

PRECALCULUS A/P 2023-2024

Document: PreCalculusSyllabusDocument.odt

Welcome to ----- AP PreCalculus!¹ Our advanced PreCalculus course will be an exciting course for our students. The study of mathematics is literally the study of the language that God implicitly applied to the universe, that explains much of its actions even now, right down to the sub-atomic level.

While much of this material is developing the "sophistication" of the high school mathematics student, it is so important for their easy grasp of limits and calculus in the following year. Success at this course will make calculus fun!

College Level Investigation

Students should be prepared to provide the required level of attention to the course material, concepts, and problems. This is not to say that students cannot pursue a well-rounded set of life activities, but they are cautioned to remember that we are under the authority of the College Board to move ahead and provide material at the required pace and depth.

College Board AP Test

In order to receive the AP designation on their transcript, students are **REQUIRED** to take the AP Test at the end of the year. If that test is not taken, their transcript entry will not be marked with the AP designation.

The 2024 AP Precalculus test will be administered on Monday May 13, 2024 at 12 PM local time. It is the responsibility of the AP Students to personally register for this test.

In order to obtain the widely-respected "AP" designation, students and parents should be aware that we meet the following required Curricular Requirements -- and indeed, if we don't, there are actions you can take to report our failure. As such, this Syllabus will provide documentation for each requirement.

¹ This document will suffice for both the A/P and Honors classes/students. The major difference between the two classifications has to do with the rigor of the testing. Honors students will take tests that are more suited for "high school."

Calculator

A graphing calculator is now allowed and RECOMMENDED by the College Board for AP Precalculus in some sections, beginning with 2024. A graphing calculator is required for portions of the AP Precalculus test and also for the AP Calculus test. **For our school, the Texas Instruments TI-84 Plus CE Color Graphing Calculator is required.** (See: <https://www.amazon.com/gp/product/B00TFYYWQA> for example) If a student's family is unable to acquire this calculator, one will be made available for loan to the student.

Curricular Requirements (College Board)

The College Board has very explicit course requirements for our course to be labeled as "AP" on transcripts. We take great care to be certain to meet all of these requirements. For the benefit of students & parents involved in this course, the following information demonstrates the requirements and how we are meeting them:

No.	Requirement	Applicable portions of Syllabus
1	The school ensures that each student has a Precalculus textbook (in print or electronic format) for individual use inside and outside the classroom. The textbook is supplemented when necessary to meet the curricular requirements.	Larson & Hostetler, PreCalculus
2	The school ensures that the teacher has a copy of a Precalculus textbook or other appropriate materials to support instruction.	The teacher has not only the textbook, but additional texts as well, and has previously successfully taught AP Calculus.
3	The school ensures each student has a graphing calculator for individual use inside and outside of the classroom, with all required capabilities listed in the course and exam description.	Each student is required to have a TI-84 Plus graphic calculator and one will be provided each student on loan for the year if required.
4	The course is structured to incorporate the required content outlined in units 1, 2, and 3 in the AP Precalculus Course and Exam Description.	See Course Content -- our course includes all required content outlined in Units 1, 2, and 3 of the AP Precalculus Course and Exam Description.

5	<p>The course provides opportunities for students to develop the skills outlined in the course and exam description related to:</p> <p>Mathematical Practice 1: Procedural and Symbolic Fluency</p> <ul style="list-style-type: none"> Algebraically manipulate functions, equations, and expressions. 	<p>Throughout the course, our students will be constantly manipulating functions, equations and expressions in class, on the board, and in homework, developing and demonstrating procedural and symbolic fluency in mathematics.</p> <p>Examples:</p> <p>Section 1.9 has students finding the inverse function of a function, algebraically.</p> <p>Section 2.3 has students doing long division of polynomial expressions.</p> <p>Section 2.4 has students multiplying complex numbers, including by complex conjugates.</p>
6	<p>The course provides opportunities for students to develop the skills outlined in the course and exam description related to:</p> <p>Mathematical Practice 2: Multiple Representations</p> <ul style="list-style-type: none"> Translate mathematical information between representations. 	<p>Throughout the course, our students will confront mathematical information in a variety of presentations, such as equations, tabular, graphical or wording and translate the material between representations.</p> <p>Section 3.5 Exercises 1-6 present data in graphical format and require recognition of the matching algebraic equation.</p> <p>Section 3.5 Exercise 36 has student take tabular data and represent it as exponential decay equations.</p> <p>Section 3.5 Exercise 44 has students take verbal data and represent it as a linear model, then an exponential model, and then review graphical representations of all presentations.</p>

