

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. INTRODUCTIONS TO EQUATIONS

● ONE-STEP EQUATIONS AND INEQUALITIES

- **IA.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.
- **IA.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.

● MULTI-STEP EQUATIONS AND INEQUALITIES

- **IA.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.

● LITERAL EQUATIONS

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

● DOMAIN AND RANGE

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

2. WRITING EXPRESSIONS AND EQUATIONS

● FORMULATING AND SIMPLIFYING ALGEBRAIC EXPRESSIONS

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

● FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- **IA.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.

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

- **IA.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.
- **IA.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.

3. GRAPHS OF LINEAR EQUATIONS AND INEQUALITIES

- **SLOPE**

- **IA.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.
- **IA.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**

- **IA.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.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **IA.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **IA.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 $Y = MX + B$**

- **IA.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.
- **IA.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.
- **IA.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.
- **IA.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.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **IA.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.

4. LINEAR EQUATIONS

• SLOPE-INTERCEPT FORM OF A LINEAR EQUATION

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

• POINT-SLOPE FORM OF A LINEAR EQUATION

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

5. LINEAR SYSTEMS

• SOLVING SYSTEMS OF LINEAR EQUATIONS: GRAPHING

- **IA.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.
- **IA.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 $y = g(x)$.

• SOLVING SYSTEMS OF LINEAR EQUATIONS: SUBSTITUTION

- **IA.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.

• SOLVING SYSTEMS OF LINEAR EQUATIONS: ELIMINATION

- **IA.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.

• SOLVING SYSTEMS OF LINEAR INEQUALITIES

- **IA.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.

6. EXPONENTIAL FUNCTIONS, EQUATIONS, AND INEQUALITIES

• EXPONENTIAL FUNCTIONS

- **IA.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.
- **IA.FIF.8.b** Interpret expressions for exponential functions by using the properties of exponents.
- **IA.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.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **IA.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.

- **IA.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **IA.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.
- **IA.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.

● EXPONENTIAL GROWTH AND DECAY

- **IA.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.
- **IA.FIF.8.b** Interpret expressions for exponential functions by using the properties of exponents.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **IA.FLQE.5** Interpret the parameters in a linear or exponential function in terms of the context.
- **IA.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.

● SOLVING EXPONENTIAL INEQUALITIES

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

7. SEQUENCES

● SEQUENCES

- **IA.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.
- **IA.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.
- **IA.FIF.3** Define functions recursively and recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- **IA.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

- **IA.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.
- **IA.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.
- **IA.FIF.3** Define functions recursively and recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

8. POLYNOMIALS

● POLYNOMIAL BASICS

- **IA.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.

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

- **ADDITION AND SUBTRACTION OF POLYNOMIALS**

- **IA.AAPR.1** Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.
- **IA.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.

- **MULTIPLICATION OF POLYNOMIALS**

- **IA.AAPR.1** Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.
- **IA.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.

9. FACTORING

- **FACTORING QUADRATIC TRINOMIALS**

- **IA.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 .
- **IA.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.
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.

- **FACTORING SPECIAL CASES**

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

- **FACTORING HIGHER-ORDER POLYNOMIALS**

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

10. GRAPHS OF QUADRATIC FUNCTIONS

- **QUADRATIC FUNCTIONS**

- **IA.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.
- **IA.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.
- **IA.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.
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.ASE.3.b** Determine the maximum or minimum value of a quadratic function by completing the square.

- **ANALYZING GRAPHS OF QUADRATIC FUNCTIONS**

- **IA.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.

- **IA.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **IA.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **IA.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.
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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

- **IA.AREI.4.a** Use the method of completing the square to transform any quadratic equation in xx into an equation of the form $(x - h)^2 = k$ that has the same solutions. Derive the quadratic formula from this form.
- **IA.ASE.2** Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.
- **IA.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.
- **IA.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.
- **IA.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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.
- **IA.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.

11. SOLVING QUADRATIC FUNCTIONS

● SOLVING QUADRATIC EQUATIONS BY FACTORING

- **IA.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 .
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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.
- **IA.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.
- **IA.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.

● COMPLETING THE SQUARE

- **IA.AREI.4.a** Use the method of completing the square to transform any quadratic equation in $ax^2 + bx + c = 0$ into an equation of the form $(x - h)^2 = k$ that has the same solutions. Derive the quadratic formula from this form.
- **IA.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 .
- **IA.ASE.3.b** Determine the maximum or minimum value of a quadratic function by completing the square.
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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.
- **IA.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.

● QUADRATIC FORMULA

- **IA.AREI.4.a** Use the method of completing the square to transform any quadratic equation in $ax^2 + bx + c = 0$ into an equation of the form $(x - h)^2 = k$ that has the same solutions. Derive the quadratic formula from this form.
- **IA.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.
- **IA.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 .
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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.
- **IA.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.

12. WORKING WITH COMPLEX NUMBERS

● COMPLEX NUMBERS

- **IA.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.
- **IA.NCNS.7** Solve quadratic equations in one variable that have complex solutions.

● COMPLEX NUMBERS AND QUADRATIC FUNCTIONS

- **IA.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 .
- **IA.ASE.3.a** Find the zeros of a quadratic function by rewriting it in equivalent factored form and explain the connection between the zeros of the function, its linear factors, the x -intercepts of its graph, and the solutions to the corresponding quadratic equation.
- **IA.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.

13. PARENT FUNCTIONS AND TRANSFORMATIONS

● LINEAR AND EXPONENTIAL PARENT FUNCTIONS

- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.
- **IA.FIF.5** Relate the domain and range of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **IA.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.

- **QUADRATIC PARENT FUNCTION**

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

- **T TRANSFORMATIONS OF THE LINEAR AND EXPONENTIAL PARENT FUNCTIONS**

- **IA.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.
- **IA.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.

- **T TRANSFORMATIONS OF THE QUADRATIC PARENT FUNCTION**

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

14. COMPARING AND COMBINING FUNCTIONS

- **ARITHMETIC OPERATIONS ON FUNCTIONS**

- **IA.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.
- **IA.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**

- **IA.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.
- **IA.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.
- **IA.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.
- **IA.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**

- **IA.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.

- **IA.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.
- **IA.FIF.9** Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

15. NONLINEAR FUNCTIONS

● ABSOLUTE VALUE FUNCTIONS

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

● SYSTEMS OF NONLINEAR EQUATIONS

- **IA.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 $y = g(x)$.
- **IA.FLQE.2** Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

16. RADICAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

● SOLVING SQUARE ROOT EQUATIONS

- **IA.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.
- **IA.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.
- **IA.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.

17. RATIONAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

● SOLVING RATIONAL EQUATIONS

- **IA.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.
- **IA.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.

● MODELING SITUATIONS WITH RATIONAL FUNCTIONS

- **IA.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.
- **IA.AREI.2** Solve simple rational and radical equations in one variable and understand how extraneous solutions may arise.
- **IA.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.