Calculus 12

General Curriculum Outcomes

A. Students will demonstrate number sense and apply number-theory concepts.
B. Students will demonstrate operation sense and apply operation principles and procedures in both numeric and algebraic situations.
C. Students will explore, recognize, represent, and apply patterns and relationships, both informally and formally.
D. Students will demonstrate an understanding of and apply concepts and skills associated with measurement.
E. Students will demonstrate spatial sense and apply geometric concepts, properties, and relationships.
F. Students will solve problems involving the collection, display, and analysis of data.
G. Students will represent and solve problems involving uncertainty.

Specific Curriculum Outcomes

Students will be expected to

Limits and Continuity

A1   apply, understand, and explain average and instantaneous rates of change and extend these concepts to secant line and tangent line slopes

B1   calculate and interpret average and instantaneous rate of change
B2   calculate limits for function values and apply the properties with and without technology
B3   remove removable discontinuities by extending or modifying a function
B4   apply the properties of algebraic combinations and composites of continuous functions

C1   identify the intervals upon with a given function is continuous and understand the meaning of a continuous function
C2   understand the development of the slope of a tangent line from the slope of a secant line
C3   find the equations of the tangent and normal lines at a given point

Derivatives

A2   demonstrate an understanding of the definition of the derivative
A3   demonstrate an understanding of implicit differentiation and identify situations that require implicit differentiation

B5   find where a function is not differentiable and distinguish between corners, cusps, discontinuities, and vertical tangents
B6   derive, apply, and explain power, sum, difference, product and quotient rules
B7   apply the chain rule to composite functions
B8   use derivatives to analyze and solve problems involving rates of change
B9   apply the rules for differentiating the six trigonometric functions

B10   (optional) apply the rules for differentiating the six inverse trigonometric functions
B11   calculate and apply derivatives of exponential and logarithmic functions
B12   (optional) apply Newton's method to approximate zeros of a function
B13   estimate the change in a function using differentials and apply them to real world situations
B14   solve and interpret related rate problems

More Applications of Derivatives

B15   demonstrate an understanding of critical points and absolute extreme values of a function
B16   find the intervals on which a function is increasing or decreasing
B17   solve application problems involving maximum or minimum values of a function

C5   apply the First and Second Derivative Tests to determine the local extreme values of a function
C6   determine the concavity of a function and locate the points of inflection by analyzing the second derivative

B18   apply rules for definite integrals
B19   apply the Fundamental Theorem of Calculus
B20   compute indefinite and definite integrals by the method of substitution
B21   (optional) apply integration by parts to evaluate indefinite and definite integrals
B22   solve problems in which a rate is integrated to find the net change over time

C8   understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus
C9   construct antiderivatives using the Fundamental Theorem of Calculus
C10   find antiderivatives of polynomials, e^{kx}, and selected trigonometric functions of kx

D1   apply and understand how Riemann's sum can be used to determine the area under a polynomial curve
D2   demonstrate an understanding of the meaning of area under the curve
D3   express the area under the curve as a definite integral
D4   compute the area under the curve using numerical integration procedures
D5   apply integration to calculate areas of regions in a plane

B23   (optional) solve a differential equation of the form $dy/dx = g(x)h(y)$, in which the variables are separable
B24   (optional) solve problems involving exponential growth and decay
B25   (optional) apply Euler's method to find approximate solutions to differential equations with initial values

C11   (optional) construct slope fields using technology and interpret them as visualizations of differential equations

D6   (optional) apply integration (by slices or shells) to calculate volumes of solids

The Definite Integral and its Applications

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Techniques of Integration (optional)

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D6   (optional) apply integration (by slices or shells) to calculate volumes of solids