Common Core State Standards
ALGEBRA

Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.★

    Interpret parts of an expression, such as terms, factors, and coefficients.

    Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*

2. Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.*

Write expressions in equivalent forms to solve problems.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.★

    a. Factor a quadratic expression to reveal the zeros of the function it defines.

    b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

    c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*★

Arithmetic with Polynomials & Rational Expressions

Perform arithmetic operations on polynomials.

1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials.

2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$.

3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Use polynomial identities to solve problems.

4. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.*

5. (+) Know and apply the Binomial Theorem for the expansion of $(x + y)n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.[1]

Rewrite rational expressions.

6. Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Reasoning with Equations & Inequalities

Understand solving equations as a process of reasoning and explain the reasoning.

1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Solve equations and inequalities in one variable.

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

4. Solve quadratic equations in one variable.

   Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x – p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

   Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Solve systems of equations.

5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = –3x$ and the circle $x^2 + y^2 = 3$.

8. (+) Represent a system of linear equations as a single matrix equation in a vector variable.

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).

Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.★

12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

KEY ELEMENTS	CONTENT (What Students should know)	PERFORMANCE TARGETS (What Students should know)
Number and Number Sense	***Equations and Inequalities*** • **Expressions can be evaluated by the order of operations** • **Evaluate and simplify** • **Equations** • **Inequalities** • **Expressions and formulas** • **Properties of Real Numbers** • **Graphs and measures** • **Solving equations** • **Solving absolute equations**	**Students will attain the skills to:** • Use order of operations to evaluate expressions • Use formulas • Determine the set of numbers to which a number belongs • Use the properties of real numbers to simplify expressions • Translate verbal expressions and sentences into algebraic expressions and equations • Solve equations by using the properties of equality • Solve equations for a specific variable • Solve equations containing absolute value • Solve inequalities and graph the solution sets • Solve compound inequalities • Solve inequalities involving absolute value and graph the solution set. • Find the value of each expression • Evaluate each expression when given a certain value for a variable • Name the sets of numbers to which each value belongs • Name the property illustrated by each equation • Find the median, mode, and mean for each set of data • Solve linear equations

		• Solve each equation or formula for the variable specified • Solve absolute equations • Solve inequalities and graph them on a number line • Solve compound inequalities and graph them on a number line • Solve absolute inequalities and graph them on a number line. • State the domain and range of each relation • Graph a relation and identify whether it is a function or not • Find the value of a function given an input • State whether each equation is linear
Data Analysis and Probability	***Linear Relations and Functions*** • **Functions** • **Slope**	• Find values of functions for given elements of the domain • Use a graphing calculator to graph linear equations • Identify equations that are linear and graph them • Write linear equations in standard form. • Determine the intercepts of a line and use them to graph an equation • Determine the slope of a line • Use slope and a point to graph an equation • Determine if two lines are parallel, perpendicular or neither • Solve problems by identifying and using a pattern • Write an equation of a line in slope-intercept form given the slope and one or two points • Write an equation of a line that is parallel

		or perpendicular to the graph of a given equation • Draw a scatterplot • Find and use prediction equations • Use a graphing calculator to graph lines of regression • Draw graphs of inequalities in two variables • Graph absolute value inequalities
Patterns, Functions, Algebraic Standards	***Systems of Linear Equations and Inequalities*** • Equations • Inequalities • Linear Programming • Three Variables • Writing linear equations • Integration: statistics • Special functions • Graphing linear equations • Graphing systems of inequalities • Linear programming • Applications of linear programming • Solving systems of equations in three variables	• Find the maximum and minimum values of a function over a region • Solve problems involving maximum and minimum values • Solve a system of three equations in three variables by elimination • Determine the slope of the line that passes through each pair of points • Write an equation in slope-intercept form for each given situation • Describe each function to be either constant, direct variation, absolute value, or a greatest integer function • Graph inequalities • Graph systems of equations and state the solution • Solve systems of equations using either substitution or elimination • Solve systems of inequalities by graphing • Graph systems of inequalities and locate the possible solutions to the system

