

**Course Purpose:** AP Calculus BC is a course in which students will learn the mathematics surrounding the derivative and integral and prepare themselves to take college-level mathematics and the higher sciences.

**Course Goal:** That the students display their God-given talents by applying Calculus to various real-world and mathematical situations in service to Him.

**Course Outcomes:** The student will. . .

- use regression equations to solve problems
- work with functions to:
  - identify the domain and range of a function using its graph or equation
  - recognize even functions and odd functions using equations and graphs
  - write and evaluate compositions of two functions
  - solve problems
  - identify a one-to-one function
  - determine the algebraic representation and the graphical representation of a function and its inverse
  - generate the graphs of functions and explore various transformations upon these graphs
- graph curves that are described using parametric equations
- calculate average and instantaneous speeds and average rate of change of a function
- define and calculate limits for function values and apply the properties of limits
- find and verify end behavior models for various functions
- identify the intervals upon which a given function is continuous
- understand the meaning of a continuous function
- apply the Intermediate Value Theorem
- apply directly the definition of the slope of a curve in order to calculate slopes
- find the equations of the tangent line and normal line to a curve at a given point
- calculate slopes and derivatives using the definition of the derivative.
- graph a function from the graph of its derivative
- graph the derivative from the graph of a function
- graph the derivative of a function given numerically with data
- find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents
- approximate derivatives numerically and graphically
- use the rules of differentiation to calculate derivatives, including second and higher order derivatives
- use derivatives to solve problems involving rates of change
- use the rules for differentiating the six basic trigonometric functions and their inverses
- differentiate composite functions using the Chain Rule, implicit differentiation, and the Power Rule
- find slopes of parameterized curves
- calculate derivatives of exponential and logarithmic functions
- determine the local or global extreme values of a function
- apply the Mean Value Theorem and to find the intervals on which a function is increasing or decreasing
- use the First and Second Derivative Tests to determine the local extreme values of a function
- determine the concavity of a function and locate the points of inflection by analyzing the second derivative
- solve application problems involving finding minimum or maximum values of functions
- find linearizations and use Newton's method to approximate the zeros of a function
- estimate the change in a function using differentials
- solve related rate problems
- approximate the area under the graph of a nonnegative continuous function by using rectangle approximation methods
- interpret the area under a graph
- express the area under a curve as a definite integral and as a limit of Riemann sums
- compute the area under a curve using a numerical integration procedure
- apply rules for definite integrals and find the average value of a function over a closed interval
- apply the Fundamental Theorem of Calculus and explain the relationship between the derivative and the definite integral as expressed in the Fundamental Theorem of Calculus
- approximate the definite integral by using the Trapezoidal Rule and by using Simpson's Rule
- construct antiderivatives using the Fundamental Theorem of Calculus
- find antiderivatives of polynomials, exponential functions, and trigonometric functions, as well as linear combinations of these functions
- solve initial value problems
- construct slope fields using technology and interpret slope fields as visualizations of differential equations
- compute indefinite and definite integrals by the method of substitution and by integration by parts
- solve a differential equation in which the variables are separable

