

INPUT FROM PARCC CAMPUS LEADERSHIP TEAMS ESSENTIAL CORE COMPETENCIES FOR COLLEGE ALGEBRA

#	Critical core competencies that should be measured on a PARCC assessment that would indicate that a high school student would be successful in a credit-bearing College Algebra course without need for remediation
Number and Quantity	
1	<p>Fractions</p> <ol style="list-style-type: none"> a. Perform arithmetic operations with fractions b. Understand equivalent forms of fractions; add, subtract, multiply and divide fractions; solve routine arithmetic problems using integers and rational numbers c. Proficiency with arithmetic with fraction d. Order of operations with fractions e. Adding and subtracting fractions f. Multiplying and dividing fractions g. Changing mixed numbers to improper fractions and vice versa h. Simplify complex fractions
2	<p>Decimals</p> <ol style="list-style-type: none"> a. Perform arithmetic operations with decimals b. Converting decimals to fractions and vice versa c. Demonstrate a facility with the percentages including conversion to and from decimal notation and a complete understanding percent increase and percent decrease especially how the percent change is related to the whole
3	<p>Complex Numbers</p> <ol style="list-style-type: none"> a. Perform arithmetic operations with complex numbers b. Perform operations with complex numbers c. Perform operations on complex numbers d. Perform arithmetic operations with complex numbers. e. Represent complex numbers and their operations on the complex plane f. Use complex numbers in polynomial identities and equations g. Simplify and perform operations with complex numbers h. Understand the four operations (+, -, *, /) of complex numbers
4	<p>Problem Solving</p> <ol style="list-style-type: none"> a. Proficiency in the problem solving process (Polya) b. Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent c. Solve routine one-step arithmetic problems (using whole numbers, fractions, and decimals) such as single-step percent d. Solve routine two-step or three step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and computing with a given average

	<ul style="list-style-type: none"> e. Solve some routine two-step arithmetic problems f. Simplify problems using the order of operations g. Use order of operations h. Make sense of problems and persevere in solving them
5	<p>Signed Numbers</p> <ul style="list-style-type: none"> a. Arithmetic with signed numbers b. Perform basic operations using signed numbers
6	<p>Elementary Number Concepts</p> <ul style="list-style-type: none"> a. Exhibit knowledge of elementary number concepts including rounding, the ordering of real numbers in various forms, pattern identification, absolute value, primes, and greatest common factor b. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, least common multiples, exact values versus approximate values, rational numbers and irrational numbers c. Exhibit knowledge of elementary number concepts including rounding, the ordering of decimals, pattern identification, absolute value, primes, and greatest common factor d. Use basic mathematics skill that includes the fundamental numerical operations of addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals e. Arithmetic: Add, subtract, multiply, and divide integers, decimals, and fractions (without use of calculator); order of operations; properties of real numbers, exponents and roots, rounding and accuracy, Scientific Notation – conversion to and from; percents; and absolute value) f. Proper understanding and use of the symbol “=” g. Basic number sense/proficient mental math h. Understand the use of properties of real numbers i. Perform Operations with real numbers j. Understand the properties of real numbers
7	<p>Rational Numbers/Expressions</p> <ul style="list-style-type: none"> a. Know the difference between a rational and irrational number b. Perform arithmetic operations with rational expressions c. Use properties of rational and irrational numbers d. Extend the properties of exponents to rational exponents e. Evaluate and perform basic operations on exponents using the rules for multiplication, division, power of a power, and negative exponents. f. Work with exponents, including negative and rational g. Properties of exponents h. Know properties of exponents i. Demonstrate knowledge of properties of exponents and be able to extend the properties of exponents to rational exponents j. Rewrite rational expressions k. 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.

- l. Rewrite rational expressions
- m. 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
- n. Extend properties of exponents to rational exponents
- o. Solve rational equations
- p. Solving rational equation
- q. Intermediate Algebra: Solve rational equations (include concept of domain of the rational expressions)
- r. Apply properties of operations on rational numbers - Commutative, associative, identity, inverse, closure for addition and multiplication and distributive property of multiplication over addition
- s. Defining rational expressions
- t. Rewrite rational expressions
- u. Rewrite expressions involving radicals and rational exponents using the properties of exponents
- v. Simplify rational expressions using multiplication, division, addition, and subtraction
- w. Simplify rational expressions including complex rational expressions, solve rational equations and applications
- x. Simplify rational expressions and perform arithmetic on rational expressions
- y. Simplify expressions using laws of exponents
- z. Simplify rational expressions
- aa. Extend the properties of exponents to rational exponents
- bb. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5*
- cc. Explain why the sum or product of two rational numbers are rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational

