DRAFT

Algebra 1 EOC Item Specifications

Florida
Standards Assessments

The draft Florida Standards Assessment (FSA) *Test Item Specifications* (*Specifications)* are based upon the Florida Standards and the Florida Course Descriptions as provided in CPALMs. The *Specifications* are a resource that defines the content and format of the test and test items for item writers and reviewers. Each grade-level and course *Specifications* document indicates the alignment of items with the Florida Standards. It also serves to provide all stakeholders with information about the scope and function of the FSA.

Item Specifications Definitions

Also assesses refers to standard(s) closely related to the primary standard statement.

Clarification statements explain what students are expected to do when responding to the question.

Assessment limits define the range of content knowledge and degree of difficulty that should be assessed in the assessment items for the standard.

Acceptable response mechanisms describe the characteristics from which a student must answer a question.

Context defines types of stimulus materials that can be used in the assessment items.

MAFS.912.A-APR.1.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
Item Types	Equation response – May require creating a value or an expression. Multiple-choice response – May require selecting a value or an expression from a list. Natural Language response – May require creating a written explanation. Selectable text response – May require the student to highlight text from an informal argument on closure.
Clarifications	Students will relate the addition, subtraction, and multiplication of integers to the addition, subtraction, and multiplication of polynomials with integral coefficients through application of the distributive property. Students will apply their understanding of closure to adding, subtracting, and multiplying polynomials with integral coefficients. Students will add, subtract, and multiply polynomials.
Assessment Limits	Items set in a real-world context should not result in a nonreal answer if the polynomial is used to solve for the unknown. In items that require addition and subtraction, polynomials are limited to monomials, binomials, and trinomials. The simplified polynomial should contain no more than six terms. Items requiring multiplication of polynomials are limited to a product of: two monomials, a monomial and a binomial, a monomial and a trinomial, two binomials, and a binomial and a trinomial.
Stimulus Attributes	Items can be set in a mathematical or real-world context. Items can use function notation.
Response Attributes	Items may require students to recognize equivalent expressions. Items may require students to rewrite expressions with negative exponents, but items must not require the student to rewrite rational expression as seen in the standard MAFS.912.A-APR.4.7.

Calculator	No

MAFS.912.A-CED.1.1 Also assesses MAFS.912.A-REI.2.3 Also assesses MAFS.912.A-CED.1.4	Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions and simple rational, absolute, and exponential functions.* Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law, $V = IR$, to highlight resistance, R.*
Item Types	Drag and drop response – May require rearranging equations. Equation response – May require creating an equation, an inequality, or a value. Hot spot response – May require selecting key features of linear equations and inequalities. Multiple-choice response – May require identifying an equation, an inequality, or a value from a list of four choices. Natural Language response – May require creating a written explanation.
Clarifications	Students will write an equation in one variable that represents a real-world context. Students will write an inequality in one variable that represents a real-world context. Students will solve a linear equation. Students will solve a linear inequality. Students will solve multi-variable formulas or literal equations for a specific variable. Students will solve formulas and equations with coefficients represented by letters.
Assessment Limits	In items that require students to write an equation, equations are limited to linear, quadratic, and exponential. Items may include equations or inequalities that contain variables on both

