

Calculus

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
MA.912.C	Calculus		
MA.912.C.1	Develop an understanding of the concept of limit by estimating limits graphically and numerically, and evaluating limits analytically. Extend the idea of a limit to one-sided limits and limits at infinity. Use limits to define and understand the concept of continuity, decide whether a function is continuous at a point, and find types of discontinuities. Understand and apply continuity theorems.		
MA.912.C.1.1	Understand the concept of limit and estimate limits from graphs and tables of values.	Limits and Continuity	Concept of a Limit
MA.912.C.1.2	Find limits by substitution.	Limits and Continuity	Algebraic Computation of a Limit
MA.912.C.1.3	Find limits of sums, differences, products, and quotients.	Limits and Continuity	Algebraic Computation of a Limit
MA.912.C.1.4	Find limits of rational functions that are undefined at a point.	Limits and Continuity	Algebraic Computation of a Limit
MA.912.C.1.5	Find one-sided limits.	Limits and Continuity	Concept of a Limit
MA.912.C.1.6	Find limits at infinity.	Limits and Continuity	Limits Involving Infinity
MA.912.C.1.7	Decide when a limit is infinite and use limits involving infinity to describe asymptotic behavior.	Limits and Continuity	Continuity
MA.912.C.1.8	Find special limits such as the limit as x approaches 0 of $(\sin x) / x$.	Limits and Continuity	Limits Involving Infinity

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MA.912.C.1.9	Understand continuity in terms of limits.	Limits and Continuity	Continuity
MA.912.C.1.10	Decide if a function is continuous at a point.	Limits and Continuity	Continuity
MA.912.C.1.11	Find the types of discontinuities of a function.	Limits and Continuity	Continuity
MA.912.C.1.12	Understand and use the Intermediate Value Theorem on a function over a closed interval.	Limits and Continuity	Intermediate Value Theorem
MA.912.C.1.13	Understand and apply the Extreme Value Theorem: If $f(x)$ is continuous over a closed interval, then f has a maximum and a minimum on the interval.	Graph Behavior	Absolute Extreme Values and Extreme Value Theorem
MA.912.C.2	Develop an understanding of the derivative as an instantaneous rate of change, using geometrical, numerical, and analytical methods. Use this definition to find derivatives of algebraic and transcendental functions and combinations of these functions (using, for example, sums, composites, and inverses). Find second and higher order derivatives. Understand and use the relationship between differentiability and continuity. Understand and apply the Mean Value Theorem. Find derivatives of algebraic, trigonometric,		

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	logarithmic, and exponential functions. Find derivatives of sums, products, and quotients, and composite and inverse functions. Find derivatives of higher order, and use logarithmic differentiation and the Mean Value Theorem.		
MA.912.C.2.1	Understand the concept of derivative geometrically, numerically, and analytically, and interpret the derivative as an instantaneous rate of change, or as the slope of the tangent line.	Derivatives	Concept of a Derivative
MA.912.C.2.2	State, understand, and apply the definition of derivative.	Derivatives	Concept of a Derivative
MA.912.C.2.3	Find the derivatives of functions, including algebraic, trigonometric, logarithmic, and exponential functions.	Differentiation	Basic Computation Rules
MA.912.C.2.4	Find the derivatives of sums, products, and quotients.	Differentiation	Basic Computation Rules
MA.912.C.2.5	Find the derivatives of composite functions, using the Chain Rule.	Differentiation	Product, Quotient and Chain Rules
MA.912.C.2.6	Find the derivatives of implicitly-defined functions.	Differentiation	Implicit Differentiation
MA.912.C.2.7	Find derivatives of inverse functions.	Differentiation	Derivatives of Inverse Functions

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MA.912.C.2.8	Find second derivatives and derivatives of higher order.	Differentiation	Higher Order Derivatives
MA.912.C.2.9	Find derivatives using logarithmic differentiation.	Differentiation	Implicit Differentiation
MA.912.C.2.10	Understand and use the relationship between differentiability and continuity.	Derivatives Differentiation	Covered throughout units
MA.912.C.2.11	Understand and apply the Mean Value Theorem.	Derivative Applications	Mean Value and Rolle's Theorems
MA.912.C.3	Apply knowledge about derivatives to find slopes of curves and the related tangent lines. Analyze and graph functions, finding where they are increasing or decreasing, their maximum and minimum points, their points of inflection, and their concavity. Solve optimization problems, find average and instantaneous rates of change (including velocities and accelerations), and model rates of change. Find slopes and equations of tangent lines, maximum and minimum points, and points of inflection. Solve optimization problems, and find rates of change.		
MA.912.C.3.1	Find the slope of a curve at a point, including points at which there are vertical tangent lines and no tangent lines.		

