

# Math

## PRE CALCULUS

### STANDARD 1

**The student understands and applies the concepts and procedures of number sense and numeration.**

To meet this standard, the student will:

**Benchmark PC.1.1: Understand numbers, ways of representing numbers, relationships among numbers, and number systems**

**Indicators:**

- PC.1.1.1 Apply their understanding of very large and very small numbers and of various representations of them
- PC.1.1.2 Demonstrate fluency in operations with real and complex numbers
- PC.1.1.3 Understand vectors as a system that has some of the properties of the real-number system
- PC.1.1.4 Evaluate, simplify, or rearrange numbers of rational powers in exponential or radical form
- PC.1.1.5 Simplify or evaluate logarithmic or exponential expressions using the properties of logarithms
- PC.1.1.6 Understand trigonometric identities and their relationships to algebraic properties
- PC.1.1.7 Understand both degree and radian modes as acceptable methods for measuring angles
- PC.1.1.8 Translate radian to degree mode measures and visa versa
- PC.1.1.9 Memorize the trigonometric ratios for  $30^\circ$ ,  $45^\circ$ , and  $60^\circ$  (the unit circle)

**Benchmark PC.1.2: Demonstrate understanding of operations and how they relate to one another**

**Indicators:**

- PC.1.2.1 Apply and operate within the properties of numbers and number systems; including real and complex numbers
- PC.1.2.2 Judge the effects of such operations as multiplication, division, and computing powers and roots on the magnitudes of quantities
- PC.1.2.3 Understand properties of, and representations for the addition and multiplication of vectors
- PC.1.2.4 Evaluate limits of functions to determine slope or value of an infinite series
- PC.1.2.5 Evaluate definite integrals using the Fundamental Theorem of Calculus

**Benchmark PC.1.3: Compute fluently and make reasonable estimates, using a variety of strategies and tools**

**Indicators:**

- PC.1.3.1 Solve multi-step problems involving applications of ~~percent, ratio, and rate~~ as they arise throughout the course
- PC.1.3.2 Distinguish between exact and approximate representations of the same quantity and choose appropriately between them in the given situation (e.g. values involving  $\pi$  or radicals)
- PC.1.3.3 Evaluate the slope of a tangent line of a curve at a given point, using the equation of the derivative for that curve
- PC.1.3.4 Use a graphing calculator effectively for applications that arise throughout the course

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- PC.1.3.5 Judge the reasonableness of answers to problems by considering likely results within the situation described in the problem
- PC.1.3.6 Judge the reasonableness of answers produced by a calculator, a computer, pencil and paper, or using mental mathematics and estimation

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# Math

## PRE CALCULUS

### STANDARD 2

*The student understands and applies the concepts and procedures of algebra and patterns.*

**To meet this standard, the student will:**

**Benchmark PC.2.1: Understand patterns, relations, and functions**

**Indicators:**

- PC.2.1.1 Identify and evaluate functions, including domain and range
- PC.2.1.2 Classify functions by symmetry families, continuity
- PC.2.1.3 Describe the behavior of a function
- PC.2.1.4 Write terms of an arithmetic and geometric sequence, given the formula for the nth term
- PC.2.1.5 Determine the explicit formula to express sequences and describe as convergent or divergent
- PC.2.1.6 Express a finite or infinite series using sigma notation

**Benchmark PC.2.2: Solve problems, using the properties of patterns, relations, and functions**

**Indicators:**

- PC.2.2.1 Perform operations with functions, including composites and iterates
- PC.2.2.2 Solve equations and applications involving rational exponents, logarithms, exponential variables, or radicals
- PC.2.2.3 Solve inequalities using algebraic manipulation and graphing
- PC.2.2.4 Use algebraic modeling as a problem-solving strategy in various topics of the course
- PC.2.2.5 Evaluate the area under the curve using the Fundamental Theorem of Calculus

**Benchmark PC.2.3: Rearrange formulas and expressions to solve equations**

**Indicators:**

- PC.2.3.1 Manipulate algebraic or geometric equations and formulas, with and without substitution, as they arise in topics throughout the course to solve or simplify
- PC.2.3.2 Manipulate equations involving trigonometry, with and without substitution, to simplify, verify, or solve, appropriate to the given domain
- PC.2.3.3 Simplify or evaluate trigonometric expressions using the properties of trigonometry
- PC.2.3.4 Determine the equation of the derivative of a function using the properties of derivatives

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**Benchmark PC.2.4: Demonstrate the relationships between the form of an equation and the shape of its graph**