	sides. In items that require the student to write or solve an inequality, variables are restricted to an exponent of one. Items that involve formulas should not include overused contexts such as Fahrenheit/Celsius or three-dimensional geometry formulas. In items that require students to solve literal equations and formulas, a linear term should be the term of interest. Items should not require more than three procedural steps to isolate the variable of interest. Items may require the student to recognize equivalent expressions but may not require a student to perform an algebraic operation outside the context of Algebra 1.
Stimulus Attribute	Items assessing REI.2.3 do not have to be in a real-world context.
Response Attributes	Items assessing REI.2.3 should not require the student to write the equation. Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.A-CED.1.2 Also assesses MAFS.912.A-REI.3.5 Also assesses MAFS.912.A-REI.3.6 Also assesses MAFS.912.A-REI.4.12	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
Item Types	Equation response – May require creating a set of equations, a set of inequalities, or giving an ordered pair. Graphic response – May require graphing a representation of a set of equations, a set of inequalities, or an ordered pair. Hot spot response – May require selecting a solution region. Movable text response – May require the student to drag and drop text to complete a proof. Multiple-choice response – May require identifying a set of equations, a set of inequalities, a value, an ordered pair, or a graph. Multi-select response – May require identifying equations or inequalities. Natural Language response – May require the student to give an ordered pair, or write an explanation. Selectable text response – May require the student to highlight parts of a proof.
Clarifications	Students will identify the quantities in a real-world situation that should be represented by distinct variables. Students will write a system of equations given a real-world situation. Students will graph a system of equations that represents a real-world context using appropriate axis labels and scale. Students will solve systems of linear equations. Students will provide steps in an algebraic proof that shows one equation being

	replaced with another to find a solution for a system of equations. Students will identify systems whose solutions would be the same through examination of the coefficients. Students will identify the graph that represents a linear inequality. Students will graph a linear inequality. Students will identify the solution set to a system of inequalities. Students will identify ordered pairs that are in the solution set of a system of inequalities. Students will graph the solution set to a system of inequalities.
Assessment Limits	Items that require a student to write a system of equations using a real-world context are limited to a system of 2 x 2 linear equations with integral coefficients. Items that require a student to solve a system of equations are limited to a system of 2 x 2 linear equations with rational coefficients. Items that require a student to graph a system of equations or inequalities to find the solution are limited to a 2 x 2 system. Items that require a student to write a system of inequalities using a real-world context are limited to integer coefficients.
Stimulus Attributes	Items can be set in a real-world or mathematical context. Items may result in infinitely many solutions or no solution.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.A-CED.1.3	Represent constraints by equations or inequalities and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*.
Item Types	Equation response – May require creating a set of equations, inequalities, or values. Graphic response – May require graphing a representation. Hot spot response – May require selecting a representation. Movable text response – May require the student to drag and drop text to interpret solutions. Multiple-choice response – May require identifying an equation, an inequality, or a value. Natural Language response – May require the student to write an explanation. Selectable text response – May require the student to highlight correct interpretations of a solution.
Clarifications	Students will write constraints for a real-world context using equations, inequalities, a system of equations, or a system of inequalities. Students will interpret the solution of a real-world context as viable or not viable.
Assessment Limits	In items that require the student to write an equation as a constraint, the equation can be a linear function. In items that require the student to write a system of equations to represent a constraint, the system is limited to a 2 x 2 with integral coefficients. In items that require the student to write a system of inequalities to represent a constraint, the system is limited to a 2 x 2 with integral coefficients.
Stimulus Attributes	Items should be set in a real-world context. Items can use function notation.
Response Attributes	Items may require the student to choose an appropriate level of accuracy.

	Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.A-REI.1.1	Explain 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.
Item Types	Drag and drop response – May require rearranging equations or justifications. Equation response – May require creating an expression or value. Movable text response – May require the student to drag and drop steps and/or justifications to create a variable argument. Multiple-choice response – May require identifying expressions, statements, or values. Natural Language response – May require creating a written response. Selectable text response – May require the student to highlight an incorrect step in a solution method.
Clarifications	Students will complete an algebraic proof of solving a linear equation. Students will construct a viable argument to justify a solution method.
Assessment Limit	Items will not require the student to recall names of properties from memory.
Stimulus Attributes	Items should be set in a mathematical context. Items can use function notation. Items should be linear equations in the form of $ax + b = c$, $a(bx + c) = d$, $ax + b = cx + d$, or $a(bx + c) = d(ex + f)$, where a, b, c, d, e, and f are rational numbers. Equations may be given in forms that are equivalent to these. Coefficients can be a rational number or a variable that represents any real number. Items should not require more than four procedural steps to reach a solution.
Response Attribute	Items will not ask the student to provide the solution.
Calculator	No

