ACT® Tutorials are built from ACT College and Career Readiness Standards and provide students with a less stressful and more successful preparation effort for key areas of the ACT exam.

ACT Mathematics, English, and Reading Tutorials offer targeted instruction, practice, and review. Students engage with the content in an interactive, feedback-rich environment as they progress through ACT test aligned modules.  Students will practice skills essential to the test they're preparing for and build the depth of knowledge, confidence, and higher order skills required to demonstrate mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, guided analysis, and practice with personalized feedback so students are empowered to increase their Exam Readiness. The Review It offers an engaging and high impact video summary of key concepts and important to grasp connections. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers, linking a student's performance to ACT key idea details and score ranges. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are ready for test day and where they need to continue their review and practice.

This Tutorial is aligned with ACT College and Career Readiness Standards (2014) and ACT College Readiness Benchmark score ranges.

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## 1. NUMBER SENSE

- **DIVIDING MULTI-DIGIT WHOLE NUMBERS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **AF 301** *Solve routine one-step arithmetic problems using positive rational numbers, such as single-step percent*

- **DECIMAL OPERATIONS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **N 302** *Identify a digit's place value*
  - **AF 201** *Solve problems in one or two steps using whole numbers and using decimals in the context of money*

- **MONITORING PRECISION AND ACCURACY**
  - **G 504** *Recognize that real-world measurements are typically imprecise and that an appropriate level of precision is related to the measuring device and procedure*

- **GREATEST COMMON FACTOR AND LEAST COMMON MULTIPLE**
  - **N 301** *Recognize one-digit factors of a number*
  - **N 401** *Exhibit knowledge of elementary number concepts such as rounding, the ordering of decimals, pattern identification, primes, and greatest common factor*
  - **N 502** *Find and use the least common multiple*
  - **N 503** *Work with numerical factors*
  - **N 602** *Apply number properties involving even/odd numbers and factors/multiples*

## 2. RATIOS

- **RATIOS**
  - **AF 701** *Solve complex arithmetic problems involving percent of increase or decrease or requiring integration of several concepts (e.g., using several ratios, comparing percentages, or comparing averages)*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **N 202** *Recognize equivalent fractions and fractions in lowest terms*
  - **G 304** *Locate points in the first quadrant*
  - **G 406** *Locate points in the coordinate plane*

- **UNIT RATES**
  - **AF 401** *Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and estimating by using a given average value in place of actual values*
  - **AF 701** *Solve complex arithmetic problems involving percent of increase or decrease or requiring integration of several concepts (e.g., using several ratios, comparing percentages, or comparing averages)*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*

- **UNIT CONVERSIONS**
  - **G 203** *Perform common conversions of money and of length, weight, mass, and time within a measurement system (e.g., dollars to dimes, inches to feet, and hours to minutes)*
  - **AF 501** *Solve multistep arithmetic problems that involve planning or converting common derived units of measure (e.g., feet per second to miles per hour)*

- **SOLVING PERCENT PROBLEMS**
  - **AF 401** *Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and estimating by using a given average value in place of actual values*
  - **AF 701** *Solve complex arithmetic problems involving percent of increase or decrease or requiring integration of several concepts (e.g., using several ratios, comparing percentages, or comparing averages)*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **N 701** *Analyze and draw conclusions based on number concepts*
  - **AF 301** *Solve routine one-step arithmetic problems using positive rational numbers, such as single-step percent*

## 3. SIGNED NUMBERS

- **SIGNED NUMBERS**
  - **N 203** *Locate positive rational numbers (expressed as whole numbers, fractions, decimals, and mixed numbers) on the number line*
  - **N 303** *Locate rational numbers on the number line*
  - **N 401** *Exhibit knowledge of elementary number concepts such as rounding, the ordering of decimals, pattern identification, primes, and greatest common factor*

- **ABSOLUTE VALUE**
  - **N 403** *Comprehend the concept of length on the number line, and find the distance between two points*
  - **N 404** *Understand absolute value in terms of distance*

## 4. PROPORTIONS

- **REPRESENTING PROPORTIONAL RELATIONSHIPS**
  - **AF 601** *Solve word problems containing several rates, proportions, or percentages*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 401** *Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and estimating by using a given average value in place of actual values*

