

**SUBJECT AREA:** Calculus/AP Calculus

**GRADE/COURSE** 12

**Standard And Strand** 2.1 Numbers, Number Systems and Number Relationships

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Order and describe solution sets of real numbers using various methods.</p> <p>Graph relations and functions and analyze important criteria culminating with application of theory to real world problems.</p>	<p>Build upon previously learned mathematical skills and concepts to analyze and then analytically confirm solutions to problems and then properly construct solutions sets.</p> <p>Verify solutions on the graphing calculator where applicable.</p> <p>Write solutions in proper notation for all types of problems including absolute value, inequalities of degree higher than two, piecewise functions, etc.</p> <p>Apply previously learned information about relations, functions, their graphs, their inverses and properties to determine domain, range, intercepts, and calculus tools to determine maxima, minima, increasing and decreasing intervals, and concavity of functions.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

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**Standard And Strand** 2.2 Computation and Estimation

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Determine reasonableness of answer.</p> <p>Analyze graphs of polynomial functions culminating with those modeled from real data.</p> <p>Estimate answers when the exact answer is not needed.</p> <p>Use operations and procedures to solve problems.</p>	<p>Solve problems using analytical skills, and then verify these answers graphically and numerically using the graphing calculator.</p> <p>Determine and explain the meaning of zeros of functions.</p> <p>Use graphing calculators to verify results of found points of intersection, roots of equations, maxima, minima, etc.</p> <p>Perform operations such as reciprocal, absolute value, raising to a power, finding roots, finding logarithms, etc.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

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**Standard And Strand** 2.3 Measurement and Estimation

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Solve trigonometric equations emphasizing radians. Apply procedures real world situations.</p> <p>Apply linear, square and cubic relations in real-world problems.</p> <p>Use appropriate units when problem solving.</p>	<p>Use calculus to solve real life problems involving using trigonometric equations in such concepts as related rates (rate of change of angle of elevation and angular velocity).</p> <p>Use proper units of measurement such as meters, <math>cm</math>, <math>cm^2</math>, <math>ft/sec</math>, <math>ft/sec^2</math>, revolutions per minute, etc. when answering real world application problems.</p> <p>Estimate answers and calculate acceptable error using linear approximations and differentials.*</p> <p>* Used with AP Calculus Class</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

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**Standard And Strand** 2.4 Mathematical Reasoning and Connections

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Apply the concepts of direct proofs, indirect proofs or proof by contradiction to prove mathematical theorems, where applicable.</p> <p>Demonstrate the nexus from the theoretical realm to the realm of applications..</p>	<p>Prove the power rule, derivatives to trigonometric functions, the relationship between the derivatives of the natural logarithmic function and the exponential function, etc.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

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**Standard And Strand** 2.5 Mathematical Problem Solving and Communication

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Solve complex problems using appropriate mathematical concepts and techniques.</p> <p>Solve problems analytically, graphically, numerically, and verbally using proper mathematical techniques and terminology.</p> <p>Justify and defend solutions.</p> <p>Present mathematical concepts and solutions clearly, systematically, and correctly.</p> <p>Ensure answers relate to the essence of the problem.</p> <p>* Used with AP Calculus Class ***Requirement for the AP test.</p>	<p>The student will demonstrate the following:</p> <p>Solve real life problems by translating word problems and creating mathematical models.</p> <p>In addition to analytical methods, use graphing calculators to solve equations.***</p> <p>Justify the results to maxima and minima problems.</p> <p>Analyze solutions to problems in order to ensure the original question was answered properly.</p> <p>Evaluate whether the solutions are an acceptable response to the initial problem.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

<b>SUBJECT AREA:</b>	Calculus/AP Calculus	<b>GRADE/COURSE:</b>	12
<b>Standard And Strand</b>	2.8: Algebra and Functions		

