DRAFT

Algebra 2 EOC
Item Specifications

Florida Standards Assessments

The draft Florida Standards Assessments (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.

Item types describe the characteristics of the question.

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

Florida Standards Assessments Modeling Cycle

The basic modeling cycle involves (1) identifying variables in the situation and selecting those that represent essential features, (2) formulating a model by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables, (3) analyzing and performing operations on these relationships to draw conclusions, (4) interpreting the results of the mathematics in terms of the original situation, (5) validating the conclusions by comparing them with the situation, and then either improving the model or, if it is acceptable, (6) reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.
http://www.cpalms.org/Standards/mafs_modeling_standards.aspx

Mathematical Practices:

The Mathematical Practices are a part of each course description for Grades 3-8, Algebra 1, Geometry, and Algebra 2. These practices are an important part of the curriculum. The Mathematical Practices will be assessed throughout.

MAFS.K12.MP.1.1:	**Make sense of problems and persevere in solving them.** Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, “Does this make sense?” They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.
MAFS.K12.MP.2.1:	**Reason abstractly and quantitatively**. Mathematically proficient students make sense of quantities and their relationships in problem situations. They bring two complementary abilities to bear on problems involving quantitative relationships: the ability to decontextualize—to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents—and the ability to contextualize, to pause as needed during the manipulation process in order to probe into the referents for the symbols involved. Quantitative reasoning entails habits of creating a coherent

	representation of the problem at hand; considering the units involved; attending to the meaning of quantities, not just how to compute them; and knowing and flexibly using different properties of operations and objects.
MAFS.K12.MP.3.1:	**Construct viable arguments and critique the reasoning of others.** Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.
MAFS.K12.MP.4.1:	**Model with mathematics.** Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the

	situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
MAFS.K12.MP.5.1:	**Use appropriate tools strategically.** Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations. For example, mathematically proficient high school students analyze graphs of functions and solutions generated using a graphing calculator. They detect possible errors by strategically using estimation and other mathematical knowledge. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources, such as digital content located on a website, and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.
MAFS.K12.MP.6.1:	**Attend to precision.** Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning. They state the meaning of the symbols they choose, including using the equal sign consistently and appropriately. They are careful about specifying units of measure, and labeling axes to clarify the correspondence with quantities in a problem. They calculate accurately and efficiently, express numerical answers with a degree of precision appropriate for the problem context. In the elementary grades, students give carefully formulated explanations to each other. By the time they reach high school they have learned to examine claims and make explicit use of definitions.

MAFS.K12.MP.7.1:	**Look for and make use of structure.** Mathematically proficient students look closely to discern a pattern or structure. Young students, for example, might notice that three and seven more is the same amount as seven and three more, or they may sort a collection of shapes according to how many sides the shapes have. Later, students will see 7 × 8 equals the well remembered 7 × 5 + 7 × 3, in preparation for learning about the distributive property. In the expression $x^2 + 9x + 14$, older students can see the 14 as 2 × 7 and the 9 as 2 + 7. They recognize the significance of an existing line in a geometric figure and can use the strategy of drawing an auxiliary line for solving problems. They also can step back for an overview and shift perspective. They can see complicated things, such as some algebraic expressions, as single objects or as being composed of several objects. For example, they can see $5 – 3(x – y)^2$ as 5 minus a positive number times a square and use that to realize that its value cannot be more than 5 for any real numbers x and y.
MAFS.K12.MP.8.1:	**Look for and express regularity in repeated reasoning.** Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts. Upper elementary students might notice when dividing 25 by 11 that they are repeating the same calculations over and over again, and conclude they have a repeating decimal. By paying attention to the calculation of slope as they repeatedly check whether points are on the line through (1, 2) with slope 3, middle school students might abstract the equation $(y – 2)/(x – 1) = 3$. Noticing the regularity in the way terms cancel when expanding $(x – 1)(x + 1)$, $(x – 1)(x^2 + x + 1)$, and $(x – 1)(x^3 + x^2 + x + 1)$ might lead them to the general formula for the sum of a geometric series. As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.

Technology-Enhanced Item Descriptions:

The Florida Standards Assessments (FSA) are composed of test items that include traditional multiple- choice items, items that require students to type or write a response, and technology-enhanced items (TEI). Technology-enhanced items are computer-delivered items that require students to interact with test content to select, construct, and/or support their answers.

Currently, there are nine types of TEIs that may appear on computer-based assessments for FSA Mathematics. For students with an IEP or 504 plan that specifies a paper-based accommodation, TEIs will be modified or replaced with test items that can be scanned and scored electronically.

For samples of each of the item types described below, see the FSA Training Tests.

Technology-Enhanced Item Types – Mathematics

1. **Editing Task Choice –** The student clicks a highlighted word or phrase, which reveals a drop-down menu containing options for correcting an error as well as the highlighted word or phrase as it is shown in the sentence to indicate that no correction is needed. The student then selects the correct word or phrase from the drop-down menu. For paper-based assessments, the item is modified so that it can be scanned and scored electronically. The student fills in a circle to indicate the correct word or phrase.
2. **Editing Task –** The student clicks on a highlighted word or phrase that may be incorrect, which reveals a text box. The directions in the text box direct the student to replace the highlighted word or phrase with the correct word or phrase. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
3. **Hot Text –**
    a. **Selectable Hot Text –** Excerpted sentences from the text are presented in this item type. When the student hovers over certain words, phrases, or sentences, the options highlight. This indicates that the text is selectable ("hot"). The student can then click on an option to select it. For paper- based assessments, a "selectable" hot text item is modified so that it can be scanned and scored electronically. In this version, the student fills in a circle to indicate a selection.

b. **Drag-and-Drop Hot Text** – Certain numbers, words, phrases, or sentences may be designated "draggable" in this item type. When the student hovers over these areas, the text highlights. The student can then click on the option, hold down the mouse button, and drag it to a graphic or other format. For paper-based assessments, drag-and-drop hot text items will be replaced with another item type that assesses the same standard and can be scanned and scored electronically.