Algebra

8 Polynomials

- a. Perform arithmetic operations with polynomials
- b. Simplify numeric and algebraic expressions by removing parentheses and collecting like terms to include multiplying polynomials.
- c. Simplify polynomial expressions using addition, subtraction, multiplication - Combine like terms, division of monomials
- d. Factor polynomials including special products
- e. Understand the concept of a function and use function notation
- f. Interpret functions that arise in applications in terms of the context
- g. Perform arithmetic operations on polynomials
- h. Polynomials and factoring
- i. Multiplying polynomials
- j. Perform arithmetic operations on polynomials. 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.
- k. Perform operations on polynomials
- l. Elementary Algebra: Add, subtract, multiply, and divide algebraic expressions including polynomials
- m. Perform operations on polynomials

	<ul style="list-style-type: none"> n. Perform arithmetic operations on polynomials o. Understand the relationship between zeros and factors of polynomials p. Use polynomial identities to solve problems q. Evaluate and perform basic algebraic expressions using both polynomial and functional notation r. Simplify polynomials by collecting like terms using addition and subtraction s. Understand the arithmetic of polynomial and rational expression t. Understand the relationship between zeros and factors of polynomials u. Perform arithmetic operations on polynomials v. Exponents and Polynomials, the student will be able to multiply, divide and raise exponential expressions with like bases
9	<p>Algebraic Equations/Expressions</p> <ul style="list-style-type: none"> a. Create equations that describe numbers or relationships b. Solve equations in one variable involving multiple steps c. Solve equations and inequalities in one variable. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters d. Solve routine first-degree equations e. Solve routine first-degree equations - simplify algebraic expressions using basic operations - the four basic operations, square roots, and the rules of rational exponents f. Solve equations and inequalities in one variable g. Add and subtract simple algebraic expressions h. Solve inequalities i. Solve inequalities in one variable involving multiple steps j. Understand solving equations as a process of reasoning and explain the reasoning k. Understand use of solving inequalities and solution representation l. Represent and solve equations and inequalities graphically m. Create equations that describe numbers or relationship. 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 n. Perform straightforward word-to-symbol translations o. Multiply two binomials p. Apply order of operations to evaluate expressions - expressions and equations involving integer exponents - expressions and equations involving various groupings and operations (e.g., fractions as division, parentheses) q. Interpret the structure of expressions r. Understand solving equations as a process of reasoning and explain the reasoning. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise s. Write expressions in equivalent forms to solve problems t. Simplify algebraic expressions u. Simplify algebraic expressions with fractions as well v. Elementary Algebra: Rewrite algebraic expressions in equivalent forms w. Interpret the structure of expressions. x. Elementary Algebra: Rewrite algebraic expressions in equivalent forms

	y. Reasoning with Equations and Inequalities
10	Evaluate Algebraic Expressions <ol style="list-style-type: none"> Evaluate algebraic expressions by substituting integers for unknown quantities Evaluate expressions using order of operations Evaluate algebraic expressions Evaluate algebraic expressions at integer values Evaluate algebraic expressions Solve and evaluate linear and literal equations, inequalities, word problems Elementary Algebra: Evaluate Algebraic expressions given value of variables Evaluate functions and perform basic operations Evaluate algebraic expressions for given values of variables
11	Systems of Equations <ol style="list-style-type: none"> Solve systems of linear equations - by graphing - by substitution - by elimination Solve systems of equations Know that a “solution” of an equation or system of equations is value(s) of the variable(s) that make the equation true and that a solution can be verified by substituting into the original equation or system – regardless if the student can find the solution or not Be able to solve systems of equations Elementary Algebra: Solve a system of equations Solve systems of equations
12	Factoring <ol style="list-style-type: none"> Factor polynomials including binomials using the sums of cubes and the difference of squares and cubes, trinomials using grouping, four terms using grouping, multiple terms using greatest common factor Factoring out the GCF Be able to factor Elementary Algebra: Factor polynomials completely Factor polynomials Factoring, the student will be able to factor polynomials containing a common factor in each term Rational Expressions and Equations, the student will be able to simplify an algebraic fraction by factoring
Functions	
13	Functions & Notation <ol style="list-style-type: none"> Understand the concept of a function and use function notation Be able to evaluate a function when it is expressed in symbolic form or approximate a function value from its graph. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$ Interpret functions that arise in applications in terms of the context. For a function that models a relationship between two quantities, interpret