- **USING PROPORTIONS TO SOLVE PROBLEMS**

- **USING PROPORTIONS TO SOLVE PROBLEMS**
  - **N 701** *Analyze and draw conclusions based on number concepts*
  - **AF 401** *Solve routine two-step or three-step arithmetic problems involving concepts such as rate and proportion, tax added, percentage off, and estimating by using a given average value in place of actual values*
  - **AF 701** *Solve complex arithmetic problems involving percent of increase or decrease or requiring integration of several concepts (e.g., using several ratios, comparing percentages, or comparing averages)*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **AF 302** *Solve some routine two-step arithmetic problems*
  - **AF 601** *Solve word problems containing several rates, proportions, or percentages*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*

## 5. EXPONENTS

- **POWERS OF 10**
  - **N 402** *Write positive powers of 10 by using exponents*

- **LAWS OF EXPONENTS**
  - **N 605** *Apply properties of rational exponents*
  - **A 601** *Manipulate expressions and equations*
  - **A 512** *Work problems involving positive integer exponents*

- **SCIENTIFIC NOTATION**
  - **A 511** *Work with scientific notation*
  - **N 402** *Write positive powers of 10 by using exponents*

## 6. RATIONAL AND IRRATIONAL NUMBERS

- **RATIONAL AND IRRATIONAL NUMBERS**
  - **N 401** *Exhibit knowledge of elementary number concepts such as rounding, the ordering of decimals, pattern identification, primes, and greatest common factor*
  - **N 604** *Apply the facts that π is irrational and that the square root of an integer is rational only if that integer is a perfect square*
  - **N 702** *Apply properties of rational numbers and the rational number system*

- **APPROXIMATING IRRATIONAL NUMBERS**
  - **N 604** *Apply the facts that π is irrational and that the square root of an integer is rational only if that integer is a perfect square*
  - **N 703** *Apply properties of real numbers and the real number system, including properties of irrational numbers*
  - **A 509** *Work with squares and square roots of numbers*
  - **N 303** *Locate rational numbers on the number line*

## 7. ADDING AND SUBTRACTING RATIONAL NUMBERS

- **ADDING RATIONAL NUMBERS**
  - **N 403** *Comprehend the concept of length on the number line, and find the distance between two points*
  - **N 404** *Understand absolute value in terms of distance*
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **N 203** *Locate positive rational numbers (expressed as whole numbers, fractions, decimals, and mixed numbers) on the number line*
  - **N 303** *Locate rational numbers on the number line*
  - **AF 302** *Solve some routine two-step arithmetic problems*

- **SUBTRACTING RATIONAL NUMBERS**
  - **N 403** *Comprehend the concept of length on the number line, and find the distance between two points*
  - **N 404** *Understand absolute value in terms of distance*
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **N 203** *Locate positive rational numbers (expressed as whole numbers, fractions, decimals, and mixed numbers) on the number line*
  - **N 303** *Locate rational numbers on the number line*

- **USING PROPERTIES TO ADD AND SUBTRACT RATIONAL NUMBERS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **N 603** *Apply number properties involving positive/negative numbers*
  - **N 702** *Apply properties of rational numbers and the rational number system*
  - **N 703** *Apply properties of real numbers and the real number system, including properties of irrational numbers*
  - **AF 302** *Solve some routine two-step arithmetic problems*

## 8. MULTIPLYING AND DIVIDING RATIONAL NUMBERS

- **MULTIPLYING RATIONAL NUMBERS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **AF 302** *Solve some routine two-step arithmetic problems*

- **DIVIDING FRACTIONS**
  - **N 202** *Recognize equivalent fractions and fractions in lowest terms*
  - **N 701** *Analyze and draw conclusions based on number concepts*

- **DIVIDING RATIONAL NUMBERS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **AF 302** *Solve some routine two-step arithmetic problems*

- **USING PROPERTIES TO MULTIPLY AND DIVIDE RATIONAL NUMBERS**
  - **N 201** *Perform one-operation computation with whole numbers and decimals*
  - **N 603** *Apply number properties involving positive/negative numbers*
  - **N 702** *Apply properties of rational numbers and the rational number system*
  - **N 703** *Apply properties of real numbers and the real number system, including properties of irrational numbers*

## 9. EXPRESSIONS AND EQUATIONS

- **FORMULATING AND SIMPLIFYING ALGEBRAIC EXPRESSIONS**
  - **A 513** *Determine when an expression is undefined*
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **A 201** *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **A 601** *Manipulate expressions and equations*
  - **A 301** *Substitute whole numbers for unknown quantities to evaluate expressions*
  - **A 303** *Combine like terms (e.g., 2x + 5x)*

