Missouri Mathematics

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 = ½ ab sin(C) for the area of a triangle. G.SRT.C.8

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

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

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

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

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