

# Grades 9, 10, 11, 12

Adopted 2016

## Algebra I

### Number and Quantity

- A. Extend and use properties of rational exponents. **A1.NQ.A**
  - 1. Explain how the meaning of rational exponents extends from the properties of integer exponents. **A1.NQ.A.1**
  - 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. Limit to rational exponents with a numerator of 1. **A1.NQ.A.2**
- B. Use units to solve problems. **A1.NQ.B**
  - 3. Use units of measure as a way to understand and solve problems involving quantities. **A1.NQ.B.3**
    - a. Identify, label and use appropriate units of measure within a problem. **A1.NQ.B.3.A**
    - b. Convert units and rates. **A1.NQ.B.3.B**
    - c. Use units within problems. **A1.NQ.B.3.C**
    - d. Choose and interpret the scale and the origin in graphs and data displays. **A1.NQ.B.3.D**
  - 4. Define and use appropriate quantities for representing a given context or problem. **A1.NQ.B.4**
  - 5. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **A1.NQ.B.5**

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## Seeing Structure in Expressions

- A. Interpret and use structure. [A1.SSE.A](#)
1. Interpret the contextual meaning of individual terms or factors from a given problem that utilizes formulas or expressions. [A1.SSE.A.1](#)
  2. Analyze the structure of polynomials to create equivalent expressions or equations. [A1.SSE.A.2](#)
  3. Choose and produce equivalent forms of a quadratic expression or equations to reveal and explain properties. [A1.SSE.A.3](#)
    - a. Find the zeros of a quadratic function by rewriting it in factored form. [A1.SSE.A.3.A](#)
    - b. Find the maximum or minimum value of a quadratic function by completing the square. [A1.SSE.A.3.B](#)

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## Creating Equations

- A. Create equations that describe linear, quadratic and exponential relationships. [A1.CED.A](#)
1. Create equations and inequalities in one variable and use them to model and/or solve problems. [A1.CED.A.1](#)
  2. Create and graph linear, quadratic and exponential equations in two variables. [A1.CED.A.2](#)
  3. Represent constraints by equations or inequalities and by systems of equations or inequalities, and interpret the data points as a solution or non-solution in a modeling context. [A1.CED.A.3](#)
  4. Solve literal equations and formulas for a specified variable that highlights a quantity of interest. [A1.CED.A.4](#)

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## Reasoning with Equations and Inequalities

- A. Understand solving equations as a process, and solve equations and inequalities in one variable. [A1.REI.A](#)
  - 1. Explain how each step taken when solving an equation or inequality in one variable creates an equivalent equation or inequality that has the same solution(s) as the original. [A1.REI.A.1](#)
  - 2. Solve problems involving quadratic equations. [A1.REI.A.2](#)
    - a. Use the method of completing the square to create an equivalent quadratic equation. [A1.REI.A.2.A](#)
    - b. Derive the quadratic formula. [A1.REI.A.2.B](#)
    - c. Analyze different methods of solving quadratic equations. [A1.REI.A.2.C](#)
- B. Solve systems of equations. [A1.REI.B](#)
  - 3. Solve a system of linear equations algebraically and/or graphically. [A1.REI.B.3](#)
  - 4. Solve a system consisting of a linear equation and a quadratic equation algebraically and/or graphically. [A1.REI.B.4](#)
  - 5. Justify that the technique of linear combination produces an equivalent system of equations. [A1.REI.B.5](#)
- C. Represent and solve linear and exponential equations and inequalities graphically. [A1.REI.C](#)
  - 6. Explain that the graph of an equation in two variables is the set of all its solutions plotted in the Cartesian coordinate plane. [A1.REI.C.6](#)
  - 7. Graph the solution to a linear inequality in two variables. [A1.REI.C.7](#)
  - 8. Solve problems involving a system of linear inequalities. [A1.REI.C.8](#)

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## Arithmetic with Polynomials and Rational Expressions

- A. Perform operations on polynomials. [A1.APR.A](#)
  - 1. Add, subtract and multiply polynomials, and understand that polynomials follow the same general rules of arithmetic and are closed under these operations. [A1.APR.A.1](#)
  - 2. Divide polynomials by monomials. [A1.APR.A.2](#)

