

South Carolina Tutorials are designed specifically for the South Carolina College and Career Readiness Standards and the South Carolina Academic Standards to prepare students for the South Carolina End-of-Course Examination Program (EOCEP), ACT Aspire, and the South Carolina Palmetto Assessment of State Standards (SCPASS).

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

## 1. EXPRESSIONS, EQUATIONS, AND INEQUALITIES

### • LITERAL EQUATIONS

- **A2.ACE.4** Solve literal equations and formulas for a specified variable including equations and formulas that arise in a variety of disciplines.

### • FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- **A2.ACE.1** Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.
- **A2.FLQE.1.b** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.

### • FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS

- **A2.ACE.1** Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.

## 2. FUNCTIONS

### • FUNCTIONS AND RELATIONS

- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or

tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

- **DOMAIN AND RANGE**

- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.

### 3. LINEAR FUNCTIONS, EQUATIONS, AND INEQUALITIES

- **SLOPE**

- **A2.FIF.6** Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

- **GRAPHING AND ANALYZING LINEAR FUNCTIONS**

- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

- **GRAPHING AND MANIPULATING  $Y = MX + B$**

- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.6** Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.FLQE.1.b** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

- **A2.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.

## 4. EXPONENTIAL AND LOGARITHMIC FUNCTIONS

### • EXPONENTIAL FUNCTIONS

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.3.c** Use the properties of exponents to transform expressions for exponential functions.
- **A2.FIF.8.b** Interpret expressions for exponential functions by using the properties of exponents.
- **A2.FIF.6** Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **A2.ACE.1** Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.

### • EXPONENTIAL GROWTH AND DECAY

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.FIF.8.b** Interpret expressions for exponential functions by using the properties of exponents.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.
- **A2.FLQE.1.b** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.

### • LOGARITHMIC FUNCTIONS

- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.

## 5. EXPONENTIAL EQUATIONS AND INEQUALITIES

### • SOLVING EXPONENTIAL EQUATIONS

- **A2.ASE.3.c** Use the properties of exponents to transform expressions for exponential functions.
- **A2.FIF.8.b** Interpret expressions for exponential functions by using the properties of exponents.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or

tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

## • SOLVING EXPONENTIAL INEQUALITIES

- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **A2.ACE.3** Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programming. Interpret the solution within the context of the situation. (Limit to linear programming.)
- **A2.ACE.1** Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

## 6. POLYNOMIALS

### • POLYNOMIAL BASICS

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.

### • ADDITION AND SUBTRACTION OF POLYNOMIALS

- **A2.AAPR.1** Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.
- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

### • MULTIPLICATION OF POLYNOMIALS

- **A2.AAPR.1** Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.
- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

### • DIVISION OF POLYNOMIALS

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

## 7. COMPARING AND COMBINING FUNCTIONS

### • ARITHMETIC OPERATIONS ON FUNCTIONS

- **A2.FBF.1.a** Write a function that models a relationship between two quantities using both explicit expressions and a recursive process and by combining standard forms using addition, subtraction, multiplication and division to build new functions.
- **A2.FBF.1.b** Combine functions using the operations addition, subtraction, multiplication, and division to build new functions

that describe the relationship between two quantities in mathematical and real-world situations.

### • LINEAR VERSUS NONLINEAR FUNCTIONS

- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.6** Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FLQE.1.b** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

### • MULTIPLE REPRESENTATIONS OF FUNCTIONS

- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

## 8. GRAPHS AND REPRESENTATIONS OF QUADRATIC FUNCTIONS

### • ANALYZING GRAPHS OF QUADRATIC FUNCTIONS

- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)
- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .

### • REPRESENTATIONS OF QUADRATIC FUNCTIONS

- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums;

symmetries; end behavior and periodicity.

- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.ACE.3** Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programming. Interpret the solution within the context of the situation. (Limit to linear programming.)

## 9. SOLVING QUADRATIC EQUATIONS

### • SOLVING QUADRATIC FUNCTIONS WITH FACTORING

- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.FBF.1.a** Write a function that models a relationship between two quantities using both explicit expressions and a recursive process and by combining standard forms using addition, subtraction, multiplication and division to build new functions.

### • QUADRATIC FORMULA

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.

### • COMPLETING THE SQUARE

- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .



- **A2.ASE.3.b** Determine the maximum or minimum value of a quadratic function by completing the square.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.

- **COMPLEX NUMBERS AND QUADRATIC FUNCTIONS**

- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .
- **A2.NCNS.1** Know there is a complex number  $i$  such that  $i^2 = -1$ , and every complex number has the form  $a + bi$  with  $a$  and  $b$  real.

## 10. FACTORING POLYNOMIALS AND THE FACTOR THEOREM

- **FACTORING SPECIAL CASES**

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)

- **FACTORING CUBIC POLYNOMIALS**

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)

- **FACTORING HIGHER-ORDER POLYNOMIALS**

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

## 11. POLYNOMIAL FUNCTIONS AND POLYNOMIAL IDENTITIES

- **GRAPHS OF POLYNOMIAL FUNCTIONS**

- **A2.AAPR.3** Graph polynomials identifying zeros when suitable factorizations are available and indicating end behavior. Write a polynomial function of least degree corresponding to a given graph. (Limit to polynomials with degrees 3 or less.)
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.