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MA.912.C.3.2	Find an equation for the tangent line to a curve at a point and a local linear approximation.		
MA.912.C.3.3	Decide where functions are decreasing and increasing. Understand the relationship between the increasing and decreasing behavior of f and the sign of f' .	Graph Behavior	Increasing/Decreasing Behavior and Concavity
MA.912.C.3.4	Find local and absolute maximum and minimum points.	Graph Behavior	Absolute Extreme Values and Extreme Value Theorem
MA.912.C.3.5	Find points of inflection of functions. Understand the relationship between the concavity of f and the sign of f'' . Understand points of inflection as places where concavity changes.	Graph Behavior	Relative Extreme Values and Points of Inflection
MA.912.C.3.6	Use first and second derivatives to help sketch graphs. Compare the corresponding characteristics of the graphs of f , f' , and f'' .	Graph Behavior	Relative Extreme Values and Points of Inflection
MA.912.C.3.7	Use implicit differentiation to find the derivative of an inverse function.	Differentiation	Implicit Differentiation
MA.912.C.3.8	Solve optimization problems.	Derivative Applications	Optimization
MA.912.C.3.9	Find average and instantaneous rates of change. Understand the instantaneous rate of change as the limit of the average rate of change. Interpret a derivative as a rate of change in applications, including velocity, speed, and acceleration.	Derivative Applications	Mean Value and Rolle's Theorems

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MA.912.C.3.10	Find the velocity and acceleration of a particle moving in a straight line.	Derivative Applications	Rates of Change
MA.912.C.3.11	Model rates of change, including related rates problems.	Derivative Applications	Rates of Change
MA.912.C.3.12	Solve problems using the Newton-Raphson method.		
MA.912.C.4	Understand that integration is used to find areas, and evaluate integrals using rectangular approximations. From this, develop the idea that integration is the inverse operation to differentiation - the Fundamental Theorem of Calculus. Use this result to find definite and indefinite integrals, including using the method of integration by substitution. Apply approximate methods, such as the Trapezoidal Rule, to find definite integrals. Define integrals using Riemann sums, use the Fundamental Theorem of Calculus to find integrals using antiderivatives, and use basic properties of integrals. Integrate by substitution, and find approximate integrals.		
MA.912.C.4.1	Use rectangle approximations to find approximate values of integrals.	The Definite Integral	Area and Riemann Sums
MA.912.C.4.2	Calculate the values of Riemann Sums over equal subdivisions using left, right, and midpoint evaluation points.	The Definite Integral	Approximation Methods

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MA.912.C.4.3	Interpret a definite integral as a limit of Riemann sums.	The Definite Integral	Area and Riemann Sums
MA.912.C.4.4	Interpret a definite integral of the rate of change of a quantity over an interval as the change of the quantity over the interval. That is, the integral from a to b of $f'(x)dx = f(b) - f(a)$ (Fundamental Theorem of Calculus).	The Definite Integral	The Fundamental Theorem of Calculus
MA.912.C.4.5	Use the Fundamental Theorem of Calculus to evaluate definite and indefinite integrals and to represent particular antiderivatives. Perform analytical and graphical analysis of functions so defined.	The Definite Integral	The Fundamental Theorem of Calculus
MA.912.C.4.6	Use these properties of definite integrals:		
MA.912.C.4.6.a	The integral from a to b of $[f(x) + g(x)]dx =$ the integral from a to b of $f(x)dx +$ the integral from a to b of $g(x)dx$.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.6.b	The integral from a to b of $k * f(x)dx =$ k times the integral from a to b of $f(x)dx$.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.6.c	The integral from a to b of $f(x)dx = 0$.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.6.d	The integral from a to b of $f(x)dx =$ negative 1 times the integral from b to a of $f(x)dx$.	The Definite Integral	Computation of Definite Integrals

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MA.912.C.4.6.e	The integral from a to b of $f(x)dx$ + the integral from b to c of $f(x)dx$ = the integral from a to c of $f(x)dx$.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.6.f	If $f(x)$ is less than or equal to $g(x)$ on $[a, b]$, then the integral from a to b of $f(x)dx$ is less than or equal to the integral from a to b of $g(x)dx$.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.7	Use integration by substitution (or change of variable) to find values of integrals.	The Definite Integral	Computation of Definite Integrals
MA.912.C.4.8	Use Riemann Sums, the Trapezoidal Rule, and technology to approximate definite integrals of functions represented algebraically, geometrically, and by tables of values.	The Definite Integral	Approximation Methods
MA.912.C.5	Apply knowledge about integrals to finding velocities from accelerations, solving separable differential equations, and finding areas and volumes. Apply integration to model, and solve problems in physics, biology, economics, etc. Find velocity functions and position functions from their derivatives, solve separable differential equations, and use definite integrals to find areas and volumes.		
MA.912.C.5.1	Find specific antiderivatives using initial conditions, including finding velocity functions from acceleration functions, finding position functions from velocity functions, and solving applications related to motion along a line.	Antidifferentiation	Initial Value Problems
MA.912.C.5.2	Solve separable differential equations and use them in modeling.	Differential Equations and Their Applications	Separable Differential Equations

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MA.912.C.5.3	Solve differential equations of the form $dy/dt = ky$ as applied to growth and decay problems.	Differential Equations and Their Applications	Growth and Decay Models
MA.912.C.5.4	Use slope fields to display a graphic representation of the solution to a differential equation and locate particular solutions to the equation.	Antidifferentiation	Slope Fields
MA.912.C.5.5	Use definite integrals to find the area between a curve and the x-axis, or between two curves.	Area and Volume	Area Between Two Curves
MA.912.C.5.6	Use definite integrals to find the average value of a function over a closed interval.	Area and Volume	Area Between Two Curves
MA.912.C.5.7	Use definite integrals to find the volume of a solid with known cross-sectional area, including solids of revolution.	Area and Volume	Volume of Solids Using Cross Sections
MA.912.C.5.8	Apply integration to model and solve problems in physical, biological, and social sciences.	Differential Equations and Their Applications	Growth and Decay Models