- **A 401** *Evaluate algebraic expressions by substituting integers for unknown quantities*
- **A 402** *Add and subtract simple algebraic expressions*

- **ONE-STEP EQUATIONS AND INEQUALITIES**
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **A 601** *Manipulate expressions and equations*
  - **A 202** *Solve equations in the form $x + a = b$, where $a$ and $b$ are whole numbers or decimals*
  - **A 302** *Solve one-step equations to get integer or decimal answers*
  - **A 403** *Solve routine first-degree equations*
  - **A 602** *Solve linear inequalities when the method involves reversing the inequality sign*
  - **AF 301** *Solve routine one-step arithmetic problems using positive rational numbers, such as single-step percent*
  - **A 502** *Solve real-world problems by using first-degree equations*
  - **A 503** *Solve first-degree inequalities when the method does not involve reversing the inequality sign*
  - **A 405** *Match simple inequalities with their graphs on the number line (e.g., $x \geq -3/5$)*

- **MULTI-STEP EQUATIONS AND INEQUALITIES**
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **A 502** *Solve real-world problems by using first-degree equations*
  - **A 503** *Solve first-degree inequalities when the method does not involve reversing the inequality sign*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **A 601** *Manipulate expressions and equations*
  - **A 602** *Solve linear inequalities when the method involves reversing the inequality sign*
  - **A 405** *Match simple inequalities with their graphs on the number line (e.g., $x \geq -3/5$)*

- **SOLVING SQUARE ROOT EQUATIONS**
  - **A 513** *Determine when an expression is undefined*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **F 511** *Use function notation for simple functions of two variables*

## 10. BUILDING EQUATIONS AND INEQUALITIES

- **FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS**
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra*

*settings (e.g., rate and distance problems and problems that can be solved by using proportions)*

- o **A 502** *Solve real-world problems by using first-degree equations*
- o **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
- o **A 403** *Solve routine first-degree equations*
- o **F 401** *Evaluate linear and quadratic functions, expressed in function notation, at integer values*
- o **F 503** *Build functions and use quantitative information to identify graphs for relations that are proportional or linear*
- o **A 513** *Determine when an expression is undefined*
- o **A 201** *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*

- • **FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS**
  - o **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - o **A 602** *Solve linear inequalities when the method involves reversing the inequality sign*
  - o **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - o **A 503** *Solve first-degree inequalities when the method does not involve reversing the inequality sign*
  - o **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - o **A 504** *Match compound inequalities with their graphs on the number line (e.g., −10.5 < x ≤ 20.3)*

## 11. LINEAR EQUATIONS

- • **SLOPE**
  - o **A 406** *Exhibit knowledge of slope*
  - o **G 510** *Determine the slope of a line from points or a graph*
  - o **F 505** *Understand the concept of a function as having a well-defined output value at each valid input value*
  - o **A 514** *Determine the slope of a line from an equation*

- • **SLOPE-INTERCEPT FORM OF A LINEAR EQUATION**
  - o **A 514** *Determine the slope of a line from an equation*
  - o **A 406** *Exhibit knowledge of slope*
  - o **G 510** *Determine the slope of a line from points or a graph*
  - o **F 503** *Build functions and use quantitative information to identify graphs for relations that are proportional or linear*
  - o **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - o **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - o **G 606** *Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point*
  - o **G 704** *Analyze and draw conclusions based on a set of conditions*

- • **POINT-SLOPE FORM OF A LINEAR EQUATION**
  - o **A 514** *Determine the slope of a line from an equation*
  - o **AF 503** *Match linear equations with their graphs in the coordinate plane*
  - o **F 503** *Build functions and use quantitative information to identify graphs for relations that are proportional or linear*
  - o **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - o **G 704** *Analyze and draw conclusions based on a set of conditions*
  - o **G 606** *Use properties of parallel and perpendicular lines to determine an equation of a line or coordinates of a point*
  - o **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*

