AzM2 | Arizona's Statewide Achievement Assessment for English Language Arts and Mathematics

Mathematics Item Specifications

GRADE 10

Arizona Department of Education with American Institutes for Research - 2019

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Introduction

AzM2 is Arizona's statewide achievement test. AzM2 assesses the Arizona English Language Arts Standards and Arizona Mathematics Standards adopted by the Arizona State Board of Education in December 2016. AzM2 will inform students, teachers, and parents about preparedness for college and careers upon graduating from high school. AzM2 tests are computer-based, meaning that they can better assess students' critical thinking skills and provide them with opportunities to demonstrate a deeper understanding of the materials. Computer-based testing also allows for the use of a variety of innovative items types.

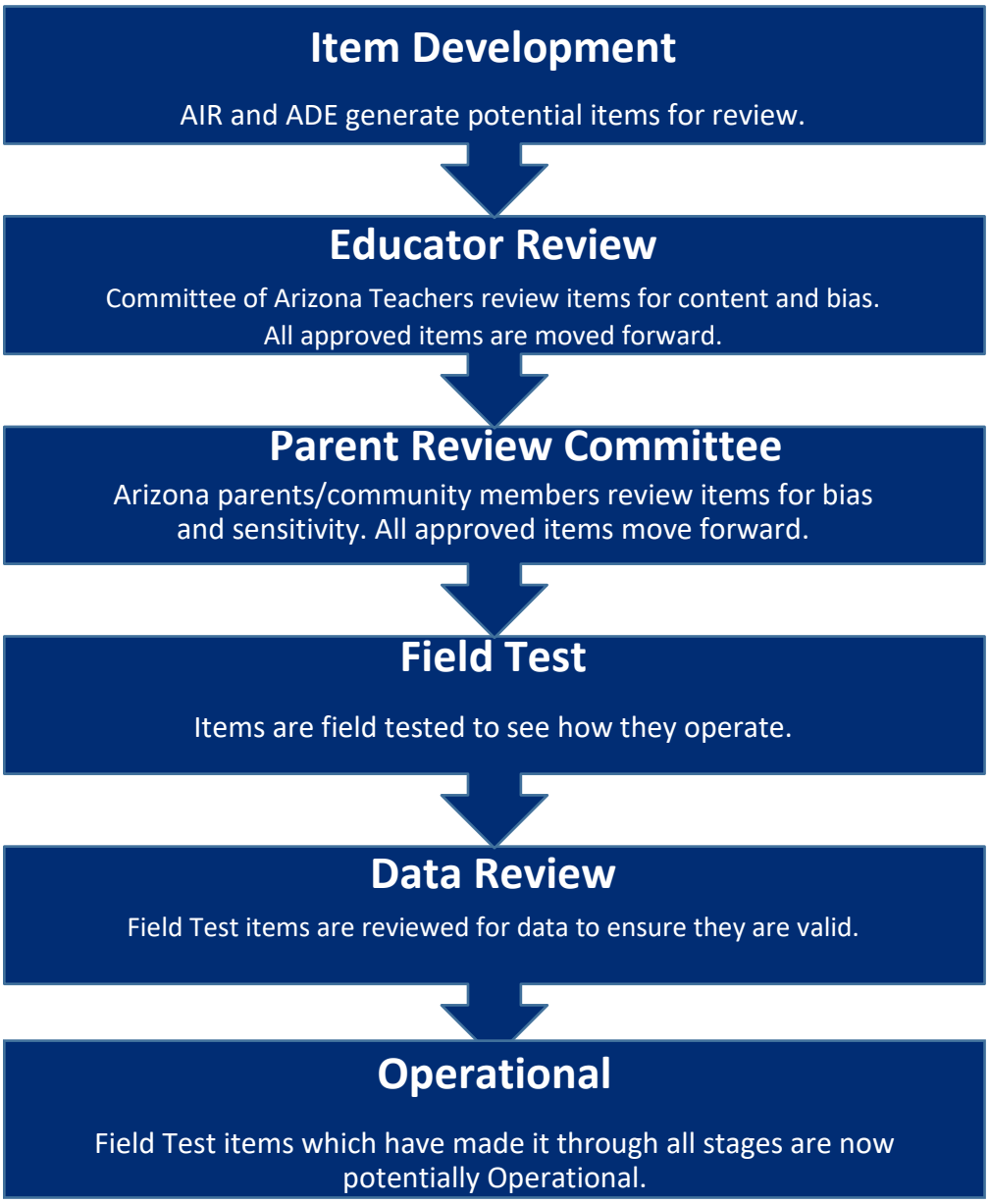
During the item-development process, all AzM2 items are written in accordance with the Item Specifications and are reviewed and approved by a committee of Arizona educators to confirm alignment and appropriateness for inclusion in the test. AzM2 items are generally representative of Arizona's geographic regions and culturally diverse population. Items are reviewed for the following kinds of bias: gender, racial, ethnic, linguistic, religious, geographic, and socioeconomic. Item reviews also include consideration of issues related to individuals with disabilities. Arizona community members also have an opportunity to review items for issues of potential concern to members of the community at large. Reviewers are asked to consider the variety of cultural, regional, philosophical, political, and religious backgrounds throughout Arizona, and then to determine whether the subject matter will be acceptable to Arizona students, families, and other members of Arizona communities.

This *AzM2 Item Specifications* is a resource document that defines the content and format of the test and test items for item writers and reviewers. Each *Item Specifications* document indicates the alignment of items with the Arizona Mathematics Standards. It also serves to provide all stakeholders with information about the scope and function of assessment items. This document can also serve to assist educators to understand how assessment items are developed in alignment with the standards for English language arts and math. These item specifications for AzM2 are intended to provide information regarding standards, item formats and response types. The descriptions of blueprints, and depth of knowledge in this document are meant to provide an overview of the test. Item specifications are meant for the purposes of assessment, not instruction. They are not intended to be tools for instruction or the basis for curricula. AzM2 has a test blueprint that was developed by Arizona and is different from any other state or consortium test blueprint.

