

AP Calculus AB

Course Overview and Syllabus

Revised 8/2023

This course is aligned to the topics covered in the Calculus AB course description. This includes the topics of functions, graphs, and their limits; derivatives and their applications; integrals and their applications.

Textbook

Sullivan, Michael., Kathleen Miranda, *Calculus: For the AP Course*. Bedford, Freeman & Worth High School Publishers 2018

Recommended supplementary texts

Polya, George. *How to Solve it: A New Aspect of Mathematical Method*. Princeton University Press 2004.

Ryan, Mark. *Calculus for Dummies*. Wiley Publishing 2003.

AP Calculus AB Course Planner

Timelines are approximate and may change from year to year. Topics generally correspond to text chapters and the course outline set by College Board.

Prerequisites for Calculus (embedded throughout semester 1)

- Use of a graphing calculator including intersection points and roots of functions
- Lines
- Trigonometry including trigonometric identities and the unit circle
- Rational, exponential, logarithmic, and trigonometric functions
- Graphing and function analysis

Limits and Their Properties (Four Weeks)

- Continuity
- One sided limits
- Formal definition of a limit
- Numeric Limits
- Finding limits algebraically and graphically
- Properties of limits
- Using limits to find asymptotes
- Techniques for evaluating limits
- Infinite involving infinity
- Intermediate value theorem

Differentiation (Six Weeks)

- The tangent line problem
- Local linearity
- Definition of the derivative/difference quotient/notation
- Basic differentiation rules
- Derivative as a rate of change or slope of a tangent line
- Product and quotient rules
- Chain Rule
- Derivatives of trigonometric functions
- Higher order derivatives and notation
- Implicit differentiation
- Derivatives of inverse trigonometric functions
- Derivatives of exponential and logarithmic functions
- Derivatives of inverses of functions indirectly

Applications of Differentiation (Four Weeks)

- Absolute and relative extrema
- Rolle's Theorem and Mean Value Theorem
- The first derivative test/ Increasing and decreasing functions
- The second derivative test/ Concavity and inflection
- Relationship between functions f' , f'' and their graphs
- Function analysis and sketching
- Related rates
- Position, speed, and acceleration with derivatives
- Optimization Problems
- Business and economics applications
- Linearization
- Differentials
- L'Hopital's Rule

The Definite Integral and Numerical Integration (Five Weeks)

- Estimating with finite sums
- Antiderivatives and basic integration rules
- Sigma notation; area; upper, lower, and midpoint sums
- Riemann Sums
- Trapezoid Rule
- First and second Fundamental Theorems of Calculus
- Average value of a function
- Graphical analysis of antiderivatives

Differential Equations and Mathematical Modeling (Four Weeks)

- Slope Fields
- Integration by parts (optional)
- Product rule for integration
- Integrals involving powers of trigonometric functions
- Trigonometric Substitution (optional)
- Inverse trigonometric and logarithmic functions
- Integration by tables
- Evaluation of improper integrals (optional)
- Growth and decay
- Periodic and continuously compound interest

Applications of the Definite Integral (Three Weeks)

- Integral as an accumulation of net change
- Areas in the plane
- Volume using disk, washer, and shell (optional) methods
- Finding volume using known cross sections

AP Test Review (3-4 Weeks)

Teaching Strategies

Instruction is mainly lecture based in a direct instruction format. Students are also given the opportunity to explore problems in small groups or to complete discovery activities. The discovery activities lead into the day's topic of discussion or into further areas of exploration. Precise vocabulary is stressed and practiced daily through lecture and during discussion. Method and the ability to explain and rationalize methods of solution is emphasized throughout the class. Concepts and problems are presented and analyzed from multiple representations: graphical, numerical, and algebraic, and verbal.

Analytical Methods

Throughout the book and the course, students are given opportunities to solve problems analytically. They learn strategies and organization necessary to solve complex application problems, whether the problems are presented from an analytical, verbal, or graphical viewpoint.

Graphical Methods

Graphical methods, especially involving the use of a graphing calculator are used throughout the course. Graphical methods are used to connect concepts of functions and their derivatives as well as definite integrals and their areas. Students also develop conceptual understanding of concepts and relationships through graphical explorations. Students link graphical methods to analytical and numerical methods. A graphical interpretation is presented to reinforce concepts, such as limiting a secant line to show a tangent and derivative. Graphical methods are also used to link the unfamiliar parametric and polar systems to the more familiar rectangular.

