
CALCULUS WITH ANALYTIC GEOMETRY

Sixth Edition

correlated to the



**Advanced Placement
Calculus BC Standards**

created for Georgia



McDougal Littell

Advanced Placement for Georgia

Subject Area: Mathematics Course: Advanced Placement Calculus (BC)
 Textbook Title: Calculus with Analytic Geometry, Sixth Edition © 1998
 Publisher: Houghton Mifflin

BC Topic Outline	Where Taught
<p><i>I. Functions, Graphs, and Limits</i></p>	
<p>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.</p>	<p>PE: Students are encouraged to use a graphing utility or computer algebra system as a tool for exploration, discovery, and problem solving throughout the text, although access is not required to use the text effectively. (selected sections) Graphs and Models, 3-10; Linear Models and Rates of Change, 11-19; Functions and Their Graphs, 20-30; A Preview of Calculus, 41-46; The Tangent Line Problem, 91-94, 98-99; A Summary of Curve Sketching, 196-204; Inverse Functions, 329-337; Exponential Functions, 338-339, 348-349; Inverse Trigonometric Functions, 377-379, 383-384; Introduction to Functions of Several Variables, 819-830; Graphs of Trigonometric Functions, A23-A27; (selected features) Motivating the Chapter, 2, 40, 90, 154, 240, 310, 406, 474, 546, 636, 700, 768, 818, 914, 984, 1068; Explorations, 4, 12, 24, 44, 45, 47, 56, 67, 80, 91, 102, 125, 134, 141, 155, 172, 182, 221, 241, 258, 266, 274, 280, 287, 292, 311, 315, 321, 329, 333, 358, 377, 379, 445, 447, 461, 475, 481, 484, 499, 518, 525, 547, 558, 560, 588, 606, 689, 720, 729, 780, 785, 803, 819, 877, 887, 928, 936, 958, 968, 1005, 1034; Section Projects, 86, 140, 178, 195, 237, 286, 357, 402, 434, 453, 489, 498, 567, 573, 580, 661, 680, 747, 764, 776, 793, 848, 885, 901, 949, 955, 973, 1027, 1049, 1066, 1084; see also technology notes and graphing exercises throughout.</p> <p>IRG: P.1, P.2, P.3, 1.1, 2.1, 3.6, 5.3, 5.4, 5.8, 12.1; Motivating the Chapter, 272-281; Explorations, 282-307; Section Projects, 314-336</p>

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
Limits of functions (including one-sided limits).	
<ul style="list-style-type: none"> An intuitive understanding of the limiting process. 	PE: Finding Limits Graphically and Numerically, 47-55; Infinite Limits, 79-86 IRG: 1.2, 1.5
<ul style="list-style-type: none"> Calculating limits using algebra. 	PE: Evaluating Limits Analytically, 56-66; Continuity and One-Sided Limits, 67-78; Infinite Limits, 79-86; Limits at Infinity, 187-195; Limits and Continuity of Vector-Valued Functions, 772-776; Limit of a Function of Two Variables, 832-834 IRG: 1.3, 1.4, 1.5, 3.5, 11.1, 12.2
<ul style="list-style-type: none"> Estimating limits from graphs or tables of data. 	PE: Finding Limits Graphically and Numerically, 47-55; Evaluating Limits Analytically, 56-66; Continuity and One-Sided Limits, 67-78; Infinite Limits, 79-86; Limits at Infinity, 187-195; Limits and Continuity of Vector-Valued Functions, 772-776; Limit of a Function of Two Variables, 832-834 IRG: 1.2, 1.3, 1.4, 1.5, 3.5, 11.1, 12.2
Asymptotic and unbounded behavior.	
<ul style="list-style-type: none"> Understanding asymptotes in terms of graphical behavior. 	PE: Vertical Asymptotes, 80-86; Horizontal Asymptotes, 188-195; Slant Asymptote, 198 IRG: 1.5, 3.5
<ul style="list-style-type: none"> Describing asymptotic behavior in terms of limits involving infinity. 	PE: Infinite Limits, 79-86; Limits at Infinity, 187-195 IRG: 1.5, 3.5
<ul style="list-style-type: none"> Comparing relative magnitudes of functions and their rates of change. (For example, contrasting exponential growth, polynomial growth, and logarithmic growth.) 	PE: Graphs and Models, 3-10; Linear Models and Rates of Change, 11-19; Functions and Their Graphs, 20-30; Newton's Method, 215-220; Exponential Functions, 338-339, 348-349; Vector-Valued Functions, 769-776; Review of Trigonometric Functions, A17-A27 IRG: P.1, P.2, P.3, 3.8, 5.4, 5.5, 11.1, A.3