# 12. GRAPHS OF LINEAR FUNCTIONS

- ## GRAPHING AND MANIPULATING Y = MX + B
  - **A 514** *Determine the slope of a line from an equation*
  - **A 406** *Exhibit knowledge of slope*
  - **G 510** *Determine the slope of a line from points or a graph*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 503** *Match linear equations with their graphs in the coordinate plane*
  - **AF 403** *Relate a graph to a situation described in terms of a starting value and an additional amount per unit (e.g., unit cost, weekly growth)*
  - **AF 703** *Analyze and draw conclusions based on properties of algebra and/or functions*
  - **AF 704** *Analyze and draw conclusions based on information from graphs in the coordinate plane*

- ## GRAPHING AND ANALYZING LINEAR FUNCTIONS
  - **F 505** *Understand the concept of a function as having a well-defined output value at each valid input value*
  - **A 514** *Determine the slope of a line from an equation*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **AF 704** *Analyze and draw conclusions based on information from graphs in the coordinate plane*
  - **F 503** *Build functions and use quantitative information to identify graphs for relations that are proportional or linear*
  - **F 511** *Use function notation for simple functions of two variables*
  - **F 506** *Understand the concept of domain and range in terms of valid input and output, and in terms of function graphs*
  - **AF 603** *Interpret and use information from graphs in the coordinate plane*
  - **AF 503** *Match linear equations with their graphs in the coordinate plane*
  - **AF 703** *Analyze and draw conclusions based on properties of algebra and/or functions*
  - **F 401** *Evaluate linear and quadratic functions, expressed in function notation, at integer values*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*

- ## GRAPHS OF LINEAR INEQUALITIES
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **A 602** *Solve linear inequalities when the method involves reversing the inequality sign*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **A 503** *Solve first-degree inequalities when the method does not involve reversing the inequality sign*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **A 603** *Match linear inequalities with their graphs on the number line*
  - **AF 603** *Interpret and use information from graphs in the coordinate plane*

# 13. SYSTEMS OF LINEAR EQUATIONS

- ## SOLVING SYSTEMS OF LINEAR EQUATIONS: GRAPHING
  - **AF 603** *Interpret and use information from graphs in the coordinate plane*
  - **AF 503** *Match linear equations with their graphs in the coordinate plane*
  - **A 604** *Solve systems of two linear equations*

- ## SOLVING SYSTEMS OF LINEAR EQUATIONS: SUBSTITUTION
  - **A 604** *Solve systems of two linear equations*

- ## SOLVING SYSTEMS OF LINEAR EQUATIONS: ELIMINATION
  - **A 604** *Solve systems of two linear equations*

## 14. FUNCTIONS

- **FUNCTIONS AND RELATIONS**
  - *F 511* *Use function notation for simple functions of two variables*
  - *F 507* *Interpret statements that use function notation in terms of their context*
  - *F 504* *Attend to the difference between a function modeling a situation and the reality of the situation*
  - *F 505* *Understand the concept of a function as having a well-defined output value at each valid input value*
  - *AF 602* *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - *AF 402* *Perform straightforward word-to-symbol translations*
  - *AF 502* *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - *AF 702* *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*

- **EVALUATING FUNCTIONS**
  - *F 501* *Evaluate polynomial functions, expressed in function notation, at integer values*
  - *F 505* *Understand the concept of a function as having a well-defined output value at each valid input value*
  - *F 401* *Evaluate linear and quadratic functions, expressed in function notation, at integer values*
  - *F 511* *Use function notation for simple functions of two variables*
  - *F 508* *Find the domain of polynomial functions and rational functions*
  - *F 509* *Find the range of polynomial functions*

- **DOMAIN AND RANGE**
  - *F 506* *Understand the concept of domain and range in terms of valid input and output, and in terms of function graphs*
  - *F 508* *Find the domain of polynomial functions and rational functions*

## 15. EXPONENTIAL AND LOGARITHMIC FUNCTIONS

- **EXPONENTIAL FUNCTIONS**
  - *A 513* *Determine when an expression is undefined*
  - *A 201* *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*
  - *F 505* *Understand the concept of a function as having a well-defined output value at each valid input value*
  - *AF 705* *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - *AF 602* *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - *AF 502* *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - *AF 702* *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - *F 702* *Build functions for relations that are exponential*

- **EXPONENTIAL GROWTH AND DECAY**
  - *A 513* *Determine when an expression is undefined*
  - *A 201* *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*
  - *A 601* *Manipulate expressions and equations*
  - *F 702* *Build functions for relations that are exponential*

- **LOGARITHMIC FUNCTIONS**
  - *AF 705* *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - *F 707* *Exhibit knowledge of logarithms*

