

Strands	Standards	Pg No	Topic
<p>MATHEMATICAL PRACTICES (MP) The Standards for Mathematical Practice in PreCalculus describe mathematical habits of mind that teachers should seek to develop in their students. Students become mathematically proficient in engaging with mathematical content and concepts as they learn, experience, and apply these skills and attitudes (Standards MP.1-8).</p>	<p>P.MP.1 <b>Make sense of problems and persevere in solving them.</b> Explain the meaning of a problem and look for entry points to its solution. Analyze givens, constraints, relationships, and goals. Make conjectures about the form and meaning of the solution, plan a solution pathway, and continually monitor progress asking, "Does this make sense?" Consider analogous problems, make connections between multiple representations, identify the correspondence between different approaches, look for trends, and transform algebraic expressions to highlight meaningful mathematics. Check answers to problems using a different method.</p>	<p>591</p>	<p>Problem 55 Tuning Fork</p>
	<p>P.MP.2 <b>Reason abstractly and quantitatively.</b> Make sense of the quantities and their relationships in problem situations. Translate between context and algebraic representations by contextualizing and decontextualizing quantitative relationships. This includes the ability to decontextualize a given situation, representing it algebraically and manipulating symbols fluently as well as the ability to contextualize algebraic representations to make sense of the problem.</p>	<p>85</p>	<p>Problem 85 Correct Direction for Crossing a River</p>

<p>P.MP.3  <b>Construct viable arguments and critique the reasoning of others.</b> Understand and use stated assumptions, definitions, and previously established results in constructing arguments. Make conjectures and build a logical progression of statements to explore the truth of their conjectures. Justify conclusions and communicate them to others. Respond to the arguments of others by listening, asking clarifying questions, and critiquing the reasoning of others.</p>	<p>122</p>	<p>[Interactive Figure Exercise] Exploring Horizontal Compressions and Stretches</p>
<p>P.MP.4  <b>Model with mathematics.</b> Apply mathematics to solve problems arising in everyday life, society, and the workplace. Make assumptions and approximations, identifying important quantities to construct a mathematical model. Routinely interpret mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.</p>	<p>326</p>	<p>[Modeling] Alcohol and Driving</p>
<p>P.MP.5  <b>Use appropriate tools strategically.</b> Consider the available tools and be sufficiently familiar with them to make sound decisions about when each tool might be helpful, recognizing both the insight to be gained as well as the limitations. Identify relevant external mathematical resources and use them to pose or solve problems. Use tools to explore and deepen their understanding of concepts.</p>	<p>470</p>	<p>Internet-based Project</p>

	<p>P.MP.6  <b>Attend to precision.</b> Communicate precisely to others. Use explicit definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose. Specify units of measure and label axes to clarify the correspondence with quantities in a problem. Calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context.</p>	NA	
	<p>P.MP.7  <b>Look for and make use of structure.</b> Look closely at mathematical relationships to identify the underlying structure by recognizing a simple structure within a more complicated structure. See complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, see <math>5 - 3(x - y)^2</math> as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers <math>x</math> and <math>y</math>.</p>	844	Example 4: Maximizing Profit
	<p>P.MP.8  <b>Look for and express regularity in repeated reasoning.</b> Notice if reasoning is repeated, and look for both generalizations and shortcuts. Evaluate the reasonableness of intermediate results by maintaining oversight of the process while attending to the details.</p>	569	Explaining Concepts
<p>NUMBER AND QUANTITY  - Vector and Matrix  Quantities (N.VM)  Represent and model</p>	<p>N.VM.1  Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use</p>	637	Vectors

with vector quantities (Standards 1-3). Perform operations on vectors (Standards 4-5). Perform operations on matrices and use matrices in applications (Standards 6-13).	appropriate symbols for vectors and their magnitudes (e.g., $v$ , $ v $ , $\ v\ $ , $v$ ).		
	N.VM.2 Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.	640-641	Objective 2: Find a Position Vector
	N.VM.3 Solve problems involving velocity and other quantities that can be represented by vectors.	649	Finding the Actual Speed and Direction of an Aircraft
	N.VM.4 Add and subtract vectors. a. 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. b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. c. 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.	641-642	Objective 3: Add and Subtract Vectors Algebraically

<p>N.VM.5 Multiply a vector by a scalar. a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as <math>c(v_x, v_y) = (cv_x, cv_y)</math>. b. Compute the magnitude of a scalar multiple <math>cv</math> using <math>\ cv\  =  c v</math>. Compute the direction of <math>cv</math> knowing that when <math> c v \neq 0</math>, the direction of <math>cv</math> is either along <math>v</math> (for <math>c &gt; 0</math>) or against <math>v</math> (for <math>c &lt; 0</math>).</p>	642	Objective 4: Find a Scalar Multiple and the Magnitude of a Vector
<p>N.VM.6 Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.</p>	644	Example 6: Finding a Vector When Its Magnitude and Direction Are Given
<p>N.VM.7 Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.</p>	798-799	Objective 2: Find Scalar Multiples of a Matrix
<p>N.VM.8 Add, subtract, and multiply matrices of appropriate dimensions.</p>	796-798 799-803	Objective 1: Find the Sum and Difference of Two Matrices Objective 3: Find the Product of Two Matrices
<p>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.</p>	802	Example 9: Multiplying Two Matrices Example 10: Multiplying Two Square Matrices
<p>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.</p>	803 798	Example 11: Multiplication with an Identity Matrix zero matrix