For the math portion of AzM2, all test questions are aligned to the mathematic content standards for these subject areas. Any item specifications that are absent for standards listed in this document may be under development. This document does not endorse the exclusion of the instruction of any grade-level content standards. The test will ask questions that check a student's conceptual understanding of math as well as their procedural skills. These items have been written to be free from bias and sensitivity, and widely vary in their degree of difficulty.

Item Development Process

AzM2 items go through a rigorous review before they are operational. When an item is "operational" it means it is used to determine a student's score on the assessment. This is a description of the process every item must go through before it is operational on AzM2.



Sample tests are available online for the math portion of AzM2. For more information view the Guide to the Sample Tests at www.AzM2portal.org.

Test Construction Guidelines

The construction of the AzM2 assessment is guided by the depth and rigor of the Arizona College and Career Ready Standards. Items are created to address key components of the standards and assess a range of important skills. The AzM2 Blueprint provides an overview of the distribution of items on the AzM2 according to the standards. The standards for Math Practices are embedded within all AzM2 items. Further, the AzM2 blueprint outlines the Depth of Knowledge distribution of items.

Blueprint

Grade 10 AzM2 Blueprint 2016 Standards		
Reporting Category	**Min.**	**Max.**
Algebra	20%	28%
Functions	16%	20%
Statistics and Quantitative Reasoning	16%	20%
Congruence & Geometric Properties with Equations	18%	22%
Similarity, Right Triangles and Trigonometry & Circles and Geometric Measurement	18%	22%

Within a test, approximately 70% of the assessment will be on major content within that grade or course.

Percentage of Points by Depth of Knowledge Level	
DOK 1	10% - 20%
DOK 2	53% - 63%
DOK 3	19% - 37%

Depth of Knowledge (DOK)

DOK refers to the level of rigor or sophistication of the task in a given item, designed to reflect the complexity of the Arizona Mathematics Standards. Items at DOK level 1 focus on the recall of information, such as definitions, terms, and simple procedures. Items at DOK 2 require students to make decisions, solve problems, or recognize patterns; in general, they require a greater degree of engagement and cognitive processing than items at DOK 1. Items at DOK 3 feature higher-order cognitive tasks that assess students' capacities to approach abstract or complex problems.

Calculators

Arizona Desmos Graphing Calculator is permitted for both the paper-based and computer-based assessment for High School Math.

Item Formats

The AzM2 Assessments are composed of item formats that include traditional multiple-choice response items and technology-enhanced response items (TEI). TEIs are computer-delivered response items that require students to interact with test content to select, construct, and/or support their responses. TEIs are better able to assess a deeper level of understanding.

Currently, there are nine types of TEIs that may appear on the Math computer-based assessment for AzM2:

- Editing Tasks (ET)
- Editing Task Choice (ETC)
- Equation Editor (EQ)
- Graphic Response Item Display (GRID)
- Hot Text (HT)
    - Selectable Hot Text
    - Drag-and-Drop Hot Text
- Matching Item (MI)
- Multi-Select (MS)
- Open Response
- Table Item (TI)

For paper-based assessments (including those for students with an IEP or 504 plan that specifies a paper-based accommodation), TEIs will be modified so that they can be scanned and scored electronically or hand-scored.

See the table below for a description of each TEI. In addition, for examples of each response item format described, see the AzM2 Training Tests at www.AzM2portal.org.

Item Format	Description
Editing Task (ET)	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.
Editing Task Choice (ETC)	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.

Item Format	Description
Equation Editor (EQ)	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.
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.
Hot Text (HT)	**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.
	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.
Matching Item (MI)	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.
Multi-Select (MS)	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.
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.

Item Format	Description
Table Item (TI)	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.

Arizona Mathematics Standards Algebra I

Number and Quantity - N		
The Real Number System (N-RN)		
A1.N-RN.B **Use properties of rational and irrational numbers.**	**A1.N-RN.B.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.
Quantities (N-Q)		
A1.N-Q.A **Reason quantitatively and use units to solve problems.**	**A1.N-Q.A.1**	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.
	A1.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.
	A1.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
Algebra - A		
Seeing Structure in Expressions (A-SSE)		
A1.A-SSE.A **Interpret the structure of expressions.**	**A1.A-SSE.A.1**	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 expressions by viewing one or more of their parts as a single entity.
	A1.A-SSE.A.2	Use structure to identify ways to rewrite numerical and polynomial expressions. Focus on polynomial multiplication and factoring patterns.
A1.A-SSE.B **Write expressions in equivalent forms to solve problems.**	**A1.A-SSE.B.3**	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.
Arithmetic with Polynomials and Rational Expressions (A-APR)		
A1.A-APR.A **Perform arithmetic operations on polynomials.**	**A1.A-APR.A.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.
A1.A-APR.B **Understand the relationship between zeros and factors of polynomials.**	**A1.A-APR.B.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. Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.
Creating Equations (A-CED)		
A1.A-CED.A **Create equations that describe numbers or relationships.**	**A1.A-CED.A.1**	Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
	A1.A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	A1.A-CED.A.3	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
	A1.A-CED.A.4	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.*
Reasoning with Equations and Inequalities (A-REI)		
A1.A-REI.A **Understand solving equations as a process of reasoning and explain the reasoning.**	**A1.A-REI.A.1**	Explain each step in solving linear and quadratic equations 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.
A1.REI.B **Solve equations and inequalities in one variable.**	**A1.A-REI.B.3**	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
	A1.A-REI.B.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 $(x – k)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real solutions.
A1.A-REI.C **Solve systems of equations.**	**A1.A-REI.C.5**	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.
	A1.A-REI.C.6	Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.
A1.A-REI.D **Represent and solve equations and inequalities graphically.**	**A1.A-REI.D.10**	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.
	A1.A-REI.D.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). Focus on cases where $f(x)$ and/or $g(x)$ are linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
	A1.A-REI.D.12	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.
Functions - F		
Interpreting Functions (F-IF)		
A1.F-IF.A **Understand the concept of a function and use function notation.**	**A1.F-IF.A.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 $y = f(x)$.