	Matricies • Adding and subtracting Matrices • Multiplying matrices • Matrices and determinants • Inverses and identities • Using matrices to solve systems	• Use matrix logic to problem solve • Perform operations with matricies and find determinants and inverse • Evaluate the determinant of a 2X2 matrix and the determinant of a 3X3 matrix • Write the identity matrix for any square matrix • Find the inverse of a 2X2 matrix • Solve systems of linear equations using inverse matrices • Geometric transformations using matricies • Add, subtract, or multiply two matrices • Determine whether each matrix has a determinant • Find the determinant of each matrix • Find the inverse of each matrix • Solve a matrix equations or systems of equations using inverse matrices • Solve a system of equations by using augmented matrices
	Quadratic Functions & Relations • Factoring Review	• Solve quadratic equations by using the quadratic formula • Use discriminants to determine the nature of the roots of quadratic equations • Find the sum and product of the roots of quadratic equations to use in writing equations • Graph Quadratic Functions • Solve by Graphing • Transformations with Quadratic Functions • Solving & Graphing Quadratic Inequalities
Patterns and Functions **Numbers and Number Sense**	***Complex Numbers***	• Simplify square roots containing negative radicands • Solve quadratic equations that have pure imaginary solutions • Add, subtract and multiply complex numbers

		• Simplify rational expressions containing complex numbers in denominators
	Polynomial and Polynomial Functions • **Monomials** • **Polynomials** • **Polynomial Functions** • **Dividing polynomials** • **Factoring** • **Roots of real numbers** • **Radical expressions**	• Multiply and Divide monomials • Divide polynomials using long division and synthetic division • Factor polynomials • Use factoring to simplify polynomial quotients • Add & Subtract Polynomials • Determine the degree and name of a polynomial • Polynomial Functions • Remainder and Factor Theorems • Graph Polynomial Functions and approximate the zeros • Find roots and zeros using fundamental theorem of algebra • Evaluate polynomial functions • Analyze graphs of polynomial functions • Solve polynomial functions • Write a polynomial function given the roots • Rational zero theorem
	Inverse and Radical Functions and Relations • ***Operations and functions*** • ***Radicals***	• Add, subtract, multiply and divide functions • Composition of functions • Find and graph inverse functions • Simplify radicals having various indices • Use a calculator to estimate roots of number • Simplify radical expressions • Rationalize the denominator of a fraction containing a radical expression • Add subtract, multiply and divide radical

		expressions • Write expressions with radical exponents in simplest radical form and vice versa • Evaluate expressions in either exponential or radical form • Solve equations and inequalities containing radicals • Graphing square root functions and inequalities
Patterns, functions, algebraic standards	***Exponential and Logarithmic Function and Relations*** ***Rational Functions and Relations***	• Introduce exponential and logarithmic functions • Logarithmic functions • Properties of logarithms • Common logarithms • Natural logarithms • Solve exponential equations and inequalities • Solve logarithmic equations and inequalities • Graph exponential functions • Applications of exponential functions & inequalities • Graph rational functions • Direct, inverse and joint variation • Multiply and divide rational expression • Add and subtract rational expressions • Solve rational equations
	Exponential and Logarithmic Functions and Relations	• Introduce exponential and logarithmic functions • Logarithmic functions • Properties of Logarithms • Common Logarithms • Natural Logarithms • Solve Exponential Equations and Inequalities

	Rational Functions and Relations	• Solve Logarithmic Equations & Inequalities • Graph Exponential Functions • Applications of Exponential Functions & Inequalities • Graph Rational Functions Direct, Inverse and Joint Variation • Multiply and Divide Rational Expression • Add and Subtract Rational Expressions • Solve Rational Equations and Inequalities
Geometry and Spatial Sense	***Analyzing Conic Sections*** ***Sequences and Series***	• Distance and Midpoint Formulas • Explore Parabolas • Explore Circles • Explore Ellipses • Explore Hyperbolas • Identify conic sections • Solve linear and non linear systems of equations • Find the nth term of an arithmetic or geometric sequence • Find the sums of an arithmetic or geometric systems
	• Rational exponents • Solving radical equations and inequalities • Complex numbers • Simplifying expressions • Containing complex numbers • Solving quadratic equations by graphing • Solving quadratic equations by factoring	• Simplify expressions with rational exponents • Solve equations containing radicals and rational expressions • Simplify radical expressions using complex numbers • Solve quadratic equations by graphing and locating their solutions • Solve quadratic equations by factoring • Solve quadratic equations by completing

		the square • Solve quadratic equations by using the quadratic formula • Find the discriminant of a quadratic equation and decipher the nature of the equations roots/zeros
	• The sum and product of roots • Analyzing graphs of quadratic functions • Graphing and solving quadratic inequalities	• Given the roots/zeroes find the equation of the quadratic line, solve problems • Write the equations of parabola using general form • Graph