

Kentucky Tutorials are designed specifically for the Kentucky Academic Standards to prepare students for the K-PREP, EOC exams, ACT, and ACT Plan.

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. PRECISION, ACCURACY, AND LITERAL EQUATIONS

● MONITORING PRECISION AND ACCURACY

- **KY.HS.N.5** Define appropriate units in context for the purpose of descriptive modeling.
- **KY.HS.N.6** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- **KY.HS.N.4.a** Choose and interpret units consistently in formulas;
- **KY.HS.N.4.b** Choose and interpret the scale and the origin in graphs and data displays.
- **KY.HS.G.8.a** Make formal geometric constructions with a variety of tools and methods.

● LITERAL EQUATIONS

- **KY.HS.A.18** Solve linear equations and inequalities in one variable, including literal equations with coefficients represented by letters.
- **KY.HS.A.15** Rearrange formulas to solve a literal equation, highlighting a quantity of interest, using the same reasoning as in solving equations.
- **KY.HS.A.12** Create equations and inequalities in one variable and use them to solve problems.
- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.

2. WRITING AND SOLVING EQUATIONS AND INEQUALITIES

● FORMULATING AND SOLVING EQUATIONS FROM WORD PROBLEMS

- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.11.b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **KY.HS.A.12** Create equations and inequalities in one variable and use them to solve problems.
- **KY.HS.A.18** Solve linear equations and inequalities in one variable, including literal equations with coefficients represented by letters.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.

- **FORMULATING AND SOLVING INEQUALITIES FROM WORD PROBLEMS**

- **KY.HS.A.18** Solve linear equations and inequalities in one variable, including literal equations with coefficients represented by letters.
- **KY.HS.A.14** Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.
- **KY.HS.A.12** Create equations and inequalities in one variable and use them to solve problems.

3. FUNCTIONS

- **FUNCTIONS AND RELATIONS**

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.4.f** Graph piecewise functions, including step functions.

- **DOMAIN AND RANGE**

- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

- **INVERSE FUNCTIONS**

- **KY.HS.F.9.c** Read values of an inverse function from a graph or a table, given that the function has an inverse.
- **KY.HS.F.9.d** Produce an invertible function from a non-invertible function by restricting the domain.
- **KY.HS.F.9.a** Given the equation of an invertible function, find the inverse.

4. LINEAR FUNCTIONS, EQUATIONS, AND INEQUALITIES

- **SLOPE**

- **KY.HS.F.3.a** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- **KY.HS.F.3.b** Estimate the rate of change from a graph.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.G.22** Justify and apply the slope criteria for parallel and perpendicular lines and use them to solve geometric problems.

- **GRAPHING AND ANALYZING LINEAR FUNCTIONS**

- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in

terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.

- **KY.HS.F.4.a** Graph linear and quadratic functions and show intercepts, maxima and minima.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.
- **KY.HS.F.14** Interpret the parameters in a linear or exponential function in terms of a context.
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **KY.HS.A.23** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.
- **KY.HS.F.4.d** Graph exponential and logarithmic functions, showing intercepts and end behavior.
- **KY.HS.F.13** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

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

- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.F.3.a** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- **KY.HS.F.4.a** Graph linear and quadratic functions and show intercepts, maxima and minima.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.SP.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
- **KY.HS.F.14** Interpret the parameters in a linear or exponential function in terms of a context.
- **KY.HS.F.11.b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

5. EXPONENTIAL FUNCTIONS

● **EXPONENTIAL FUNCTIONS**

- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.
- **KY.HS.F.11.a** Recognize and justify that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.
- **KY.HS.F.5.b** Use the properties of exponents to interpret expressions for exponential functions and classify the exponential function as representing growth or decay.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.3.a** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- **KY.HS.F.13** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **KY.HS.F.14** Interpret the parameters in a linear or exponential function in terms of a context.
- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.F.11.c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **KY.HS.A.12** Create equations and inequalities in one variable and use them to solve problems.

