

Pre-Calculus

Vectors & Matrices VM

Vector Quantities: Students recognize, model, and write vector quantities.

- 1 Recognize that vector quantities have both magnitude and direction and can be represented by directed line segments. PC.VM.1
- 2 Write vector quantities using appropriate symbols indicating magnitude and direction. PC.VM.2

Vector Operations: Students perform operations involving vectors.

- 3 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. PC.VM.3
- 4 Solve problems involving velocity and other quantities that can be represented by vectors. PC.VM.4
- 5 Add and subtract vectors graphically and algebraically. PC.VM.5
- 6 Multiply a vector by a scalar graphically and analytically; reverse their direction when possible. PC.VM.6

Matrix Operations: Students represent and perform operations with matrices.

- 7 Use matrices to list, describe, and manipulate data with and without technology. PC.VM.7
- 8 Multiply matrices, understanding that matrix multiplication for square matrices is not commutative. PC.VM.8
- 9 Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. PC.VM.9
- 10 Work with 2×2 matrices as transformations of the plane; interpret the absolute value of the determinant in terms of area. PC.VM.10

Trigonometry TR

Radians: Students understand, explain, and describe radian measure.

- 1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. PC.TR.1
- 2 Convert between radian and degree measure. PC.TR.2
- 3 Explain how the unit circle can be used to model sine, cosine, tangent, secant, cosecant, and cotangent for all real numbers. PC.TR.3

Unit Circle: Students use the unit circle to express and find exact values for trigonometric functions.

- 4 Construct special right triangles on the unit circle to find the exact values of sine, cosine, tangent for $\pi/3$, $\pi/4$, $\pi/6$, and $\pi/2$. **PC.TR.4**
- 5 Use the unit circle to express the values of sine, cosine, and tangent for $\pi - x$, $\pi + x$, and $2\pi - x$ in terms of their exact values for x , where x is one of these values: $\pi/3$, $\pi/4$, $\pi/6$, and $\pi/2$. **PC.TR.5**

Identities, Formulas, & Laws: Students develop and apply identities, formulas, and laws using trigonometry.

- 6 Develop the Pythagorean identity, $\sin^2(\theta) + \cos^2(\theta) = 1$. **PC.TR.6**
- 7 Apply the Pythagorean identity to find the remaining trigonometric functions when given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle. **PC.TR.7**
- 8 Develop addition, subtraction, double, and half-angle formulas for sine, cosine, and tangent and use them to solve problems, including verifying other identities. **PC.TR.8**
- 9 Develop the formula for the area of a triangle, $A = \frac{1}{2} ab \sin C$, using trigonometry. **PC.TR.9**
- 10 Develop and apply the Law of Sines and the Law of Cosines to solve real-world and mathematical problems including finding unknown measurements in right and non-right triangles. **PC.TR.10**
- 11 Define and use reciprocal functions, cosecant, secant, and cotangent to solve problems. **PC.TR.11**

Solve & Graph: Students explore, solve, and sketch the graphs of periodic trigonometric functions.

- 12 Explain whether a trigonometric function is even or odd and recognize the periodicity of the graph using the unit circle. **PC.TR.12**
- 13 Graph trigonometric and inverse trigonometric functions and show period, midline, and amplitude. **PC.TR.13**
- 14 Select a trigonometric function that models real-world contexts. **PC.TR.14**
- 15 Explain how restricting the domain of a trigonometric function allows the creation of its inverse. **PC.TR.15**
- 16 Solve and evaluate the solution of trigonometric equations in real-world contexts; interpret the solution in terms of its context. **PC.TR.16**
- 17 Recognize that some trigonometric equations have infinitely many solutions and be able to state a general formula to represent the infinite solutions. **PC.TR.17**
- 18 Calculate and interpret the average rate of change over a specified interval of a trigonometric function represented in a table, graph, or as an equation in the context of real-world and mathematical problems. **PC.TR.18**

- 1 Derive the general form of the equation of a circle using the Distance Formula or Pythagorean Theorem. [PC.CS.1](#)
- 2 Derive the equation of a parabola given a focus and directrix. [PC.CS.2](#)
- 3 Derive the equations of ellipses and hyperbolas given the foci using the Distance Formula. [PC.CS.3](#)

Explore Equations: Students identify, analyze, and sketch the graphs of the conic sections and relate their equations and graphs.

- 4 Find the equations for the asymptotes of a hyperbola. [PC.CS.4](#)
- 5 Generate an equivalent form of an equation for a conic section by completing the square to identify key characteristics. [PC.CS.5](#)
 - 1 Conic sections include: circles, ellipses, parabolas, and hyperbolas [PC.CS.5.1](#)
- 6 Identify, graph, write, and analyze equations of each type of conic section using properties and technology when appropriate. [PC.CS.6](#)
 - 1 Conic sections include: circles, ellipses, parabolas, and hyperbolas [PC.CS.6.1](#)
 - 2 Properties include: symmetry, intercepts, foci, asymptotes, and eccentricity [PC.CS.6.2](#)

Systems of Equations & Inequalities: Students solve systems of equations and inequalities involving conic sections.

7. Solve systems of equations and inequalities involving conics and other types of equations, with and without technology. [PC.CS.7](#)
 - 1 Equations include: conic-conic and conic-linear [PC.CS.7.1](#)

Functions [FN](#)

Solve Problems: Students derive and apply functions.

- 1 Understand that sequences are functions, sometimes defined recursively, whose domains are a subset of the integers. [PC.FN.1](#)
- 2 Derive the formula for the sum of a finite geometric series; apply the formula to solve conceptual problems. [PC.FN.2](#)
- 3 Apply the Binomial Theorem for the expansion of $(a + b)^n$ in powers of a and b for a positive integer n , where a and b are any number. [PC.FN.3](#)
- 4 Build functions to model real-world contexts using algebraic operations on functions and composition, with and without appropriate technology. [PC.FN.4](#)

Explore Graphing: Students graph and interpret functions.

- 5 Graph power and polynomial functions, identify zeros (when suitable factorizations are available), and show end behavior. [PC.FN.5](#)
- 6 Graph rational functions, identify zeros, holes and asymptotes (when suitable factorizations are available), and show end behavior. [PC.FN.6](#)
 - 1 Asymptotes include: horizontal, vertical, and oblique [PC.FN.6.1](#)

- 7 Graph exponential and logarithmic functions; show intercepts and end behavior. **PC.FN.7**
- 8 Compare key features of two functions each represented in a different way. **PC.FN.8**
 - 1 Representations include: algebraic, graphic, numeric in tables, and verbal descriptions **PC.FN.8.1**