## 16. SEQUENCES AND FUNCTIONS

- **SEQUENCES**
  - **F 511** *Use function notation for simple functions of two variables*
  - **F 603** *Find a recursive expression for the general term in a sequence described recursively*
  - **F 703** *Exhibit knowledge of geometric sequences*

- **ARITHMETIC AND GEOMETRIC SEQUENCES**
  - **F 201** *Extend a given pattern by a few terms for patterns that have a constant increase or decrease between terms*
  - **F 301** *Extend a given pattern by a few terms for patterns that have a constant factor between terms*
  - **F 703** *Exhibit knowledge of geometric sequences*
  - **F 502** *Find the next term in a sequence described recursively*

- **LINEAR VERSUS NONLINEAR FUNCTIONS**
  - **F 503** *Build functions and use quantitative information to identify graphs for relations that are proportional or linear*
  - **A 502** *Solve real-world problems by using first-degree equations*
  - **AF 402** *Perform straightforward word-to-symbol translations*

## 17. RATIONAL EXPRESSIONS AND FUNCTIONS

- **OPERATIONS WITH RATIONAL EXPRESSIONS**
  - **A 513** *Determine when an expression is undefined*
  - **A 601** *Manipulate expressions and equations*
  - **A 201** *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*
  - **A 303** *Combine like terms (e.g., 2x + 5x)*

- **ANALYZING GRAPHS OF RATIONAL FUNCTIONS**
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **F 510** *Find where a rational function's graph has a vertical asymptote*
  - **F 508** *Find the domain of polynomial functions and rational functions*

## 18. SOLVING QUADRATIC EQUATIONS

- **FACTORING SPECIAL CASES**
  - **A 508** *Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)*
  - **A 513** *Determine when an expression is undefined*
  - **A 601** *Manipulate expressions and equations*
  - **A 201** *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*

- **SOLVING QUADRATIC EQUATIONS BY FACTORING**
  - **A 508** *Factor simple quadratics (e.g., the difference of squares and perfect square trinomials)*
  - **A 506** *Identify solutions to simple quadratic equations*
  - **A 605** *Solve quadratic equations*
  - **A 507** *Solve quadratic equations in the form (x + a)(x + b) = 0, where a and b are numbers or variables*
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*

- **COMPLETING THE SQUARE**
  - **A 506** *Identify solutions to simple quadratic equations*
  - **A 605** *Solve quadratic equations*
  - **A 507** *Solve quadratic equations in the form (x + a)(x + b) = 0, where a and b are numbers or variables*

- **QUADRATIC FORMULA**
  - **A 513** *Determine when an expression is undefined*
  - **A 201** *Exhibit knowledge of basic expressions (e.g., identify an expression for a total as b + g)*
  - **A 506** *Identify solutions to simple quadratic equations*
  - **A 605** *Solve quadratic equations*
  - **A 507** *Solve quadratic equations in the form (x + a)(x + b) = 0, where a and b are numbers or variables*
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*
  - **F 511** *Use function notation for simple functions of two variables*

## 19. QUADRATIC FUNCTIONS AND COMPLEX NUMBERS

- **FACTOR THEOREM AND REMAINDER THEOREM**
  - **A 703** *Apply the remainder theorem for polynomials, that P(a) is the remainder when P(x) is divided by (x − a)*
  - **F 501** *Evaluate polynomial functions, expressed in function notation, at integer values*

- **COMPLEX NUMBERS**
  - **N 504** *Exhibit some knowledge of the complex numbers*
  - **N 606** *Multiply two complex numbers*
  - **N 704** *Apply properties of complex numbers and the complex number system*
  - **N 703** *Apply properties of real numbers and the real number system, including properties of irrational numbers*

- **ANALYZING GRAPHS OF QUADRATIC FUNCTIONS**
  - **F 511** *Use function notation for simple functions of two variables*
  - **F 506** *Understand the concept of domain and range in terms of valid input and output, and in terms of function graphs*
  - **F 509** *Find the range of polynomial functions*
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **AF 402** *Perform straightforward word-to-symbol translations*
  - **F 504** *Attend to the difference between a function modeling a situation and the reality of the situation*

## 20. NONLINEAR EQUATIONS

- **SYSTEMS OF NONLINEAR EQUATIONS**
  - **A 604** *Solve systems of two linear equations*
  - **AF 603** *Interpret and use information from graphs in the coordinate plane*

