Advanced Placement Calculus

Functions	Differentiation	Integration
1.01 Demonstrate an understanding of limits both local and global. a) Calculate limits, including one-sided, using algebra. b) Estimate limits from graphs or tables of data. 1.02 Recognize and describe the nature of aberrant behavior caused by asymptotes and unboundedness. a) Understand asymptotes in terms of graphical behavior. b) Describe asymptotic behavior in terms of limits involving infinity. c) Compare relative magnitudes of functions and their rates of change. 1.03 Identify and demonstrate an understanding of continuity of functions. a) Develop an intuitive understanding of continuity. (Close values of the domain lead to close values of the range.) b) Understand continuity in terms of limits. c) Develop a geometric understanding of graphs of continuous functions. (Intermediate Value Theorem and Extreme Value Theorem).	2.01 Explore and interpret the concept of the derivative graphically, numerically, analytically and verbally. a) Interpret derivative as an instantaneous rate of change. b) Define derivative as the limit of the difference quotient. c) Identify the relationship between differentiability and continuity. 2.02 Apply the concept of the derivative at a point. a) Find the 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. b) Find the tangent line to a curve at a point and local linear approximation. c) Find the instantaneous rate of change as the limit of average rate of change. d) Approximate a rate of change from graphs and tables of values. 2.03 Interpret the derivative as a function. a) Identify corresponding characteristics of graphs of f and f'. b) Identify relationship between the increasing and decreasing behavior of f and the sign of f'. c) Investigate the Mean Value Theorem and its geometric consequences. d) Translate between verbal and algebraic descriptions of equations involving derivatives. 2.04 Demonstrate fluency and accuracy in the computation of derivatives. a) Find the derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. b) Use the basic rules for the derivative of sums, products, and quotients of functions. c) Use the chain rule and implicit differentiation. 2.05 Interpret the second derivative. a) Identify the corresponding characteristics of the graphs of f, f', and f''. b) Identify the relationship between the concavity of f and the sign of f''. c) Identify points of inflection as places where concavity changes. 2.06 Apply the derivative in graphing and modeling contexts. a) Analyze curves, with attention to monotonicity and concavity. b) Optimize with both absolute (global) and relative (local) extrema. c) Model rates of change, including related rates problems. d) Use implicit differentiation to find the derivative of an inverse function. e) Interpret the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration. f) Interpret differential equations geometrically via slope fields and the relationship between slope fields and solution curves for differential equations.	3.01 Explore and interpret the concept of the definite integral. a) Compute Riemann sums using left, right, and midpoint evaluation points. b) Find the definite integral as a limit of Riemann sums over equal subdivisions. c) Find the definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval: $\int_a^b f'(x)dx = f(b) - f(a)$ d) Identify basic properties of definite integrals. 3.02 Apply standard techniques of anti-differentiation. a) Find anti-derivatives following directly from derivatives of basic functions. b) Find anti-derivatives by substitution of variables. (including change of limits for definite integrals). 3.03 Apply and interpret the Fundamental Theorem of Calculus. a) Use the Fundamental Theorem to evaluate definite integrals. b) Use the Fundamental Theorem to represent a particular anti-derivative, and the analytical and graphical analysis of functions so defined. 3.04 Define and use appropriate integrals in a variety of applications. a) Interpret the integral of a rate of change to give accumulated change. b) Find specific anti-derivatives using initial conditions. c) Set up and use an approximating Riemann sum or trapezoidal sum and represent its limit as a definite integral. d) Find the area of a region. e) Find the volume of a solid with known cross sections. f) Find the average value of a function. g) Find the distance traveled by a particle along a line. h) Solve separable differential equations and use them in modeling. In particular, study the equation y' = ky and exponential growth.