4. **Open Response** – The student uses the keyboard to enter a response into a text field. These items can usually be answered in a sentence or two. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
5. **Multiselect** – The student is directed to select all of the correct answers from among a number of options. These items are different from multiple-choice items, which allow the student to select only one correct answer. These items appear in the online and paper-based assessments.
6. **Graphic Response Item Display (GRID)** – The student selects numbers, words, phrases, or images and uses the drag-and-drop feature to place them into a graphic. This item type may also require the student to use the point, line, or arrow tools to create a response on a graph. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
7. **Equation Editor** – The student is presented with a toolbar that includes a variety of mathematical symbols that can be used to create a response. Responses may be in the form of a number, variable, expression, or equation, as appropriate to the test item. For paper-based assessments, this item type may be replaced with a modified version of the item that can be scanned and scored electronically or replaced with another item type that assesses the same standard and can be scanned and scored electronically.
8. **Matching Item** – The student checks a box to indicate if information from a column header matches information from a row. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.
9. **Table Item** – The student types numeric values into a given table. The student may complete the entire table or portions of the table depending on what is being asked. For paper-based assessments, this item type may be replaced with another item type that assesses the same standard and can be scanned and scored electronically.

Reference Sheets:

• Reference sheets and z-tables will be available as online references (in a pop-up window). A paper version will be available for paper-based tests.
• Reference sheets with conversions will be provided for FSA Mathematics assessments in Grades 4–8 and EOC Mathematics assessments.
• There is no reference sheet for Grade 3.
• For Grades 4, 6, and 7, Geometry, and Algebra 2, some formulas will be provided on the reference sheet.
• For Grade 5 and Algebra 1, some formulas may be included with the test item if needed to meet the intent of the standard being assessed.
• For Grade 8, no formulas will be provided; however, conversions will be available on a reference sheet.
• For Algebra 2, a z-table will be available.

Grade	Conversions	Some Formulas	z-table
3	No	No	No
4	On Reference Sheet	On Reference Sheet	No
5	On Reference Sheet	With Item	No
6	On Reference Sheet	On Reference Sheet	No
7	On Reference Sheet	On Reference Sheet	No
8	On Reference Sheet	No	No
Algebra 1	On Reference Sheet	With Item	No
Algebra 2	On Reference Sheet	On Reference Sheet	Yes
Geometry	On Reference Sheet	On Reference Sheet	No

MAFS.912.A-APR.1.1 Also assesses MAFS.912.A-APR.3.4	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. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.*
Item Types	Editing Task Choice– May require choosing steps in an informal argument. Equation Editor – May require creating a value or an expression. GRID – May require dragging and dropping graphics to construct a proof or ordering steps in a proof. Hot Text – May require ordering steps in a proof. Matching Item – May require matching equivalent expressions. Multiple Choice – May require selecting a value, an expression, or a statement from a list. Multiselect – May require selecting all equivalent expressions. Open Response – May require explaining the steps used in generating a polynomial identity.
Clarifications	Students will apply their understanding of closure to adding, subtracting, and multiplying polynomials. Students will add, subtract, and multiply polynomials with rational coefficients. Students will use polynomial identities to describe numerical relationships. Students will use the structure of algebra to complete an algebraic proof of a polynomial identity.
Assessment Limits	Items set in a real-world context should not result in a nonreal answer if the polynomial is solved. In items that require addition and subtraction, polynomials are limited to polynomials with no more than 5 terms. The simplified polynomial should contain no more than 8 terms.

	In items that require multiplication of polynomials, factors are limited to: two binomials; a monomial and two binomials; a monomial, a binomial, and a trinomial; two trinomials; and a binomial and a polynomial with four terms. The simplified product should contain no more than 9 terms. Polynomial identities are restricted to trinomials, difference of squares, sum of cubes, and difference of cubes.
Stimulus Attributes	Items may be set in a mathematical or real-world context. Items may use function notation.
Response Attributes	Items may require the student to recognize equivalent expressions. Items may require the student to write the answer in standard form. Items may require the student to rewrite expressions with negative exponents, but items must not require the student to rewrite rational expressions as seen in the standard MAFS.912.A-APR.4.6.
Calculator	No
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.A-APR.4.6 Also assesses MAFS.912.A-APR.2.2	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$.
Item Types	Equation Editor – May require creating an expression or a value. GRID – May require dragging and dropping graphics to complete long division. Hot Text – May require completing long division. Multiple Choice – May require identifying an expression or a value. Multiselect – May require choosing factors from a list. Open Response – May require explaining what a value means.
Clarifications	Students will rewrite a rational expression as the quotient in the form of a polynomial added to the remainder divided by the divisor. Students will use polynomial long division to divide a polynomial by a polynomial. Students will use the Remainder Theorem to determine if $(x – a)$ is a factor of a polynomial. Students will use the Remainder Theorem to determine the remainder of $p(x)/(x – a)$.
Assessment Limits	The polynomial that is the dividend should have a degree no less than 3 and no greater than 6. The polynomial that is the divisor should have a degree of 1, 2, or 3. In items that require the Remainder Theorem, the value of a in $(x – a)$, the divisor, may be a rational number.
Stimulus Attributes	Items should be set in a mathematical context. Items may use function notation.
Response Attribute	Items may require the student to provide sub-steps to complete polynomial long division.
Calculator	No

Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.A-CED.1.1 Also assesses MAFS.912.A-REI.1.2 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 simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. 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	Editing Task Choice – May require choosing the correct definition of a variable or an equation. Equation Editor – May require creating an equation, an inequality, or a value. GRID – May require dragging and dropping expressions or statements to complete a model. Hot Text– May require dragging and dropping values and/or expressions to create functions or to solve equations. Multiple Choice – May require identifying an equation or a value from a list of four choices. Multiselect – May require selecting an equation and identifying a variable. Open 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 and solve an equation in one variable that represents a real-world context. Students will solve a rational equation in one variable. Students will solve a radical equation in one variable. Students will justify algebraically why a solution is extraneous. Students will solve multi-variable formulas or literal equations for a specific variable.
Assessment Limits	Items may include equations that contain variables on both sides. Items that involve formulas should not include overused contexts such as Fahrenheit/Celsius or three-dimensional geometry formulas.