7	<p>The course provides opportunities for students to develop the skills outlined in the course and exam description related to:</p> <p>Mathematical Practice 3: Communication and Reasoning</p> <ul style="list-style-type: none"> Communicate with precise language, and provide rationales for conclusions. 	<p>Throughout the course, students will present in class and on the board, communicating with precise language and improving in those capabilities, and providing rationales for their process and conclusions.</p> <p>In section 4.3, Problem #63 has the student standing 45 meters from the base of the Empire State Building, and estimating the angle of elevation to the top of the 86th floor at 82 degrees. With the total height of the building presumed to be another 123 meters above the 86th floor, the student will be asked to provide a method of attack, and solution to find the approximate height of the building using precise mathematical language, rationales for their choice of technique and for their conclusion.</p>
8	<p>Students have access to graphing calculators and opportunities to use them to solve problems and to explore and interpret Precalculus concepts.</p>	<p>From the beginning, our students will be using graphing calculators to gain addition insight into mathematics and to solve problems too difficult for pen and paper</p>
9	<p>The course provides opportunities for students to practice building function models in settings where students must choose, construct, and defend the selection of a function model.</p>	<p>At multiple points in the course students will practice building function models in settings where they must choose, construct and defend the selection of a function model.</p> <p>For example: Section 1.10, Problem 371 presents ocean temperatures at multiple depths, a tabular data. Students then make a scatter plot of the data, and test a potential model for the data, comparing the results of the model and defending or attacking the accuracy of the resulting model</p> <p>Section 3.5 Exercise 44 has students take verbal data and represent it as a linear model, then an exponential model, and then review graphical representations of all presentations.</p> <p>Section 4.8 Problems 51-54 have students create a</p>

SYLLABUS

		model for waves of given boundary value displacement, amplitude and period. Students will then be asked to choose, construct and the defend their selection of a model for the data.
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COURSE MATERIALS

We will be using multiple textbooks. These include:

PRIMARY TEXTBOOK

Larson & Hostetler. Precalculus with limits.

ADDITIONAL MATERIALS

Barron's AP Precalculus Premium 2024. <https://www.amazon.com/AP-Precalculus-Premium-2024-Comprehensive/dp/1506288634>

All students are required to obtain a copy of this text.

COURSE OUTLINE

The ----- AP Precalculus course rounds out the high school mathematics education of the student and prepares them well for Calculus -- which actually seems easier than PreCalculus. Our class times are:

Tuesday	50-minute regular class period
Wednesday	50-minute regular class period
Thursday	50-minute regular class period
Friday	50-minute regular class period

Additional instructional time by appointment as needed. Because of our very small class size, we can be more flexible...

STUDENT PRACTICE

Throughout each unit, students will get a list of important TOPICS and key understanding that must be achieved. There will be presented via the weekly/biweekly "packets" of course scheduling and assignments.. They will also be posted in lesson plans using the school's online FACTS system. Students are responsible for being up to date with all assignments. *In our course, students will normally have homework questions to answer after every lecture and experience.*² These questions will begin at, or reach the A/P level, so that early in the course, every test question is based, in one way or another, on published A/P Exams--setting the *rigor* of the course is easy-- all work must be at college level! This process is made somewhat more difficult by the paucity of existing material regarding the AP Precalculus course, but we will give it our best.

It is our policy that all student work is graded absolutely as soon as possible, and *almost always* returned the very next class period so that the students get **immediate and pointed feedback of their progress**. It is our policy that student work, as much as possible, is carefully reviewed LINE BY LINE so that very detailed corrections can be made to A/P students' work. While many of the problems of an AP Test involve immediate application of principle and experience from addressing problems in a multiple-choice answer, in general this is not a multiple choice class--this is a "work problems and show mathematical understanding" class.

