Calculus 1 (AP Calculus AB)

Introduction

Welcome to the elegant and fascinating world of calculus - the study of rates of change and accumulations that result from change.

Calculus is not an end; it's a beginning! It is one of man's crowning intellectual achievements in the history of ideas, both in terms of its tremendous usefulness in science and the beauty with which it captures the subtle patterns of change that underlie all of what we can see, hear, and measure. Calculus is a course that beautifully unites many of the topics of previous mathematics courses to generate two new mathematical tools: the derivative and the antiderivative. With these new tools we will be able to study and describe an impressive variety of mathematical and physical situations.

While some students will find the concepts explored in this course elegant and interesting in their own right, the curriculum is designed to lay a foundation for the application of calculus in a myriad of technical and quantitative fields. There will be lots of word problems, and figuring out how to start a problem may sometimes be worth more points than actually finishing it. Neatness and the ability to use precise notation are very important, and the right answer without supporting work is worthless. A multi-representational approach to calculus with concepts, results, and problems being expressed geometrically, numerically, analytically, and verbally will be emphasized. The connections among these representations are demonstrated through the unifying themes of derivatives, integrals, limits, approximation, applications, and modeling.

This course also prepares students to take the Advanced Placement (AP) Calculus AB exam, giving students the opportunity to receive credit for Calculus I at almost all colleges throughout the United States. Over the past several years the THS Calculus 1 students have passed the AP exam at an exemplary rate.

Course Description: (11th-12th)

An Advanced Placement (AP) course in calculus consists of a full high school academic year of work that is comparable to a calculus course in colleges and universities. AP Calculus will follow the topics outlined by the College Board, along with additional topics that the instructor deems fit to include. The course is primarily concerned with developing students' understanding of the concepts of calculus and providing experience with its methods and applications.

I. Functions, Graphs, & Limit

• **Analysis of graphs** With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.

• **Limits of functions (including one-sided limits)**
   o An intuitive understanding of the limiting process
   o Calculating limits using algebra
   o Estimating limits from graphs or tables of data
   o L'Hospital's Rule including its use in determining limits

• **Asymptotic and unbounded behavior**
   o Understanding asymptotes in terms of graphical behavior
   o Describing asymptotic behavior in terms of limits involving infinity
   o Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)

• **Continuity as a property of functions**
   o An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain)
   o Understanding continuity in terms of limits
   o Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)

II. Derivatives

• **Concept of the derivative**
   o Derivative presented graphically, numerically, and analytically
   o Derivative interpreted as an instantaneous rate of change
   o Derivative defined as the limit of the difference quotient
   o Relationship between differentiability and continuity

• **Derivative at a point**
   o Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are 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 Corresponding characteristics of graphs of f and f'
    - o Relationship between the 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
- **Second derivatives**
    - o Corresponding characteristics of the graphs of f, f', and f"
    - o Relationship between the concavity of f and the sign of f"
    - o Points of inflection as places where concavity changes
- **Applications of derivatives**
    - o Analysis of curves, including the notions of monotonicity and concavity
    - o Optimization, both absolute (global) 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 functions, 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

III. Integrals
- Interpretations and properties of definite integrals
    - o Definite integral as a limit of Riemann sums
    - o Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval.
    - o Basic properties of definite integrals

- **Applications of integrals** Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a small sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques 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. To provide a common foundation, specific applications 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, the average value of a function, and the distance traveled by a particle along a line.

- **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 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
- **Numerical approximations to definite integra**ls 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 tables of values.

IV. Possible Additional Topics that will be Included in the course:
- Calculation of volume through use of cylindrical shells in addition to disk and washer methods.
- Advanced Integration Techniques
- Numerical solutions to differential equations using Euler's Method

Note: No formal review of previous mathematics will be provided at the beginning of this course. The course will begin with calculus and review will be provided as needed. Topics will not necessarily be covered in the order listed on this syllabus.

The Role of Technology in AP Calculus:
 Technology is designed to make our lives as mathematicians easier; yet, technology is not a substitute for mathematical understanding and proficiency. Students are expected, both by the instructor and by College Board, to understand the underlying mathematical concepts associated with the use of technology. This course will involve the use of the

graphing calculator and various computer programs to give students mathematical understanding across multiple representations.

 Required Daily Materials:
• Textbook: Calculus Of A Single Variable-11th edition (Larson and Edwards)
• Pens, Pencils, and Paper.
• A Three-Ring Binder is strongly suggested for organization of class materials.

Grading:
 A preliminary average is determined by dividing the total points earned by the total points possible. Five points will be added to one's preliminary quarter average in order to determine the final quarter grade.

 Students will earn points as follows:

- • TESTS <100 points each; 60% of grade>
- • HOMEWORK <100 points, total; 15% of grade>
     Daily homework assignments are expected to be completed in good form and to show appropriate detail. You will be awarded 3 points for satisfactory work based primarily on determination of good faith attempt. For unsatisfactory attempts, a grade of 0 will be given. If you are unable to complete an assignment due to extraordinary circumstances, please discuss this with me before 8:10 a.m. For an excused absence, you will be given a 0 until the assignment and class notes for the day(s) missed have been satisfactorily completed. Once completed, the 0 will be removed. Make-up assignments do not earn homework-attempted points except in special or pre-arranged cases. It is permissible to have another student turn in one's homework by no later than the date due and still earn the homework attempted points. Students who will miss class due to a school-sponsored (or supported) event or by checking out during the school day are expected to turn in the assignment on time.

