Precalculus Yearlong Mathematics Map

Resources: Approved from Board of Education	**Assessments:** District Benchmark Assessments

Common Core State Standards – Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Conceptual Category	Domain	Cluster	Common Core Standard	Content	Skills	Academic Vocabulary
N	CN	Perform arithmetic operations with complex numbers.	N-CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	Complex numbers - Conjugate	N-CN.3 Find the conjugate of a complex number	moduli, rationalizing the denominator
N	CN	Perform arithmetic operations with complex numbers.	N-CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	Complex numbers - Conjugate	N-CN.3 Find moduli and quotients of complex numbers using conjugates	moduli
N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.	Complex numbers - Complex plane	N-CN.4 Represent complex numbers on the complex plane in rectangular and polar form	polar coordinates, rectangular coordinates, lemniscate, limacon, rose, cardioid
N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.	Complex numbers - Complex plane	N-CN.4 Explain why the rectangular and polar forms of a given complex number represent the same number	equivalent forms, unit conversions
N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.5 (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, (-1 + √3 i)3 = 8 because (-1 + √3 i) has modulus 2 and argument 120°.	Complex numbers - Complex plane	N-CN.5 Utilize properties to add, subtract, multiply, and conjugate complex numbers	Operations with variables

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N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.5 (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, (-1 + √3 i)3 = 8 because (-1 + √3 i) has modulus 2 and argument 120°.	Complex numbers - Complex plane	N-CN.5 Represent complex computations geometrically on a complex plane (Calculus)	
N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.6 (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.	Complex numbers - Complex plane	N-CN.6 Calculate the distance between numbers in the complex plane as the modulus of the difference (Calculus)	
N	CN	Represent complex numbers and their operations on the complex plane.	N-CN.6 (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.	Complex numbers - Complex plane	N-CN.6 Calculate the midpoint of a segment as the average of the numbers at its endpoints (Calculus)	
N	VM	Represent and model with vector quantities.	N-VM.1 (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).	Vectors	N-VM.1 Represent vector quantities by directed line segments with appropriate symbols for the vectors and their magnitudes	Distance formula, translations, magnitude, vector, component
N	VM	Represent and model with vector quantities.	N-VM.2 (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	Vectors	N-VM.2 Find the components of a vector	vector, component
N	VM	Represent and model with vector quantities.	N-VM.3 (+) Solve problems involving velocity and other quantities that can be represented by vectors.	Vectors	N-VM.3 Solve problems involving velocity and other quantities that can be represented by vectors	vector
N	VM	Perform operations on vectors.	N-VM.4 (+) Add and subtract vectors.	Vectors	N-VM.4	
N	VM	Perform operations on vectors.	N-VM.4a Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.	Vectors - Operations	N-VM.4a Add vectors using their components	vector, component

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N	VM	Perform operations on vectors.	N-VM.4a Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.	Vectors - Operations	N-VM 4a Add vectors using the parallelogram rule	vector, component
N	VM	Perform operations on vectors.	N-VM.4b Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.	Vectors - Operations	N-VM.4b Determine the magnitude and direction of the sum of two vectors	trigonometric properties of angles, magnitude, vector, component
N	VM	Perform operations on vectors.	N-VM.4c Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.	Vectors - Operations	N-VM.4c Subtract vectors using their components	vector, component
N	VM	Perform operations on vectors.	N-VM.4c Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.	Vectors - Operations	N-VM.4c Subtract vectors graphically	vector
N	VM	Perform operations on vectors.	N-VM.5 (+) Multiply a vector by a scalar.	Vectors - Operations	N-VM.5	
N	VM	Perform operations on vectors.	N-VM.5a Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).	Vectors - Operations	N-VM.5a Multiply a vector and a scalar using the vector components	scalar, vector
N	VM	Perform operations on vectors.	N-VM.5a Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).	Vectors - Operations	N-VM.5a Multiply a vector and a scalar graphically	scalar, vector