	A1.F-IF.A.2	Evaluate a function for inputs in the domain, and interpret statements that use function notation in terms of a context.
	A1.F-IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
A1.F-IF.B **Interpret functions that arise in applications in terms of the context**	**A1.F-IF.B.4**	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. Include problem-solving opportunities utilizing real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
	A1.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
A1.F-IF.B (cont.)	**A1.F-IF.B.6**	Calculate and interpret the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
A1.F-IF.C **Analyze functions using different representations.**	**A1.F-IF.C.7**	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
	A1.F-IF.C.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 of a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
	A1.F-IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

		Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Building Functions (F-BF)		
A1.F-BF.A **Build a function that models a relationship between two quantities.**	**A1.F-BF.A.1**	Write a function that describes a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
A1.F-BF.B **Build new functions from existing functions.**	**A1.F-BF.B.3**	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, 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. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Linear, Quadratic, and Exponential Models (F-LE)		
A1.F-LE.A **Construct and compare linear, quadratic, and exponential models and solve problems.**	**A1.F-LE.A.1**	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.
A1.F-LE.A (cont.)	**A1.F-LE.A.2**	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input/output pairs.
	A1.F-LE.A.3	Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.
A1.F-LE.B **Interpret expressions for functions in terms of the situation they model.**	**A1.F-LE.B.5**	Interpret the parameters in a linear or exponential function with integer exponents utilizing real world context.

Statistics and Probability - S		
Summarize, represent, and interpret data on a single count or measurement variable. (S-ID)		
A1.S-ID.A **Summarize, represent, and interpret data on a single count or measurement variable.**	**A1.S-ID.A.1**	Represent real-value data with plots for the purpose of comparing two or more data sets.
	A1.S-ID.A.2	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.
	A1.S-ID.A.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers if present.
A1.S-ID.B **Summarize, represent, and interpret data on two categorical and quantitative variables.**	**A1.S-ID.B.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.
	A1.S-ID.B.6	Represent data on two quantitative variables on a scatter plot and describe how the quantities are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Focus on linear models. b. Informally assess the fit of a function by plotting and analyzing residuals.
A1.S-ID.C **Interpret linear models.**	**A1.S-ID.C.7**	Interpret the slope as a rate of change and the constant term of a linear model in the context of the data.
	A1.S-ID.C.8	Compute and interpret the correlation coefficient of a linear relationship.
	A1.S-ID.C.9	Distinguish between correlation and causation.
Conditional Probability and the rules of Probability (S-CP)		
A1.S-CP.A **Understand independence and conditional probability and use them to interpret data.**	**A1.S-CP.A.1**	Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.
	A1.S-CP.A.2	Use the Multiplication Rule for independent events to 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.

Algebra I Math Item Specifications

The Real Number System (N-RN)

A1.N-RN.B.3

Content Standards	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.
Explanations	Since every difference is a sum and every quotient is a product, this includes differences and quotients as well. Explaining why the four operations on rational numbers produce rational numbers can be a review of students understanding of fractions and negative numbers. Explaining why the sum of a rational and an irrational number is irrational, or why the product is irrational, includes reasoning about the inverse relationship between addition and subtraction (or between multiplication and addition).
Content Limits	This standard is aligned to Algebra I only. For products, can include [irrational number] x 0 as rational.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to given sums/products of numbers, identify which are rational and which are irrational.	• Multiple Choice Response • Multi-Select Response
Students will be required to justify why the sums/products of two rational numbers, two irrational numbers, and one irrational and one rational numbers are necessarily rational or irrational.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**

Recognize that the sum or product of two rational numbers is rational.	Recognize that the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational.
Proficient	**Highly Proficient**
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.	Generalize and develops rules for the sum or product of two rational numbers being rational; the sum of a rational number and an irrational number being irrational; and the product of a nonzero rational number and an irrational number being irrational.

Quantities (N-Q)

A1.N-Q.A.1

Content Standards	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.
Explanations	Include word problems where quantities are given in different units, which must be converted to make sense of the problem. Graphical representations and data displays include, but are not limited to: line graphs, circle graphs, histograms, multi-line graphs, scatterplots, and multi-bar graphs.
Content Limits	Rational numbers Linear equations and graph Exponential equations and graphs Customary and metric units of measure
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Given a solution, students will determine the correct units based on the context.	• Equation Response • Multiple Choice Response • Multiple Select Response • Editing Task Choice
Students will use dimensional analysis to convert one unit to another in order provide a solution within a real-world situation.	
Students will convert between different units in order to determine the solution for a real-world problem.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**

Identify units for the solution of multi-step problems; Identify units consistently in formulas; Identify the scale and the origin in graphs and data displays, include utilizing real-world context.	Choose units for the solution of multi-step problems; choose units consistently in formulas; choose the scale and the origin in graphs and data displays, include utilizing real-world context.
Proficient	**Highly Proficient**
Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.	Use units as a way to understand problems and to justify the solution of multi-step problems; choose and interpret units consistently in formulas; interpret and explain the scale and the origin in graphs and data displays, include utilizing real-world context.

A1.N-Q.A.2

Content Standards	Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.
Explanations	Reason quantitatively and use units to solve problems.
Content Limits	Linear and exponential models.
Context	Context is required.

Sample Task Demands	Common Item Formats
Students will be required to use quantities appropriate to the context to solve problems.	• Equation Response • Editing Task Choice • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify appropriate quantities for the purpose of descriptive modeling.	Define appropriate quantities for the purpose of descriptive modeling.
Proficient	**Highly Proficient**
Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.	Define and use appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.

A1.N-Q.A.3

Content Standards	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
Explanations	The margin of error and tolerance limit varies according to the measure, tool used, and context.
Content Limits	
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to choose a level of accuracy when reporting quantities in a real-world context.	• Editing Task Choice • Equation Response • Multiple Choice Response • Multi-Select Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify a level of accuracy on measurement when reporting quantities utilizing real-world context.	Identify a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
Proficient	**Highly Proficient**
Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.	Compare the levels of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.