**Indicators:**

- PC.2.4.1 Understand how to test and interpret an equation to determine the location and shape based on: transformations from its parent graph, asymptotes, [dis]continuity, symmetry, intercepts, and slope of the curve
- PC.2.4.2 Demonstrate understanding of the relationship between the equation and graph of a function: linear, polynomial, quadratic, cubic, radical, absolute value, rational, trigonometric, exponential, logarithmic, piecewise defined, and greatest integer function.
- PC.2.4.3 Demonstrate strategies of graphing or algebraic manipulation to determine the inverse of functions, applying appropriate domain and range restrictions
- PC.2.4.4 Identify and write equations using period, altitude, and phase shift of the six trigonometric functions
- PC.2.4.5 Graph the composites and inverses of trigonometric functions applying appropriate domain if functions are required
- PC.2.4.6 Write and graph parametric equations
- PC.2.4.7 Determine the slope of the curve and the equation of the tangent line to a point on the curve by differentiation
- PC.2.4.8 Understand and apply basic properties of differentiation to determine relative maximum and minimum, and points of inflection

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*SCS Curriculum, Math, Pre Calculus, approved Jan. 15, 2007, revised May, 2009*

# Math

## PRE CALCULUS

### STANDARD 3

*The student understands and applies the concepts and procedures of geometry.*

**To meet this standard, the student will:**

**Benchmark PC.3.1: Specify locations and describe spatial relationships using coordinate geometry**

**Indicators:**

- PC.3.1.1 Understand and represent translations, reflections, rotations, and dilations (and compositions of these) of objects in the plane by using coordinates, vectors, and function notation
- PC.3.1.2 Locate a point in three-dimensional space using x, y, and z axes
- PC.3.1.3 Use coordinates to describe and analyze vectors

**Benchmark PC.3.2: Analyze characteristics and properties of two- and three-dimensional geometric shapes and use geometric relationships to solve problems**

**Indicators:**

- PC.3.2.1 Visualize three-dimensional objects (specifically cones) and analyze their cross sections (conic sections: parabola, hyperbola, ellipse, circle)
- PC.3.2.2 Apply properties of circles and right triangles to develop trigonometric ratios
- PC.3.2.3 Use trigonometric ratios and right triangles to determine lengths and angle measures in mathematical and real world applications
- PC.3.2.4 Apply geometric relationships to solve problems as they arise in the course (e.g. parallelism, perpendicularity, polygons, circles)

**Benchmark PC.3.3: Use visualization, spatial reasoning, and geometric modeling to solve problems**

**Indicator:**

- PC.3.3.1 Use geometric ideas to solve problems in, and gain insights into, other disciplines and other areas of interest

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# Math

## PRE CALCULUS

### STANDARD 4

The student *understands and applies the concepts and procedures of measurement.*

To meet this standard, the student will:

**Benchmark PC.4.1: Understand measurable attributes of objects and the units, systems, and processes of measurement**

**Indicators:**

- PC.4.1.1 Make decisions about units and scales that are appropriate for problem situations involving measurement
- PC.4.1.2 Apply informal concepts of successive approximation, upper and lower bounds, and limit in measurement situations
- PC.4.1.3 Judge the reasonableness of answers to measurement problems considering likely results within the situations described in the problem

**Benchmark PC.4.2: Apply appropriate techniques, tools, and formulas to determine measurements**

**Indicators:**

- PC.4.2.1 Apply appropriate trigonometric relationships to find the lengths, angles, or area of a given right or non-right triangle
- PC.4.2.2 Apply Law of Sines and Law of Cosines to find angles, side lengths, and area in triangles or vectors
- PC.4.2.3 Evaluate arc length and sector and section area, using appropriate formulas

**Benchmark PC.4.3: Solve problems involving situations involving one or more formulas from science, statistics, finance, or other as they arise in the course**

**Indicators:**

- PC.4.3.1 Use trigonometric relationships to solve problems involving triangles in real world situations

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SCS Curriculum, Math, Pre Calculus, approved Jan. 15, 2007, revised May, 2009

# Math

## PRE CALCULUS

### STANDARD 5

*The student understands and applies the concepts and procedures of data analysis and probability.*

**To meet this standard, the student will:**

**Benchmark PC.5.1: Understand how to evaluate the probability of an event based on its parameters**

**Indicators:**

- PC.5.1.1 Solve problems involving formulas for permutations, combinations, and the basic counting principle
- PC.5.1.2 Classify events as independent, dependent, and mutually exclusive or inclusive
- PC.5.1.3 Evaluate the odds of an event occurring or not occurring
- PC.5.1.4 Use experimental probability and simulations for models

**Benchmark PC.5.2: Students will collect, organize, evaluate, and display data using appropriate statistical methods**

**Indicators:**

- PC.5.2.1 Demonstrate an understanding of principles of sampling and surveying and apply the principles in designing and carrying out experiments to investigate the relationships between variables
- PC.5.2.2 Organize and analyze data, using measures of central tendency (mean, median), spread (range, standard deviation, mean deviation), a frequency distribution table, and possible outliers
- PC.5.2.3 Describe trends and relationships observed in data, make inferences from data, compare the inferences with hypotheses about the data, and explain the differences between the inferences and the hypotheses
- PC.5.2.4 Analyze scatter plots with linear and non-linear models

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