- **SOLVING RATIONAL EQUATIONS**
  - **A 513** *Determine when an expression is undefined*

## 21. TRANSFORMATIONS

- **TRANSFORMATIONS OF PARENT FUNCTIONS**
  - **AF 604** *Given an equation or function, find an equation or function whose graph is a translation by a specified amount up or down*
  - **AF 706** *Given an equation or function, find an equation or function whose graph is a translation by specified amounts in the horizontal and vertical directions*

- **MULTIPLE TRANSFORMATIONS OF PARENT FUNCTIONS**
  - **AF 706** *Given an equation or function, find an equation or function whose graph is a translation by specified amounts in the horizontal and vertical directions*

## 22. OPERATIONS WITH POLYNOMIALS

- **ADDITION AND SUBTRACTION OF POLYNOMIALS**
  - **A 505** *Add, subtract, and multiply polynomials*
  - **A 601** *Manipulate expressions and equations*
  - **A 402** *Add and subtract simple algebraic expressions*

- **MULTIPLICATION OF POLYNOMIALS**
  - **A 601** *Manipulate expressions and equations*
  - **A 404** *Multiply two binomials*
  - **A 505** *Add, subtract, and multiply polynomials*

## 23. PLOTTING POINTS

- **PLOTTING POINTS IN THE COORDINATE PLANE**
  - **N 203** *Locate positive rational numbers (expressed as whole numbers, fractions, decimals, and mixed numbers) on the number line*
  - **N 303** *Locate rational numbers on the number line*
  - **G 304** *Locate points in the first quadrant*
  - **G 406** *Locate points in the coordinate plane*
  - **N 405** *Find the distance in the coordinate plane between two points with the same x-coordinate or y-coordinate*

- **QUADRANTS AND AXES**
  - **G 304** *Locate points in the first quadrant*
  - **G 406** *Locate points in the coordinate plane*

## 24. COORDINATE GEOMETRY

- **DISTANCE ON THE COORDINATE PLANE**
  - **N 405** *Find the distance in the coordinate plane between two points with the same x-coordinate or y-coordinate*
  - **AF 201** *Solve problems in one or two steps using whole numbers and using decimals in the context of money*
  - **G 602** *Use the Pythagorean theorem*
  - **G 605** *Use the distance formula*

- **MIDPOINT FORMULA ON THE COORDINATE PLANE**
  - **G 511** *Find the midpoint of a line segment*
  - **N 405** *Find the distance in the coordinate plane between two points with the same x-coordinate or y-coordinate*
  - **G 605** *Use the distance formula*

- **PERIMETER ON THE COORDINATE PLANE**

- ○ **G 302** *Compute the perimeter of polygons when all side lengths are given*
- ○ **G 403** *Compute the area and perimeter of triangles and rectangles in simple problems*
- ○ **G 505** *Compute the perimeter of simple composite geometric figures with unknown side lengths*
- ○ **G 304** *Locate points in the first quadrant*
- ○ **G 406** *Locate points in the coordinate plane*

## 25. AREA AND VOLUME

- **INTRODUCTION TO AREA**
  - ○ **G 303** *Compute the area of rectangles when whole number dimensions are given*
  - ○ **G 403** *Compute the area and perimeter of triangles and rectangles in simple problems*
  - ○ **G 702** *Compute the area of composite geometric figures when planning and/or visualization is required*

- **AREA, VOLUME, AND SURFACE AREA**
  - ○ **G 405** *Use geometric formulas when all necessary information is given*
  - ○ **G 505** *Compute the perimeter of simple composite geometric figures with unknown side lengths*
  - ○ **G 702** *Compute the area of composite geometric figures when planning and/or visualization is required*
  - ○ **G 601** *Use relationships involving area, perimeter, and volume of geometric figures to compute another measure (e.g., surface area for a cube of a given volume and simple geometric probability)*

- **AREA ON THE COORDINATE PLANE**
  - ○ **G 506** *Compute the area of triangles and rectangles when one or more additional simple steps are required*
  - ○ **G 702** *Compute the area of composite geometric figures when planning and/or visualization is required*