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Solve real world problems using patterns, series, and sequences.</p> <p>Solve problems using the understanding of algebraic equations, inequalities, and systems of equations culminating with solutions of real life problems.</p> <p>Using data, create a model for solution. Students will solve these problems using proper mathematical techniques.</p>	<p>Use previously learned knowledge of algebra and geometry (such as writing equations of lines, graphing conic sections, solving linear, quadratic, and exponential equations both analytically and graphically, finding area, surface area, and volumes of geometric figures etc.) to create and solve application calculus problems.</p> <p>Analyze charts and tables to determine the relationship between functions and their graphs.</p> <p>Estimate average and instantaneous rates of change using graphs, tables, and charts.</p> <p>Analyze properties and relationships of functions such as linear, rational, polynomial, logarithmic, and trigonometric.</p> <p>Find slopes and equations of lines for use in various formulas.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

OBJECTIVES	PERFORMANCE INDICATORS	ASSESSMENTS (Variety as per Section 4.52, Chapter 4)
<p>Use a variety of methods to represent relationships.</p>	<p>Use the definition of absolute value and its properties to solve problems.</p> <p>Graph piecewise functions.</p> <p>Test analytically symmetry of graphs.</p> <p>Write the equations of geometrically transformed graphs.</p> <p>Solve equations and inequalities.</p> <p>Graph functions using the properties of intercepts, zeros, symmetry, asymptotes. (And the relationship between the graph of:*</p> <p><math>y = f(x)</math> and the graphs of</p> <p><math>y = kf(x)</math>, <math>y = f(kx)</math>,</p> <p><math>y - k = f(x - h)</math>, <math>y =  f(x) </math>,</p> <p>and <math>y = f( x )</math>.</p> <p>Write new functions using the concepts of sum, product, quotient, and composition.</p>	

\* Used with AP Calculus Class

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**Standard And Strand** 2.9 Geometry

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
Use previously learned knowledge of geometry (finding area, surface area, and volumes of geometric figures, graphing conic sections, etc.) to create and solve application calculus problems.	<p>Analyze conic sections using the general quadratic relationship and standard form to describe such terms as center, vertices, foci, asymptotes, etc.</p> <p>Apply geometric concepts such as congruent triangles, similar triangles, proportion, right triangle relationships, and vectors in the solution of problems where applicable.</p> <p>Utilize previously learned knowledge to graph conic sections in order to set up applied calculus problems to concepts such as area under the curve, distance between points, etc.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
Analyze graphs using symmetry.	Utilize their geometry knowledge to set up verbal problems such as related rate cone problems, shadow problems, height problems, etc., prior to using calculus to solve these problems. Use the concept of symmetry to assist in sketching graphs of functions.	

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**Standard And Strand** 2.10 Trigonometry

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Describe and apply circular functions.</p> <p>Apply translations of sine and cosine functions, analyze period, and amplitude,</p> <p>Solve problems using inverse trigonometric functions and trigonometric functions.</p>	<p>Use graphing calculators to display and analyze properties of circular functions.</p> <p>Use previously learned trigonometric skills and apply them to real world problems, such as blood pressure, pendulums, temperature, etc.</p> <p>Apply the previously learned concepts of inverse trigonometric functions to solve real world problems involving rates of motion, catenary applications*, etc.</p> <p>Use the trigonometric functions of right triangles to solve real world application problems.</p> <p>Use trigonometric identities to solve problems.</p>	<p>Tests: non-calculator tests, calculator tests</p> <p>Quizzes: non-calculator, calculator quizzes</p> <p>Homework assignments</p> <p>Submitted problem sets</p> <p>Group activity projects</p> <p>Oral Questions</p> <p>Observation of board work</p> <p>Class participation</p> <p>Portfolio</p>

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**Standard And Strand** 2.11 Concepts of Calculus

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
Understand intuitively the concept of limit.  Calculate limits using algebra.  Estimate limits from graphs or tables of data.     Understand asymptotes in terms of graphical behavior, and limits involving infinity.	Evaluate limits analytically and justify their answer by using tables and, graphs.  Solve limits using infinity.  Use the algebra of limits to calculate answers to limit problems.  Calculate limits of trigonometric functions.  Determine one-sided and two-sided limits.  Determine non-existent limits and the reasons for their non-existence.*  Find equations of horizontal, slant and vertical asymptotes.  Understand the relationship between limit and continuity.	Tests: non-calculator tests, calculator tests  Quizzes: non-calculator, calculator quizzes  Homework assignments  Submitted problem sets  Group activity projects  Oral Questions  Observation of board work  Class participation  Portfolio