At the end of each Unit or at key points, students will have some form of a Personal Progress Check which may be a homework assignment, or an examination, to allow them to measure and evaluate their performance. These are graded as soon as possible and generally returned the very next period, during which there is extensive review of all the problems. It has only occasionally been a significant issue

2 In a large percentage of the homework problems, selection of a valid mathematical routine to solve the problem will be a key portion of the problem. (SP2.1) The mathematical routine must be applied properly (SP2.2) and in many problems there may be a degree of estimation of reasonable quantities (SP2.3). These will provide many opportunities to satisfy Course Requirement 5 (CR4)

that this caliber of students enrolled in this A/P class would fall behind, but in that event, individualized tutoring can be provided to bring that student back up to speed. These cases have generally been related not to the caliber of the student, but instead to extracurricular activities that are secondary to the mission of a School. Each student and family must carefully consider their priorities.³

3 In Luke 14:28-32 Jesus is recorded as expecting his subjects to plan wisely and make priority decisions: "For which one of you, when he wants to build a tower, does not first sit down and calculate the cost, to *see* if he has *enough* to complete *it*? Otherwise, when he has laid a foundation and is not able to finish, all who are watching *it* will begin to ridicule him, saying, 'This person began to build, and was not able to finish!' Or what king, when he sets out to meet another king in battle, will not first sit down and consider whether he is strong *enough* with ten thousand *men* to face the one coming against him with twenty thousand? Otherwise, while the other is still far away, he sends a delegation and requests terms of peace.

COURSE CONTENT

The format of the Course follows the Larson & Hostetler Precalculus text, but includes all the required content described in the AP Course and Exam Description. The following Course materials/topics flow demonstrates how the material of each AP Unit is covered.

Major Topic	Addresses	Big Ideas
Functions and Their Graphs 1.1 Rectangular Coordinates 1.2 Graphs of Equations 1.3 Linear Equations in Two Variables 1.4 Functions 1.5 Analyzing Graphs of Functions 1.6 A library of Parent Functions 1.7 Transformations of Functions 1.8 Combinations of functions: Composite Functions 1.9 Inverse Functions 1.10 Mathematical Modeling and Variation	Preparatory work for Required Unit 1: Polynomial and Rational Functions	
Polynomial and Rational Functions 2.1 Quadratic functions and models 2.2 Polynomial functions of higher degree 2.3 Polynomial and synthetic division 2.4 Complex numbers 2.5 Zeros of polynomial functions 2.6 Rational functions 2.7 Nonlinear inequalities	Required Unit 1: Polynomial and Rational Functions	
Exponential and Logarithmic Functions 3.1 Exponential functions and their graphs 3.2 Logarithmic functions and their graphs 3.3 Properties of Logarithms 3.4 Exponential and logarithmic equations 3.5 Exponential and logarithmic models	Required Unit 2: Exponential and Logarithmic Functions	

<p>Trigonometry</p> <p>4.1 Radian and degree measure</p> <p>4.2 Trigonometric functions: the unit circle</p> <p>4.3 Right triangle trigonometry</p> <p>4.4 Trigonometric functions of any angle</p> <p>4.5 Graphs of sine and cosine functions</p> <p>4.6 Graphs of other trigonometric functions</p> <p>4.7. Inverse trigonometric functions</p> <p>4.8. Applications and models</p>	<p>Required Unit 3: Trigonometric and Polar Functions</p>	
<p>Analytic Trigonometry</p> <p>5.1 Using fundamental identities</p> <p>5.2 Verifying trigonometric identities</p> <p>5.3 Solving trigonometric equations</p> <p>5.4 Sum and difference formulas</p> <p>5.5 Multiple-angle and product-to-sum formulas</p>	<p>Required Unit 3: Trigonometric and Polar Functions</p>	
<p>Additional Topics in Trigonometry</p> <p>6.1 Law of sines</p> <p>6.2 Law of cosines</p> <p>6.3 Vectors in the plane</p> <p>6.4 Vectors and dot products</p> <p>6.5 Trigonometric form of a complex number</p>	<p>Required Unit 3: Trigonometric and Polar Functions</p>	
<p>Systems of Equations and Inequalities</p> <p>7.1 Linear and nonlinear systems of equations</p> <p>7.2 Two-variable linear systems</p> <p>7.3 Multivariable linear systems</p> <p>7.4 Partial fractions</p> <p>7.5 Systems of inequalities</p> <p>7.6 Linear Programming</p>	<p>Required Unit 1: Polynomial and Rational Functions</p>	
<p>Matrices and Determinants</p> <p>8.1 Matrices and systems of equations</p> <p>8.2 Operations with matrices</p> <p>8.3 The inverse of a square matrix</p> <p>8.4 The determinant of a square matrix</p> <p>8.5 Applications of matrices and determinants</p>		