## 26. MODELING WITH GEOMETRY

- **MODELING SITUATIONS WITH GEOMETRY**
  - ○ **AF 301** *Solve routine one-step arithmetic problems using positive rational numbers, such as single-step percent*
  - ○ **G 405** *Use geometric formulas when all necessary information is given*
  - ○ **G 704** *Analyze and draw conclusions based on a set of conditions*
  - ○ **G 705** *Solve multistep geometry problems that involve integrating concepts, planning, and/or visualization*

- **SCALE DRAWINGS**
  - ○ **G 703** *Use scale factors to determine the magnitude of a size change*

## 27. ANGLE RELATIONSHIPS

- **ANGLE RELATIONSHIPS**
  - ○ **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*
  - ○ **G 501** *Use several angle properties to find an unknown angle measure*

- **PARALLEL LINES AND ANGLE RELATIONSHIPS**
  - ○ **G 301** *Exhibit some knowledge of the angles associated with parallel lines*
  - ○ **G 401** *Use properties of parallel lines to find the measure of an angle*
  - ○ **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*
  - ○ **G 501** *Use several angle properties to find an unknown angle measure*

## 28. TRIANGLES

- **TRIANGLE ANGLE THEOREMS**
  - ○ **G 501** *Use several angle properties to find an unknown angle measure*

- **G 704** *Analyze and draw conclusions based on a set of conditions*
- **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*
- **G 503** *Use symmetry of isosceles triangles to find unknown side lengths or angle measures*

- **THE PYTHAGOREAN THEOREM**
  - **G 602** *Use the Pythagorean theorem*
  - **G 404** *Find the length of the hypotenuse of a right triangle when only very simple computation is involved (e.g., 3-4-5 and 6-8-10 triangles)*
  - **G 508** *Given the length of two sides of a right triangle, find the third when the lengths are Pythagorean triples*

## 29. CONGRUENCE AND SIMILARITY WITH TRIANGLES

- **TRIANGLES AND CONGRUENCE TRANSFORMATIONS**
  - **G 603** *Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles*

- **TRIANGLES AND SIMILARITY TRANSFORMATIONS**
  - **G 603** *Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles*

## 30. TRIGONOMETRY AND TRIGONOMETRIC FUNCTIONS

- **TRIGONOMETRIC RATIOS**
  - **G 509** *Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths*
  - **G 604** *Apply basic trigonometric ratios to solve right-triangle problems*
  - **G 603** *Apply properties of 30°-60°-90°, 45°-45°-90°, similar, and congruent triangles*
  - **F 706** *Use trigonometric concepts and basic identities to solve problems*

- **LAWS OF SINE AND COSINE**
  - **F 706** *Use trigonometric concepts and basic identities to solve problems*
  - **G 509** *Express the sine, cosine, and tangent of an angle in a right triangle as a ratio of given side lengths*
  - **G 604** *Apply basic trigonometric ratios to solve right-triangle problems*

- **RADIANS AND THE UNIT CIRCLE**
  - **F 704** *Exhibit knowledge of unit circle trigonometry*

- **TRIGONOMETRIC FUNCTIONS**
  - **AF 705** *Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$*
  - **F 705** *Match graphs of basic trigonometric functions with their equations*
  - **F 706** *Use trigonometric concepts and basic identities to solve problems*

## 31. INTRODUCTION TO CIRCLES

- **CIRCLES AND FORMULAS**
  - **G 507** *Compute the area and circumference of circles after identifying necessary information*
  - **G 405** *Use geometric formulas when all necessary information is given*

- **CIRCLE BASICS**
  - **G 701** *Use relationships among angles, arcs, and distances in a circle*

## 32. CIRCLES

- **CENTRAL ANGLES, INSCRIBED ANGLES, AND CHORDS**
  - **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*
  - **G 701** *Use relationships among angles, arcs, and distances in a circle*
  - **G 501** *Use several angle properties to find an unknown angle measure*

- **SECANTS, ANGLES, AND INTERCEPTED ARCS**
  - **G 701** *Use relationships among angles, arcs, and distances in a circle*
  - **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*

- **TANGENTS, ANGLES, AND INTERCEPTED ARCS**
  - **G 701** *Use relationships among angles, arcs, and distances in a circle*
  - **G 402** *Exhibit knowledge of basic angle properties and special sums of angle measures (e.g., 90°, 180°, and 360°)*

## 33. CONIC SECTIONS

- **CIRCLES**
  - **G 609** *Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)*