- use Euler's method and the improved Euler's method to find approximate solutions to differential equations with initial values.
- use integration to calculate areas of regions in a plane
- use integration (by slices or shells) to calculate volumes of solids
- use integration to calculate surface areas of solids of revolution
- use integration to calculate lengths of curves in a plane
- define sequences explicitly or recursively
- define explicit and recursive rules for arithmetic and geometric sequences
- graph sequences using parametric or graphing mode on a graphic calculator
- use properties of limits to find the limit of a sequence
- determine whether a sequence converges or diverges and find its limit using the Sandwich Theorem for Sequence or the Absolute Value theorem
- find limits of indeterminate forms using l'Hôpital's Rule
- use l'Hôpital's Rule to compare the rates of growth of functions
- use limits to evaluate improper integrals
- use the direct comparison test and the limit comparison test to determine the convergence or divergence of improper integrals
- apply the properties of geometric series
- differentiate, integrate, or substitute into a known power series in order to find additional power series representations
- use derivatives to find the Maclaurin series or Taylor series generated by a differentiable function
- approximate a function with a Taylor polynomial
- analyze the truncation error of a series using graphical methods or the Remainder Estimation Theorem
- use Euler's formula to relate the functions  $\sin x$ ,  $\cos x$ , and  $e^x$
- use the nth-Term Test, the Direct Comparison Test, and the Ratio Test to determine the convergence or divergence of a series of numbers or the radius of convergence of a power series
- use the Integral Test and the Alternating Series Test to determine the convergence or divergence of a series of numbers
- determine the convergence or divergence of p-series, including the harmonic series
- determine the absolute convergence, conditional convergence, or divergence of a power series at the endpoints of its interval or convergence
- find derivatives and second derivatives of parametrically defined functions
- calculate lengths of parametrically defined curves
- represent vectors in the form  $\langle a, b \rangle$  and perform algebraic computations involving vectors
- use vectors to solve problems involving the modeling of planar motion, velocity, acceleration, speed, and displacement and distance traveled
- graph polar equations and determine the symmetry of polar graphs
- convert Cartesian equations into polar form and vice versa
- calculate slopes and areas of regions in the plane determined by polar curves

**Course Outline:** Text: Calculus: Graphical, Numerical, Algebraic (Pearson Prentice Hall, 2007)

**Semester One:**

- Chapter 1: Prerequisites for Calculus (pp. 2-57) (Review as needed)
- Chapter 2: Limits and Continuity (pp. 58-97) (Review as needed)
- Chapter 3: Derivatives (pp. 98-185) (Review as needed)
- Chapter 4: Applications of Derivatives (pp. 186-261)
- Chapter 5: The Definite Integral (pp. 262-319)
- Chapter 6: Differential Equations and Mathematical Modeling (pp. 320-377)

**Semester Two:**

- Chapter 7: Applications of Definite Integrals (pp. 378-433)
  - Chapter 8: Sequences, l'Hopital's Rule, and Improper Integrals (pp. 434 -471)
  - Chapter 9: Infinite Series (pp. 472-529)
  - Chapter 10: Parametric, Vector, and Polar Functions (pp. 530-561)
- (Review as needed for the AP test.)

**Instructional Strategies:**

- Correcting of Homework/Questions/Quiz (10%)
- Lecture/Discussion (60%)
- Small group/independent work (30%)

**Grading:**

Percentage breakdown:

Homework (15%)      Quizzes (15%)      Projects (30%)      Tests (40%)

## Homework:

Homework is extremely important to learning mathematics. In order to be successful on the quizzes, tests, and projects, and with math in general, you **MUST** do and understand the problems you are assigned for homework. Homework, however, is where you practice the new math skills you are learning. Treat homework like any other practice: practice hard, practice often, and learn from your successes and your failures. *This is particularly important in Calculus. I have assigned particular problems, **each** of which need to be completely understood, otherwise you will be lacking necessary understanding for the AP test and for success in Calculus.* It is okay to have some failures in practice as long as you learn from your mistakes. This is the reason homework does not make up a large percentage of your overall grade, and is also the reason why I use a rubric to grade your homework, rather than a strict percentage of the number you got correct. The rubric I will use to assess your homework is:

5	Homework complete with all appropriate work shown. Homework done neatly. Few mistakes, if any.
4	Homework complete with all appropriate work shown. Homework done neatly. Moderate number of mistakes.
3	Homework complete with all appropriate work shown. Homework done neatly. Many mistakes. -or- Homework mostly complete with all appropriate work shown. Homework done legibly, but not neatly. Few to moderate number of mistakes.
2	Little homework completed or does not have all appropriate work shown. Homework done legibly, but not neatly. Few to moderate number of mistakes.
1	Little homework completed with no appropriate work shown. Homework done legibly, but not neatly. Many mistakes.
0	Homework not done or unacceptable.

All homework will be corrected at the beginning of class on the day it is due. You will be given an answer sheet, and you are to correct your own homework in **red pen**. While you correct your homework, be sure to write-in the correct answers to any problems you got wrong or simply did not get. Try to determine what you did wrong on your own, and make notes on your homework to help you remember how to do those problems correctly in the future. When everyone is finished correcting their papers, you will then have the opportunity to ask questions about problems you still do not understand on the homework. I will collect your homework afterwards so I can grade your homework (or to correct it myself if not done in class). It is my intent to provide written feedback on some assignments before returning them to you as time allows.