● **EXPONENTIAL GROWTH AND DECAY**

- **KY.HS.F.14** Interpret the parameters in a linear or exponential function in terms of a context.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.
- **KY.HS.F.11.a** Recognize and justify that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.
- **KY.HS.F.11.c** Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- **KY.HS.A.1.b** Interpret complicated expressions, given a context, by viewing one or more of their parts as a single entity.
- **KY.HS.F.5.b** Use the properties of exponents to interpret expressions for exponential functions and classify the exponential function as representing growth or decay.
- **KY.HS.F.13** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- **KY.HS.A.3.c** Use the properties of exponents to rewrite exponential expressions.
- **KY.HS.F.11.b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **KY.HS.F.4.d** Graph exponential and logarithmic functions, showing intercepts and end behavior.

6. LOGARITHMIC EXPRESSIONS, EQUATIONS, AND FUNCTIONS

• LOGARITHMIC FUNCTIONS

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.9.c** Read values of an inverse function from a graph or a table, given that the function has an inverse.
- **KY.HS.F.10** Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents with the use of technology.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.4.d** Graph exponential and logarithmic functions, showing intercepts and end behavior.

• EVALUATING LOGARITHMIC EXPRESSIONS

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.

• SOLVING LOGARITHMIC EQUATIONS

- **KY.HS.F.10** Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents with the use of technology.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.A.16** Understand each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

7. SIMPLIFYING, ADDING, AND SUBTRACTING POLYNOMIAL EXPRESSIONS

• POLYNOMIAL BASICS

- **KY.HS.A.3.a** Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient and constant term.
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.

• ADDITION AND SUBTRACTION OF POLYNOMIALS

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.

- **KY.HS.A.5** Add, subtract and multiply polynomials.

8. MULTIPLYING POLYNOMIAL EXPRESSIONS AND COMPOSING FUNCTIONS

• MULTIPLICATION OF POLYNOMIALS

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.5** Add, subtract and multiply polynomials.
- **KY.HS.A.3.a** Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient and constant term.

• ARITHMETIC OPERATIONS ON FUNCTIONS

- **KY.HS.F.6.b** Combine standard function types using arithmetic operations.

9. GRAPHS AND REPRESENTATIONS OF QUADRATIC FUNCTIONS

• ANALYZING GRAPHS OF QUADRATIC FUNCTIONS

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.4.a** Graph linear and quadratic functions and show intercepts, maxima and minima.
- **KY.HS.F.5.a** Identify zeros, extreme values and symmetry of the graph within the context of a quadratic function.
- **KY.HS.A.23** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.
- **KY.HS.A.7** Identify roots of polynomials when suitable factorizations are available. Know these roots become the zeros (x -intercepts) for the corresponding polynomial function.
- **KY.HS.F.1.e** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

• REPRESENTATIONS OF QUADRATIC FUNCTIONS

- **KY.HS.A.19.b** Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.A.23** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.
- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **KY.HS.A.19.a** Solve quadratic equations by taking square roots, 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 $a \pm bi$ for real numbers a and b .
- **KY.HS.A.3.b** Factor a quadratic expression to reveal the zeros of the function it defines.

● MULTIPLE REPRESENTATIONS OF FUNCTIONS

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.
- **KY.HS.F.1.e** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- **KY.HS.F.11.a** Recognize and justify that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

10. SOLVING QUADRATIC EQUATIONS

● SOLVING QUADRATIC EQUATIONS BY FACTORING

- **KY.HS.A.19.a** Solve quadratic equations by taking square roots, 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 $a \pm bi$ for real numbers a and b .
- **KY.HS.F.5.a** Identify zeros, extreme values and symmetry of the graph within the context of a quadratic function.
- **KY.HS.A.3.b** Factor a quadratic expression to reveal the zeros of the function it defines.
- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.7** Identify roots of polynomials when suitable factorizations are available. Know these roots become the zeros (x -intercepts) for the corresponding polynomial function.
- **KY.HS.A.8** Prove polynomial identities and use them to describe numerical relationships.
- **KY.HS.F.4.a** Graph linear and quadratic functions and show intercepts, maxima and minima.
- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.