- **PARABOLAS**
  - **G 609** *Recognize special characteristics of parabolas and circles (e.g., the vertex of a parabola and the center or radius of a circle)*
  - **AF 602** *Build functions and write expressions, equations, and inequalities for common algebra settings (e.g., distance to a point on a curve and profit for variable cost and demand)*
  - **AF 502** *Build functions and write expressions, equations, or inequalities with a single variable for common pre-algebra settings (e.g., rate and distance problems and problems that can be solved by using proportions)*
  - **AF 702** *Build functions and write expressions, equations, and inequalities when the process requires planning and/or strategic manipulation*

## 34. STATISTICS

- **EXPERIMENTAL AND OBSERVATIONAL DESIGN**
  - **S 703** *Understand the role of randomization in surveys, experiments, and observational studies*

- **DATA ANALYSIS**
  - **S 201** *Calculate the average of a list of positive whole numbers*
  - **S 301** *Calculate the average of a list of numbers*
  - **S 302** *Calculate the average given the number of data values and the sum of the data values*
  - **S 304** *Extract relevant data from a basic table or chart and use the data in a computation*
  - **S 702** *Analyze and draw conclusions based on information from tables and charts, including two-way frequency tables*
  - **S 202** *Extract one relevant number from a basic table or chart, and use it in a single computation*
  - **S 501** *Calculate the average given the frequency counts of all the data values*
  - **S 502** *Manipulate data from tables and charts*
  - **S 602** *Interpret and use information from tables and charts, including two-way frequency tables*
  - **S 701** *Distinguish between mean, median, and mode for a list of numbers*

- **FREQUENCY TABLES**
  - **S 502** *Manipulate data from tables and charts*
  - **S 602** *Interpret and use information from tables and charts, including two-way frequency tables*
  - **S 605** *Recognize the concepts of conditional and joint probability expressed in real-world contexts*
  - **S 702** *Analyze and draw conclusions based on information from tables and charts, including two-way frequency tables*

- S 303 *Read basic tables and charts*

## 35. INTRODUCTION TO PROBABILITY

- **INTRODUCTION TO PROBABILITY**
  - S 305 *Use the relationship between the probability of an event and the probability of its complement*
  - S 404 *Describe events as combinations of other events (e.g., using and, or, and not)*
  - S 503 *Compute straightforward probabilities for common situations*
  - S 604 *Compute a probability when the event and/or sample space are not given or obvious*
  - S 606 *Recognize the concept of independence expressed in real-world contexts*
  - S 405 *Exhibit knowledge of simple counting techniques*
  - S 603 *Apply counting techniques*

- **CALCULATING PROBABILITY**
  - S 403 *Determine the probability of a simple event*
  - S 503 *Compute straightforward probabilities for common situations*
  - S 604 *Compute a probability when the event and/or sample space are not given or obvious*
  - S 404 *Describe events as combinations of other events (e.g., using and, or, and not)*

## 36. PROBABILITY

- **GEOMETRIC PROBABILITIES**
  - S 403 *Determine the probability of a simple event*
  - S 503 *Compute straightforward probabilities for common situations*
  - G 601 *Use relationships involving area, perimeter, and volume of geometric figures to compute another measure (e.g., surface area for a cube of a given volume and simple geometric probability)*
  - S 604 *Compute a probability when the event and/or sample space are not given or obvious*

- **CONDITIONAL PROBABILITY**
  - S 503 *Compute straightforward probabilities for common situations*
  - S 604 *Compute a probability when the event and/or sample space are not given or obvious*
  - S 605 *Recognize the concepts of conditional and joint probability expressed in real-world contexts*
  - S 704 *Exhibit knowledge of conditional and joint probability*
  - S 404 *Describe events as combinations of other events (e.g., using and, or, and not)*
  - S 606 *Recognize the concept of independence expressed in real-world contexts*
  - S 502 *Manipulate data from tables and charts*
  - S 602 *Interpret and use information from tables and charts, including two-way frequency tables*
  - S 702 *Analyze and draw conclusions based on information from tables and charts, including two-way frequency tables*
  - S 303 *Read basic tables and charts*

- **COMBINATIONS AND PERMUTATIONS**
  - S 404 *Describe events as combinations of other events (e.g., using and, or, and not)*
  - S 405 *Exhibit knowledge of simple counting techniques*
  - S 603 *Apply counting techniques*
  - S 503 *Compute straightforward probabilities for common situations*
  - S 604 *Compute a probability when the event and/or sample space are not given or obvious*