The homework to be completed for a section will be identified at the top of the "Section Notes" sheets for that section. These will be distributed at the beginning of each section as we go through them. All homework is to be done **in pencil** on loose-leaf paper. Write your full name, the class period, and section number on the top of your homework sheet.

Usually you will be given two days to complete a homework assignment once discussion on the section is finished. Begin working on the assignment the same day it is assigned or earlier. If you are having many problems with an assignment, plan some time to get help outside of class. **NEVER** come to class with your assignment not done for *any* reason, including "I didn't understand the assignment!" or "I didn't have time to print my graphs!" Only a minimal amount of time will be given for questions in class, so be sure to get your questions answered outside of class if you have many questions. Time will not be "given" for you to print off calculator graphs in class, but you might find some "downtime" on some class days which allow you to do some printing. Assignments are due at the **beginning** of class on the day assigned unless otherwise told.

Assigned homework is for your benefit. To make the most of it, you should include all work and personal notes so when it comes time to study, you will be reminded of what you did right or wrong, and how to correct it. Keep your homework handy for studying purposes as well.

In addition to regular homework, each week you will be given a "Weekly HW" sheet to work on, which will be graded as homework. It will be given on the first school day of the week and will be due on the last school day of the week. The intent of these assignments is to have you review some concepts from the past which you may need to use in the near future or to have you challenge your mathematical skills.

## Quizzes

On the day a homework assignment is due, you will have a quiz covering the content of that assignment. The quiz will have a few questions similar to those found in the homework assignment. Due to the nature of the problems in Calculus, you will typically have "take-home" quizzes (but some will be in class), which will be due at the beginning of the next class period.

## Projects

Each chapter will have a corresponding project that will have you apply the concepts you should have learned in that chapter. Each will be a series of six essay problems similar to those you will find in the essay portion of the AP test. As with the AP test, each problem will be worth 9 points, with a total of 54 points for the project. Your grade will be determined by dividing the number of points you earned by the total 54 points. They will also be graded following the AP grading guidelines, which you will be given in class.

## Tests

Tests will be given after each chapter or half-chapter to assess your understanding of the concepts studied in those sections. The semester exam period will be used as a regular class day. The cumulative semester exams will be “take-home” and assigned when we have completed the appropriate chapters.

## Major Grades

All projects and tests are considered **MAJOR GRADES**. ***Failure to complete even one of these will result in an F grade for the semester.*** Although homework and daily quizzes are not “major” grades, failure to practice your math skills will result in a poor grade for the class, in addition to the poor grade resulting in these counting a “zeros” in the grade book.

## Absences/Late Work

If you have an excused unplanned absence (due to illness, etc.), you will have as many days you were absent to make-up late tests without penalty. Homework and daily quizzes may also be “made up” within this time, but you are not required to do so. It is to your advantage to make up missed homework and quizzes, as they are more likely to help your overall grade than to harm your grade. (If you do not make up the homework or quiz, the grade goes in as “excused” which doesn’t hurt or help your grade.) Projects have specific due-dates, and are due on that day or the day you come back from your absence or they are considered late.

I do not accept unexcused late homework. Homework not turned in on the day it is due will receive a grade of zero and you will be expected to take the daily quiz. **Tests and projects not completed on time will result in a 5% reduction in the final grade per school day.** After 2 weeks or 10 school days the grade will be a zero grade and you will automatically fail the semester.

Pre-planned absences need to be cleared following normal school procedures, with assignments indicated on the form due when indicated or they will be considered late. It is **your** responsibility, not the instructor’s, to be sure you are following these procedures and getting make-up work in on time, so make appropriate use of your planner.

## Semester/Quarter Grades

Note that semester grades are cumulative, meaning I use the indicated percentage breakdown to determine grades. (I do **NOT** use 40% Q1, 40% Q2, and 20% Semester Exam.) Since I can only show one grade break-down on Parent Connect, I will have the overall semester grade display at all times. For me, on ParentConnect, an “N” grade means an assignment is “not done” and is counting as a “0”. An “X” grade means an assignment is “excused” for you and you do not need to make up the assignment.