Numerical Methods

Numerical and tabular methods are used for approximations and to introduce topics. These are used so that students begin to create their own connection before a concept is formally presented. Examples are topics such as the introduction to limits or rectangle sums to approximate area, or Newton's method. Euler's method is another example of a numerical method used. With numerical methods, care is taken analyze the error of numerically derived solutions compared to an analytic method.

Verbal Methods

Verbal skills are formatively assessed and taught throughout the course. This occurs both orally and through written methods. Students are encouraged to explain concepts and processes verbally. Students must be able to enumerate the multiple representations of a problem or concepts as well as the advantages and disadvantages of each method. Students learn to justify their work on both independent work and assessments.

AP Review

Released test questions are used to create assessments. Students given timed response questions periodically throughout the year. Students must write the explanation of how they solved the problem as well as verbalize the method and solution in small groups and in front of the entire class.

Students are graded based upon the rubric for the AP test. Students also grade peer work in order to become familiar with grading standards and expectations and the justifications needed to clearly explain the methods.

Released Free Response packets are also given as a review. Students work independently in and out of class, and then they collaborate in class, discussing their approaches. This gives immediate feedback and allows students to properly complete or append their responses even if the original solution was incorrect.

In the weeks leading up to the AP test, released test questions are used directly in order to familiarize the students with the test format and structure of questions. Students practice by taking a full length practice test outside of class time in order to prepare their expectations for the actual AP exam. Through these strategies, students become familiarized with the test format, time constraints, and scoring rubrics.

Graphing Calculators

Students are required to have a graphing calculator, preferably the TI-84+CE or similarly equipped model. The classroom is equipped with calculators that students may borrow for the period only. The Ayala library has a limited number of graphing calculators that students may check out for the year.

Assessment follows the guidelines of the Calculus AB in terms of calculator use. During exams that allow calculator use, care is taken to allow students to use the four capabilities allowed to be referenced from the AP Calculus course description: “plot the graph of a function within an arbitrary viewing window, find the zeros of functions (solve equations numerically), numerically calculate the derivative of a function, and numerically calculate the value of a definite integral.” Other functions may be used but will not give the student an advantage. Students need to be competent without the calculator as well, so it only when directed when working at home.

Graphing calculators are not simple tools. Often functionalities are hidden in menus or are multiple button presses away. For this reason as well as the capabilities listed above, only graphing calculators will be used in class (no scientific calculators).

Students are routinely encouraged to use the calculator as an exploratory tool. Often graphical methods are used to help confirm analytical solutions, but they must be able to mathematically explain justification too. Care is taken to note that graphical solutions are typically not exact and often not precise enough.

Students may find techniques and concepts through experimentation that will lead them to an analytic solution that may not have occurred to them otherwise. Students also use them to visualize problems including the graphs and relationships among functions and their derivatives or their integrals. They also find numerical derivatives and integrals. Students use the calculator to find the reasonableness of a result, such as finding a root graphically to compare to a numerical solution. They are encouraged to express verbally why or in what manner a graphical solution is related to an analytical one.

Online graphing tools are used to quickly calculate and display slope fields to give a second interpretation of a family of anti-derivatives. Students also explore the relationships amongst functions and their higher order derivatives to gain insight into the relationships between them; this is especially useful when covering position, velocity, and acceleration functions.

Grading Scales

Course grades are based upon assessments, class work, homework, and projects. According to district policy, 75% of the grade is based on assessments and 25% is based on the classwork and homework. Grades will be updated periodically on Aeries.

A+	Greater than or equal to 99 %
A	Greater than or equal to 93 % and less than 99%
A-	Greater than or equal to 90 % and less than 93%
B+	Greater than or equal to 87 % and less than 90%
B	Greater than or equal to 83 % and less than 87%
B-	Greater than or equal to 80 % and less than 83%
C+	Greater than or equal to 77 % and less than 80%
C	Greater than or equal to 73 % and less than 77%
C-	Greater than or equal to 70 % and less than 73%
D+	Greater than or equal to 67 % and less than 70 %
D	Greater than or equal to 63 % and less than 67%
D-	Greater than or equal to 60 % and less than 63%
F	Less than 60 %

Homework is for practicing skills and exploring knowledge. This may be different than you are used to since a lot of lower level math homework is regurgitation of an algorithm from class. Be prepared to not get everything correct the first time. Homework is scored on effort, not necessarily completion and accuracy. See the supplement on homework scoring.