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N	VM	Perform operations on vectors.	N-VM.5b Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).	Vectors - Operations	N-VM.5b Compute the direction and magnitude of a scalar multiple	vector, scalar multiple, magnitude
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.	Matrices - Operations	N-VM.6 Represent and manipulate data using matrices	matrix
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.	Matrices - Operations	N-VM.7 Multiply matrices by scalars to produce new matrices	distribution, scalar, matrix
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.	Matrices - Operations	N-VM.8 Add, subtract, and multiply matrices of appropriate dimensions	dimensions, matrix
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.9 (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.	Matrices - Operations	N-VM.9 Prove commutative, associative, and distributive properties of matrices	commutative, associative, distributive properties from algebra, matrices
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.10 (+) 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.	Matrices - Operations	N-VM.10 Explain the role of zero and identity matrices in matrix addition and multiplication	matrices, square matrices

Conceptual Category	Domain	Cluster	Common Core Standard	Content	Skills	Academic Vocabulary
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.10 (+) 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.	Matrices - Operations	N-VM.10 Find the determinant of a square matrix	determinant, matrix
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.11 (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.	Matrices - Operations	N-VM.11 Multiply a vector by a matrix of suitable dimensions to produce another vector	vector, dimensions, matrix
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.11 (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.	Matrices - Operations	N-VM.11 Transform vectors using matrices	transform, vector, matrix, distribution
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.12 (+) Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area.	Matrices - Operations	N-VM.12 Transform 2x2 matrices (Calculus)	transform, matrix, square matrices
N	VM	Perform operations on matrices and use matrices in applications.	N-VM.12 (+) Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area.	Matrices - Operations	N-VM.12 Interpret the absolute value of the determinant in terms of area (Calculus)	determinant, matrix
A	REI	Solve systems of equations.	A-REI.8 (+) Represent a system of linear equations as a single matrix equation in a vector variable.	Matrices - Solving Systems of equations	A-REI.8 Represent a system of linear equations as a single matrix equation in a vector variable	matrix, vector
A	REI	Solve systems of equations.	A-REI.9 (+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).	Matrices - Solving Systems of equations	A-REI.9 Solve systems of linear equations using the inverse of a matrix	matrices, invertible

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F	IF	Analyze functions using different representations.	F-IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.★	Functions - Analysis	F-IF.7	
F	IF	Analyze functions using different representations.	F-IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.	Functions - Analysis	F-IF.7d Identify zeros through graphing rational functions	x-intercepts, interval notation, oblique asymptote, average rate of change
F	IF	Analyze functions using different representations.	F-IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.	Functions - Analysis	F-IF.7d Identify asymptotes through graphing rational functions	dividing by zero, interval notation, oblique asymptote, average rate of change
F	IF	Analyze functions using different representations.	F-IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.	Functions - Analysis	F-IF.7d Recognize end behavior through graphing rational functions	even and odd degree, interval notation, oblique asymptote, average rate of change
F	BF	Build a function that models a relationship between two quantities.	F-BF.1c (+) Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.	Functions - Composition	F-BF.1c Compose functions	Substitution
F	BF	Build new functions from existing functions.	F-BF.4 Find inverse functions.	Building functions - Inverses	F-BF.4	
F	BF	Build new functions from existing functions.	F-BF.4b (+) Verify by composition that one function is the inverse of another.	Building functions - Inverses	F-BF.4b Verify functions are inverses through composition	one to one