Seeing Structure in Expressions (A-SSE)

A1.A-SSE.A.1, A1.A-SSE.A.1a, A1.A-SSE.A.1b

Content Standards	A1.A-SSE.A.1 Interpret expressions that represent a quantity in terms of its context. A1.A-SSE.A.1a Interpret parts of an expression, such as terms, factors, and coefficients. A1.A-SSE.A.1b Interpret expressions by viewing one or more of their parts as a single entity.
Explanations	Students should understand the vocabulary for the parts that make up the whole expression and be able to identify those parts and interpret their meaning in terms of a context.
Content Limits	This standard is aligned to Algebra I only. Focus on factors and coefficients of simpler expressions for A-SSE.A.1a. Focus on termos of complicated expressions for A-SSE.A.1b.
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to select the meaning for part of a given expression.	• Multiple Choice Response
Students will be required to identify what part of a given expression has a given meaning.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Interpret expressions that represent a quantity in terms of its context. a. Identify parts of an expression, such as terms, factors, and coefficients. b. Match expressions by viewing one or more of their parts as a single entity.	Interpret expressions that represent a quantity in terms of its context. a. Define parts of an expression, such as terms, factors, and coefficients. b. Use expressions by viewing one or more of their parts as a single entity.
Proficient	**Highly Proficient**
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 expressions by viewing one or more of their parts as a single entity.	Interpret expressions that represent a quantity in terms of its context. a. Differentiate parts of an expression, such as terms, factors, and coefficients. b. Make observations about expressions by viewing one or more of their parts as a single entity.

A1.A-SSE.A.2

Content Standards	Use structure to identify ways to rewrite numerical and polynomial expressions. Focus on polynomial multiplication and factoring patterns.
Explanations	Students should extract the greatest common factor (whether a constant, a variable, or a combination of each). If the remaining expression is quadratic, students should factor the expression further.
Content Limits	Numerical expressions and polynomial expression in one variable The given expression must be in a form that allows students to use the structure to identify an equivalent expression - not simply using properties of operations.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify an equivalent expression.	• Equation Response • Multiple Choice Response • Multi-Select Response
Students will be required to construct a new equivalent expression from a given expression.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify equivalent numerical and polynomial expressions. Focus on polynomial multiplication patterns.	Identify ways to rewrite equivalent numerical and polynomial expressions. Focus on polynomial multiplication and factoring patterns.
Proficient	**Highly Proficient**

Use structure to identify ways to rewrite numerical and polynomial expressions. Focus on polynomial multiplication and factoring patterns.	Assess ways to rewrite numerical and polynomial expressions. Focus on polynomial multiplication and factoring patterns.

A1.A-SSE.B.3, A1.A-SSE.B.3a, A1.A-SSE.B.3b

Content Standards	A1.A-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A1.A-SSE.B.3a Factor a quadratic expression to reveal the zeros of the function it defines. A1.A-SSE.B.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
Explanations	Students will use the properties of operations to create equivalent expressions.
Content Limits	This standard is aligned to Algebra I only. Quadratic expressions The item must require factoring as the solution method for A-SSE.B.3a. The item must require completing the square as a solution method for A-SSE.B.3b.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the zeros of a function given in factored form.	• Equation Response • Multiple Choice Response
Students will be required to identify the factored form of a quadratic expression.	

Content Standards	A1.A-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A1.A-SSE.B.3a Factor a quadratic expression to reveal the zeros of the function it defines. A1.A-SSE.B.3b Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Students will be required to identify the factored form of a quadratic expression and the zeroes of the function it defines.	
Students will be required to identify the maximum or minimum of a quadratic expression in vertex form.	
Students will be required to identify the vertex form of a quadratic expression.	
Students will be required to identify the vertex form of a quadratic expression and the max/min of the function it defines.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

a. Identify a factored quadratic expression that reveals the zeros of the function it defines. b. Identify a quadratic expression that reveals the maximum or minimum value of the function it defines.	a. Use a factored quadratic expression that reveals the zeros of the function it defines. b. Use a quadratic expression that reveals the maximum or minimum value of the function it defines.
Proficient	**Highly Proficient**
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.	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Explain conditions for the zeros of a quadratic function. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines and use it to solve problems

Arithmetic with Polynomials & Rational Expressions (A-APR)

A1.A-APR.A.1

Content Standards	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.
Explanations	Perform arithmetic operations on polynomials.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to calculate the sum, difference or product of polynomials.	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Add and subtract polynomials.	Add, subtract, and multiply polynomials.
Proficient	**Highly Proficient**
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.	Explain 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.

A1.A-APR.B.3

Content Standards	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. Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.
Explanations	Understand the relationship between zeros and factors of polynomials.
Content Limits	Quadratic and cubic polynomials in which linear and quadratic factors are available
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the zeroes of a polynomial.	• Equation Response • Multiple Choice Response • Multi-Select Response
Students will be required to given a polynomial, determine its graph.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify zeros of polynomials when suitable factorizations are available. Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.	Use the zeros of polynomials to construct a rough graph of the function defined by the polynomial. Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.
Proficient	**Highly Proficient**
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.	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the

Content Standards	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. Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.
Focus on quadratic and cubic polynomials in which linear and quadratic factors are available.	polynomial. Focus cubic polynomials in which quadratic factors are available.

Creating Equations (A-CED)

A1.A-CED.A.1

Content Standards	Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Context	Context is subject to task demand.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the solution for a given equation or inequality. Context is not allowed.	• Equation Response • Multiple Choice Response
Students will be required to construct an equation or inequality to model a context. Context is required.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify equations and inequalities in one variable that can be used to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Use equations and inequalities in one variable to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

Content Standards	Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Proficient	**Highly Proficient**
Create equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Analyze equations and inequalities in one variable and use them to solve problems. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.A-CED.A.2

Content Standards	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
Explanations	Create equations that describe numbers or relationships.
Content Limits	This standard is aligned to Algebra I only. Students must be required to construct an equation and/or graph given equations.
Context	Context is subject to task demand.