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## Interpreting Functions

- A. Understand the concept of a function and use function notation. **A1.IF.A**
  - 1. Understand that a function from one set (domain) to another set (range) assigns to each element of the domain exactly one element of the range. **A1.IF.A.1**
    - a. Represent a function using function notation. **A1.IF.A.1.A**
    - b. Understand that the graph of a function labeled  $f$  **A1.IF.A.1.B**
  - 2. Use function notation to evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. **A1.IF.A.2**
- B. Interpret linear, quadratic and exponential functions in terms of the context. **A1.IF.B**
  - 3. Using tables, graphs and verbal descriptions, interpret key characteristics of a function that models the relationship between two quantities. **A1.IF.B.3**
  - 4. Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes. **A1.IF.B.4**
  - 5. Determine the average rate of change of a function over a specified interval and interpret the meaning. **A1.IF.B.5**
  - 6. Interpret the parameters of a linear or exponential function in terms of the context. **A1.IF.B.6**
- C. Analyze linear, quadratic and exponential functions using different representations. **A1.IF.C**
  - 7. Graph functions expressed symbolically and identify and interpret key features of the graph. **A1.IF.C.7**
  - 8. Translate between different but equivalent forms of a function to reveal and explain properties of the function and interpret these in terms of a context. **A1.IF.C.8**
  - 9. Compare the properties of two functions given different representations. **A1.IF.C.9**

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## Building Functions

- A. Build new functions from existing functions (limited to linear, quadratic and exponential). **A1.BF.A**
  - 1. Analyze the effect of translations and scale changes on functions. **A1.BF.A.1**

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## Linear, Quadratic and Exponential Models

- A. Construct and compare linear, quadratic and exponential models and solve problems. **A1.LQE.A**
  - 1. Distinguish between situations that can be modeled with linear or exponential functions. **A1.LQE.A.1**
    - a. Determine that linear functions change by equal differences over equal intervals. **A1.LQE.A.1.A**
    - b. Recognize exponential situations in which a quantity grows or decays by a constant percent rate per unit interval. **A1.LQE.A.1.B**
  - 2. Describe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. **A1.LQE.A.2**
  - 3. Construct linear, quadratic and exponential equations given graphs, verbal descriptions or tables. **A1.LQE.A.3**
- B. Use arithmetic and geometric sequences. **A1.LQE.B**
  - 4. Write arithmetic and geometric sequences in recursive and explicit forms, and use them to model situations and translate between the two forms. **A1.LQE.B.4**
  - 5. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the set of integers. **A1.LQE.B.5**
  - 6. Find the terms of sequences given an explicit or recursive formula. **A1.LQE.B.6**

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## Data and Statistical Analysis

- A. Summarize, represent and interpret data. [A1.DS.A](#)
  - 1. Analyze and interpret graphical displays of data. [A1.DS.A.1](#)
  - 2. Use statistics appropriate to the shape of the data distribution to compare center and spread of two or more different data sets. [A1.DS.A.2](#)
  - 3. Interpret differences in shape, center and spreads in the context of the data sets, accounting for possible effects of outliers. [A1.DS.A.3](#)
  - 4. Summarize data in two-way frequency tables. [A1.DS.A.4](#)
    - a. Interpret relative frequencies in the context of the data. [A1.DS.A.4.A](#)
    - b. Recognize possible associations and trends in the data. [A1.DS.A.4.B](#)
  - 5. Construct a scatter plot of bivariate quantitative data describing how the variables are related; determine and use a function that models the relationship. [A1.DS.A.5](#)
    - a. Construct a linear function to model bivariate data represented on a scatter plot that minimizes residuals. [A1.DS.A.5.A](#)
    - b. Construct an exponential function to model bivariate data represented on a scatter plot that minimizes residuals. [A1.DS.A.5.B](#)
  - 6. Interpret the slope (rate of change) and the y-intercept (constant term) of a linear model in the context of the data. [A1.DS.A.6](#)
  - 7. Determine and interpret the correlation coefficient for a linear association. [A1.DS.A.7](#)
  - 8. Distinguish between correlation and causation. [A1.DS.A.8](#)

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## Algebra II

### Number and Quantity

- A. Extend and use the relationship between rational exponents and radicals. [A2.NQ.A](#)
  - 1. Extend the system of powers and roots to include rational exponents. [A2.NQ.A.1](#)
  - 2. Create and recognize equivalent expressions involving radical and exponential forms of expressions. [A2.NQ.A.2](#)
  - 3. Add, subtract, multiply and divide radical expressions. [A2.NQ.A.3](#)
  - 4. Solve equations involving rational exponents and/or radicals and identify situations where extraneous solutions may result. [A2.NQ.A.4](#)
- B. Use complex numbers. [A2.NQ.B](#)
  - 5. Represent complex numbers. [A2.NQ.B.5](#)
  - 6. Add, subtract, multiply and divide complex numbers. [A2.NQ.B.6](#)
  - 7. Know and apply the Fundamental Theorem of Algebra. [A2.NQ.B.7](#)

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## Seeing Structure in Expressions