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F	BF	Build new functions from existing functions.	F-BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.	Building functions - Inverses	F-BF.4c Calculate the coordinates of an inverse function from a graph or table	one to one
F	BF	Build new functions from existing functions.	F-BF.4d (+) Produce an invertible function from a non-invertible function by restricting the domain.	Building functions - Inverses	F-BF.4d Produce an invertible function from a non-invertible function by restricting the domain	invertible, one to one
F	BF	Build new functions from existing functions.	F-BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	Building functions - Inverses	F-BF.5 Compare the characteristics of exponents and logarithms	
F	BF	Build new functions from existing functions.	F-BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	Building functions - Inverses	F-BF.5 Solve problems involving logarithms and exponents	logistic
F	TF	Extend the domain of trigonometric functions using the unit circle.	F-TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosines, and tangent for x, π + x, and 2π – x in terms of their values for x, where x is any real number.	Trigonometric Functions - Special Triangles	F-TF.3 Geometrically determine the values of sine, cosine, and tangent for π/3, π/4 and π/6 using special triangles	30-60-90, 45-45-90 triangles, cosecant, secant, cotangent
F	TF	Extend the domain of trigonometric functions using the unit circle.	F-TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosines, and tangent for x, π + x, and 2π – x in terms of their values for x, where x is any real number.	Trigonometric Functions - Unit Circle	F-TF.3 Express the values of sine, cosine, and tangent for x, π + x, and 2π – x using the unit circle	cosecant, secant, cotangent, midline, phase shift
F	TF	Extend the domain of trigonometric functions using the unit circle.	F-TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	Trigonometric Functions - Unit Circle	F-TF.4 Explain even/odd symmetry and periodicity of trigonometric functions using the unit circle	fold along y axis, rotate 180 degrees, even symmetry, odd symmetry

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F	TF	Model periodic phenomena with trigonometric functions.	F-TF.6 (+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.	Trigonometric Functions - Inverse	F-TF.6 Construct the inverse of a trigonometric function through restricting the domain	one to one
F	TF	Model periodic phenomena with trigonometric functions.	F-TF.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.★	Trigonometric Functions - Modeling	F-TF.7 Model trigonometric equation word problems using inverses and technology	Solving inverse trigonometric equations, one-to-one, linear speed, angular speed
F	TF	Prove and apply trigonometric identities.	F-TF.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.	Trigonometric Functions - Proving Identities	F-TF.9 Prove the addition and subtraction formulas for sine, cosine, and tangent	Substitution
F	TF	Prove and apply trigonometric identities.	F-TF.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.	Trigonometric Functions - Solving equations	F-TF.9 Solve trigonometric problems using the addition and subtraction formulas for sine, cosine, and tangent	
G	SRT	Apply trigonometry to general triangles	G-SRT.9 (+) Derive the formula a = 1/2 absinc for the area of a triangle by drawing an auxillary line from a vertex perpendicular to the opposite side.	Trigonometric Functions - Similarity, right triangles, and trigonometry	G-SRT.9 Derive the formula a = 1/2 absinc for the area of a triangle by drawing an auxillary line from a vertex perpendicular to the opposite side.	law of sines, law of cosines, Heron's formula
G	SRT	Apply trigonometry to general triangles	G-SRT.10 (+) Prove the law of cosines and sines and use them to solve problems.	Trigonometric Functions - Similarity, right triangles, and trigonometry	G-SRT.10 Prove the law of cosines and sines and use them to solve problems.	law of sines, law of cosines
G	SRT	Apply trigonometry to general triangles	G-SRT.11 (+) Understand and apply the law of sines and law of cosines to find unknown measurements in right and non-right triangles. (e.g. Surveying problems, resultant forces)	Trigonometric Functions - Similarity, right triangles, and trigonometry	G-SRT.11 Understand and apply the law of sines and law of cosines to find unknown measurements in right and non-right triangles. (e.g. Surveying problems, resultant forces)	law of sines, law of cosines

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G	GPE	Translate between the geometric description and the equation for a conic section	G-GPE.3 (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	Conic Sections - Forming Equations	G-GPE.3 Derive the equations of ellipses given the foci, using the fact that the sum or difference of distances from the foci is constant	circles, Pythagorean theorem
G	GPE	Translate between the geometric description and the equation for a conic section	G-GPE.3 (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.	Conic Sections - Forming Equations	G-GPE.3 Derive the equations of hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant	conic section, co-vertices, directrix, ellipse, focus, hyperbola, major axis, minor axis