MAFS.912.A-REI.2.4	Solve quadratic equations in one variable. a. 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. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), 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 $a \pm bi$ for real numbers a and b.
Item Types	Drag and drop response – May require rearranging equations. Equation response – May require creating a value or an expression. Matching item response – May require the student to click on cells within a table to show whether a solution is real or complex. Movable text response – May require the student to drag and drop text to complete the derivation of the quadratic formula, or to drag and drop text to complete steps for solving a quadratic. Multiple-choice response – May require selecting a value or an expression from a list. Multi-select response – May require selecting multiple values. Natural Language response – May require the student to write an explanation. Selectable text response – May require the student to highlight steps in a derivation of the quadratic formula.
Clarifications	Students will rewrite a quadratic equation in vertex form by completing the square. Students will use the vertex form of a quadratic equation to complete steps in the derivation of the quadratic formula. Students will solve a simple quadratic equation by inspection or by taking square roots. Students will solve a quadratic equation by choosing an appropriate method (i.e., completing the square, the quadratic formula, or factoring). Students will validate why taking the square root of both sides when solving a quadratic equation will yield two solutions. Students will recognize that the quadratic formula can be used to find complex

	solutions.
Assessment Limits	In items that require students to transform any quadratic equation to vertex form, the coefficient of the quadratic term must be an integer. In items that require students to solve a simple quadratic equation by inspection or by taking square roots, equations should be in the form $ax^2 = c$ or $ax^2 + d = c$, where a, c, and d are rational numbers. In items that allow the student to choose the method for solving a quadratic equation, equations should be in the form of $ax^2 + bx + c = d$, where a, b, c, and d are rational numbers. Items may require the student to recognize that a solution is nonreal, but should not require the student to find a nonreal solution. Items may require the student to recall from memory the quadratic formula.
Stimulus Attributes	Items should be set in a mathematical context. Items can use function notation.
Response Attributes	Items may require the student to complete a missing step in the derivation of the quadratic formula. Items may require the student to recognize equivalent solutions to the quadratic equation.
Calculator	Neutral

MAFS.912.A-REI.4.11 Also assesses MAFS.912.A-REI.4.10	Explain why the x-coordinates of the points where the graphs of the equations y = f(x) and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately (e.g., using technology to graph the functions, make tables of values, or find successive approximations). Include cases where f(x) and/or g(x) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
Item Types	Drag and drop response – May require rearranging equations or creating a table. Equation response – May require creating a value, an equation, or an expression. Matching item response – May require the student to choose ordered pairs that are solutions of a function. Multiple-choice response – May require selecting a value or an expression from a list. Multi-select response – May require selecting multiple values. Natural Language response – May require creating a written response. Simulation response – May require inputting values. Table response – May require complete missing cells in a table.
Clarifications	Students will find an approximate solution for f(x) = g(x) using a graphing tool. Students will find an approximate solution for f(x) = g(x) using a table of values. Students will find an approximate solution for f(x) = g(x) using successive approximations that give the solution to a given place value. Students will justify why the intersection of two functions is a solution to f(x) = g(x). Students will verify if a set of ordered pairs is a solution of a function.
Assessment Limit	The following function types can be used: linear, quadratic, and exponential.