	In items that require the student to solve literal equations and formulas, the term of interest may be quadratic, a cubic in a monomial term, a linear term in the denominator of rational equation, a linear term in a square root equation, or a linear term as the base of an exponential equation with a rational number as the value for the exponent. For A-CED.1.4, items should not require more than six procedural steps to isolate the variable of interest. Items will not assess inequalities.
Stimulus Attributes	For A-CED.1.1 and A-CED.1.4, items should be set in a real-world context. For A-REI.1.2, items may be set in a mathematical or real-world context. Items may use function notation. Items may require the student to choose and interpret units.
Response Attributes	For A-CED.1.1 and A-CED.1.4, items may require the student to apply the basic modeling cycle. Items may require the student to recognize equivalent expressions.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.A-CED.1.2 Also assesses MAFS.912.A-CED.1.3 Also assesses MAFS.912.A-REI.3.6 Also assesses MAFS.912.A-REI.3.7	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. 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*. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line* $y = -3x$ *and the circle* $x^2 + y^2 = 3$.
Item Types	Editing Task Choice – May require choosing the correct definition of a variable. Equation Editor – May require creating a set of equations, a set of inequalities, or giving an ordered pair. GRID – May require graphing a representation of a set of equations, a set of inequalities, or an ordered pair, or selecting a solution region. Hot Text – May require selecting a solution or constraints. Multiple Choice – May require identifying an equation or a value from a list of four possible choices, identifying graphs, or identifying inequalities. Multiselect – May require identifying equations or inequalities, or selecting constraints, or variable definitions. Open Response – May require defining a variable or interpreting a solution.
Clarifications	Students will identify the quantities in a real-world situation that should be represented by distinct variables. Students will write constraints for a real-world context using equations, inequalities, a system of equations, or a system of inequalities. 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 write a system of equations for a modeling context that is best represented by a system of equations. Students will write a system of inequalities for a modeling context that is best represented by a system of inequalities. Students will interpret the solution of a real-world context as viable or not viable. Students will solve a simple system of a linear equation and a quadratic equation in two variables algebraically. Students will solve a simple system of a linear equation and a quadratic equation in two variables graphically.
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 rational coefficients; • a system of 3 x 3 linear equations with rational coefficients; • a system of two equations with a linear equation with rational coefficients and a quadratic that can be written in the form $y = ax^2 + bx + c$, where a, b, and c are integers; and • a system of two equations with a linear equation with rational coefficients and a bivariate quadratic that can be written in the form $ax^2 + by^2 = c$, where a, b, and c are integers. For A-REI.3.7, quadratics may be univariate or bivariate. Items that require a student to graph a system of equations are limited to a 2 x 2 system.
Stimulus Attributes	For A-CED.1.2 and A-CED.1.3, items must be placed in a real-world context. For A-REI.3.6 and A-REI.3.7, items may be placed in a mathematical or real-world context. Items may result in infinitely many solutions or no solution.
Response Attributes	For A-CED.1.2 and A-CED.1.3, items may require the student to apply the basic modeling cycle. Responses with square roots should require the student to rewrite the square root so that the radicand has no square factors. Items may require the student to choose and interpret the scale in a graph.

	Items may require the student to graph a circle whose center is (0, 0). Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

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	Editing Task Choice – May require correcting a step in an informal argument. Equation Editor – May require creating an expression. GRID – May require dragging and dropping steps, equations, and/or justifications to create a viable argument. Hot Text – May require rearranging equations or justifications. Multiple Choice – May require identifying expressions or statements. Open Response – May require creating a written response, justifying a solution method.
Clarifications	Students will complete an algebraic proof to explain steps for solving a simple equation. Students will construct a viable argument to justify a solution method.
Assessment Limits	Items should not assess linear equations. Items will not require the student to recall names of properties from memory.
Stimulus Attributes	Items should be set in a mathematical context. Items may use function notation. Coefficients may be a rational number or a variable that represents any real number.
Response Attributes	Items may ask the student to complete steps in a viable argument. Items will not ask the student to provide the solution.
Calculator	No
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.A-REI.4.11	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.
Item Types	Equation Editor – May require creating a value or an expression. GRID – May require identifying intersections of graphs. Hot Text – May require dragging labels to a graph or dragging numbers and symbols to complete a solution. Matching Item – May require finding solutions or appropriate approximations. Multiple Choice – May require selecting a value or an expression from a list. Multiselect – May require selecting multiple values. Open Response – May require creating a written response. Table Item – May require completing missing cells in a table.
Clarifications	Students will find a solution or an approximate solution for $f(x) = g(x)$ using a graph. Students will find a solution or an approximate solution for $f(x) = g(x)$ using a table of values. Students will find a solution or an approximate solution for $f(x) = g(x)$ using successive approximations that gives the solution to a given place value. Students will demonstrate why the intersection of two functions is a solution to $f(x) = g(x)$.
Assessment Limits	In items where a function is represented by an equation, the function may be linear, quadratic, exponential with a rational exponent, polynomial of degree greater than 2, rational, absolute value, and logarithmic. In items where a function is represented by a graph or a table, the function may be any continuous function.
Stimulus Attributes	Items may be set in a mathematical or real-world context. Items may use function notation.

