Pre-Calculus GT Essential Curriculum

The Mathematical Practices

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students.

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

The Mathematical Content Standards

The Mathematical Content Standards (Essential Curriculum) that follow are designed to promote a balanced combination of procedure and understanding. Expectations that begin with the word "understand" are often especially good opportunities to connect the mathematical practices to the content. Students who lack understanding of a topic may rely on procedures too heavily. Without a flexible base from which to work, they may be less likely to consider analogous problems, represent problems coherently, justify conclusions, apply the mathematics to practical situations, use technology mindfully to work with the mathematics, explain the mathematics accurately to other students, step back for an overview, or deviate from a known procedure to find a shortcut. *In short, a lack of understanding effectively prevents a student from engaging in the mathematical practices.* In this respect, those content standards that set an expectation of understanding are potential "points of intersection" between the Mathematical Content Standards and the Mathematical Practices.

Unit 1: Matrices

N.VM.C Perform operations on matrices and use matrices in applications.
N.VM.C.6 Use matrices to represent and manipulate data.

N.VM.C.7 Multiply matrices by scalars to produce new matrices.

N.VM.C.8 Add, subtract, and multiply matrices of appropriate dimensions.

N.VM.C.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.

N.VM.C.12 Work with 2 × 2 matrices as a transformations of the plane, and interpret the absolute value of the determinant in terms of area.

PC.M.A Apply understanding of matrices to systems of equations.
PC.M.A.1 Find determinants of matrices and use the determinant to determine whether the matrix has a multiplicative inverse.

A.REI.C Solve systems of equations.
A.REI.C.8 Represent systems of linear equations, presented in real world contexts, as a single matrix equation.

A.REI.C.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 3x3 or greater).

Unit 2: Trigonometry

Part I: Circular Functions

PC.T.A Define and evaluate circular functions.
PC.T.A.1 Define and evaluate the six trigonometric functions of an angle given a point on its terminal side. Use inverse functions to find angle measures.

PC.T.A.2 Find and state the six trigonometric functions of special and quadrantal angles.

PC.T.A.3 Find the radian measure of an angle when the circular function value is given.

PC.T.A.4 Evaluate the composition of trigonometric functions with inverses.

PC.T.A.5 Solve real-world problems involving arc length, linear and angular speed, and uniform circular motion. Use co-terminal angles for problems involving multiple revolutions.

Part II: Modeling with Graphs of Circular Functions

PC.T.B Use circular functions to model real-world functions.
PC.T.B.6 Graph trigonometric functions represented symbolically and show key features of the graph, including domain, range, amplitude, period, midline, and phase shift. Identify transformations from the parent function.

PC.T.B.7 Write a trigonometric function that models a graph of a trigonometric function and/or describes a relationship between two quantities.

PC.T.B.8 Use trigonometric functions to solve real-world problems. Find solutions by evaluating the function and graphing to approximate values.

PC.T.B.9 Graph the inverse trigonometric functions and identify key features of the graph. Compare graphs the trigonometric functions and inverse trigonometric functions.

Part III: Applying Trigonometry to Solve Equations

PC.T.C Prove trigonometric identities in order to solve trigonometric equations.
PC.T.C.10 Prove trigonometric identities using a variety of strategies and verify identities graphically. (Identities include Pythagorean identities and the even and odd identities.)

PC.T.C.11 Use sum and difference formulas, double-angle and half-angle identities to simplify, verify, and solve expressions and equations involving sine, cosine, and tangent.

PC.T.C.12 Solve trigonometric equations and inequalities algebraically and graphically, including quadratic form.

Unit 3: Vectors and Parametrics

N.VM.A Represent and model with vector quantities.
N.VM.A.1 Recognize geometric 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). Combine geometric vectors to determine the magnitude of the resultant vector.

N.VM.A.3 Use geometric vectors to solve problems involving velocity and other quantities that can be represented by vectors. (Applications may include velocity, force, air navigation)

N.VM.A.2 Find the components of an algebraic vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.

PC.VP.A. Perform operations with algebraic vectors.
PC.VP.A.1 Perform operations with algebraic vectors, including scalar multiplication, addition, subtraction, and finding the dot product.

PC.VP.A.2 Use vector operations to determine if vectors are parallel or orthogonal (perpendicular). Find the angle between vectors.

N.VM.C Perform operations on matrices and use matrices in applications.
N.VM.C.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.

PC.VP.B Work with parametric equations.
PC.VP.B.3 Find a parametrization of a given equation.

PC.VP.B.4 Graph parametric equations and make comparisons to the equivalent Cartesian equations.

PC.VP.B.5 Use parametric equations to solve motion problems.

Unit 4: Complex Numbers and Polar Equations

N.CN.B Represent complex numbers and their operations on the complex plane.
N.CN.B.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. Find the trigonometric form of complex numbers.

N.CN.B.5 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation.

PC.CP.A Represent functions as polar equations.
PC.CP.A.1 Convert between Cartesian coordinates and polar coordinates.

PC.CP.A.2 Graph polar equations and convert between rectangular and polar forms.

PC.CP.A.3 Perform operations on complex numbers in trigonometric form, including multiplying and dividing complex numbers and applying DeMoivre's theorem.

PC.CP.A.4 Graph polar equations using parametric form.

Unit 5: Analytic Geometry

PC.AG.A Translate between the geometric description and the equation for a conic section.
PC.AG.A.1 Derive and write the equations for the conic sections (circle, parabola, ellipse, and hyperbola) given the focus/foci and directrix.

PC.AG.A.2 Analyze and sketch the graphs of the conic sections.

PC.AG.A.3 Write the equation of a translated conic section and sketch the graph.

PC.AG.A.4 Use conic sections to model and solve real-world problems.

Unit 6: Series

PC.S.A Analyze and apply series to solve real-world and mathematical problems.
PC.S.A.1 Determine whether a sequence converges or diverges.

PC.S.A.2 Find the partial sum of an arithmetic or geometric series.

PC.S.A.3 Define an infinite series as the limit of the partial sums.

PC.S.A.4 Find the sum of a convergent infinite geometric series.

PC.S.A.5 Use the binomial theorem to expand a binomial.

PC.S.A.6 Solve problems involving binomial distributions.

Unit 7: Algebraic Functions: Behavior, Rates of Change and Limits

PC.AF.A Build and interpret functions that model relationships between two quantities.
PC.AF.A.1 Identify key features of functions, including domain, range, end behavior, local (relative) and/or absolute extrema, continuity, zeros, symmetry, asymptotes, and whether the function is even/odd. (Focus primarily on logarithmic, logistic, rational, step, and piecewise-defined functions.)

PC.AF.A.2 Model real-world data with functions. Justify why the model is most appropriate for the problem situation.

PC.AF.A.3 Calculate limits algebraically and estimate limits from graphs and tables of values.

PC.AF.A.4 Perform algebraic operations on functions and sketch the resulting graph.

PC.AF.A.5 Compose functions. Verify by composition that one function is the inverse of another.

PC.AF.B Use functions to solve equations and inequalities.
PC.AF.B.6 Use the properties of logarithms, including change of base, to solve real-world and mathematical problems algebraically.

PC.AF.B.7 Solve equations and inequalities involving rational functions.

PC.AF.C Analyze and apply limits of functions to describe function behavior.
PC.AF.C.8 Use one-sided limits to describe continuity of functions.

PC.AF.C.9 Determine if a function is continuous at a point or over an interval.

PC.AF.C.10 Apply limits using the definition of derivative with respect to tangent lines of functions.