## Representing Your Savior by Using Your Talents

By virtue of being in this class, you have shown yourself to be blessed by God with mathematical ability. God asks us to use our gifts and talents to serve and represent Him. As such, you will be asked to represent your Savior and your school in various math competitions during the year. Participation in these meets does not automatically make you a member of the KML Math Team. You must meet the other criteria of being a team member to be considered a member of the math team. Participation in a math meet will earn you 10 free quiz points (as long as you score a point) and award winning participation in a math meet will be considered for a class participation grade adjustment at the end of a quarter.

Another way you can serve God with your talents is to use your abilities to help others with their math by becoming a peer tutor. I will omit the lowest test grade for the semester to any student that is a peer tutor during that semester. In order to take advantage of this, you must sign-up to be a peer tutor with Mrs. Boeldt at the beginning of the semester. The peer tutoring can be done during the school day or during ELP.

## **Student Materials:**

Pencil	Pen	TI-83/84 type graphics calculator	Three-ring binder (at least 1" width)
Red pen Notebook	Textbook	Student Planner	Loose-leaf paper

## **Classroom Procedures:**

- Be in the classroom in your assigned desk quietly working on the opening activity when the bell rings or you will be considered tardy
- Begin working on the opening activity upon arrival in the classroom
- Bring the above materials to class each day
- Respect classmates and teachers
- Participate courteously in class activities
- Be attentive to the class discussion and provide appropriate input to the discussion when called upon or given permission after raising your hand
- Finish all work on time and completely
- Find a "study-buddy" whom you can call for help with an assignment, or to get the assignment when you are absent. When you are absent, see me the first day you return for make-up work responsibilities
- Take notes of what is discussed in class and what is demonstrated

## Extra Information about the AP Calculus class:

A typical class day would be:

- Enter class and begin working on the opening activity (typically correcting the assignment due).
- Attendance will be done while you are working on the opening activity.
- Questions taken on any homework due.
- Discussion on the new lesson.
- Lesson investigation activities/class practice.

A typical homework session should include:

- Review and self-evaluation of the objectives for the section of HW to be done.
- Review and clarification of your notebook notes for that day including vocabulary.
- Reading the section in the textbook the HW is for.
- Completion of the HW assigned (in pencil) or review for test.
- Pre-reading the objectives for the next section.
- Progress check/work on the chapter project.

For extra practice on a section you can:

- use the odd problems in a section (the answers are in the back of the text)
- use the odd problems from the chapter reviews
- make corrections on your homework
- go to the textbook's website for online tutoring and practice tests

Your calculator:

- don't be afraid to investigate what it can do
- don't use it as a crutch to do simple calculations you should do in your head
- store the calculator safely in your locker - don't leave it unattended on a table or in your book bag, especially during exam week or the last day of school before vacation
- be sure you have your name engraved on it
- you may have games on it, but no games are allowed to be played during any class
- you must maintain enough free memory on your calculator so it can function for class work
- calculator programs and data sets provided by the school for use in class take precedence over game programs - at no time should these be deleted to make room for games
- the school reserves the right to delete offensive and unnecessary programs from your calculator at any time
- no password programs are allowed on your calculator
- repeated abuse of these calculator rules is grounds for a detention

Assignments are printed in detail on the chapter homework sheet

Assignments are posted on the smaller white board near the closet door. Use your planner appropriately.

Graph paper is provided for free - no need to buy any.

Always have your binder, and keep all work, notes, and papers organized and neat

Mr. Kuehl's email address is [tkuehl@wi.rr.com](mailto:tkuehl@wi.rr.com) or [tkuehl@kmlhs.org](mailto:tkuehl@kmlhs.org). Both email addresses are checked fairly regularly, even on weekends and in the late evening.

The textbook's website is <http://www.phschool.com/atschool/calculus/index.html>. It has many helpful resources.

The class website can be found at the school website under Departments. It has many useful resources, including printable graph paper, the complete course syllabus, the homework assignment sheets, the section notes, and a web version of the classroom assignment board.