	Items will designate the place value accuracy necessary for approximate solutions.
Response Attributes	Items may require the student to apply the basic modeling cycle. 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 know the role of the x-coordinate and the y-coordinate in the intersection of $f(x) = g(x)$.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

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* $(1.15^{1/12})^{12t} \approx (1.012)^{12t}$ *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	Editing Task Choice – May require choosing equivalent forms of an expression, an explanation, or an interpretation. Equation Editor – May require creating an equivalent expression or numerical response. GRID – May require dragging values into an expression to create an equivalent expression. Hot Text – May require dragging and dropping terms, factors, coefficients, or expressions to complete an equivalent expression or interpretation. Matching Item – May require choosing equivalent expressions. Multiple Choice – May require selecting an expression or a value from a set of options. Multiselect – May require selecting expressions or values from a set of options. Open Response – May require constructing a written response.
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 (i.e., combining like terms, using the distributive property, and using other operations with polynomials).
Assessment Limits	Items may have a greatest common factor that is a monomial with no more than two variables. In items that require the student to write equivalent expressions by factoring, the given expression may be a difference of two squares, a quadratic with rational coefficients, a sum or difference of cubes, or a polynomial with the highest degree of 3. Items may use the compound interest formula but should not require the student to recall the formula. Items that use the number *e* should not include an approximate value. For A-SSE.2.3b, items should only ask the student to interpret the y-value of the vertex within a real-world context. A-SSE.1.1, items should not ask the student to interpret zeros, the vertex , or axis of symmetry when the quadratic expression is in the form $ax^2 + bx + c$ (see F-IF.3.8). Items should require the student to choose how to rewrite the expression.
Stimulus Attributes	For A-SSE.1.1 and A-SSE.2.3, items should be set in a real-world context. For A-SSE.1.1 and A-SSE.2.3, items may require the student to apply the basic modeling cycle. For A-SSE.1.2, items may be in a real-world or mathematical context. Items should contain expressions only.
Response Attribute	Items may require the student to choose and interpret units. Items may require the student to provide the answer in a specific form.

Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.N-CN.3.7 Also assesses MAFS.912.A-REI.2.4	Solve quadratic equations with real coefficients that have complex solutions. 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	Equation Editor – May require creating a value or an expression. GRID – May require completing steps in solving a quadratic. Hot Text – May require rearranging equations, dragging values to complete a solution or choosing solutions. Multiple Choice – May require selecting a value or an expression from a list. Multiselect – May require selecting multiple values.
Clarifications	Students will rewrite a quadratic equation in vertex form by completing the square. Students will solve a quadratic equation by choosing an appropriate method (i.e., completing the square, the quadratic formula, or factoring).
Assessment Limits	Items may have complex solutions. 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.
Stimulus Attributes	Items should be set in a mathematical context. Items may use function notation.
Response Attributes	Items may require the student to recognize equivalent solutions to the quadratic equation. Items may require the student to provide the answer in a specific form.

	Responses with square roots should require the student to rewrite the square root so that the radicand has no square factors or negative numbers.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.G-GPE.1.2	Derive the equation of a parabola given a focus and directrix.
Item Type	Equation Editor – May require constructing an equation for a parabola. GRID – May require creating an equation by dragging and dropping values and/or expressions. Hot Text – May require completing an equation by dragging values. Multiple Choice – May require selecting a choice from a set of possible choices.
Clarification	Students will write the equation of a parabola when given the focus and directrix.
Assessment Limit	The directrix should be parallel to a coordinate axis.
Stimulus Attributes	Items may be set in a mathematical or real-world context. Items may use function notation.
Response Attribute	Items may require the student to recognize equivalent forms of an equation.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.F-BF.1.2 Also assesses MAFS.912.F-BF.1.1 Also assesses MAFS.912.A-SSE.2.4	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. 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.* Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*
Item Types	Editing Task Choice – May require choosing the definition of a variable. Equation Editor – May require creating a value, an expression, or a function or showing steps for a calculation. GRID – May require creating an equation by dragging values and/or expressions. Hot Text – May require dragging expressions to complete a derivation of the formula for the sum of a finite geometric series. Multiple Choice – May require selecting a choice from a set of possible choices. Multiselect – May require choosing equivalent expressions and/or interpretations. Open Response – May require explaining and interpreting a resulting function. Table Item – May require completing missing cells in a table.
Clarifications	Students will write an arithmetic sequence using a recursive formula to model a real-world context. Students will write an arithmetic sequence using an explicit formula to model a real-world context.

	Students will write a geometric sequence using a recursive formula to model a real-world context. Students will write a geometric sequence using an explicit formula to model a real-world context. Students will rewrite recursive formulas using an explicit formula and vice versa. 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 use the formula for a sum of a finite geometric series to solve real-world problems. Students will derive the formula for a sum of a finite geometric series where r is not equal to 1.
Assessment Limits	Items will not expect the student to find the sum of an infinite geometric series. In items where the student constructs an arithmetic sequence, consecutive values of n should not be given. In items where the student constructs an exponential function, a geometric sequence, or a recursive definition from input-output pairs, consecutive inputs should not be given. In items that require the student to construct arithmetic or geometric sequences, the real-world context should be discrete. In items that require the student to construct a linear or exponential function, the real-world context should be continuous. Items may require the student to construct an exponential function, a geometric sequence or a recursive definition from a graph or a description of a model.
Stimulus Attributes	Items should be set in a real-world context. Items may require the student to apply the basic modeling cycle.