● COMPLETING THE SQUARE

- **KY.HS.A.19.b** Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
- **KY.HS.A.19.a** Solve quadratic equations by taking square roots, 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 $a \pm bi$ for real numbers a and b .
- **KY.HS.A.3.d** Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
- **KY.HS.A.19.c** Solve quadratic equations by completing the square.
- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.F.4.a** Graph linear and quadratic functions and show intercepts, maxima and minima.
- **KY.HS.F.5.a** Identify zeros, extreme values and symmetry of the graph within the context of a quadratic function.

11. QUADRATIC FORMULA AND COMPLEX NUMBERS

● QUADRATIC FORMULA

- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.
- **KY.HS.A.19.a** Solve quadratic equations by taking square roots, 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 $a \pm bi$ for real numbers a and b .
- **KY.HS.N.9** Solve quadratic equations with real coefficients that have complex solutions.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.5.a** Identify zeros, extreme values and symmetry of the graph within the context of a quadratic function.
- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that

use function notation in terms of a context.

- **KY.HS.A.14** Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.

- **COMPLEX NUMBERS AND QUADRATIC FUNCTIONS**

- **KY.HS.A.19.a** Solve quadratic equations by taking square roots, 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 $a \pm bi$ for real numbers a and b .
- **KY.HS.N.9** Solve quadratic equations with real coefficients that have complex solutions.

12. FACTORING SPECIAL CASES AND CUBIC POLYNOMIALS

- **FACTORING SPECIAL CASES**

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.
- **KY.HS.A.1.b** Interpret complicated expressions, given a context, by viewing one or more of their parts as a single entity.
- **KY.HS.A.8** Prove polynomial identities and use them to describe numerical relationships.

- **FACTORING CUBIC POLYNOMIALS**

- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.A.8** Prove polynomial identities and use them to describe numerical relationships.

13. POLYNOMIAL FUNCTIONS AND COMPLEX NUMBERS

- **GRAPHS OF POLYNOMIAL FUNCTIONS**

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.4.c** Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior.

- **COMPLEX NUMBERS**

- **KY.HS.N.7.a** 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.
- **KY.HS.N.7.b** Use the relation $i^2 = -1$ and the commutative, associative and distributive properties to add, subtract and multiply complex numbers.
- **KY.HS.N.10.1** When multiplying complex binomials, students recognize and understand the value of i^2 as -1 and fluently simplify each polynomial appropriately navigating between the real number system and complex numbers. One example of this might be that students should understand that it would be appropriate to rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.

14. RADICAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

- **ANALYZING GRAPHS OF SQUARE ROOT FUNCTIONS**

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.G.4.c** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **KY.HS.F.8.b** Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- **KY.HS.F.8.a** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.
- **KY.HS.F.4.b** Graph square root, cube root and absolute value functions.

- **KY.HS.F.9.c** Read values of an inverse function from a graph or a table, given that the function has an inverse.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .

● SOLVING SQUARE ROOT EQUATIONS

- **KY.HS.A.17.b** Solve radical equations in one variable.
- **KY.HS.A.16** Understand each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- **KY.HS.F.6.a** Determine an explicit expression, a recursive process, or steps for calculation from a context.
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.F.1.b** Using appropriate function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in terms of a context.

15. RATIONAL EXPRESSIONS AND EQUATIONS

● OPERATIONS WITH RATIONAL EXPRESSIONS

- **KY.HS.A.11** Add, subtract, multiply and divide rational algebraic expressions.
- **KY.HS.A.1.a** Interpret parts of an expression, such as terms, factors and coefficients.
- **KY.HS.A.2** Use the structure of an expression to identify ways to rewrite it and consistently look for opportunities to rewrite expressions in equivalent forms.
- **KY.HS.A.10** Rewrite simple rational expressions in different forms.