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
Continuity as a property of functions.	
<ul style="list-style-type: none"> An intuitive understanding of continuity. (Close values of the domain lead to close values of the range.) 	PE: Continuity at a Point and on an Open Interval, 67-68, 75; Continuity of a Function of Two or Three Variables, 835-837 IRG: 1.4, 12.2
<ul style="list-style-type: none"> Understanding continuity in terms of limits. 	PE: Continuity and One-Sided Limits, 67-78; Limits and Continuity of Vector-Valued Functions, 772-776; Limits and Continuity, 831-839 IRG: 1.4, 11.1, 12.2
<ul style="list-style-type: none"> Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem). 	PE: The Intermediate Value Theorem, 74-75, 77-78; Extrema of Functions of Two Variables, 886-888, 893 IRG: 1.4, 12.8
*Parametric, polar, and vector functions. The analysis of planar curves includes those given in parametric form, polar form, and vector form.	PE: Plane Curves and Parametric Equations, 652-661; Polar Coordinates and Polar Graphs, 671-680; Vectors in the Plane, 701-711; Vector-Valued Functions, 769-775; Tangent Vectors and Normal Vectors, 794-801 IRG: 9.2, 9.4, 10.1, 11.1, 11.4

II. Derivatives

Concept of the derivative.	
<ul style="list-style-type: none"> Derivative presented geometrically, numerically, and analytically. 	PE: The Derivative and the Tangent Line Problem, 91-101 IRG: 2.1
<ul style="list-style-type: none"> Derivative interpreted as an instantaneous rate of change. 	PE: Rates of Change, 108-113 IRG: 2.2
<ul style="list-style-type: none"> Derivative defined as the limit of the difference quotient. 	PE: The Derivative of a Function, 94-96, 99-100 IRG: 2.1

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
<ul style="list-style-type: none"> Relationship between differentiability and continuity. 	PE: Differentiability and Continuity, 96-98, 101 IRG: 2.1
Derivative at a point.	
<ul style="list-style-type: none"> 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. 	PE: The Derivative and the Tangent Line Problem, 91-101 IRG: 2.1
<ul style="list-style-type: none"> Tangent line to a curve at a point and local linear approximation. 	PE: The Derivative and the Tangent Line Problem, 91-101 IRG: 2.1
<ul style="list-style-type: none"> Instantaneous rate of change as the limit of average rate of change. 	PE: Rates of Change, 108-113 IRG: 2.2
<ul style="list-style-type: none"> Approximate rate of change from graphs and tables of values. 	PE: Rates of Change, 108-113 IRG: 2.2
Derivative as a function.	
<ul style="list-style-type: none"> Corresponding characteristics of graphs of f and f'. 	PE: Extrema on an Interval, 155-162; Increasing and Decreasing Functions and the First Derivative Test, 169-178; A Summary of Curve Sketching, 196-204 IRG: 3.1, 3.3, 3.6
<ul style="list-style-type: none"> Relationship between the increasing and decreasing behavior of f and the sign of f'. 	PE: Increasing and Decreasing Functions and the First Derivative Test, 169-178 IRG: 3.3
<ul style="list-style-type: none"> The Mean Value Theorem and its geometric consequences. 	PE: Rolle's Theorem and the Mean Value Theorem, 163-168 IRG: 3.2
<ul style="list-style-type: none"> Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa. 	PE: A Summary of Curve Sketching, 196-204 IRG: 3.6