Stimulus Attributes	Items should be set in a mathematical context. Items can use function notation. Items will designate the place value accuracy necessary for approximate solutions.
Response Attributes	Items may require the student to complete a missing step in an algebraic justification of the solution of $f(x) = g(x)$. Items may require the student to explain the role of the x-coordinate and the y-coordinate in the intersection of $f(x) = g(x)$. Items may require the student to explain a process. Items may require students to record successive approximations used to find the solution of $f(x) = g(x)$.
Calculator	Neutral

MAFS.912.A-SSE.2.3 Also assesses MAFS.912.A-SSE.1.1 Also assesses MAFS.912.A-SSE.1.2	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12} \approx (1.012)^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$*, thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$*.*
Item Types	Drag and drop response – May require sorting expressions. Equation response – May require creating an equivalent expression or numerical response. Movable text response – May require the student to drag and drop steps in completing the square of a quadratic expression, or in rewriting an expression using algebraic structure. Multiple-choice response – May require selecting an expression or a value from a set of options. Multi-select response – May require selecting expressions or values from a set of options. Natural Language response – May require constructing a written response. Selectable text response – May require the student to highlight steps in a derivation of the quadratic formula.
Clarifications	Students will use equivalent forms of a quadratic expression to interpret the expression's terms, factors, zeros, maximum, minimum, coefficients, or parts in terms of the real-world situation the expression represents. Students will use equivalent forms of an exponential expression to interpret the

	expression's terms, factors, coefficients, or parts in terms of the real-world situation the expression represents. Students will rewrite algebraic expressions in different equivalent forms by recognizing the expression's structure. Students will rewrite algebraic expressions in different equivalent forms using factoring techniques (e.g., common factors, grouping, the difference of two squares, the sum or difference of two cubes, or a combination of methods to factor completely) or simplifying expressions (e.g., combining like terms, using the distributive property, and other operations with polynomials).
Assessment Limits	In items that require students to complete a square, the greatest common factor of the quadratic and linear term must be an integer. In items that require students to write equivalent expressions by factoring, the given expression can have integral common factors, be a difference of two squares up to a degree of 4, be a quadratic, $ax^2 + bx + c$, where $a > 0$ and b and c are integers, or be a polynomial of four terms with a leading coefficient of 1 and highest degree of 3.
Stimulus Attributes	Items that require interpretation should be set in a real-world context. Items that require an equivalent expression found by factoring can be in a real-world or mathematical context. Items can use function notation.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.F-BF.2.3	Identify the effect on the graph of replacing f(x) by f(x) + *k*, *k*f(x), f(*k*x), and f(x + *k*) for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
Item Types	Equation response – May require creating a value or an expression. Graphic response – May require plotting points or a transformed function. Multiple-choice response – May require selecting a graph or a table from a list. Natural Language response – May require explaining the effects of a transformation.
Clarifications	Students will determine the value of *k* when given a graph of the function and its transformation. Students will identify differences and similarities between a function and its transformation. Students will identify a graph of a function given a graph or a table of a transformation and the type of transformation that is represented. Students will graph by applying a given transformation to a function. Students will identify ordered pairs of a transformed graph. Students will complete a table for a transformed function.
Assessment Limits	Functions can be linear, quadratic, or exponential. Functions can also be represented using tables or graphs. Functions can have closed domains. Functions can be discontinuous. Items should have a single transformation.
Stimulus Attributes	Items should be given in a mathematical context. Items can use function notation. Items can present a function using an equation, a table of values, or a graph.
Response Attributes	Items may require the student to explain or justify a transformation that has

	been applied to a function. Items may require students to explain how a graph is affected by a value of *k*. Items may require students to find the value of *k*. Items may require a student to complete a table of values.
Calculator	Neutral

MAFS.912.F-IF.1.2	Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
Also assesses MAFS.912.F-IF.1.1	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. The graph of f is the graph of the equation y = f(x).
Also assesses MAFS.912.F-IF.2.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
Item Types	Equation response – May require expressing a value, an inequality, an expression, or a function. Graphic response – May require mapping a relation, or choosing ordered pairs. Matching item response – May require selecting cells in a table that associate a function to its domain, values for inputs, or to choose elements of the domain of a relation. Multiple-choice response – May require selecting a choice from a set of possible choices. Multi-select response – May require selecting responses from a set of possible choices. Natural Language response – May require explaining the relationship of related values, or to interpret within a context. Table response – May require completing a table of values.
Clarifications	Students will evaluate functions that model a real-world context for inputs in the domain. Students will interpret the domain of a function within the real-world context given. Students will interpret statements that use function notation within the real-world context given.