Sample Task Demands	Common Item Formats
Students will be required to identify the solution for an equation. Context is not allowed.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to construct a graphical representation of an equation. Context is not allowed.	
Students will be required to construct an equation to represent a context. Context is required.	
Students will be required to construct an equation and identify a solution. Context is required.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient

Content Standards	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
Identify equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	Use equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
Proficient	**Highly Proficient**
Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	Analyze equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A1.A-CED.A.3

Content Standards	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
Explanations	Create equations that describe numbers or relationships.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to given a constraint or set of constraints, identify possible solutions.	• Equation Response • Graphic Response • Multiple Choice Response • Multi-Select Response
Students will be required to construct a graphical representation of a constraint or set of constraints.	
Students will be required to create or identify a constraint or set of constraints given a context.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify constraints of equations or inequalities, and of systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.	Apply constraints of equations or inequalities, and of systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
Proficient	**Highly Proficient**

Content Standards	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.
Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.	Justify constraints of equations or inequalities, and by systems of equations and/or inequalities, and justify solutions as viable or non-viable options in a modeling context.

A1.A-CED.A.4

Content Standards	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.*
Explanations	Create equations that describe numbers or relationships.
Content Limits	This standard is aligned to Algebra I only. The student must be provided an equation. Generally, if the equation to be created is very complex, consider using multiple choice response rather than equation response.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to given an equation, identify or create a form of that equation solved for a specific variable.	• Equation Response • Multiple Choice Response
Students will be required to given an equation, describe how one quantity changes when another changes (ex. Given $V = IR$, how does I change if R is doubled and V remains constant?).	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify formulas that highlight a quantity of interest, using the same reasoning as in solving equations.	Apply formulas that highlight a quantity of interest, using the same reasoning as in solving equations.
Proficient	**Highly Proficient**

Content Standards	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.*
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.*	Rearrange and apply formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

Reasoning with Equations and Inequalities (A-REI)

A1.A-REI.A.1

Content Standards	Explain each step in solving linear and quadratic equations 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.
Explanations	Properties of operations can be used to change expressions on either side of the equation to equivalent expressions. In addition, adding the same term to both sides of an equation or multiplying both sides by a non-zero constant produces an equation with the same solutions. Other operations, such as squaring both sides, may produce equations that have extraneous solutions.
Content Limits	Linear and quadratic equations
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to justify a next step in a solution process (i.e., "commutative property", etc.).	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to identify a correct next step in a solution process.	
Students will be required to given a series of steps in an attempt to solve an equation identify the error(s) and the correct solution.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**

Identify each step in solving linear and quadratic equations as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution.	Carry out each step in solving linear and quadratic equations as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Identify a viable argument to justify a solution method.
Proficient	**Highly Proficient**
Explain each step in solving linear and quadratic equations 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.	Critique each step in solving linear and quadratic equations 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.

A1.A-REI.B.3

Content Standards	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
Explanations	Solve equations and inequalities in one variable.
Content Limits	This standard is aligned to Algebra I only. Equations must be given to the student.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to solve equations or inequalities from context or no context.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to graph the solution of an inequality on a number line.	
Students will be required to analyze and solve equations or inequalities with unknown constant coefficients.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Solve one-step and two-step linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Solve two- step linear equations and inequalities in one variable, including equations with coefficients represented by letters.
Proficient	**Highly Proficient**
Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	Compare different methods to solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

A1.A-REI.B.4, A1.A-REI.B.4a, A1.A-REI.B.4b

Content Standards	A1.A-REI.B.4 Solve quadratic equations in one variable. A1.A-REI.B.4a Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - k)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. A1.A-REI.B.4b Solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real solutions.
Explanations	Students should solve by factoring, completing the square, and using the quadratic formula. The zero product property is used to explain why the factors are set equal to zero. Students should relate the value of the discriminant to the type of root to expect. A natural extension would be to relate the type of solutions to $ax^2 + bx + c = 0$ to the behavior of the graph of $y = ax^2 + bx + c$.
Content Limits	This standard is aligned to Algebra I only. Quadratics with real solutions.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to create equivalent quadratic equations in the form $(x - p)^2 = q$.	• Equation Response • Multiple Choice Response • Multi-Select
Students will be required to solve quadratic equations.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Solve quadratic equations in one variable. a. Identify the quadratic formula. b. Solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real 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 $(x - k)^2 = q$ that has the same solutions where $q = 0$. Use the quadratic formula. b. Solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, the quadratic formula and factoring, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real solutions.
Proficient	**Highly Proficient**
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 $(x - k)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real solutions.	Solve quadratic equations in one variable. a. Derive the quadratic formula. b. Determine whether to solve quadratic equations by inspection (e.g., $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Focus on solutions for quadratic equations that have real roots. Include cases that recognize when a quadratic equation has no real solutions.

A1.A-REI.C.5

Content Standards	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.
Explanations	Solve systems of equations.
Content Limits	This standard is aligned to Algebra I only. Linear systems.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to given a system of equations, identify another system that has the same solutions (based on the process described in the standard).	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Understand 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.	Explain 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.
Proficient	**Highly Proficient**
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.	Given two systems of two equations in two variables, verify that they have the same solutions by replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A1.A-REI.C.6

Content Standards	Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.
Explanations	The system solution methods can include but are not limited to graphical, elimination/linear combination, substitution, and modeling. Systems can be written algebraically or can be represented in context.
Content Limits	Linear systems with exact solutions and limited calculations. Include cases where the two equations describe the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution)
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to given the graph of a system of equations, identify a possible solution.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to solve a system of equations.	
Students will be required to graph a system of equations and identify an approximate solution.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Solve systems of linear equations approximately, focusing on pairs of linear equations in two variables.	Solve systems of linear equations approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.