	Items may use function notation. In items where the student has to find the sum of a finite geometric series, the student will be expected to know the formula. A series may be written in summation notation.
Response Attributes	In items where the student has to write a recursive formula, the student should be expected to give the initial condition and the recursion formula. Items may require the student to complete algebraic steps in a deviation of the formula for the sum of a geometric series. Items may require the student to rearrange steps in an algebraic deviation of the formula for the sum of a geometric series. Items that ask the student to derive the formula for the sum of a geometric series may use equivalent forms of the formula. Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.F-BF.2.3	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. 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 Editor – May require creating a value or an expression. GRID – May require plotting points or a transformed function. Hot Text – May require choosing an equation and an effect on the graph. Matching Item – May require matching an equation, transformation values, and/or an explanation of the effect on a graph. Multiple Choice – May require selecting a graph or a table from a list. Open Response – May require explaining the effects of a transformation. Table Item – May require completing a table of values.
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. Students will recognize even and odd functions from their graphs and equations.
Assessment Limits	Functions represented algebraically are limited to linear, quadratic, exponential, or square root. Functions represented using tables or graphs are not limited to linear, quadratic, exponential or square root. Functions may have closed domains. Functions may be discontinuous.

	Items should have at least two transformations.
Stimulus Attributes	Items should be set in a mathematical context. Items may use function notation.
Response Attributes	Items may require the student to explain or justify a transformation that has been applied to a function. Items may require the student to explain how a graph is affected by a value of *k*. Items may require the student to find the value of *k*. Items may require the student to complete a table of values.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.F-BF.2.4	Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function, f, that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.* b. Verify by composition that one function is the inverse of another. c. Read values of an inverse function from a graph or a table, given that the function has an inverse. d. Produce an invertible function from a non-invertible function by restricting the domain.
Item Types	Editing Task Choice – May require choosing a domain that can be used to produce an invertible function from a non-invertible function. Equation Editor – May require expressing a function or showing steps to find the inverse of a function. GRID – May require plotting points on a coordinate plane. Hot Text – May require dragging steps in a verification of an inverse by composition. Multiple Choice – May require selecting a choice from a set of possible choices. Table Item – May require completing a table of values for an inverse function.
Clarifications	Students will find the inverse of a function. Students will use composition of functions to determine if two functions are inverses. Students will use a graph or a table of a function to determine values of the function's inverse. Students will restrict the domain of a function whose inverse is not a function so that the inverse will be a function.
Assessment Limit	In items that require the student to find the inverse of a function, functions may consist of linear functions, quadratics of the form $f(x) = ax^2 + c$, radical functions with a linear function as the radicand, and rational functions whose numerator is a integer and whose denominator is a linear function.
Stimulus Attributes	Items may be set in a real-world or mathematical context. Items may use function notation.
Response Attribute	Items may require the student to use inequalities or interval notation to represent the domain.
Calculator	Neutral

Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.F-IF.2.4 Also assesses MAFS.912.F-IF.3.9 Also assesses MAFS.912.F-IF.2.5 Also assesses MAFS.912.F-LE.2.5	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.* 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.* Interpret the parameters in a linear or an exponential function in terms of a context.
Item Types	Editing Task Choice – May require choosing a phrase that describes a domain. Equation Editor – May require expressing a value, an inequality, an expression, or a function. GRID – May require dragging and dropping a phrase onto a graph. Hot Text– May require rearranging comparisons and labeling key features. Multiple Choice – May require selecting a choice from a set of possible choices. Open Response – May require explaining the relationship of key features. Table response – May require completing a table of values.
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 models the relationship.

	Students will differentiate between different types of functions using a variety of descriptors (e.g., graphical, verbal, numerical, and algebraic). Students will compare properties of two functions using a variety of function representations (e.g., algebraic, graphical, numerical in tables, or verbal descriptions). 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 determine the feasible domain of a function in relation to its graph and/or the quantitative relationship it describes. Students will interpret the rate of change and the intercepts of a linear function given in a real-world context. Students will interpret the parameters of an exponential function given in a real-world context.
Assessment Limits	For F-IF.2.4, F-IF.3.9, and F-IF.2.5, functions may be polynomial, rational, square root, absolute value, piece-wise, exponential, or logarithmic. In items requiring the student to find the domain from graphs, relationships may be on a closed or open interval. In items requiring the student to find the domain from graphs, relationships may be discontinuous. Items may have domains expressed using inequalities or interval notation. Key features include *x*-intercepts; *y*-intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior. For F-LE.2.5, linear functions should not be given in the form $y = mx + b$.
Stimulus Attributes	Items should be set in a real-world context. Items may use function notation.
Response Attributes	For F-IF.2.4, F-IF.2.5, and F-LE.2.5, items may require the student to apply the basic modeling cycle. Items may require the student to write domains using inequalities or interval notation.

	Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

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* $y=(1.2)^{\frac{t}{10}}$ *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.2.6	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.
Also assesses MAFS.912.F-IF.3.7a, b, c, d, 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	Equation Editor – May require creating a value, an expression, or an equation. GRID – May require plotting points, key features, or an equation on a graph. Hot Text – May require identifying key features. Multiple Choice – May require selecting from a list, a statement about the rate of a data display, an interpretation, or context.

	Multiselect – May require selecting multiple responses or multiple statements about the rate of change. Open Response – May require explaining and interpreting a function.
Clarifications	Students will calculate and 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 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 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 identify 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 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 symbolically. Students will identify intercepts and end behavior for an exponential function. Students will identify intercepts, asymptotes, and end behavior of a rational function. Students will graph a 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	For A-APR.2.3, the polynomial must be in factored form. Factors may have complex zeros. Polynomials may have zeros with multiplicity.