	Students will use the definition of a function to determine if a relationship is a function, given tables, graphs, mapping diagrams, or sets of ordered pairs. Students will determine the feasible domain of a function that models a real-world context.
Assessment Limits	Items that require students to determine the domain using equations within a context are limited to linear, quadratic, and exponential functions. Items may present relations in a variety of formats, including sets of ordered pairs, mapping diagrams, graphs, and input/output models. In items requiring students to find the domain from graphs, relationships can be on a closed or open interval. In items requiring students to find domain from graphs, relationships may be discontinuous. Items may not require students to use or know interval notation.
Stimulus Attributes	Items assessing the definition of a function can be set in a real-world or mathematical context. Items not assessing the definition of a function should be set in a real-world context. Items can use function notation.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units. Items may require students to write domains using inequalities.
Calculator	Neutral

MAFS.912.F-IF.2.4 Also assesses MAFS.912.F-IF.3.9	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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*
Item Types	Equation response – May require expressing a value, expression, or equation. Graphic response – May require plotting points on a coordinate plane, graphing a linear function, graphing a function, or matching key features as verbal descriptions to points on the graph. Hot spot response – May require selecting a key feature or region on a graph. Movable text response – May require dragging and dropping written descriptions to given intervals of a function. Multiple-choice response – May require selecting a choice from a set of possible choices. Natural Language response – May require explaining the meaning of key features or the comparison of two functions.
Clarifications	Students will determine and relate the key features of a function within a real-world context by examining the function's table. Students will determine and relate the key features of a function within a real-world context by examining the function's graph. Students will use a given verbal description of the relationship between two quantities to label key features of a graph of a function that model the relationship. Students will differentiate between different types of functions using a variety of descriptors (e.g., graphically, verbally, numerically, and algebraically). Students will compare and contrast properties of two functions using a variety of function representations (e.g., algebraic, graphic, numeric in tables, or verbal descriptions).

Assessment Limits	Functions can be linear, quadratic, or exponential. Functions can also be represented using tables or graphs. Functions can have closed domains. Functions can be discontinuous. Items may not require students to use or know interval notation. Key features include x-intercepts, y-intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; and end behavior.
Stimulus Attributes	Items should be set in a real-world context. Items may use verbal descriptions of functions. Items can use function notation.
Response Attributes	Items may require students to write intervals using inequalities. Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	No

MAFS.912.F-IF.2.6 Also assesses MAFS.912.S-ID.3.7	Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
Item Types	Equation response – May require creating rate of change as a numeric value. Multiple-choice response – May require selecting a statement about the rate of a data display, an interpretation, or context. Multi-select response – May require selecting multiple statements about the rate of change and/or the constant term in a given context. Natural Language response – May require explaining the rate of change or y-intercept in context.
Clarifications	Students will calculate the average rate of change of a continuous function that is represented algebraically, in a table of values, on a graph, or as a set of data. Students will interpret the average rate of change of a continuous function that is represented algebraically, in a table of values, on a graph, or as a set of data with a real-world context. Students will interpret the y-intercept of a linear model that represents a set of data with a real-world context.
Assessment Limits	Items requiring the student calculate the rate of change will give a specified interval that is both continuous and differentiable. Items should not require the student to find an equation of a line. Items assessing S-ID.3.7 should include data sets. Data sets must contain at least six data pairs.
Stimulus Attributes	Items should be set in a real-world context. Items can use function notation.
Response Attributes	Items may require the student to use a graphing tool or table to determine values for a function.