Grade Discussions

If I have made an error, please let me know during class so that I can fix it. Everything is online so finding my errors is usually pretty straight forward. Your grade is supposed to represent what you know. If you want a higher grade, we need to figure out how to get you to know more or be better at showing it. This is complicated and will also need to be talked about in person. Your grade generally corresponds to the score you should expect on the AP test: an A is a 5, a B is a 4, etc. Please do not email about grades or scores, come talk to me in class.

Extra Credit

This class contains many opportunities for extra credit. The goal is to give students that want more practice a valid reason to do so. The rules for extra credit can be found in Teams and on my Ayala website. Extra credit is not guaranteed to be offered.

Late Work

All work that is assigned needs to be completed. I understand that sometimes other things get in the way or your priorities lie elsewhere. That is fine, I accept late work. Late work turned in before the Friday before end of semester finals the work is eligible for 50% of the original points. Work that is turned in after the due date because of excused absence is eligible for full credit. Please write 'Absent' at the top of the page as an indication for me to check.

Assessment

Assessment is both formative and summative. Students are given the opportunity to check independent work and solutions among small peer groups. This allows students to reflect upon their own learning and develop new strategies for learning that are less teacher directed. Following small grouping, students may be asked to verbally (orally or in writing) explain their methods or why a particular solution was incorrect. Assessments will be written and scored in the style of the AP test. Students will not be likely to finish all parts or all problems, but do not need to necessarily do so to score well. Students will learn to show what they know and not worry that they must know everything to earn a high score.

Tests and quizzes are used to evaluate progress and to direct future instruction based on the strengths and needs of the students. Quizzes are unscheduled and unannounced; they are based upon recent topics and are used to assess effectiveness of instruction through student progress. Quizzes are used to assess instruction and learning and to assess the need for review and re-teaching of previously learned concepts.

Formal unit tests follow each unit of study (i.e. applications of derivatives). Exams portions that do not allow calculator use foster the need for pen and paper skill. This also allows students to see their progress and level of knowledge independent of any technological aids. Embedded in assessments and review activities are the verbal explanation of methods and rationale by students.

Daily informal assessment is given in both warm up problems and exit tickets. Neither of these informal assessments are scored for gradebook use, but are self scored by the students and given feedback by the teacher. Included are prior knowledge questions, factual memorization problems on new items, as well as justifications that are necessary for success in AP Calculus AB. Warm up problems also allow for practice in reading and interpreting the meaning, and planning how to do problems since students often struggle to do this.

Behavior

Work habits grades are based upon classroom behavior. Students are expected to attend each day, complete all work, actively participate in class, and act in accordance with school rules. Excessive absences, tardies, failure to follow school and class rules (no gum, mobile phones, eating, hats indoors, etc), or incomplete/missing assignments will result in a grade of Needs Improvement (N) or Unsatisfactory (U). A variety of corrective measures will be used to maintain a successful learning environment. Inappropriate behavior will trigger the standard MTSS-B procedures adopted by Ayala.

Attendance

Students not in class before the tardy bell rings will be marked absent. If a student enters late, he or she must present the readmit slip at an appropriate time so that I can change the attendance. I will try to remember, but the onus is on the student to make sure that I change the attendance. Clearing up inaccurate attendance/tardy is a hassle with the office and I will do my best to make you (not me) deal with it. When a student is out of class, but on campus (Leadership, Band, nurse, etc.) it is again the responsibility of the student to make sure that the attendance is accurate: stop by at lunch, send over a note, have the responsible teacher send an email, etc. A student that is tardy for, leaves early from, or is in the restroom during a timed assessment will not be given additional time.

Academic Dishonesty

Any form of academic dishonesty will result in a zero for the assignment, lowered citizenship score, and report to administration and parents/guardians. Sharing of information of test/quiz topics also is considered academic dishonesty in addition to the obvious receiving of such information. See Ayala student handbook for more information on academic dishonesty.