	For F-IF.3.7a, quadratic functions given in the form $y = ax^2 + bx + c$, at least one value of *a*, *b*, or *c* should be a rational number. Quadratic functions given in vertex from $y = a(x – h)^2 + k$, at least one value of *a*, *h*, or *k* should be a rational number. For F-IF.3.7b, square root and cube root functions are limited to a linear function in the radicand. For piecewise functions, each piece of a piecewise function may be linear, quadratic, simple square root, simple cube root, or simple cubic. If a piecewise function has three pieces, the pieces are restricted to linear and/or quadratic. Absolute value functions should be in the form $y = a\|x – h\| + k$, where *a*, *h*, and *k* are integers. For F-IF.3.7c, polynomial functions are limited to cubics and quartics. For F-IF.3.7d, the asymptotes of rational functions are limited to no more than two vertical asymptotes and no more than one horizontal asymptote. For F-IF.3.7e, the base of logarithmic functions is restricted to 2, 10, and e. Logarithmic functions are restricted to one translation. Trigonometric functions will not be assessed. For F-IF.3.8, items may specify a required form using an equation or using common terminology such as standard form. In items that require the student to interpret the vertex or a zero of a quadratic within a real-world context, the student should interpret both the *x*- and *y*-values. In items that require the student to graph polynomial functions, the polynomial's degree should be no greater than 6.
Stimulus Attributes	Items may be set in a mathematical or real-world context. For F-IF.2.6 and F-IF.3.7, items may require the student to apply the basic modeling cycle. Items may use function notation. Items should not require the student to complete a sign chart for a polynomial.
Response Attribute	Items may require the student to choose and interpret units. Items may require the student to provide the answer in a specific form.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.F-LE.1.4 Also assesses MAFS.912.F-BF.2.a	For exponential models, express as a logarithm the solution to $ab^{ct} = d$, where *a*, *c*, and *d* are numbers and the base, *b*, is 2, 10, or *e*; evaluate the logarithm using technology. Use the change of base formula.
Item Types	Equation Editor – May require creating a value, an expression, or an equation. Multiple Choice – May require selecting a choice from a set of possible choices Multiselect – May require selecting responses from a set of possible choices.
Clarifications	Students will use logarithms to solve exponential functions with a base of 2, 10, or e. Students will use the base change formula to find values of logarithms with bases other than 10 and e.
Assessment Limit	N/A
Stimulus Attributes	For F-LE.1.4, items should be set in a real-world context. For F-BF.2.a, items should be set in mathematical context. Items may use function notation.
Response Attributes	For F-LE.1.4, items may require the student to apply the basic modeling cycle. Items may require the student to leave the answer as a logarithm or to find the value using a calculator.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.F-TF.1.2 Also assesses MAFS.912.F-TF.1.1 Also assesses MAFS.912.F-TF.3.8	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle; convert between degrees and radians. Prove the Pythagorean identity $\sin^2(\theta)+\cos^2(\theta)=1$ and use it to calculate trigonometric ratios.
Item Types	Editing Task Choice – May require choosing a step to complete an informal argument. Equation Editor – May require creating a value, an expression, or an equation. GRID – May require drawing an angle or plotting a point on the unit circle. Hot Text – May require ordering the steps in a proof or choosing a set of points on a unit circle. Matching Item – May require matching equivalent expressions. Multiple Choice – May require selecting a choice from a set of possible choices. Multiselect – May require selecting equivalent expressions. Open Response – May require explaining a relationship.
Clarifications	Students will extend right triangle trigonometry to the unit circle to determine an ordered pair that lies on the unit circle. Students will explain how using the radian measure of an angle traversed allows for trigonometric functions to be extended to all real numbers. Students will explain how the radian measure of an angle is the length of the arc on the unit circle subtended by the angle. Students will convert the degree measure to radian measure. Students will convert the radian measure to degree measure. Students will use their knowledge of trigonometric ratios and the Pythagorean theorem to prove the Pythagorean identity.

	Students will use the Pythagorean identity to calculate trigonometric ratios.
Assessment Limits	In items where the student extends right triangle trigonometry to the unit circle, the items should give an angle that is measured counterclockwise from the positive ray of the *x*-axis. Items may not use quadrantal angles. Trigonometric functions are limited to sine and cosine. In items where the student has to calculate trigonometric ratios, the value of either sine or cosine of an unknown angle must be given. Common sine and cosine ratios such as $\frac{1}{2}$, $\frac{\sqrt{2}}{2}$ and $\frac{\sqrt{3}}{2}$ should not be used in these items.
Stimulus Attributes	Items should be set in a mathematical or real-world context. Items may use function notation.
Response Attribute	Items may ask the student to complete steps in a proof of the Pythagorean identity.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.F-TF.2.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
Item Types	Equation Editor – May require creating a value or an equation. GRID – May require plotting a point or dragging and dropping values to complete an equation. Hot Text – May require dragging and dropping values and/or expressions to create an equation. Multiple Choice – May require selecting a choice from a set of possible choices. Multiselect – May require selecting multiple statements about a given trigonometric function.
Clarification	Students will interpret a real-world context to choose a trigonometric function that models it.
Assessment Limit	Trigonometric functions are limited to sine and cosine functions that model simple periodic phenomena such as harmonic motion or have no more than two translations.
Stimulus Attributes	Items should be set in a real-world context. Items may use function notation. Items may provide a graph of a trigonometric function that models a real-world situation.
Response Attributes	Items may require the student to apply the basic modeling cycle. Items may require the student to complete a function that models a real-world context by providing missing values. Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.N-CN.1.2 Also assesses MAFS.912.N-CN.1.1	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. 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.
Item Types	Equation Editor – May require providing a numeric value or an expression. GRID – May require dragging and dropping values and/or expressions to write a complex number. Hot Text – May require dragging and dropping values and/or expressions to write a complex number. Matching Item – May require making a complex expression with a complex number. Multiple Choice – May require selecting a choice from a set of possible choices. Multiselect – May require selecting equivalent expressions or values.
Clarification	Students will add, subtract, and multiply complex numbers and use $i^2 = -1$ to write the answer as a complex number.
Assessment Limit	Items should not require the student to perform more than 5 mathematical operations.
Stimulus Attribute	Items may be set in a mathematical or real-world context.
Response Attribute	Items should require the student to use the relation $i^2 = -1$ to convert imaginary numbers with an even power to a real number. Items should require the student to provide the answer in $a + bi$ form.
Calculator	No
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.N-RN.1.2 Also assesses MAFS.912.N-RN.1.1	Rewrite expressions involving radicals and rational exponents using the properties of exponents. 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* $\left(5^{\left(\frac{1}{3}\right)}\right)^3 = 5^{\left(\frac{1}{3}\right)^3}$ *to hold, so* $5^{\left(\frac{1}{3}\right)^3}$ *must equal* 5.
Item Types	Editing Task Choice – May require choosing a value, expression, or statement. Equation Editor – May require creating a value or an expression. GRID – May require completing an algebraic proof. Hot Text – May require dragging and dropping values, expressions, or explanations. Matching Item – May require matching equivalent expressions. Multiple Choice – May require selecting a value or an expression from a list. Multiselect – May require selecting multiple values. Open 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 to 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 explain how the definition of the meaning of rational exponents follows from the properties of integer exponents.
Assessment Limit	For N-RN.1.2, items should require the student to do at least three operations.
Stimulus Attribute	Items should be set in a mathematical context.