- **COMPLEX NUMBERS**

- **A2.NCNS.1** Know there is a complex number  $i$  such that  $i^2 = -1$ , and every complex number has the form  $a + bi$  with  $a$  and  $b$  real.

- **POLYNOMIAL IDENTITIES**

- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .

- **POLYNOMIAL IDENTITIES AND COMPLEX NUMBERS**

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
- **A2.AREI.4.b** Solve quadratic equations by inspection, 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  $a + bi$  for real numbers  $a$  and  $b$ .
- **A2.NCNS.1** Know there is a complex number  $i$  such that  $i^2 = -1$ , and every complex number has the form  $a + bi$  with  $a$  and  $b$  real.

## 12. RADICAL AND RATIONAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

- **ANALYZING GRAPHS OF SQUARE ROOT FUNCTIONS**

- **A2.FBF.3** Describe the effect of the transformations  $kf(x)$ ,  $f(x) + k$ ,  $f(x + k)$ , and combinations of such transformations on the graph of  $y = f(x)$  for any real number  $k$ . Find the value of  $k$  given the graphs and write the equation of a transformed parent function given its graph.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.

- **SOLVING SQUARE ROOT EQUATIONS**

- **A2.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.

## 13. RATIONAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

- **OPERATIONS WITH RATIONAL EXPRESSIONS**

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret



*complicated expressions as being composed of simpler expressions.*

- **A2.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

## • ANALYZING GRAPHS OF RATIONAL FUNCTIONS

- **A2.FBF.3** Describe the effect of the transformations  $kf(x)$ ,  $f(x) + k$ ,  $f(x + k)$ , and combinations of such transformations on the graph of  $y = f(x)$  for any real number  $k$ . Find the value of  $k$  given the graphs and write the equation of a transformed parent function given its graph.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.

## • SOLVING RATIONAL EQUATIONS

- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.

## • MODELING SITUATIONS WITH RATIONAL FUNCTIONS

- **A2.ASE.1** Interpret the meanings of coefficients, factors, terms, and expressions based on their real-world contexts. Interpret complicated expressions as being composed of simpler expressions.
- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.ACE.3** Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programming. Interpret the solution within the context of the situation. (Limit to linear programming.)
- **A2.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

## 14. PARENT FUNCTIONS AND TRANSFORMATIONS

### • PARENT FUNCTIONS

- **A2.FBF.3** Describe the effect of the transformations  $kf(x)$ ,  $f(x) + k$ ,  $f(x + k)$ , and combinations of such transformations on the graph of  $y = f(x)$  for any real number  $k$ . Find the value of  $k$  given the graphs and write the equation of a transformed parent function given its graph.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it

describes.

- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

## • TRANSFORMATIONS OF PARENT FUNCTIONS

- **A2.FBF.3** Describe the effect of the transformations  $kf(x)$ ,  $f(x) + k$ ,  $f(x + k)$ , and combinations of such transformations on the graph of  $y = f(x)$  for any real number  $k$ . Find the value of  $k$  given the graphs and write the equation of a transformed parent function given its graph.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.

## • MULTIPLE TRANSFORMATIONS OF PARENT FUNCTIONS

- **A2.FBF.3** Describe the effect of the transformations  $kf(x)$ ,  $f(x) + k$ ,  $f(x + k)$ , and combinations of such transformations on the graph of  $y = f(x)$  for any real number  $k$ . Find the value of  $k$  given the graphs and write the equation of a transformed parent function given its graph.
- **A2.FIF.4** Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.
- **A2.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **A2.FIF.7** Graph functions from their symbolic representations. Indicate key features including intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity. Graph simple cases by hand and use technology for complicated cases.

## 15. SYSTEMS OF EQUATIONS

### • SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS

- **A2.ACE.2** Create equations in two or more variables to represent relationships between quantities. Graph the equations on coordinate axes using appropriate labels, units, and scales.
- **A2.ACE.3** Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programming. Interpret the solution within the context of the situation. (Limit to linear programming.)

### • SYSTEMS OF NONLINEAR EQUATIONS

- **A2.ACE.3** Use systems of equations and inequalities to represent constraints arising in real-world situations. Solve such systems using graphical and analytical methods, including linear programming. Interpret the solution within the context of the situation. (Limit to linear programming.)
- **A2.AREI.7** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. Understand that such systems may have zero, one, two, or infinitely many solutions. (Limit to linear equations and quadratic functions.)
- **A2.AREI.11** Solve an equation of the form  $f(x) = g(x)$  graphically by identifying the  $x$ -coordinate(s) of the point(s) of intersection of the graphs of  $y = f(x)$  and  $y = g(x)$ .
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

## 16. SEQUENCES

### • SEQUENCES

- **A2.FBF.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- **A2.FBF.1.a** Write a function that models a relationship between two quantities using both explicit expressions and a recursive process and by combining standard forms using addition, subtraction, multiplication and division to build new functions.
- **A2.FIF.3** Define functions recursively and recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

### • ARITHMETIC AND GEOMETRIC SEQUENCES

- **A2.FBF.2** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
- **A2.FBF.1.a** Write a function that models a relationship between two quantities using both explicit expressions and a recursive process and by combining standard forms using addition, subtraction, multiplication and division to build new functions.
- **A2.FIF.3** Define functions recursively and recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- **A2.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.