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
Second derivatives.	
<ul style="list-style-type: none"> • Corresponding characteristics of the graphs of f, f', and f''. 	<p>PE: Extrema on an Interval, 155-162; Concavity and the Second Derivative Test, 179-186; A Summary of Curve Sketching, 196-204</p> <p>IRG: 3.1, 3.4, 3.6</p>
<ul style="list-style-type: none"> • Relationship between the concavity of f and the sign of f''. 	<p>PE: Concavity, 179-181, 184-185</p> <p>IRG: 3.4</p>
<ul style="list-style-type: none"> • Points of inflection as places where concavity changes. 	<p>PE: Points of Inflection, 181-182, 185-186</p> <p>IRG: 3.4</p>
Applications of derivatives.	
<ul style="list-style-type: none"> • Analysis of curves, including the notions of monotonicity and concavity. 	<p>PE: Increasing and Decreasing Functions and the First Derivative Test, 169-178; Concavity and the Second Derivative Test, 179-186; Limits at Infinity, 187-195; A Summary of Curve Sketching, 196-204</p> <p>IRG: 3.3, 3.4, 3.5, 3.6</p>
<ul style="list-style-type: none"> + Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration vectors. 	<p>PE: Plane Curves and Parametric Equations, 652-661; Polar Coordinates and Polar Graphs, 671-680; Vectors in the Plane, 701-711; Vector-Valued Functions, 769-775; Velocity and Acceleration, 785-788, 791-792; Tangent Vectors and Normal Vectors, 794-801</p> <p>IRG: 9.2, 9.4, 10.1, 11.1, 11.3, 11.4</p>
<ul style="list-style-type: none"> • Optimization, both absolute (global) and relative (local) extrema. 	<p>PE: Extrema on an Interval, 155-160; Optimization Problems, 205-214; Extrema of Functions of Two Variables, 886-893; Applications of Extrema of Functions of Two Variables, 894-901</p> <p>IRG: 3.1, 3.7, 12.8, 12.9</p>

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
<ul style="list-style-type: none"> Modeling rates of change, including related rates problems. 	<p>PE: Rates of Change, 108-109, 112-113; Related Rates, 141-149; Business and Economics Applications, 228-234; Velocity and Acceleration, 785-788, 791-792</p> <p>IRG: 2.2, 2.6, 3.10, 11.3</p>
<ul style="list-style-type: none"> Use of implicit differentiation to find the derivative of an inverse function. 	<p>PE: Derivative of an Inverse Function, 333-334, 337, 861</p> <p>IRG: 5.3</p>
<ul style="list-style-type: none"> Interpretation of derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration 	<p>PE: Rates of Change, 108-109, 112-113; Related Rates, 141-149; Business and Economics Applications, 228-234; Velocity and Acceleration, 785-788, 791-792</p> <p>IRG: 2.2, 2.6, 3.10, 11.3</p>
+ Geometric interpretation of differential equations via slope fields and the relationship between slope fields and derivatives of implicitly defined functions.	<p>PE: Direction Fields, 249, 312, 327, 347, 356, 363, 375-376; Exact First-Order Equations, 1069-1075</p> <p>IRG: 4.1, 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 15.1</p>
+ Numerical solution of differential equations using Euler's method.	<p>PE: Euler's Method, 1075</p> <p>IRG: 15.1</p>
+ L'Hôpital's rule and its use in determining convergence of improper integrals and series.	<p>PE: Indeterminate Forms and L'Hôpital's Rule, 523-532</p> <p>IRG: 7.7</p>
Computation of derivatives.	
<ul style="list-style-type: none"> Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. 	<p>PE: The Derivative and the Tangent Line Problem, 91-101; Basic Differentiation Rules and Rates of Change, 102-114; The Natural Logarithmic Function and Differentiation, 311-321; Derivative of an Inverse Function, 333-337; Bases Other than e, 348-357; Derivatives of Inverse Trigonometric Functions, 380-384; Differentiation of Inverse Hyperbolic Functions, 398-401</p> <p>IRG: 2.1, 2.2, 5.1, 5.3, 5.5, 5.8, 5.9</p>