- A. Define and use logarithms. [A2.SSE.A](#)
  - 1. Develop the definition of logarithms based on properties of exponents. [A2.SSE.A.1](#)
  - 2. Use the inverse relationship between exponents and logarithms to solve exponential and logarithmic equations. [A2.SSE.A.2](#)
  - 3. Use properties of logarithms to solve equations or find equivalent expressions. [A2.SSE.A.3](#)
  - 4. Understand why logarithmic scales are used, and use them to solve problems. [A2.SSE.A.4](#)

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## Reasoning with Equations and Inequalities

- A. Solve equations and inequalities. [A2.REI.A](#)
  - 1. Create and solve equations and inequalities, including those that involve absolute value. [A2.REI.A.1](#)
  - 2. Solve rational equations where numerators and denominators are polynomials and where extraneous solutions may result. [A2.REI.A.2](#)
- B. Solve general systems of equations and inequalities. [A2.REI.B](#)
  - 3. Create and solve systems of equations that may include nonlinear equations and inequalities. [A2.REI.B.3](#)

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## Arithmetic with Polynomials and Rational Expressions

- A. Perform operations on polynomials and rational expressions. [A2.APR.A](#)
  - 1. Extend the knowledge of factoring to include factors with complex coefficients. [A2.APR.A.1](#)
  - 2. Understand the Remainder Theorem and use it to solve problems. [A2.APR.A.2](#)
  - 3. Find the least common multiple of two or more polynomials. [A2.APR.A.3](#)
  - 4. Add, subtract, multiply and divide rational expressions. [A2.APR.A.4](#)
  - 5. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to sketch the function defined by the polynomial. [A2.APR.A.5](#)

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## Interpreting Functions

- A. Use and interpret functions. [A2.IF.A](#)
  - 1. Identify and interpret key characteristics of functions represented graphically, with tables and with algebraic symbolism to solve problems. [A2.IF.A.1](#)
  - 2. Translate between equivalent forms of functions. [A2.IF.A.2](#)

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## Building Functions

- A. Create new functions from existing functions. [A2.BF.A](#)
    - 1. Create new functions by applying the four arithmetic operations and composition of functions (modifying the domain and range as necessary). [A2.BF.A.1](#)
    - 2. Derive inverses of functions, and compose the inverse with the original function to show that the functions are inverses. [A2.BF.A.2](#)
    - 3. Describe the effects of transformations algebraically and graphically, creating vertical and horizontal translations, vertical and horizontal reflections and dilations (expansions/compressions) for linear, quadratic, cubic, square and cube root, absolute value, exponential and logarithmic functions. [A2.BF.A.3](#)
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## Modeling

- A. Use functions to model real-world problems. [A2.FM.A](#)
    - 1. Create functions and use them to solve applications of quadratic and exponential function modeling problems. [A2.FM.A.1](#)
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## Data and Statistical Analysis

- A. Make inferences and justify conclusions. [A2.DS.A](#)
    - 1. Analyze how random sampling could be used to make inferences about population parameters. [A2.DS.A.1](#)
    - 2. Determine whether a specified model is consistent with a given data set. [A2.DS.A.2](#)
    - 3. Describe and explain the purposes, relationship to randomization and differences, among sample surveys, experiments and observational studies. [A2.DS.A.3](#)
    - 4. Use data from a sample to estimate characteristics of the population and recognize the meaning of the margin of error in these estimates. [A2.DS.A.4](#)
    - 5. Describe and explain how the relative sizes of a sample and the population affect the margin of error of predictions. [A2.DS.A.5](#)
    - 6. Analyze decisions and strategies using probability concepts. [A2.DS.A.6](#)
    - 7. Evaluate reports based on data. [A2.DS.A.7](#)
  - B. Fit a data set to a normal distribution. [A2.DS.B](#)
    - 8. Know and use the characteristics of normally distributed data sets; predict what percentage of the data will be above or below a given value that is a multiple of standard deviations above or below the mean. [A2.DS.B.8](#)
    - 9. Fit a data set to a distribution using its mean and standard deviation to determine whether the data is approximately normally distributed. [A2.DS.B.9](#)
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## Geometry

### Congruence

- A. Experiment with transformations in the plane. **G.CO.A**
  - 1. Define angle, circle, perpendicular line, parallel line, line segment and ray based on the undefined notions of point, line, distance along a line and distance around a circular arc. **G.CO.A.1**
  - 2. Represent transformations in the plane, and describe them as functions that take points in the plane as inputs and give other points as outputs. **G.CO.A.2**
  - 3. Describe the rotational symmetry and lines of symmetry of two-dimensional figures. **G.CO.A.3**
  - 4. Develop definitions of rotations, reflections and translations in terms of angles, circles, perpendicular lines, parallel lines and line segments. **G.CO.A.4**
  - 5. Demonstrate the ability to rotate, reflect or translate a figure, and determine a possible sequence of transformations between two congruent figures. **G.CO.A.5**
- B. Understand congruence in terms of rigid motions. **G.CO.B**
  - 6. Develop the definition of congruence in terms of rigid motions. **G.CO.B.6**
  - 7. Develop the criteria for triangle congruence from the definition of congruence in terms of rigid motions. **G.CO.B.7**
- C. Prove geometric theorems. **G.CO.C**
  - 8. Prove theorems about lines and angles. **G.CO.C.8**
  - 9. Prove theorems about triangles. **G.CO.C.9**
  - 10. Prove theorems about polygons. **G.CO.C.10**
- D. Make geometric constructions. **G.CO.D**
  - 11. Construct geometric figures using various tools and methods. **G.CO.D.11**