	<p>key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity</p> <p>e. Find the rate of change of an exponential function from a table or a symbolic representation and be able to identify the growth/decay factor.</p> <p>f. Build new functions from existing functions</p> <p>g. Find inverse functions</p> <p>h. Recognize function notation; Identify domain and range; Identify a function, determine function value</p> <p>i. Build a function that models a relationship between two quantities</p> <p>j. Build new functions from existing functions. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them</p> <p>k. Be able to use function notation</p> <p>l. Inverse functions</p> <p>m. Understand the concept of a function and use function notation</p> <p>n. Analyze functions using different representations</p> <p>o. Interpret and explain whether a relation is a function</p> <p>p. Understand the algebra of functions, composition and inverse of function</p> <p>q. Model periodic phenomena with trigonometric functions</p> <p>r. Understand the concept of a function and use function notation</p> <p>s. Interpret functions that arise in applications in terms of the context</p> <p>t. Interpret expressions for functions in terms of the situation they model</p>
14	<p>Linear Equations</p> <p>a. Solve a linear equation</p> <p>b. Linear equations in two variables</p> <p>c. Forms of linear equations</p> <p>d. Solve any linear equation or inequality in one variable rational coefficients. This includes understanding solving equations as a process of reasoning and being able to explain the reasoning</p> <p>e. Solve equations and inequalities in one variable</p> <p>f. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters</p> <p>g. Solve linear equations with rational coefficients</p> <p>h. Linear equations with one variable</p> <p>i. Recognize the properties of positive and negative integer, exponents, operations on monomials and polynomials</p> <p>j. Solve linear equations</p> <p>k. Elementary Algebra: Solve linear equations and inequalities in one variable (include those with variable in multiple locations, grouping symbols, decimals, and fractions)</p> <p>l. Solve linear equations and inequalities</p> <p>m. Construct and compare linear, quadratic, and exponential models and solve problems</p> <p>n. Interpret expressions for functions in terms of the situation they model</p> <p>o. Solve linear equations and inequalities</p>

	<ul style="list-style-type: none"> p. Solve linear equations in one variable q. Apply linear equations to solve real world problems r. Solve linear inequalities in one variable s. Determine whether a number is a solution of a linear equation t. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. u. Create a system of linear equations that represent a situation and solve the system to answer the question v. Systems of Equations, the student will solve systems of linear equations by elimination, solve systems of linear equations by substitution
15	<p>Quadratic and Other Equations</p> <ul style="list-style-type: none"> a. Solve quadratic equations -with rational zeros using factoring - with real zeros using the quadratic formula b. Factoring quadratics c. Use complex numbers in polynomial identities and equations. Solve quadratic equations with real coefficients that have complex solutions d. Factor a quadratic expression to reveal the zeros of the function it defines e. 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 f. Solve quadratic equations using multiple strategies (i.e. – factoring, even root property, completing the square, quadratic formula) g. Solve equations using the quadratic formula h. 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 i. Solve quadratic equations j. Solving quadratic equations using the Quadratic method k. Evaluate quadratic functions, expressed in function notation, at integer values l. Solving exponential and logarithmic equations m. Intermediate Algebra: Solve quadratic equations by factoring, extracting roots, and quadratic formula that have rational, irrational, and complex roots n. Solve quadratics using factoring and quadratic formula o. Problem solving using quadratic equations and inequalities p. Solve log equations q. Solve exponential equations r. Solve problems by using the quadratic formula s. Understand how to solve linear, quadratic and exponential models t. Construct and compare linear, quadratic, and exponential models and solve problems. u. Factor quadratic and other polynomial expressions v. Factor simple quadratics (e.g., the difference of squares and perfect square trinomials) w. Construct and use linear and quadratic equations to solve real-world problems - Find simple interest - Find minimum and maximum areas. x. Factor quadratic equations

16	<p>Radicals</p> <ol style="list-style-type: none"> Perform arithmetic operations with radicals Extend the properties of exponents to rational exponents. Rewrite expressions involving radicals and rational exponents using the properties of exponents Simplify radicals Simplify and solve equations involving radicals Model, solve, and explain the solutions of applications involving quadratic and radical equations. Solve radical equations Radicals, the student will reduce radical expressions to simplest form
Modeling	
17	<p>Modeling</p> <ol style="list-style-type: none"> Apply geometric concepts in modeling situations Reasoning: Modeling - Ability to translate a word problem in an algebraic equation and solve. (Requires Reading comprehension) Understand how to apply geometric concept in model situations
Geometry	
18	<p>Pythagorean Theorem</p> <ol style="list-style-type: none"> Use Pythagorean Theorem to solve problems including applications Know and use the Pythagorean theorem and the distance formula Know the Pythagorean Formula and SOHCAHTOA
19	<p>Graphic Representation</p> <ol style="list-style-type: none"> Graph lines in coordinate plane given line in different forms Solve and graph combined inequalities Solve and graph an inequality Graph ordered pairs of real numbers as points on the Cartesian coordinate plane. Graph and label ordered pairs Write ordered pairs of points graphed on the Cartesian coordinate plane Graph ordered pairs of real numbers as points on the Cartesian coordinate plane Graph and label ordered pairs - write ordered pairs of points graphed on the Cartesian coordinate plane. Graph a linear function - given the function - given the slope and y-intercept Graph linear equations in two variables Locate points in the coordinate plane Convert from a linear inequality in one variable to a graph on the number line and vice versa. Represent and solve equations and inequalities graphically Locate points in the coordinate plane - comprehend the concept of length on the number line - exhibit knowledge of slope Interpret and use information from graphs in the coordinate plane Interpret and use information from linear equations to graph lines Graph linear and quadratic functions and show intercepts, maxima, and minima