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
<ul style="list-style-type: none"> Basic rules for the derivative of sums, products, and quotients of functions. 	PE: Basic Differentiation Rules and Rates of Change, 102-114; The Product and Quotient Rules, 114-119, 121-123 IRG: 2.2, 2.3
<ul style="list-style-type: none"> Chain rule and implicit differentiation 	PE: The Chain Rule, 124-133; Implicit Differentiation, 134-140; Chain Rules for Functions of Several Variables, 857-864 IRG: 2.4, 2.5, 12.5
+ Derivatives of parametric, polar, and vector functions	PE: Parametric Equations and Calculus, 662-670; Slope and Tangent Lines of Polar Graphs, 675-680; Differentiation of Vector-Valued Functions, 777-780, 783-784 IRG: 9.3, 9.4, 11.2

III. Integrals

Interpretations and properties of definite integrals.	
<ul style="list-style-type: none"> Computation of Riemann sums using left, right, and midpoint evaluation points. 	PE: Area, 252-263; Riemann Sums, 264-265, 271-272 IRG: 4.2, 4.3
<ul style="list-style-type: none"> Definite integral as a limit of Riemann sums over equal subdivisions 	PE: Definite Integrals, 266-273 IRG: 4.3
<ul style="list-style-type: none"> Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval: $\int_a^b f(x)dx = f(b) - f(a)$ 	PE: Definite Integrals, 266-273 IRG: 4.3
<ul style="list-style-type: none"> Basic properties of definite integrals. (Examples include additivity and linearity.) 	PE: Properties of Definite Integrals, 269-273; Integration of Vector-Values Functions, 781-784 IRG: 4.3, 11.2

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
<p>*Applications of integrals. Appropriate integrals are used in a variety of applications to model physical, social, or economic situations. Although only a 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 integral of a rate of change to give accumulated change or 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 should include finding the area of a region (including a region bound by polar curves), the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, and the length of a curve (including a curve given in parametric form).</p>	<p>PE: Area of a Region Between Two Curves, 407-415; Volume: The Disc Method, 416-426; Volume: The Shell Method, 427-434; Arc Length and Surfaces of Revolution, 435-444; Work, 445-453; Moments, Centers of Mass, and Centroids, 454-464; Fluid Pressure and Fluid Force, 465-470; Conics and Calculus, 637-651; Parametric Equations and Calculus, 662-670; Area and Arc Length in Polar Coordinates, 681-688; Polar Equations of Conics and Kepler’s Laws, 689-695; Velocity and Acceleration, 785-793; Arc Length and Curvature, 803-814</p> <p>IRG: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 9.1, 9.3, 9.5, 9.6, 11.3, 11.5</p>
<p>Fundamental Theorem of Calculus.</p>	
<ul style="list-style-type: none"> • Use of the Fundamental Theorem to evaluate definite integrals. 	<p>PE: The Fundamental Theorem of Calculus, 274-286</p> <p>IRG: 4.4</p>
<ul style="list-style-type: none"> • Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined. 	<p>PE: The Fundamental Theorem of Calculus, 274-286</p> <p>IRG: 4.4</p>
<p>Techniques of antidifferentiation.</p>	
<ul style="list-style-type: none"> • Antiderivatives following directly from derivatives of basic functions. 	<p>PE: Antiderivatives and Indefinite Integration, 241-251; Integration of Vector-Valued Functions, 781-784</p> <p>IRG: 4.1, 11.2</p>
<ul style="list-style-type: none"> + Antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions (nonrepeating linear factors only). 	<p>PE: Integration by Substitution, 287-298; Basic Integration Rules, 475-480; Integration by Parts, 481-489; Trigonometric Integrals, 490-498; Trigonometric Substitution, 499-507; Partial Fractions, 508-516; Other Integration Techniques, 517-522</p> <p>IRG: 4.5, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6</p>