Response Attribute	Items may require the student to determine equivalent expressions or equations.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.S-CP.1.1	Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
Item Types	Editing Task Choice – May require choosing a union, intersection or complement. Equation Editor – May require writing a sample space. GRID– May require interacting with a Venn diagram by placing numeric values accordingly or clicking areas within a Venn diagram to illustrate subsets. Hot Text – May require dragging and dropping values or expressions. Matching Item – May require the student to match a description of a subset with the mathematical notation (e.g. $A \cup B$). Multiple Choice – May require choosing a sample space. Multiselect – May require choosing lists.
Clarifications	Students will determine events that are subsets of a sample space. Students will determine the sample space of an event by describing it as a union of the subsets of other sample spaces. Students will determine the sample space of an event by describing it as an intersection of the subsets of other sample spaces. Students will determine the sample space of an event by describing it as a complement of another sample space.
Assessment Limits	Unions may be described verbally or use the notation $A \cup B$. Intersections may be described verbally or use the notation $A \cap B$. Complements may be described verbally or use the notation $\sim A$. Items should not ask the student to determine probability. Items should not require the student to apply understanding of independence or dependence.
Stimulus Attributes	Items should be set in a real-world context. Sample spaces may be written as a set, a list, in a table, or in a Venn diagram.
Response Attribute	Items may require the student to apply the basic modeling cycle.
Calculator	No
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.S-CP.1.5 Also assesses MAFS.912.S-CP.1.4 Also assesses MAFS.912.S-CP.1.2 Also assesses MAFS.912.S-CP.1.3 Also assesses MAFS.912.S-CP.2.6	Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and 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*. 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.
Item Types	Equation Editor – May require providing a numeric value or constructing an expression. GRID – May require constructing a frequency table with data to create independent or disjoint events or constructing probabilities for events *A* and *B*. Hot Text – May require dragging and dropping values. Matching Item – May require matching real-world associations with the type of probability. Multiple Choice – May require selecting a numeric value, specific sample groups within a given context, or a statement regarding the probability of an event or a set of data. Multiselect – May require selecting sets of data that have independent events. Open Response – May require explaining an interpretation of an event's probability.

	Table Item – May require completing missing cells in a table.
Clarifications	Students will determine probability or independence in a real-world context. Students will explain the concepts of probability and independence found within a real-world context. Students will construct a two-way frequency table when two categories are associated with each object being classified. Students will use a two-way frequency table to determine the independence of events. Students will use a two-way frequency table to approximate conditional probabilities. Students will find the probability of two independent events occurring together. Students will use given probabilities to determine if two events are independent. Students will find the conditional probability of *A* given *B* and the conditional probability of *B* given *A* to determine if *A* and *B* are independent events. Students will find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that belong to *A*. Students will interpret a conditional probability in terms of a real-world context.
Assessment Limits	Items may use Venn diagrams. Unions may be described verbally or use the notation $A \cup B$. Intersections may be described verbally or use the notation $A \cap B$. Complements may be described verbally or use the notation $\sim A$.
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to apply the basic modeling cycle. Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.S-CP.2.7	Apply the Addition Rule, P(*A* or *B*) = P(*A*) + P(*B*) – P(*A* and *B*), and interpret the answer in terms of the model.
Item Types	Editing Task Choice – May require choosing an interpretation. Equation Editor – May require identifying a value. GRID – May require dragging and dropping values. Hot Text – May require dragging and dropping values and/or an interpretation. Matching Item – May require matching a result with an interpretation. Multiple Choice – May require selecting a numeric value. Multiselect – May require choosing a result and an interpretation of the result. Open Response – May require interpreting the Addition Rule within a context.
Clarification	Students will find probabilities using the Addition Rule and interpret the answer within the real-world context.
Assessment Limit	Data may be displayed in a two-way table, a Venn diagram, a tree diagram, or simply described.
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to apply the basic modeling cycle. Item may require the student to find the unknown value when given three of the values in P(*A* or *B*) = P(*A*) + P(*B*) – P(*A* and *B*).
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.S-IC.1.1	Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
Item Types	Editing Task Choice – May require choosing an inference or correcting a mistake in a process. Equation Editor – May require the student identifying a quantity. Matching Item – May require choosing inferences, statistics, parameters and/or sampling methods. Multiple Choice – May require selecting a choice from a set of possible choices. Open Response – May require describing flaws in data collection or interpretation or recommending a correct course of action.
Clarification	Students will use observed results from a random sample to make an inference about the population.
Assessment Limits	Items may require the student to distinguish between a statistic and a parameter. Items may require a student to be familiar with different kinds of sampling methods but not the specific names of the methods. Items may require a student to be familiar with the process of statistical inference but not require the student to state the process.
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to apply the basic modeling cycle. Items may require the student to choose and interpret units.
Calculator	No
Sample Item	See Appendix for the practice test item aligned to this standard.