● SOLVING RATIONAL EQUATIONS

- **KY.HS.A.16** Understand each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
- **KY.HS.A.17.a** Solve rational equations written as proportions in one variable.
- **KY.HS.A.14** Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.

16. NONLINEAR FUNCTIONS

● LINEAR VERSUS NONLINEAR FUNCTIONS

- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
- **KY.HS.F.11.a** Recognize and justify that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.
- **KY.HS.F.3.a** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval.
- **KY.HS.F.13** Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- **KY.HS.F.3.b** Estimate the rate of change from a graph.
- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.11.b** Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

● ABSOLUTE VALUE FUNCTIONS

- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

- **KY.HS.F.4.f** Graph piecewise functions, including step functions.
- **KY.HS.F.4.b** Graph square root, cube root and absolute value functions.

17. PARENT FUNCTIONS AND TRANSFORMATIONS

● PARENT FUNCTIONS

- **KY.HS.F.1.c** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities and sketch graphs showing key features given a verbal description of the relationship.
- **KY.HS.F.4.b** Graph square root, cube root and absolute value functions.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .
- **KY.HS.F.1.d** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

● TRANSFORMATIONS OF PARENT FUNCTIONS

- **KY.HS.F.8.b** Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- **KY.HS.F.8.a** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.
- **KY.HS.G.2.b** Compare transformations that preserve distance and angle measures to those that do not.
- **KY.HS.G.4.c** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **KY.HS.F.1.a** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x .

● MULTIPLE TRANSFORMATIONS OF PARENT FUNCTIONS

- **KY.HS.G.4.c** Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
- **KY.HS.F.8.b** Experiment with cases and illustrate an explanation of the effects on the graph using technology.
- **KY.HS.G.2.a** Describe transformations as functions that take points in the plane as inputs and give other points as outputs.
- **KY.HS.F.8.a** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs.
- **KY.HS.G.2.b** Compare transformations that preserve distance and angle measures to those that do not.
- **KY.HS.G.4.b** Specify a sequence of transformations that will carry a given figure onto another.

18. SYSTEMS OF EQUATIONS

● SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS

- **KY.HS.A.20.a** Understand a system of two equations in two variables has the same solution as a new system formed by replacing one of the original equations with an equivalent equation.
- **KY.HS.A.13** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
- **KY.HS.A.14** Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.
- **KY.HS.A.24** Justify that the solutions of the equations $f(x) = g(x)$ are the x -coordinates of the points where the graphs of $y = f(x)$ and $y = g(x)$ intersect. Find the approximate solutions graphically, using technology or tables.

● SYSTEMS OF NONLINEAR EQUATIONS

- **KY.HS.A.24** Justify that the solutions of the equations $f(x) = g(x)$ are the x -coordinates of the points where the graphs of $y = f(x)$ and $y = g(x)$ intersect. Find the approximate solutions graphically, using technology or tables.
- **KY.HS.A.21** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.

- **KY.HS.A.20.a** Understand a system of two equations in two variables has the same solution as a new system formed by replacing one of the original equations with an equivalent equation.
- **KY.HS.A.14** Create a system of equations or inequalities to represent constraints within a modeling context. Interpret the solution(s) to the corresponding system as viable or nonviable options within the context.
- **KY.HS.F.12** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

19. STATISTICS

● DATA ANALYSIS

- **KY.HS.SP.1** Represent the distribution of data with plots on the real number line (stem plots, dot plots, histograms and box plots).
- **KY.HS.SP.2** Use statistics appropriate to the shape of the numerical data distribution to compare center (median, mean) and spread (interquartile range when comparing medians and standard deviation when comparing means) of different data distributions.
- **KY.HS.SP.3** Interpret differences in shape, center and spread in the context of the distributions of the numerical data, accounting for the presence and possible effects of extreme data points (outliers).