## Here is some great advice for math students I received from a teacher (Terry Guay) on the AP Stats listserve:

You need to do so many problems that there is nothing that can be thrown at you that you haven't seen before. Do every problem you can get your hands on. This also reduces any anxiety during a test. You know you've prepared well, so you are more likely to try the tough problems and not fear them, AND you actually know quite a bit of stuff since you studied well and that knowledge will help you figure out new "stretch-type" problems.

My list of math studying advice:

1. You can never do too many problems.
2. Do several problems of each type until you are VERY comfortable with a technique, then do a couple more so it is cemented in your brain and becomes automatic.
3. Always do the homework that is assigned. If you have any difficulties, do MORE than what was assigned.
4. Check your answers - ALWAYS. If you have answers in the book, check them. If the teacher provides an answer key in the classroom or online, check them. If there is a classmate who does quality work, check answers with them.
5. Make a list of the types of problems you are responsible for- every kind and their variations. Then write down an example of each and the steps involved.
6. Make a list of math techniques that you can apply to problems in the chapter you are studying. This is your bag of tricks. Memorize them! If you are working a new problem (or are taking a test) and get stuck, go through your list and see if any of those techniques might apply.
7. Write yourself little notes as you learn little important things, little tricks, and things to remember.
8. Find outside resources when available. Use all your resources. If there is stuff online from your teacher, be sure to use it. If there are outside review books, get several and use them. If the teacher has old practice tests, do them. You can never do enough problems. If you have an older sibling or a parent that can do this stuff, by all means take their assistance.
9. Take notes in class. Put the date on your notes. Have your friends take notes and date them also. This helps when comparing notes. Write down everything that the teacher puts on the board or overhead. The more material you have to work with, the more you can study. You need material to study from. Sometimes the more difficult types of problems are modeled for you in class. Study these. When you are stuck on a homework question, check your class notes. Sometimes problems done in class are previews of test questions.
10. When doing a problem, you don't need to know how it will turn out when you start. Just start and see where it leads you. Remember to simplify (but not round) as you go; you may get to a point where you "see" what to do next by what form your intermediate work is taking.
11. Sometimes you can work a problem from both ends and meet in the middle.
12. When possible, do not round until the end of the problem. Work your calculator or your math on paper so that you keep it as exact as possible.
13. Study and do homework with a study partner. Find someone you can work well with. Do homework simultaneously - checking each other's work. Talk about different methods. Be sure you discuss the little details. This will help you remember.
14. Spend about 2 hours studying per section in a math book. Another rule of thumb is to spend 2 hours studying for every 1 hour in class. It might take you less time if you are efficient, but don't be afraid to spend a lot of time studying math. You need to go over concepts - make a list of the techniques - and do a bunch of problems to practice, and list anything else you feel is important to remember. That could take 2 hours per section. Each section is a separate concept with techniques and variations. Give it its due time. The goal isn't to "get by" but to learn it well.
15. You need to analyze what it is that you need to know. MAKE LISTS. MAKE SHEETS of all the important things in the chapter. This will help you study for the current chapter test and will help you review for the final later.
16. When studying for a test, you should be reviewing stuff you already learned - this is not the time to learn something for the first time. Be sure to keep up with class, doing and checking all homework as you go. Be sure you can do all the types of problems you are responsible for. Master the material. Then when you are at the end of the chapter, you are simply reviewing and bringing it fresh in your mind.
17. Go see the teacher if you have any questions. If you study 2 days before the test, then you can still ask questions on the day before the test.
18. Be sure to go back through class notes and chapter quizzes when you make your lists to study for the chapter. Don't leave anything out.
19. Once you've made your list, study it. Memorize techniques, go over the tricky problems enough so that you'll recognize them on a test and you'll remember what to do.
20. Another quote: "Studying is what you do to firmly fix new information in your memory. You study to learn and to improve your ability to recall what you need to know." I often ask students, "How will you remember this?" Find a way to get it into your brain so that you'll know it the next time you need it.
21. Never, ever, say you "looked it over". You need to DO IT, and do LOTS of it."