	<ul style="list-style-type: none"> r. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions s. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior t. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context u. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another v. Solve and graph absolute value equations and inequalities w. Read tables and graphs x. Graph linear equations in two variables y. Graph quadratic functions z. Elementary Algebra: Graph an equation in 2 variables on the Cartesian coordinate system (include concepts of slope and intercepts) aa. Construct linear equations and graph linear equations bb. Locate points in the coordinate plane cc. Represent and solve equations and inequalities graphically dd. Translate between the geometric description and the equation for a conic section ee. Use coordinates to prove simple geometric theorems algebraically ff. Graph a linear and quadratic equation gg. Represent and solve equations and inequalities graphically hh. Problem solving by graphing a linear equation ii. Graphing and Functions, the student will graph linear equations in two variables jj. Graph quadratic equations
20	<p>Area, Length, Width, and Volume</p> <ul style="list-style-type: none"> a. Explain area and volume formulas and use them to solve problems b. Perpendicular lines c. Comprehend the concept of length on the number line d. Find the measure of an angle using properties of parallel lines e. Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°) f. Use basic geometry formulas for area, perimeter, volume, and surface area g. Compute the perimeter or area of simple geometric figures h. Compute the area and perimeter of triangles and rectangles in simple problems
21	<p>Equations and Problem Solving</p> <ul style="list-style-type: none"> a. Write the equation of a line - given the slope and y-intercept given two points on the line given the graph of the line b. Write linear equations as a function from slope-intercept form - from standard form. c. Prove geometric theorems d. Explain volume formulas and use them to solve problems e. Solve problems that involve various types of units and converting units of measure f. Create an equation or inequality from a context that requires translations of English expressions into mathematical expressions, use of basic geometric formulas, and rate/amount situations g. Use geometric formulas when all necessary information is given

	<ul style="list-style-type: none"> h. Given one representation of a line – symbolic (formula), graphical, or numerical (table with two or more points) - find the other two representations i. Find the equation of a line j. Determine the equation of a line given sufficient information
22	<p>Slope of a Line</p> <ul style="list-style-type: none"> a. Demonstrate a deep understanding of slope and be able to find it by various means and to explain the meaning of slope in a contextual situation b. Demonstrate understanding of equations of lines and the concept of slope c. Determine the slope of a line from points or equations d. Match linear graphs with their equations e. Exhibit knowledge of the slope f. Calculate slope g. Find slope h. Calculate slope and determine the equation of a line given two points or a point and the slope i. Find the slope of a line
Statistics and Probability	
23	<p>Measurement</p> <ul style="list-style-type: none"> a. Calculate the missing data value, given the average and all data values but one b. Translate from one representation of data to another (e.g., a bar graph to a circle graph) c. Determine the probability of a simple event d. Exhibit knowledge of simple counting techniques e. Analyze ratio and proportion, percent and systems of measurement f. Understand how to interpret categorical and quantitative data g. Make inferences and justify conclusions from sample surveys, experiments and observational studies h. Using probability to make decisions i. Use probability to evaluate outcomes of decisions
24	<p>Averages</p> <ul style="list-style-type: none"> a. Calculate the average of a list of numbers b. Calculate the average, given the number of data values and the sum of the data values c. Calculate the missing data value, given the average and all data values but one d. Solve problems involving the average of a list of numbers
Other	
25	<ul style="list-style-type: none"> a. Know how to write solutions in interval notation b. Determine the domain of a variable c. Factor trinomials with integer leading coefficients - leading coefficient of 1 - leading coefficient of integers other than 1 d. Recognize proportional relationships and reason proportionally e. Determine when an expression is undefined

- f. Work problems involving both integer and rational exponents and the use of the properties of exponents, including those using scientific notation
- g. Use appropriate technology strategically
- h. Substitute values for variables to evaluate expressions
- i. Work problems involving positive integer exponents
- j. Solve real-world problems using first-degree equations
- k. Reason quantitatively and use units to solve problems
- l. Know the difference between an exact answer and approximate answer
- m. Reasoning: Unit analysis – use procedure to determine appropriate units and use appropriate units to determine procedure
- n. Reasoning: Proportional reasoning – construct and solve proportions
- o. Reason abstractly and quantitatively
- p. Use appropriate tools strategically
- q. Look for and make use of structure
- r. Look for and express regularity in repeated reasoning