Sequences, Series, and Probability 9.1 Sequences and series 9.2 Arithmetic sequences and partial sums 9.3 Geometric Sequences and Series 9.4 Mathematical induction 9.5 The binomial theorem 9.6 Counting principles 9.7 Probability		
Topics in Analytic Geometry 10.1 Lines 10.2 Introduction to Conics: Parabolas 10.3 Ellipses 10.4 Hyperbolas 10.5 Rotation of conics 10.6 Parametric equations 10.7 Polar Equations 10.8. Graphs of polar equations 10.9 Polar equations of conics		
Analytic Geometry in Three Dimensions 11.1 The three-dimensional coordinate system 11.2 Vectors in space 11.3 Cross product of two vectors 11.4 Lines and planes in space Additional: Dot products		

Classical Christian Mathematics Teaching

We are at a classical Christian school. Traditionally the theory of classical Christian education revolves around a trivium of Grammar, Logic, and Rhetoric. These categorizations apply well to many of the subjects of the humanities. It has been questioned at times, and also formally discussed, how much difficulty there is in applying these to the Sciences and Mathematics. In mathematics, we are constantly presenting new concepts which are basically "grammar" and teaching the logic of how to use them. Rhetoric comes in the mathematical language the students produce to solve the problem in a correct logical sequence.

Susan Bauer⁴ has provided a framework for evaluating how Science is taught with the principles of classical Christian concepts. Primary in her analysis is that

"Classical education is language-focused; learning is accomplished through words, written and spoken, rather than through images (pictures, videos, and television)."

My math classes are very classical in this sense: we will be primarily teaching through lecture, and mathematical language written right on the board, rather than entertaining videos/television.

Monica Davis, a very experienced classical Christian teacher of high school mathematics has provided a lot of illumination about how teaching mathematics is accomplished from a classical Christian perspective:⁵

To teach math classically has many components. First, there is an emphasis on conceptual understanding and eloquent expression of that understanding. We want our students to deeply grasp the concepts they are learning. We do not merely want them to know how to solve a particular problem; we also want them to understand the mathematical principles at play in that problem. Furthermore, we want them to express their understanding in an eloquent way. This occurs through informal class discussion, where students consistently use technical math vocabulary, and through formal assessments such as oral presentations and essay questions. (Yes—you read that right—there are essay questions on our math tests!) Putting an idea into words is an excellent metric to judge true understanding, and we require this often in our math classes.

A second aspect of classical mathematics is an emphasis on history and historical context. We try to give our students a sense of where each concept falls in math history and discuss the important mathematicians who contributed the ideas, as well as where they fit into the larger context of world history. While we are not having daily history lessons (our class time is focused on mathematical content proper!), providing historical context whenever possible is a key component of classical mathematics classes.

A third element of classical mathematics is an emphasis on the integration of ideas, both within our classes and with the rest of the curriculum. Mathematics is an internally consistent body of knowledge, and we want our students to see how each concept they are learning integrates into one cohesive whole.

4 Bauer, Susan. What is Classical Christian Education? accessed 8/4/2022 at <https://www.classicalchristianmb.org/what-is-classical-christian-education>

5 Davis, Monica Classical Christian math? accessed 8/6/2023 at: <https://www.rockbridge.org/community/classical-christian-math/>

We also want our students to see how mathematics is integrated with the rest of the curriculum. The most obvious point of integration is with science, which uses math as a language to model natural phenomena. While this is the clearest place for integration, it is far from the only place! Mathematics teaches us about aesthetics, much of its vocabulary has Latin roots, it has its own history as I mentioned above, and it engenders many interesting philosophical discussions.

GRADING

This is an A/P Course. By definition, it is taught, tested, and graded at the College level. After a bit of introduction, A/P Students will be almost continually working A/P / College questions. While there will possibly be some tests that are structured more at the level of "high school" toward the beginning of the year, and for Honors students, for the AP Students, we will transition them quickly to handling the more complicated and timed questions suitable for an AP Test.