Content Standards	Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.
Proficient	**Highly Proficient**
Solve systems of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.	Analyzes a system of linear equations exactly and approximately, focusing on pairs of linear equations in two variables. Include problem solving opportunities utilizing real-world context.

A1.A-REI.D.10

Content Standards	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.
Explanations	Represent and solve equations and inequalities graphically.
Content Limits	This standard is aligned to Algebra I only. Linear and exponential equations
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify coordinates of points that lie on the graph of a given equation.	• Equation Response • Graphic Response • Multiple Choice Response • Multi-Select Response
Students will be required to plot points that are solutions to a given equation.	
Students will be required to identify other possible solutions to a given equation, type of equation, and/or the graph of a solution to the equation.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the graph of an equation in two variables.	Identify a solution given the graph of an equation in two variables.
Proficient	**Highly Proficient**

Content Standards	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.
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.	Explain 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.

A1.A-REI.D.11

Content Standards	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). Focus on cases where $f(x)$ and/or $g(x)$ are linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Students need to understand that numerical solution methods (data in a table used to approximate an algebraic function) and graphical solution methods may produce approximate solutions, and algebraic solution methods produce precise solutions that can be represented graphically or numerically.
Content Limits	Focus on cases where *f(x)* and/or *g(x)* are linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step). Note that this standard is not about systems, but about the solution(s) to $f(x) = g(x)$; thus, solutions should be values of x.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the solution(s) to $f(x) = g(x)$, given the graph of the two functions.	• Equation Response • Graphic Response • Multiple Choice Response • Proposition Response
Students will be required to identify the solutions to $f(x) = g(x)$.	
Students will be required to identify a possible $g(x)$, given $f(x)$ and the value(s) of x where $f(x) = g(x)$.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect as the solutions of the equation $f(x) = g(x)$. Focus on cases where $f(x)$ and/or $g(x)$ are linear.	Identify the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect as 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). Focus on cases where $f(x)$ and/or $g(x)$ are linear and exponential functions.
Proficient	**Highly Proficient**
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). Focus on cases where $f(x)$ and/or $g(x)$are linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	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 exactly (e.g., using technology to graph the functions, make tables of values, or find successive approximations). Focus on cases where $f(x)$ and/or $g(x)$ are linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.A-REI.D.12

Content Standards	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.
Explanations	Represent and solve equations and inequalities graphically.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to select the solution region for a system of inequalities.	• Graphic Response • Multiple Choice Response
Students will be required to graph the boundary for a non-strict inequality and drag a symbol to show the solution set.	
Students will be required to graph the boundaries for a system of non-strict inequalities and drag a symbol to show the solution set.	
Students will be required to identify the graph and solution set for a system of non-strict inequalities.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient

Content Standards	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.

Identify a solution to a linear inequality in two variables as a half-plane, excluding the boundary in the case of a strict inequality.	Graph the solutions to a linear inequality in two variables as a half-plane, excluding the boundary in the case of a strict inequality.
Proficient	**Highly Proficient**
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.	Create a system of linear inequalities given a graph of the solution set.

Functions- Interpreting Functions (F-IF)

A1.F-IF.A.1

Content Standards	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 $y = f(x)$.
Explanations	The domain of a function given by an algebraic expression, unless otherwise specified, is the largest possible domain.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to recognize functions.	• Multiple Choice Response • Matching Item Response

Content Standards	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*).
Students will be required to create or complete examples of functions and nonfunctions.	• Multi-Select Response • Proposition Response • Table Response
Students will be required to explain why a relation is or is not a function.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Understand that the graph of *f* is the graph of the equation *y* = *f*(*x*).	Understand that 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*).
Proficient	**Highly Proficient**
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*).	Create a function or non-function based on understanding that a function from the domain to the range assigns to each element of the domain exactly one element of the range.

A1.F-IF.A.2

Content Standards	Evaluate a function for inputs in the domain, and interpret statements that use function notation in terms of a context.
Explanations	The domain of a function given by an algebraic expression, unless otherwise specified, is the largest possible domain.
Content Limits	This standard is aligned to Algebra I only. Linear, quadratic, and exponential functions
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to recognize and identify input or output values from the table of a function.	• Equation Response • Graphic Response • HotText Response • Multiple Choice Response • Table Response
Students will be required to recognize correct uses of function notation.	
Students will be required to complete a table of input and output values for a given function.	
Students will be required to interpret statements that use function notation in terms of a context.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Evaluate a function for an input in the domain.	Evaluate a function for inputs in the domain.
Proficient	**Highly Proficient**

Content Standards	Evaluate a function for inputs in the domain, and interpret statements that use function notation in terms of a context.
Evaluate a function for inputs in the domain, and interpret statements that use function notation in terms of a context.	Evaluate a function for inputs in the domain, and apply statements that use function notation in terms of a context.

A1.F-IF.A.3

Content Standards	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.
Explanations	Understand the concept of a function and use function notation.
Content Limits	Linear or exponential Limit sequence representations to rational values
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct a function to model a sequence.	• Equation Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify sequences or functions defined recursively, whose domain is a subset of the integers.	Use sequences or functions defined recursively, whose domain is a subset of the integers.
Proficient	**Highly Proficient**
Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	Create a function defined recursively.

A1.F-IF.B.4

Content Standards	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. Include problem-solving opportunities utilizing real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Students may be given graphs to interpret or produce graphs given an expression or table for the function, by hand or using technology.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step). Key features may also include domain and range
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify an interval on a graph where the function is increasing or decreasing.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to identify intercepts of a function.	
Students will be required to construct the graph of a linear function with a given verbal description for the intercept and/or slope.	
Students will be required to identify key features, such as relative maximums and minimums, symmetries, and end behavior, of graphs and tables in terms of the quantities.	