	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.	799-800	Definition Product of a Row Vector and a Column Vector
	N.VM.12 Work with $2 \times 2$ matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area.	NA	
	N.VM.13 Solve systems of linear equations up to three variables using matrix row reduction.	778	Example 8: Identifying an Inconsistent System of Linear Equations Using Matrices
NUMBER AND QUANTITY - Complex Number Systems (N.CN) Perform arithmetic operations with complex numbers (Standard 3). Represent complex numbers and their operations on the complex plane (Standards 4-6). Use complex numbers in polynomial identities and equations (Standard 10).	N.CN.3 Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	978	Conjugates
	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.	627	Objective 1: Plot Points in 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, $(-1 + \sqrt{3}i)^3 = 8$ , because $(-1 + \sqrt{3}i)$ has modulus 2 and argument $120^\circ$ .	NA	

	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.	628	Definition Magnitude or Modulus
	N.CN.10 Multiply complex numbers in polar form and use DeMoivre's Theorem to find roots of complex numbers.	632	Objective 5: Find Complex Roots
ALGEBRA: Reasoning With Equations and Inequalities (A.REI) Solve systems of equations (Standards 8-9).	A.REI.8 Represent a system of linear equations as a single matrix equation in a vector variable.	770-771	Objective 1: Write the Augmented Matrix of a System of Linear 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 x 3 or greater).	807-808	Objective 5: Solve a System of Linear Equations Using an Inverse Matrix
FUNCTIONS - Interpreting Functions (F.IF) Analyze functions using different representations (Standard 7, 10-11).	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. a. Graph rational functions, identifying zeros, asymptotes, and point discontinuities when suitable factorizations are available, and showing end behavior. b. Define a curve parametrically and draw its graph.	248	Example 1: How to Analyze the Graph of a Rational Function
	F.IF.10 Use sigma notation to represent the sum of a finite arithmetic or geometric series.	860 861 878	Objective 3: Use Summation Notation Objective 4: Find the Sum of a Sequence Algebraically and Using a Graphing Utility Objective 3: Find the Sum of a Geometric Sequence

	F.IF.11 Represent series algebraically, graphically, and numerically.	861	Example 9: Finding the Sum of a Sequence
FUNCTIONS - Building Functions (F.BF) Build a function that models a relationship between two quantities (Standard 1). Build new functions from existing functions (Standard 4-5).	F.BF.1 Write a function that describes a relationship between two quantities. a. 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.	65	Objective 3: Use Function Notation; Find the Value of a Function
	F.BF.4 Find inverse functions. a. Verify by composition that one function is the inverse of another. b. Read values of an inverse function from a graph or a table, given that the function has an inverse. c. Produce an invertible function from a non-invertible function by restricting the domain.	283-284	Objective 2: Determine the Inverse of a Function Defined by a Mapping or a Set of Ordered Pairs
	F.BF.5 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.	313-314  367	Example 1: Relating Logarithms to Exponents Objective 1: Change Exponential Statements to Logarithmic Statements and Logarithmic Statements to Exponential Statements Example 1: Fitting an Exponential Function to Data
FUNCTIONS - Trigonometric Functions (F.TF) Extend the domain of trigonometric functions using the unit circle (Standard 4). Model	F.TF.4 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	451-416 422-423	Objective 2: Determine the Period of the Trigonometric Functions Objective 6: Use Even–Odd Properties to Find the Exact Values of the Trigonometric Functions
	F.TF.6 Understand that restricting a trigonometric function to a domain on which it is always	472-473	The Inverse Sine, Cosine, and Tangent Functions Objective 1: Define the Inverse Sine Function

<p>periodic phenomena with trigonometric functions (Standard 6-7). Prove and apply trigonometric identities (Standard 9).</p>	<p>increasing or always decreasing allows its inverse to be constructed.</p>		
	<p>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.</p>	484	Applications and Extensions
	<p>F.TF.9 Prove the addition and subtraction formulas for sine, cosine, and tangent, and use them to solve problems.</p>	511-516	7.5 Sum and Difference Formulas
<p>GEOMETRY - Geometric Measurement and Dimension (G.GMD) Explain volume formulas and use them to solve problems (Standard 2).</p>	<p>G.GMD.2 Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.</p>	NA	
<p>GEOMETRY - Expressing Geometric Properties With Equations (G.GPE) Translate between the geometric description and the equation for a conic section (Standards 2-3).</p>	<p>G.GPE.2 Derive the equation of a parabola given a focus and a directrix.</p>	682-683	Objective 1: Analyze Parabolas with Vertex at the Origin
	<p>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.</p>	693-694 705-706	Objective 1: Analyze Ellipses with Center at the Origin Objective 1: Analyze Hyperbolas with Center at the Origin
<p>STATISTICS - Conditional Probability and the Rules of Probability (S.CP) Understand independence and conditional probability</p>	<p>S.CP.2 Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.</p>	NA	

and use them to interpret data (Standards 2-3). Use the rules of probability to compute probabilities of compound events in a uniform probability model (Standards 7-9).	S.CP.3 Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$ , and interpret independence of A and B as saying that the conditional probability of B given A is the same as the probability of B.	NA	
	S.CP.7 Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ , and interpret the answer in terms of the model.	929	Example 7: Computing Probabilities of the Union of Two Events
	S.CP.8 Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B A) = P(B)P(A B)$ , and interpret the answer in terms of the model.	NA	
	S.CP.9 Use permutations and combinations to compute probabilities of compound events and solve problems.	921 917	Example 8: Forming Committees Example 1: Counting Airport Codes [Permutation: Distinct, with Repetition]