

ISPS AP Calculus Standards and Benchmarks

Grades 11-12

Standard 1 - The student will use elementary functions, including algebraic, trigonometric, exponential, and logarithmic.

Benchmarks - By the end of Grade 12, students will:

- 1 – 1 Define a function and relate the idea of function to real situations.
- 1 – 2 Find the domain and range of a function with and without a graphing calculator.
- 1 – 3 Find the sum, product, and quotient of two functions.
- 1 – 4 Find the composition of two functions.
- 1 – 5 Find the domain of a composition of two functions.
- 1 – 6 Find and apply the absolute value of a function.
- 1 – 7 Find and use the inverse of a function.
- 1 – 8 Determine if a function is odd, even, or neither odd nor even.
- 1 – 9 Determine periodicity and amplitude of a function.
- 1 – 10 Describe the symmetry of a function.
- 1 – 11 Find the asymptotes of a function.
- 1 – 12 Find the zeros of a function.
- 1 – 13 Use a^x and $\log_a x$ and their inverse relationships.

Standard 2 - The student will find and use limits of various functions.

Benchmarks - By the end of Grade 12, students will:

- 2 – 1 Find limits of functions by direct substitution.
- 2 – 2 Find the limit of a quotient of indeterminate form.
- 2 – 3 Find the limit of a function as the independent variable approaches infinity.
- 2 – 4 Find the limit of a function by examining its graph using a graphing calculator.
- 2 – 5 Recognize the limit of special functions.
- 2 – 6 Recognize functions that have non-existent limits.
- 2 – 7 Evaluate the limits of sums, products, quotients and compositions of functions.

Standard 3 - The student will use the definition of continuity.

Benchmarks - By the end of Grade 12, students will:

- 3 – 1 Apply the definition of continuity and find excluded values of a discontinuous function.
- 3 – 2 Use the Extreme Value Theorem
- 3 – 3 Apply the Intermediate Value Theorem

Standard 4 - The student will use the concepts of differential calculus.

Benchmarks - By the end of Grade 12, students will:

- 4 – 1 Understand the concept of the derivative.
- 4 – 2 State and apply the definitions of the derivative.
- 4 – 3 Find the derivatives of elementary functions.
- 4 – 4 Find the derivatives of a sum, product, and quotient.
- 4 – 5 Find the derivatives of a composite function (chain rule).
- 4 – 6 Find the derivatives of an implicitly defined function.
- 4 – 7 Find the derivatives of the inverse of a function.
- 4 – 8 Use logarithmic differentiation.
- 4 – 9 Find derivatives of higher order.
- 4 – 10 Apply the Mean Value Theorem and Rolle's Theorem.
- 4 – 11 Use the relation between differentiability and continuity.

Standard 5 - The student will apply the concepts of a derivative.

Benchmarks - By the end of Grade 12, students will:

- 5 – 1 Find the slope of a curve.
- 5 – 2 Find the tangent line to a curve.
- 5 – 3 Find the normal line to a curve.
- 5 – 4 Use the differential to approximate values.
- 5 – 5 Determine where a function is increasing and where it is decreasing.
- 5 – 6 Find critical points, relative (local) and absolute maximum and minimum points.
- 5 – 7 Determine the concavity and point of inflection of a function.
- 5 – 8 Use the graph of the derivative of a function to identify information about the function.
- 5 – 9 Solve extreme value problems.
- 5 – 10 Find the velocity and the acceleration of a particle moving along a line.
- 5 – 11 Find average rates of change
- 5 – 12 Find instantaneous rates of change.
- 5 – 13 Determine related rates of change.

Standard 6 - The student will use the concepts of integral calculus.

Benchmarks - By the end of Grade 12, students will:

- 6 – 1 Find antiderivatives.
- 6 – 2 Find the distance and velocity from acceleration with initial conditions.
- 6 – 3 Solve simple first order differentiable equations.
- 6 – 4 Apply solutions of $y' = ky$ to growth and decay problems.
- 6 – 5 Use basic integration formulas.
- 6 – 6 Use substitution to integrate.
- 6 – 7 Do simple integration by parts.
- 6 – 8 Approximate the area under a curve using rectangles or trapezoids.
- 6 – 9 Recognize the definitions of the definite integral as the limit of a sum.
- 6 – 10 Understand the concept of the definite integral.
- 6 – 11 Apply the properties of the definite integral.
- 6 – 12 Use the Fundamental Theorem.

Standard 7 - The student will apply the concept of the definite integral.

Benchmarks - By the end of Grade 12, students will:

- 7 – 1 Find the average (mean) value of a function over an interval.
- 7 – 2 Find the area between curves.
- 7 – 3 Find the volume of a solid of revolution about the axes of lines parallel to the axes.
- 7 – 4 Find the volume of a solid of known cross-section.
- 7 – 5 Apply the definition of the integral to model problems in physics, economics, etc.