\* Used with AP Calculus Class

OBJECTIVES	PERFORMANCE INDICATORS	ASSESSMENTS (Variety as per Section 4.52, Chapter 4)
<p>Understand the graphical, numerical and analytic concept of derivative.</p> <p>Calculate derivatives.</p> <p>Use fundamental concepts regarding derivative.</p>	<p>Graphically interpret continuity and discontinuity.</p> <p>Use the Intermediate Value Theorem as existence theorem.*</p> <p>Verbally explain the concept of limit.</p> <p>Use limits to understand asymptotic behavior.</p> <p>Develop the definition of the derivative using a graphical approach.</p> <p>Use the symbols of derivatives.</p> <p>Use the derivative to calculate the slope of the tangent line to a function <math>f(x)</math> at various points on the graph of <math>f(x)</math>.</p> <p>Use graphing calculators to evaluate derivatives.***</p> <p>Find derivatives by using the definition of the derivative.</p>	

\* Used with AP Calculus Class

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Apply differentiation techniques requiring multiple steps.</p> <p>Understand the relationship between derivatives and rates of change.</p> <p>Use calculus to predict and explain the observed local and global behavior of a function.</p> <p>Find maximum and minimum values of functions using derivatives.</p>	<p>Differentiate elementary and transcendental functions using the power rule, the chain rule, the quotient rule, the product rule, the constant rule, various formulas, etc.</p> <p>Differentiate inverse trigonometric functions.*</p> <p>Differentiate exponential and logarithmic functions.</p> <p>Differentiate implicitly defined functions.</p> <p>Apply concepts intrinsic to the Mean Value Theorem to better understand the process of rates of change and derivatives, and then apply this to real world problems based in related rates.</p> <p>Calculate maxima/minima on closed intervals (both local and global), and determine the existence of absolute extrema of a continuous function on a closed interval <math>[a, b]</math>.</p>	

\* Used with AP Calculus Class

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Apply derivatives in a variety of forms.</p> <p>Solve various types of problems using the derivative.</p> <p>Exhibit a comprehensive understanding of the concept and use of derivatives.</p>	<p>Verify maximum and minimum results on the graphing calculator where applicable.</p> <p>Create functions to optimize real world problems such as profit, interest, area, volume, etc. and to minimize real life problems such as surface area, perimeter, etc.</p> <p>Calculate average velocity, acceleration, and analyze linear motion using the derivative.*</p> <p>Defend answers to optimization questions using a selected calculus method of verification, such as an analysis of the first derivative or the second derivative test.</p> <p>Determine the reasonableness of their answer by analyzing the domain of the function.</p> <p>Solve derivatives for critical values, critical points, and inflection points.</p>	

\* Used with AP Calculus Class

OBJECTIVES	PERFORMANCE INDICATORS	ASSESSMENTS (Variety as per Section 4.52, Chapter 4)
<p>Find and apply derivatives of higher order.</p> <p>Interpret antidifferentiation as the inverse operation of differentiation.</p> <p>Use the symbols of integration properly.</p> <p>Integrate functions.</p> <p>Use substitution to integrate.</p>	<p>Describe the relationship between increasing and decreasing and the derivative of a function.</p> <p>Find inflection points and describe the relationship between concavity and the sign of the second derivative of <math>f(x)</math> using derivatives.</p> <p>Understand the relationship between derivatives and integrals.</p> <p>Write functions which are the antiderivative of the derivative.</p> <p>Write symbolic notation for both definite and indefinite integrals.</p> <p>Use the formula rules to find antiderivatives.</p> <p>Define integrands in terms of <math>u</math> in order to find <math>du</math>.</p> <p>Find antiderivatives by substitution of variables.</p>	