MAFS.912.S-IC.2.3 Also assesses MAFS.912.S-IC.1.2 Also assesses MAFS.912.S-IC.2.4 Also assesses MAFS.912.S-IC.2.5 Also assesses MAFS.912.S-IC.2.6	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. Decide if a specified model is consistent with results from a given data-generating process (e.g., using simulation). *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. Evaluate reports based on data.
Item Types	Editing Task Choice – May require choosing a purpose of a statistical model. Equation Editor – May require identifying a quantity. Hot Text – May require dragging and dropping values and/or an interpretation. GRID – May require dragging and dropping options to construct a model or to design an experiment, or complete a simulation to model data. Matching Item – May require matching models, flaws in a data collection method, or type of data collection. Multiple Choice – May require identifying a survey type or a sample. Multiselect – May require selecting acceptable models. Open Response – May require discussing aspects of a survey, explaining data reports, describing flaws in data collection, or recommending a correct course of action.
Clarifications	Students will use the purpose of a sample survey, experiment, and observational study to determine which would be the best statistical model for a given context. Students will understand the role of randomization in a sample survey, experiment, and observational study.

	Students will evaluate the randomization method chosen for a sample survey, experiment, or observational study to determine its probable effectiveness. Student will determine if a simulation is consistent with the theoretical probability. Students will design and perform a randomized experiment. Students will evaluate reports based on data.
Assessment Limits	Items should not require the student to complete a survey, perform an experiment, or do an observational study. Items will not require the student to perform a simulation.
Stimulus Attribute	Items should be set in a real-world context.
Response Attributes	Items may require the student to apply the basic modeling cycle. Items may require the student to choose and interpret units.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to a standard in this group.

MAFS.912.S-ID.1.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
Item Types	Equation Editor – May require identifying a value. GRID – May require clicking on a part of the normal curve to indicate the location of a data point. Matching Item – May require matching a piece of data to a z-score. Multiple Choice – May require selecting a correct comparison. Multiselect – May require choosing statements about a comparison. Open Response – May require explaining a comparison. Table Item – May require completing a table of *z*-scores for different data points.
Clarifications	Students will calculate the z-score and use it to compare a data point to the population. Students will calculate the z-score and use it to compare two data points.
Assessment Limit	Items should contain data that are approximately normally distributed.
Stimulus Attributes	Items should be set in a real-world context. Items should give the mean and standard deviation of the data set.
Response Attribute	Items may require the student to apply the basic modeling cycle.
Calculator	Neutral
Sample Item	See Appendix for the practice test item aligned to this standard.

Appendix A

The chart below contains information about the standard alignment for the items in the Algebra 2 Computer-Based Practice Test at http://fsassessments.org/students-and-families/practice-tests/.

Content Standard	Item Type	Computer-Based Practice Test Item Number
MAFS.912.A-APR.3.4	GRID	14
MAFS.912.A-APR.4.6	Equation Editor	8
MAFS.912.A-CED.1.1	GRID	3
MAFS.912.A-CED.1.2	Hot Text	20
MAFS.912.A-REI.1.1	Editing Task Choice	5
MAFS.912.A-REI.4.11	Equation Editor	23
MAFS.912.A-SSE.1.1	Hot Text	19
MAFS.912.N-CN.3.7	GRID	24
MAFS.912.G-GPE.1.2	Equation Editor	12
MAFS.912.F-BF.1.1	Equation Editor	18
MAFS.912.F-BF.2.3	Table Item	10
MAFS.912.F-BF.2.4	GRID	1
MAFS.912.F-IF.2.5	Multiple Choice	16
MAFS.912.F-IF.3.7	GRID	4
MAFS.912.F-LE.1.4	Equation Editor	17
MAFS.912.F-TF.1.2	GRID	7
MAFS.912.F-TF.2.5	Multiple Choice	25
MAFS.912.N-CN.1.2	Matching Item	2
MAFS.912.N-RN.1.2	Equation Editor	6
MAFS.912.S-CP.1.1	Multiselect	11
MAFS.912.S-CP.1.4	Table Item	21
MAFS.912.S-CP.2.7	Equation Editor	15
MAFS.912.S-IC.1.1	Open Response	9
MAFS.912.S-IC.2.3	Multiple Choice	13
MAFS.912.S-ID.1.4	Equation Editor	22

Appendix B: Revisions

Page(s)	Revision	Date
13-14	Item types revised.	May 2016
23-25	Response attributes revised.	May 2016
26-27	Response attributes revised.	May 2016
29-31	Item types revised.	May 2016
39-41	Clarifications and response attributes revised.	May 2016
46	Response attributes revised.	May 2016
57	Appendix A added to show Practice Test information.	May 2016

Algebra 2 EOC FSA Mathematics Reference Sheet

Formulas

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, where a, b, and c are coefficients in an equation of the form $ax^2 + bx + c = 0$

$\log_b a = \frac{\log a}{\log b}$

$\sin A° = \frac{\text{opposite}}{\text{hypotenuse}}$

$\cos A° = \frac{\text{adjacent}}{\text{hypotenuse}}$

$\tan A° = \frac{\text{opposite}}{\text{adjacent}}$

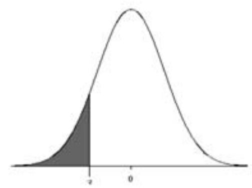
$P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$z = \frac{(x - \mu)}{\sigma}$, where μ = mean and σ = standard deviation

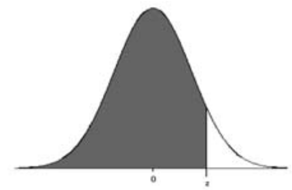
Algebra 2 EOC FSA Mathematics Reference Sheet

Table of Standard Normal Probabilities for Negative *z*-scores



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Table of Standard Normal Probabilities for Positive *z*-scores



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

$z = \frac{(x - \mu)}{\sigma}$, where μ = mean and σ = standard deviation