideally, there should be 3 areas. Homework, Reference Notes, and Corrected Assignments.
Colored Pens/Pencils	– Have 4-5 colored pens/pencils.
Pencils	– You will need pencils. Erasers are also a very good idea.
Ruler	– Get something you can easily access in class.

Graphing Calculator! A **TI-84** (or higher) is **REQUIRED** to be successful in AP Calculus.

AP Curriculum

This course follows the AP Course curriculum guide, which may be found at: https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-calculus-ab-and-bc-course-and-exam-description.pdf. Major Topics are found in the Concept Outline portion of the document. The three main Calculus topics that we will be covering in this course are:

- **Limits** – the idea of limits is essential for discovering and developing important ideas, definitions, formulas, and theorems in calculus. Students must have a solid, intuitive understanding of limits and be able to compute various limits, including one-sided limits, limits at infinity, the limit of a sequence, and infinite limits. They should be able to work with tables and graphs in order to estimate the limit of a function at a point. Students should know the algebraic properties of limits and techniques for finding limits of indeterminate forms, and they should be able to apply limits to understand the behavior of a function near a point. Students must also understand how limits are used to determine continuity, a fundamental property of functions.

- **Derivatives** – Using derivatives to describe the rate of change of one variable with respect to another variable allows students to understand change in a variety of contexts. In AP Calculus, students build the derivative using the concept of limits and use the derivative primarily to compute the instantaneous rate of change of a function. Applications of the derivative include finding the slope of a tangent line to a graph at a point, analyzing the graph of a function (for example, determining whether a function is increasing or decreasing and finding concavity and extreme values), and solving problems involving rectilinear motion. Students should be able to use different definitions of the derivative, estimate derivatives from tables and graphs, and apply various derivative rules and properties. In addition, students should be able to use different definitions of the derivative, estimate derivatives from tables and graphs, and apply various derivative rules and properties. In addition, students should by able to solve separable differential equations, understand and be able to apply the Mean Value Theorem, and be familiar with a variety of real-world applications, including related rates, optimization, and growth and decay models.

- **Integration** – Integrals are used in a wide variety of practical and theoretical applications. AP Calculus students should understand the definition of a definite integral involving a Riemann sum, be able to approximate a definite integral using different methods, and be able to compute definite integrals using geometry. Students should be familiar with basic techniques of integration and properties of integrals. The interpretation of a definite integral is an important skill, and students should be familiar with area, volume, and motion applications, as well as with the use of the definite integral as an accumulation function. It is critical that students grasp the relationship between integration and differentiation as expressed in the Fundamental Theorem of Calculus – a central idea in AP Calculus. Students should be able to work with and analyze functions defined by an integral.

Grading Percentages

A	93 - 100%	B+	87 – 89%	C+	77 – 79%	D+	67 – 69%	F	< 60%
A-	90 - 92%	B	83 – 86%	C	73 – 76%	D	63 – 66%		
		B-	80 – 82%	C-	70 – 72%	D-	60 – 62%		

Grading Categories

Mastery	
- Assessment (Individual, Group)	75%
- Projects, Presentations, etc.	15%
Total Mastery	90%

Homework/Classwork 10%

Homework Policy

Homework may be assigned Monday through Friday. Homework is **NOT** optional as it is a key component in reinforcing the mathematical concepts that the student is learning. Students are expected to complete their homework in a timely manner.

Student Expectations

- **Student Handbook:** All policies in the student handbook will be in effect.
- **Attendance:** Students are expected to be present and on-time for every class. Attendance is a critical component to success in this course. If you must be absent **YOU** are responsible to obtain the information you missed.
- **Participation:** Class participation is another key component. **Be Present** in the classroom. Paying attention to lectures or presentations, taking notes, asking questions, working with your groups, etc.
- **Electronic Devices:** Earphones are NEVER allowed in the classroom. Students may only use electronic devices when authorized by Ms. Harris.

Mathematical Practices for AP Calculus (MPACs)

1) Reasoning with definitions and theorems.
2) Connecting concepts.
3) Implementing algebraic/computational processes.
4) Connecting multiple representations.
5) Building notational fluency.
6) Communicating.

REALLY IMPORTANT! I am here teaching because I WANT you to succeed. Calculus is a VERY high-level math class. It is VERY common to need extra help during the year. If you are having trouble or feeling overwhelmed by this class, come and see me. In many cases, some one on one discussion can really assist you in getting past your area of difficulty.

DON'T wait until the last minute to discuss your concerns or get help.

Please detach and return this page to Ms. Harris.

For Students
I have read and understand the expectations for this class.

Student Name: _____ Period: _____
(Printed)

Student Signature: _____

For Parents/Guardians
I understand the expectations of my student. I have read the syllabus for this course.

Parent/Guardian Name: _____
(Printed)

Parent/Guardian Signature: _____

I use the phone and email information that is collected by OSA to contact parents/guardians. If you wish to add to that information, you may do so, but this is optional.

Alternative Phone: _____

Alternative Email: _____

Comments (anything you would like me to know or be aware of)