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## Similarity, Right Triangles, and Trigonometry

- A. Understand similarity in terms of similarity transformations. **G.SRT.A**
  - 1. Construct and analyze scale changes of geometric figures. **G.SRT.A.1**
  - 2. Use the definition of similarity to decide if figures are similar and to solve problems involving similar figures. **G.SRT.A.2**
  - 3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **G.SRT.A.3**
- B. Prove theorems involving similarity. **G.SRT.B**
  - 4. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **G.SRT.B.4**
- C. Define trigonometric ratios, and solve problems involving right triangles. **G.SRT.C**
  - 5. Understand that side ratios in right triangles define the trigonometric ratios for acute angles. **G.SRT.C.5**
  - 6. Explain and use the relationship between the sine and cosine of complementary angles. **G.SRT.C.6**
  - 7. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles. **G.SRT.C.7**
  - 8. Derive the formula  $A = \frac{1}{2} ab \sin(C)$  for the area of a triangle. **G.SRT.C.8**

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## Circles

- A. Understand and apply theorems about circles. **G.C.A**
  - 1. Prove that all circles are similar using similarity transformations. **G.C.A.1**
  - 2. Identify and describe relationships among inscribed angles, radii and chords of circles. **G.C.A.2**
  - 3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle. **G.C.A.3**
- B. Find arc lengths and areas of sectors of circles. **G.C.B**
  - 4. Derive the formula for the length of an arc of a circle. **G.C.B.4**
  - 5. Derive the formula for the area of a sector of a circle. **G.C.B.5**

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## Exploring Geometric Properties with Equations

- A. Translate between the geometric description and the equation for a conic section. **G.GPE.A**
  - 1. Derive the equation of a circle. **G.GPE.A.1**
  - 2. Derive the equation of a parabola given a focus and directrix. **G.GPE.A.2**
- B. Use coordinates to prove geometric theorems algebraically. **G.GPE.B**
  - 3. Use coordinates to prove geometric theorems algebraically. **G.GPE.B.3**
  - 4. Prove the slope criteria for parallel and perpendicular lines and use them to solve problems. **G.GPE.B.4**
  - 5. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. **G.GPE.B.5**
  - 6. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles. **G.GPE.B.6**

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## Geometric Measurement and Dimension

- A. Explain volume formulas and use them to solve problems. **G.GMD.A**
  - 1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid and cone. **G.GMD.A.1**
  - 2. Use volume formulas for cylinders, pyramids, cones, spheres and composite figures to solve problems. **G.GMD.A.2**
- B. Visualize relationships between two-dimensional and three-dimensional objects. **G.GMD.B**
  - 3. Identify the shapes of two-dimensional cross-sections of three-dimensional objects. **G.GMD.B.3**
  - 4. Identify three-dimensional objects generated by transformations of two-dimensional objects. **G.GMD.B.4**

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## Modeling with Geometry

- A. Apply geometric concepts in modeling situations. **G.MG.A**
  - 1. Use geometric shapes, their measures and their properties to describe objects. **G.MG.A.1**
  - 2. Apply concepts of density based on area and volume in modeling situations. **G.MG.A.2**
  - 3. Apply geometric methods to solve design mathematical modeling problems. **G.MG.A.3**

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## Conditional Probability and Rules of Probability

- A. Understand independence and conditional probability and use them to interpret data. **G.CP.A**
  - 1. Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections or complements of other events. **G.CP.A.1**
  - 2. Understand the definition of independent events and use it to solve problems. **G.CP.A.2**
  - 3. Calculate conditional probabilities of events. **G.CP.A.3**
  - 4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. **G.CP.A.4**
  - 5. Recognize and explain the concepts of conditional probability and independence in a context. **G.CP.A.5**
  - 6. Apply and interpret the Addition Rule for calculating probabilities. **G.CP.A.6**
  - 7. Apply and Interpret the general Multiplication Rule in a uniform probability model. **G.CP.A.7**
  - 8. Use permutations and combinations to solve problems. **G.CP.A.8**