Students will be required to create a linear function with the same slope but different y-intercept.	
Students will be required to create an exponential function that grows at a different rate than a given one.	
Students will be required to describe the meaning of key features of a function.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
For a function that models a relationship between two quantities, identify key features of graphs and tables in terms of the quantities. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear and exponential and functions.	For a function that models a relationship between two quantities, identify key features of graphs and tables in terms of the quantities. Include problem-solving opportunities utilizing real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear and exponential and functions.
Proficient	**Highly Proficient**
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. Include problem-solving opportunities utilizing real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	For a function that models a relationship between two quantities, explain key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Include problem-solving opportunities utilizing real-world context. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.F-IF.B.5

Content Standards	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.
Explanations	Students may explain orally, or in written format, the existing relationships.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to create a graph with a given domain.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to determine the domain of the given graph of a function.	
Students will be required to determine the domain of a given function based on context.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the domain of a function from its graph.	Identify the domain of a function from its graph and, where applicable, relate it to the quantitative relationship it describes.
Proficient	**Highly Proficient**
Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes in a real-world context.

A1.F-IF.B.6

Content Standards	Calculate and interpret the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	The average rate of change of a function y = f(x) over an interval [a,b] is $\Delta y/\Delta x=(f(b)-f(a))/(b-a)$ In addition to finding average rates of change from functions given symbolically, graphically, or in a table, Students may collect data from experiments or simulations (ex. falling ball, velocity of a car, etc.) and find average rates of change for the function modeling the situation.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to estimate the average rate of change of the graph of a given function over a given interval.	• Equation Response • Multiple Choice Response
Students will be required to calculate the average rate of change of a function expressed symbolically or as a table over a given interval.	
Students will be required to interpret the rate of change in context.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Estimate the rate of change from a graph. Focus on linear and exponential functions.	Calculate the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context. Focus on linear and exponential functions.
Proficient	**Highly Proficient**
Calculate and interpret the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context.	Analyze the average rate of change of a continuous function (presented symbolically or as a table) on a closed interval. Estimate the rate of change from a graph. Include problem-solving opportunities utilizing real-world context.

Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.F-IF.C.7

Content Standards	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Analyze functions using different representations.
Content Limits	Linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step)
Context	Context is not required.

Sample Task Demands	Common Item Formats
Graph a linear function	• Editing Task Choice • Equation Response • Multiple Choice Response • Multi-Select Response
Identify key features of a piecewise function	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify key features of linear and exponential functions shown on a graph.	Identify key features functions shown on a graph. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Proficient	**Highly Proficient**
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Graph more than one function expressed symbolically, and compare key features of the graphs. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.F-IF.C.8, A1.F-IF.C.8a

Content Standards	A1.F-IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. A1.F-IF.C.8a Use the process of factoring and completing the square of a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
Explanations	Analyze functions using different representations.
Content Limits	Functions in one form must be given to students, who are then expected to write these functions in different forms.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to create an equivalent function in a specific form that reveals characteristics of the function defined by that expression.	• Equation Response • Multiple Choice Response • Proposition Response
Students will be required to interpret parameters of a function in terms of the context.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
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 a quadratic function to show zeros.	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 of a quadratic function to show zeros, extreme values, and symmetry of the graph.
Proficient	**Highly Proficient**

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 of a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Determine an appropriate method to rewrite a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

A1.F-IF.C.9

Content Standards	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Analyze functions using different representations.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to compare numeric values representing properties of two functions.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to compare two functions qualitatively.	
Students will be required to construct a graph of a function for which a given comparison with another function is true.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify properties of two functions each represented in a different way (graphically or numerically in tables). Focus on linear and exponential functions.	Define properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Focus on linear, quadratic, and exponential functions.
Proficient	**Highly Proficient**

Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Analyze two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

Functions- Building Functions (F-BF)

A1.F-BF.A.1

Content Standards	Write a function that describes a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Students will analyze a given problem to determine the function expressed by identifying patterns in the function's rate of change. They will specify intervals of increase, decrease, constancy, and, if possible, relate them to the function's description in words or graphically.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to perform arithmetic operations to write one function that models a context for another.	• Equation Response • Multiple Choice Response
Students will be required to create a multi-faceted function to model a context.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify a function that describes a relationship between two quantities. Identify an explicit expression, steps for calculation from real-world context. Focus on linear and exponential functions.	Identify a function that describes a relationship between two quantities. Identify an explicit expression, a recursive process, or steps for calculation from real-world context. Focus on linear, quadratic and exponential functions.

Content Standards	Write a function that describes a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Proficient	**Highly Proficient**
Write a function that describes a relationship between two quantities. Determine an explicit expression, a recursive process, or steps for calculation from real-world context. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	Write a function that describes a relationship between two quantities. Compare the explicit expression to the recursive process. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

A1.F-BF.B.3

Content Standards	Identify the effect on the graph of replacing *f*(*x*) by *f*(*x*) + *k*, *k f*(*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. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Explanations	Students will apply transformations to functions and recognize functions as even and odd.
Content Limits	Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to show the effects of a transformation by translating a graph.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to determine the value of k from two related functions or graphs.	
Students will be required to create a function to model a transformation of a given graph.	
Students will be required to describe the effects of k on a transformation of a function.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the effect on the graph of replacing f(x) by f(x) + k, and f(x+k) for specific positive values of k. Illustrate the effects on the graph. Focus on linear and exponential functions.	Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), and f(x+k) for specific positive values of k; identify the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph. Focus on linear, quadratic, and exponential functions.
Proficient	**Highly Proficient**
Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), and f(x+k) for specific values of k (both positive and negative); find the value of k given	Explain the effect on the graph of replacing f(x) by f(x) + k, k f(x), and f(x+k) for specific values of k (both positive and negative rational numbers); determine

Content Standards	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, 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. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).
the graphs. Experiment with cases and illustrate an explanation of the effects on the graph. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).	the value of k given the graphs. Experiment with cases and explain an explanation of the effects on the graph. Focus on linear, quadratic, exponential and piecewise-defined functions (limited to absolute value and step).

