

# 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 which 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

- 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
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## Techniques of Integration (optional)

- 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