  • QUIZZES/OTHER ACTIVITIES <25 points each; 25% of grade>

Tests will be given roughly every three or four weeks and will always be announced in advance. Quizzes may be given with or without warning. Most of the time, homework will be assigned daily and must be completed before the next class meeting. On-time completion is crucial because the assignment will often form the basis for the next class. As you complete each assignment, remember to pay close attention to details, justifying

your steps, and showing all of your work. The homework is designed to provide reinforcement for previously taught content, development of skill, and enrichment opportunities.

Additional Information:

 When a test requires the use of a graphing calculator, the TI-Nspire will be the calculator supplied by the teacher. Tests will normally be announced at least three days in advance. I believe we all learn from our mistakes, therefore students are given the opportunity to come in either before or after school and earn back a percentage of the points missed by correcting all mistakes made on the test, with my assistance as needed. Usually I allow about 1 week for corrections to be completed. Test corrections are allowed on almost all tests during the first three quarters, Although tests count considerably more than homework in the overall course grade, homework is the most important component of this course. ***If a student does not complete the assigned homework, she/he will have a difficult time succeeding in this course. AP Calculus is a college level course.***

Note: A Semester Exam will be administered during the second quarter. Students will not take a Semester Exam during the fourth quarter due to taking the AP Exam. The score on the AP Exam will not be included in the fourth quarter average. College Board does not release AP Exam scores until the first week of July.

Collaboration and Additional Instruction:

Students are expected to participate in class everyday. Participation may include, but is not limited to: discussion, presentation, cooperative work, and individual work. Being able to do mathematics as an individual is a not a sufficient condition for being mathematically successful. Students must be able to discuss the daily mathematics with each other and the instructor using correct mathematical terminology. Collaboration between students outside of class is encouraged and necessary in advanced mathematics courses.

Note: Collaborate does not mean copying someone's work either on one particular problem or on a set of problems.

Calculus is a great human achievement that I hope each of you will come to appreciate this year. I am excited about teaching this course and hope you are as excited about taking it. You have been preparing yourselves for college all

your lives. If you do well in this course, you will have an advantage over those admitted to college without AP experiences. I look forward to working closely with each of you throughout the academic year to ensure your success in this course and in your future mathematical education. I will be available before school (I usually arrive around 7:15) , Tuesday through Fridays. Waiting until the end of the grading period is not the most advantageous time for help. Another powerful source of help is your classmates. Students may want to form study groups that meet regularly to share class notes, to discuss homework solutions, and to study for exams. Online sources for help are referenced in your textbook. Other sources will be shared in class.

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Important Dates

Parent/Teacher Conferences:
August 30, 2018 / November 15, 2018 / January 31, 2019 / February 7, 2019

AP Calculus Exam, Tuesday, May 14, 2019

Guidelines and Expectations

BE PROMPT-BE PREPARED-BE POLITE

 It is absolutely necessary that you be in class on a regular basis. You will be amazed at how much you will miss in just one day. Absences due to illness, family situations, or school initiated activities do not excuse one from completing the homework assigned during the absence or from learning the concepts taught during the absence. Find a buddy in your class who will notice when you are missing and will take particularly good notes to share with you. It is your responsibility to copy the class notes and complete all assignments that were due during your absence. If you are absent the day of a test, you are expected to make arrangements to make up that test on the day you return. Always bring the textbook (or e-book), writing instruments, paper, and notebook to class each day. The notebook is for you to store, in an organized fashion, the daily class notes, in-class activities, and homework assignments. Use whatever is effective for you - except DO NOT store papers in your textbook. You are expected to be in your seat and

ready to begin when the tardy bell rings. Excessive tardies may result in detention. Do not work on any other material in class without permission. Inappropriate materials or work interfering with one's participation in class will become the property of the teacher. Inappropriate use of your graphing calculator or computer will not be tolerated. Cellular phones and other electronic communication devices are NOT to be powered on, heard, used, or visible (this includes headphones, etc.) upon entering the classroom and during the class period. Cell phones and similar electronic devices that are discovered powered on, seen, or heard will be confiscated as according to school policy. Students who allow electronic devices to become a distraction may face disciplinary measures beyond confiscation. Students discovered to be in violation of this policy during a test may receive a grade of zero. Most of the time, homework will be assigned daily and must be completed before the next class meeting. On-time completion is crucial because the assignment will often form the basis for the next class. As you complete each assignment, remember to pay close attention to details, justifying your steps, and show all of your work. The homework is designed to provide reinforcement for previously taught content, development of skill, and enrichment opportunities. It is reasonable to assume that most students may need to spend on average an hour or so outside of class each day in preparation for the next day. (Please let me know if any particular daily assignment requires you to spend an unreasonable amount of time to complete.) There will also be times when you may be given an extended homework assignment comprised of a plethora of closely-related problem types. Typically you will be given a few days to complete the extended assignment before it is collected and evaluated. Developing mature work habits is critical for success in this course. It is everyone's responsibility to make academic contributions and to help others learn. Always listen silently when it is someone else's turn to talk and stay focused on the current learning activity. I expect you to devote your best effort to every task associated with this course. Remember, you are taking a college level course in mathematics!