	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.F-IF.3.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, *and* $y = (1.2)^{t/10}$ *and classify them as representing exponential growth or decay.*
Also assesses MAFS.912.A-APR.2.3	Identify zeros of polynomials when suitable factorizations are available and use the zeros to construct a rough graph of the function defined by the polynomial.
Also assesses MAFS.912.F-IF.3.7a, b, c, and e.	Graph functions expressed symbolically and show key features of the graph by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available and showing end behavior. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude and using phase shift.
Item Types	Drag and drop response – May require identifying key features. Equation response – May require creating a value, an expression, or an equation. Graphic response – May require plotting points, key features, or an equation on a graph. Hot spot response – May require selecting key features on a graph. Multiple-choice response – May require selecting from a list. Multi-select response – May require selecting multiple responses. Natural Language response – May require explaining and interpreting a function

Clarifications	Students will identify zeros, extreme values, and symmetry of a quadratic function written symbolically. Students will classify the exponential function as exponential growth or decay by examining the base, and students will give the rate of growth or decay. Students will use the properties of exponents to interpret exponential expressions in a real-world context. Students will write an exponential function defined by an expression in different but equivalent forms to reveal and explain different properties of the function, and students will determine which form of the function is the most appropriate for interpretation for a real-world context. Students will find the zeros of a polynomial function when the polynomial is in factored form. Students will create a rough graph of a polynomial function in factored form by examining the zeros of the function. Students will use the x-intercepts of a polynomial function and end behavior to graph the function. Students will identify the x- and y-intercepts and the slope of the graph of a linear function. Students will identify zeros, extreme values, and symmetry of the graph of a quadratic function. Students will identify intercepts and end behavior for an exponential function. Students will graph a linear function using key features. Students will graph a quadratic function using key features. Students will graph an exponential function using key features. Students will identify and interpret key features of a graph within the real-world context that the function represents.
Assessment Limits	In items that require the student to graph polynomial function using technology, the leading coefficient should be an integer and the polynomial's degree is restricted to 3 or 4. In items that require the student to graph polynomial functions by hand, the polynomial should be given in factored form.

Stimulus Attributes	Items may require the student to identify a correct graph. Items can be set in a mathematical or real-world context. Items can use function notation. Items should not require the student to complete a sign chart for a polynomial.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.F-LE.1.1 Also assesses MAFS.912.F-LE.2.5	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. Interpret the parameters in a linear or exponential function in terms of a context.
Item Types	Equation response – May require creating a value or an expression. Multiple-choice response – May require selecting an interpretation from a list. Multi-select response – May require selecting multiple values. Natural Language response – May require analyzing the growth of a function or explaining parameters of a function.
Clarifications	Students will determine whether the real-world context can be represented by a linear function or an exponential function and give the constant rate or the rate of growth or decay. Students will choose an explanation as to why a context can be modeled by a linear function or an exponential function. Students will interpret the rate of change and intercepts of a linear function when given an equation that models a real-world context. Students will interpret the parameters of an exponential function given in a real-world context.
Assessment Limit	Exponential functions should be in the form $b^x + k$.
Stimulus Attributes	Items should be set in a real-world context. Items can use function notation.
Response Attributes	Items may require the student to choose a parameter that is described within the real-world context.

	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	No

MAFS.912.F-LE.1.2 Also assesses MAFS.912.F-BF.1.1 Also assesses MAFS.912.F-IF.1.3	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (including reading these from a table). Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* c. Compose functions. *For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.* Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.*
Item Types	Equation response – May require creating a value, creating an expression, creating a function, or showing steps for a calculation. Movable text response – May require ordering of steps for a calculation from a context. Multiple-choice response – May require selecting a choice from a set of possible choices. Natural Language response – May require explaining and interpreting a resulting function. Simulation response – May require analyzing input and output values from a table to determine a function. Table response – May require completing missing cells in a table.
Clarifications	Students will write a linear function, an arithmetic sequence, an exponential function, or a geometric sequence when given a graph that models a real-world context. Students will write a linear function, an arithmetic sequence, an exponential function, or a geometric sequence when given a verbal description of a real-world context.