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
+ Improper integrals (as limits of definite integrals).	PE: Improper Integrals, 533-542 IRG: 7.8
Applications of antidifferentiation.	
<ul style="list-style-type: none"> Finding specific antiderivatives using initial conditions, including applications to motion along a line. 	PE: Initial Conditions and Particular Solutions, 246-251; Velocity and Acceleration, 785-793; applications throughout, e.g., 669, 775, 801, 813, 815 IRG: 4.1, 11.3
<ul style="list-style-type: none"> Solving separable differential equations and using them in modeling. In particular, studying the equation $y' = ky$ and exponential growth. 	PE: Differential Equations: Growth and Decay, 358-365; Differential Equations: Separation of Variables, 366-376 IRG: 5.6, 5.7
+ Solving logistic differential equations and using them in modeling.	PE: Logistics Growth, 516 IRG: 7.5
Numerical approximation to definite integrals. Use of Riemann and trapezoidal sums to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.	PE: Numerical Integration, 299-305 IRG: 4.6

IV. Polynomial Approximations and Series

*Concept of series. A series is defined as a sequence of partial sums, and convergence is defined in terms of the limits of the sequence of partial sums. Technology can be used to explore convergence or divergence.	PE: Sequences, 547-557; Series and Convergence, 558-567 IRG: 8.1, 8.2
*Series of constants	
+ Motivating examples including decimal expansion.	PE: Series and Convergence, 558-567 IRG: 8.2

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
+ Geometric series with applications.	PE: Geometric Series, 560-567, 615 IRG: 8.2
+ The harmonic series.	PE: Alternating Series, 584-587 IRG: 8.5
+ Alternating series with error bound.	PE: Alternating Series, 581-587 IRG: 8.5
+ Terms of series as areas of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of p -series.	PE: The Integral Test and p -series, 568-573 IRG: 8.3
+ The ratio test for convergence and divergence.	PE: The Ratio and Root Test, 588-595 IRG: 8.6
+ Comparing series to test for convergence or divergence.	PE: Comparisons of Series, 574-580 IRG: 8.4
*Taylor series.	
+ Taylor polynomial approximation with graphical demonstration of convergence. (For example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve.)	PE: Taylor Polynomials and Approximations, 596-605 IRG: 8.7
+ Maclaurin series and the general Taylor series centered at $x = a$.	PE: Taylor and Maclaurin Series, 622-631 IRG: 8.10
+ Maclaurin series for the functions e^x , $\sin x$, $\cos x$, and $1/(1 - x)$.	PE: Taylor and Maclaurin Series, 622-631 IRG: 8.10

Georgia—Mathematics: Grade 9-12—Advanced Placement Calculus (BC)
Houghton Mifflin Calculus with Analytic Geometry

BC Topic Outline	Where Taught
+ Formal manipulation of Taylor series and shortcuts to computing Taylor series, including differentiation, antidifferentiation, and the formation of new series from known series.	PE: Taylor and Maclaurin Series, 622-631 IRG: 8.10
+ Functions defined by power series.	PE: Representation of Functions by Power Series, 615-621 IRG: 8.9
+ Radius and interval of convergence of power series.	PE: Radius and Interval of Convergence, 607-609, 613 IRG: 8.8
+ Lagrange error bound for Taylor polynomials.	PE: Remainder of a Taylor Polynomial, 602-603, 605 IRG: 8.7