● FREQUENCY TABLES

- **KY.HS.SP.5** Summarize categorical data for two or more categories in frequency tables. Calculate and interpret joint, marginal and conditional relative frequencies (probabilities) in the context of the data, recognizing possible associations and trends in the data.
- **KY.HS.SP.17** 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 whether events are independent and to approximate conditional probabilities.

20. STATISTICAL DESIGN AND ANALYSIS

● ANALYZING STATISTICAL SAMPLES

- **KY.HS.SP.9** Understand statistics as a process for making inferences and justifying conclusions about population parameters based on a random sample from that population.
- **KY.HS.SP.10** Decide if a specified model is consistent with the results from a simulation.
- **KY.HS.SP.12** Use data from a sample survey to estimate a population mean or proportion and explain how bias may be involved in the process.

● EXPERIMENTAL AND OBSERVATIONAL DESIGN

- **KY.HS.SP.11** Recognize the purposes of and differences among sample surveys, experiments and observational studies; explain how randomization relates to each.

● CONCLUSIONS IN DATA

- **KY.HS.SP.13** Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between estimates or statistics are significant.
- **KY.HS.SP.9** Understand statistics as a process for making inferences and justifying conclusions about population parameters based on a random sample from that population.

21. BASIC PROBABILITY CONCEPTS

● INTRODUCTION TO PROBABILITY

- **KY.HS.SP.15.b** Determine whether two events are independent and provide a justification to support the decision.
- **KY.HS.SP.15.a** Understand that two events A and B are independent if the probability of A and B occurring together is the product of their individual probabilities, $P(A) \times P(B)$
- **KY.HS.SP.18** Apply the General Multiplication Rule, $P(A \text{ and } B) = P(A)P(B|A) = P(B)P(A|B)$, in a uniform probability model and interpret the answer in terms of the model.
- **KY.HS.SP.14.2** as unions, “ A or B ,” that are non-mutually exclusive events and

- **KY.HS.SP.14.1** as unions, “A or B,” that are mutually exclusive events and
- **KY.HS.SP.14.4** as complements of other events, “not A.”
- **KY.HS.SP.14.3** as intersections, “A and B,” and
- **KY.HS.SP.15.c** Recognize and explain the concept of independence in everyday language and everyday situations.
- **KY.HS.SP.19.b** Perform calculations using the appropriate counting technique, including simple probabilities.

- **COMBINATIONS AND PERMUTATIONS**

- **KY.HS.SP.19.c** Use permutations and combinations to compute probabilities of compound events and solve problems.
- **KY.HS.SP.19.a** Distinguish between situations that can be modeled using counting techniques, including Fundamental Counting Principle, permutations and combinations.
- **KY.HS.SP.19.b** Perform calculations using the appropriate counting technique, including simple probabilities.

- **CONDITIONAL PROBABILITY**

- **KY.HS.SP.16.a** Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$.
- **KY.HS.SP.16.d** Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A and interpret the answer in terms of the model.
- **KY.HS.SP.16.c** Recognize and explain the concept of conditional probability in everyday language and everyday situations.
- **KY.HS.SP.15.b** Determine whether two events are independent and provide a justification to support the decision.
- **KY.HS.SP.15.a** Understand that two events A and B are independent if the probability of A and B occurring together is the product of their individual probabilities, $P(A) \times P(B)$
- **KY.HS.SP.15.c** Recognize and explain the concept of independence in everyday language and everyday situations.
- **KY.HS.SP.16.b** Interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A and the conditional probability of B given A is the same as the probability of B.
- **KY.HS.SP.5** Summarize categorical data for two or more categories in frequency tables. Calculate and interpret joint, marginal and conditional relative frequencies (probabilities) in the context of the data, recognizing possible associations and trends in the data.
- **KY.HS.SP.17** 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 whether events are independent and to approximate conditional probabilities.