	Students will write a linear function, an arithmetic sequence, an exponential function, or a geometric sequence when given a table of values or a set of ordered pairs that model a real-world context. Students will write an explicit function, define a recursive process, or complete a table of calculations that can be used to mathematically define a real-world context. Students will write a function that combines functions using arithmetic operations and relate the result to the context of the problem. Students will write a function to model a real-world context by composing functions and the information within the context. Students will write a recursive definition for a sequence that is presented as a sequence, a graph, or a table.
Assessment Limit	In items where students have to write a function using arithmetic operations or by composing functions, the student should have to generate the new function only.
Stimulus Attributes	Items should be set in a real-world context. Items can use function notation. In items where students build a function using arithmetic operations or by composition, the functions can be given using verbal descriptions, function notation or as equations.
Response Attributes	In items where students build a function using arithmetic operations or compose functions, students may be asked to find a value of a composition that has been described. In items where students have to give a recursive formula, the student will be expected to give both parts of the formula. Students may be required to determine equivalent recursive formulas. Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.F-LE.1.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
Item Types	Drag and drop response – May require rearranging equations. Equation response – May require creating a value or an expression. Multiple-choice response – May require selecting a value or an expression from a list. Multi-select response – May require selecting multiple values. Natural Language response – May require explaining what happens to a function for large values of x or explaining a comparison.
Clarifications	Students will compare a linear function and an exponential function given in real-world context by interpreting the functions' graphs. Students will compare a linear function and an exponential function given in a real-world context through tables. Students will compare a quadratic function and an exponential function given in real-world context by interpreting the functions' graphs. Students will compare a quadratic function and an exponential function given in a real-world context through tables.
Assessment Limit	Exponential functions should be in the form $b^x + k$.
Stimulus Attributes	Items should give a graph or a table. Items should be given in a real-world context. Items can use function notation.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	No

MAFS.912.N-RN.1.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
Also assesses MAFS.912.N-RN.1.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{\frac{1}{3}}$ *to be the cube root of* 5 *because we want* $\left(5^{\frac{1}{3}}\right)^3 = 5^{(\frac{1}{3})3}$ *to hold, so* $\left(5^{\frac{1}{3}}\right)^3$ *must equal* 5.
Also assesses MAFS.912.N-RN.2.3	Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
Item Types	Drag and drop response – May require identifying parts of an algebraic proof. Equation response – May require creating a value or an expression. Multiple-choice response – May require selecting a value or an expression from a list. Multi-select response – May require selecting multiple values. Natural Language response – May require explaining why two rational exponent expressions are equivalent or why two expressions are equivalent.
Clarifications	Students will use the properties of exponents to rewrite a radical expression as an expression with a rational exponent. Students will use the properties of exponents to rewrite an expression with a rational exponent as a radical expression. Students will apply the properties of operations of integer exponents to expressions with rational exponents. Students will apply the properties of operations of integer exponents to radical expressions. Students will write algebraic proofs that show that a sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
Assessment Limit	Expressions should contain no more than three variables.

Stimulus Attribute	Items should be set in a mathematical context.
Response Attributes	Items may require students to complete an algebraic proof. Items may require students to determine equivalent expressions or equations.
Calculator	No