Unfortunately, we do not possess a large stock of known AP problems and grading examples, which means that there will have to be some "estimation" of where the "bar" is for AP level work. Typically, on AP tests, *students are unable to finish all the problems in the time allotted* -- this should not alarm our students. What counts is a deep knowledge of the concepts and timely application.

Students that consistently score lower than what is appropriate for an A/P Score of 4, should expect to have special discussions with their parents and the Instructor to decide how to proceed.

Homework	25%
Tests <i>There is a possibility of unannounced quizzes at any time, which will be given the weighting of 1/2 a test, presuming I can make a way to make that happen.</i>	50%
MidTerm and Final Exam	25%

Classroom Behavior

I do not anticipate having any difficulties with classroom behavior. The class will be taught as a college level class, with rigorous lecture, debate, probing questions and laboratories. As our course occurs at the beginning of the day, in Period 1, **I expect students**

- **to have attended Homebase without tardiness**
- **to have attended to normal restroom needs prior to the class.**

Emergency needs, however, will be accommodated and should be rare.

Homework

Homework should be completed either on provided sheets of 3-hole punched blank paper with filled-in heading, or on regular 3-hole punched notebook paper with an approximation of the following heading filled in. (This is to make organization & grading easier.)

<i>Student Name</i>	<i>Applicable Text Section (e.g. Chapter 1 Problems)</i>
	Due Date: e.g. 01/01/2023
	Completed: e.g. 01/01/2023

Late Work

- An assignment or homework is to be turned in at the class period and time designated by the teacher, typically at the beginning of the period. Teachers are to designate the venue for receiving the assignment or homework, electronic, hard copy, or other.
- Work not turned in as the manner delineated above will be late. The table below lists the points to be deducted per day late.

Days Late	One Day	Two Days	Three Days	Four or More
Logic & Rhetoric	- 11 percent	- 21 percent	- 31 percent	Not Accepted
<i>LATE homework cannot be guaranteed to be graded to the same standard as homework turned in on the appropriate day, and cannot be guaranteed to be graded or returned in the same timely fashion as appropriately completed work.</i>				

- As an example, Rhetoric homework assignment turned in one day late, and receiving a grade of 80% will then be reduced to 69% (reduced by 11 percent) for being turned in late.
- There are two exceptions to this standard:
 - If a student has an unplanned, but excused, absence, the due date will be extended by the number of days the student was absent.
 - If a student has a planned, but excused, absence the due date may be extended by half the number of days the student was absent.
 - I reserve the right to extend additional grace in very unusual situations.

Redo Policy

Life does not always provide make-overs for crucial testing events. *There is a trap in allowing students to feel that they will always have the chance to repeat an effort for which they did not devote sufficient planning, effort and time. As a parent, I've observed this work to the detriment of some of my own children.* Therefore, only on **rare occasions** will retakes or repeat work be allowed. In this class, students should expect that any re-do work will be at an accelerated level even for A/P.

Why do we have tests? There is an important Christian answer to this question. It is because of the Fall. Humans are innately flawed as a result of the Fall, and now we must have objective measures of accountability to guarantee performance on required studying.

Honesty and Plagiarism

I expect honesty at all times. Students may always obtain help and advice for all homework, including from the Internet, parents, other students, and even me. ***However, the work that they submit should reflect their own understanding in their own words.*** Lab work will often be done as a group and I encourage students to collaborate -- but the work handed in should reflect the student's individual presentation unless otherwise indicated.

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RECOMMENDATIONS

Students are encouraged to remember me when they need to file letters of recommendation or have character references. With my background I have dealt with tens of thousands of patients and families and many many other professionals. My friends are often leaders in law or public service, or education. It will do our students good to get to know quality examples of Christian Leaders in our community who have stood the test of time and can accurately evaluate the character and performance of aspiring young people who have an entire life ahead them and important choices to make. Everyone deserves a good recommendation for the effort they have put forward, and everyone has their own set of God-given gifts -- we are not the same! Finding the niche for which God developed each and every one of us is part of the Christian walk, and if I can help a student with that, it's great.

By signing below, you are signifying that you understand and agree to the above terms of education at AP Precalculus

 Student Signature

 Date

 Parent(s) Signature

 Date