<b>OBJECTIVES</b>	<b>PERFORMANCE INDICATORS</b>	<b>ASSESSMENTS (Variety as per Section 4.52, Chapter 4)</b>
<p>Use the Fundamental Theorem of Calculus to evaluate integrals.</p> <p>Solve first order differential equations.</p> <p>Use various methods of estimation to find area under the curve culminating with applications to real world problems.</p> <p>Apply integration methods to solve authentic problems.</p>	<p>Evaluate definite integrals.</p> <p>Use graphing calculators to evaluate integrals.***</p> <p>Use methods of integration to arrive at solutions with given initial values.</p> <p>Apply the concept of slope fields and integrals to determine equations of functions with given initial conditions,*</p> <p>Represent area under a curve by setting up a series pattern to calculate this area.</p> <p>Use left endpoint rule and right endpoint rule to estimate the value of a definite integral.</p> <p>Use the midpoint rule, trapezoidal rule and Riemann sums with unequal partitions to estimate area under the curve.*</p> <p>Use integrals to find area under the curve.</p>	

\* Used with AP Calculus Class

\*\*\*Requirement for the AP test.

OBJECTIVES	PERFORMANCE INDICATORS	ASSESSMENTS (Variety as per Section 4.52, Chapter 4)
<p>Find volumes of solids of revolution using integration.</p>	<p>Use integrals to find distance and velocity from acceleration with initial conditions.*</p> <p>Apply integrals in order to find solutions to differential equations in the form of <math>y' = ky</math>.*</p> <p>Use the integral as accumulator to solve real world problems.*</p> <p>Calculate the average value of a function over a given interval using integrals.*</p> <p>Use integrals to find the area between two graphs.</p> <p>Use integrals to set up methods of discs, washers, and shells to find volumes of solids of revolution.</p> <p>Use integrals to find the volumes of solids with known cross sections.*</p>	

\* Used with AP Calculus Class

### **Suggested Post AP Topics**

- L'Hopital's Rule for finding limits
- Newton's Method for approximating zeros of functions
- Integration by parts
- Integration using trigonometric substitution
- Integral using partial decomposition of fractions
- Higher level indeterminate forms of limits

The AP Calculus test is not stagnant form of evaluation, therefore, this outline is only a suggestion for the current topics.

Several of the topics that I have suggested for lessons after the AP test were topics on the test in previous years. The AP Calculus teacher must keep abreast of the changes and adjust the curriculum to reflect these changes.

## Books

Calculus of a Single Variable Sixth Edition, Larson, Roland E. and Hostetler, Robert P. Boston: Houghton Mifflin Company, 1998. ISBN:0-395-88578-7

Single Variable Calculus Second Edition, Bradley, Gerald L. Upper Saddle River: Prentice Hall, 1999. ISBN: 0-13-436105-9

Elements of Calculus and Analytic Geometry, Thomas, George B. Jr. Menlo Park: Addison-Wesley Publishing Company, 1976. ISBN: 0-201-07549-0

Calculus: Graphical, Numerical, Algebraic, Finney, Ross L., et al. Scott Foresman Menlo Park: Addison Wesley, 1999. ISBN: 0-201-32445-8

Calculus Concepts and Contexts Single Variable, Stewart, James. New York: Brooks/Cole Publishing Company, 1997. ISBN:0-534-34450-X

Calculus Concepts and Applications, Foerster, Paul A. Berkeley: Key Curriculum Press,1998. ISBN:1-55953-117-7

Calculus Second Edition, Hughes-Hallett, Deborah, et al. New York: John Wiley & Sons, 1998. ISBN: 0-471-16443-7

Advanced Placement Program Course Description:Calculus: Acorn Book, Princeton: Educational Testing Service (ETS), 2000 .\*

Master AP Calculus, Kelly, W. Michael. New York: ARCO: Thomson Learning. ISBN:0-7645-6181-2\*

Differential and Integral Calculus 2/ed, Schaum's Outline Series in Mathematics, Ayres, Frank Jr. New York: McGraw Hill Book Company, 1978. ISBN#:07-002653

## Internet Addresses

[www.mathgv.com](http://www.mathgv.com)

<http://mathforum.org>

[www.pde.state.us](http://www.pde.state.us)

<http://www.math.uncc.edu/placement/>

[www.collegeboard.com/ap/calculus/students/calculus/](http://www.collegeboard.com/ap/calculus/students/calculus/) \*

[www.apcentral.collegeboard.com](http://www.apcentral.collegeboard.com) \*

[www.apexus.com](http://www.apexus.com) \*

[www.ticalc.org](http://www.ticalc.org)

[www.ticares.com](http://www.ticares.com)