MAFS.912.S-ID.1.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
Item Types	Drag and drop response – May require labeling components of a graph (i.e., median, lower quartile, upper quartile, and/or outlier). Hot spot response – May require interacting with data displays (i.e., creating a dot plot by clicking on a number in a number line to generate a set number of points). Multiple-choice response – May require selecting a graph from a set. Multi-select response – May require selecting various representations of the same data. Natural Language response – May require critiquing the usage of certain displays and explaining general factors that contribute to selecting the most appropriate data display.
Clarification	Students will represent data using a dot plot, a histogram, or a box plot.
Assessment Limits	N/A
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.S-ID.1.2 Also assesses MAFS.912.S-ID.1.3	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
Item Types	Equation response – May require providing a numeric value (mean, median, and/or interquartile range). Graphic response – May require plotting points on a number line (i.e., indicate quartiles of a box plot or median and mean of a spread). Hot spot response – May require interacting with a data spread (i.e., indication of standard deviations, percentages of values in the spread). Multiple-choice response – May require selecting a statement or graph from a set or selecting a graphical representation of a data set that is approximately normally distributed. Natural Language response – May require explaining the difference/similarities between two data sets.
Clarifications	Students will identify similarities and difference in shape, center, and spread when given two or more data sets. Students will predict the effect that an outlier will have on the shape, center, and spread of a data set. Students will interpret similarities and difference in shape, center, and spread when given two or more data sets within the real-world context given. Students will use their understanding of normal distribution and the empirical rule to answer questions about data sets.
Assessment Limits	Items may require the student to calculate mean, median, and interquartile range for the purpose of identifying similarities and differences. Items should not require the student to calculate the standard deviation. Items should not require students to fit normal curves to data. Data distributions should be approximately normal. Data sets should be quantitative.

Stimulus Attributes	In items that require standard deviation, the value should be given in the stem. Items should be set in a real-world context.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral

MAFS.912.S-ID.2.5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
Item Types	Drag and drop response – May require constructing a frequency table. Equation response – May require providing a numeric value. Hot spot response – May require identifying marginal frequencies on a frequency table. Multiple-choice response – May require selecting a contingency table or selecting a numeric value Natural Language response – May require interpreting relative frequencies in the context of the data.
Clarifications	Students will create or complete a two-way frequency table to summarize categorical data. Students will determine if associations/trends are appropriate for the data. Students will interpret data displayed in a two-way frequency table. Students will calculate joint, marginal, and conditional relative frequencies.
Assessment Limits	N/A
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret units.
Calculator	Yes

MAFS.912.S-ID.2.6 Also assesses MAFS.912.S-ID.3.8 Also assesses MAFS.912.S-ID.3.9	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.* b. Informally assess the fit of a function by plotting and analyzing residuals. c. Fit a linear function for a scatter plot that suggests a linear association. Compute (using technology) and interpret the correlation coefficient of a linear fit. Distinguish between correlation and causation.
Item Types	Drag and drop – May require labeling parts of a graph. Equation response – May require creating an equation or providing a residual value. Graphic response – May require constructing a scatter plot, plotting residual values, or graphing a line of best fit. Multiple-choice response – May require selecting a linear equation or graph from a set, selecting a scatterplot graph that can or cannot fit a function, selecting a numeric value or a graph from a set, or selecting a statement describing the data given in reference to the correlation. Multi-select response – May require selecting multiple scatterplot graphs that can or cannot fit a function or selecting statements describing the data given in reference to the correlation and/or causation. Natural Language response – May require explaining why certain data cannot fit into a best fit line or identifying flaws in a data display, summarizing an interpretation of a graph (i.e., correlation) or explaining why a relationship is not causal.
Clarifications	Students will represent data on a scatter plot. Students will find a linear function, a quadratic function, or an exponential function using regression. Students will use a regression equation to solve problems in the context of the

	data. Students will calculate residuals. Students will create a residual plot and determine whether a function is an appropriate fit for the data. Students will determine the fit of a function by analyzing the correlation coefficient. Students will distinguish between situations where correlation does not imply causation. Students will distinguish variables that are correlated because one is the cause of another.
Assessment Limit	In items that require the student to interpret or use the correlation coefficient, the value of the correlation coefficient must be given in the stem.
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to choose an appropriate level of accuracy. Items may require the student to choose and interpret the scale in a graph. Items may require the student to choose and interpret units.
Calculator	Neutral