Functions- Linear, Quadratic, and Exponential Models (F-LE)

A1.F-LE.A.1, A1.F-LE.A.1a, A1.F-LE.A.1b, A1.F-LE.A.1c

Content Standards	A1.F-LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions. A1.F-LE.A.1a Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. A1.F-LE.A.1b Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. A1.F-LE.A.1c Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
Explanations	Students can investigate functions and graphs modeling different situations involving simple and compound interest. Students can compare interest rates with different periods of compounding (monthly, daily) and compare them with the corresponding annual percentage rate. Spreadsheets and applets can be used to explore and model different interest rates and loan terms.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to create a value or expression to show how a function grows over equal intervals.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to identify situations that represent linear growth.	
Students will be required to identify situations that represent exponential growth.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Recognize that linear functions grow by equal differences over equal intervals. b. Identify situations in which one quantity changes at a constant rate per unit interval relative to another. c. Identify situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Recognize that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Identify situations in which one quantity changes at a constant rate per unit interval relative to another as a situation that can be modeled with a linear function. c. Identify situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another as a situation that can be modeled with an exponential function.
Proficient	**Highly Proficient**
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.	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Explain why linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Create situations in which one quantity changes at a constant rate per unit interval relative to another. c. Create situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

A1.F-LE.A.2

Content Standards	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input/output pairs.
Explanations	Construct and compare linear and exponential models and solve problems.
Content Limits	Constructing linear and exponential functions in simple context (not multi-step)
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to create an equation of a linear function passing through two given points.	• Equation Response
Students will be required to create an equation of a linear function given a graph of that function.	
Students will be required to create an equation of a linear function given a description of that function.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify linear functions, including arithmetic sequences, given a graph, a description of a relationship, or input/output pairs.	Identify linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input/output pairs.
Proficient	**Highly Proficient**

Content Standards	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input/output pairs.
Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or input/output pairs.	Explain how linear and exponential functions, can model arithmetic and geometric sequences.

A1.F-LE.A.3

Content Standards	Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.
Explanations	Construct and compare linear, quadratic, and exponential models and solve problems.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to compare two or more functions for values over various intervals given graphs or other representations of the functions.	• Equation Response • Multi-Select Response
Students will be required to solve problems based on the fact that exponential functions grow/decay faster than linear or quadratic functions.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify graphs and tables that have a quantity increasing linearly, exponentially, or quadratically.	Compare graphs and tables that have quantities increasing linearly, exponentially, and quadratically.
Proficient	**Highly Proficient**
Observe, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.	Explain why a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.

A1.F-LE.B.5

Content Standards	Interpret the parameters in a linear or exponential function with integer exponents utilizing real-world context.
Explanations	Interpret expressions for functions in terms of the situation they model.
Content Limits	Exponential functions limited to those with domains in the integers
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to interpret the meaning of a parameter of a function.	• Multi-Select Response
Students will be required to interpret the meaning of a parameter in a function that combines linear and exponential terms.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the parameters in a linear function with integer exponents utilizing real world context.	Identify the parameters in a linear or exponential function with integer exponents utilizing real world context.
Proficient	**Highly Proficient**
Interpret the parameters in a linear or exponential function with integer exponents utilizing real world context.	Define the parameters while creating a linear or exponential function with integer exponents utilizing real world context.

Statistics and Probability- Summarize, represent, and interpret data on a single count or measurement variable (S-ID)

A1.S-ID.A.1

Content Standards	Represent real-value data with plots for the purpose of comparing two or more data sets.
Explanations	Summarize, represent, and interpret data on a single count or measurement variable.
Content Limits	This standard is aligned to Algebra I only. The amount of data to be plotted should be reasonable.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct a data display.	• Graphic Response • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Match real-value data with dot plots, histograms, and box plots.	Represent real-value data with dot plots, histograms, and box plots.
Proficient	**Highly Proficient**
Represent real-value data with plots for the purpose of comparing two or more data sets.	Represent real-value data with the most appropriate plots and analyze the similarities and differences between two or more data sets.

A1.S-ID.A.2

Content Standards	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.
Explanations	Summarize, represent, and interpret data on a single count or measurement variable.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify data distributions that share commonalities (i.e., same spread, interquartile range, median, and mean) through inspection.	• Equation Response • Multiple Choice Response • Multi-Select Response
Students will be required to distinguish between different spreads to compare the mean and medians of the data set.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the center (median, mean) and spread (interquartile range) of two or more different data sets.	Compare the center (median, mean) or spread (interquartile range, standard deviation) of two or more different data sets.
Proficient	**Highly Proficient**
	Use statistics appropriate to the shape of the data distribution to analyze and explain the similarities and differences between the center (median,

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.	mean) and spread (interquartile range, standard deviation) of two or more different data sets.

A1.S-ID.A.3

Content Standards	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers if present.
Explanations	Summarize, represent, and interpret data on a single count or measurement variable.
Content Limits	This standard is aligned to Algebra I only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to construct a graph given information about the shape, center, and spread.	• Equation Response • Graphic Response • Multiple Choice Response • Multi-Select Response
Students will be required to compare different distributions in order to draw conclusions about the effects of an extreme outlier on different spreads	
Students will be required to make inferences about the spread of distributions to draw conclusions about the given context. (i.e., what does a skewed distribution of test scores tell us about the test questions).	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify differences in shape, center, and spread in the context of the data sets.	Compare informally differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers if present.
Proficient	**Highly Proficient**

Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers if present.	Interpret and explain differences in shape, center, and spread in the context of the data sets, make observations about the effects different outlier would have.

A1.S-ID.B.5

Content Standards	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.
Explanations	Summarize, represent, and interpret data on two categorical and quantitative variables.
Content Limits	This standard is aligned to Algebra I only. Bivariate data Positive rational numbers
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct a contingency table in order to show the relationships between variables.	• Equation Response • Multiple Choice Response • Table Resposne
Students will be required to interpret tables to calculate marginal and joint frequencies within the context.	
Students will be required to identify patterns in a distribution in order to answer questions pertaining to the data set and context.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
For categorical data summarized for two categories in two-way frequency tables, identify relative frequencies in the context of the data.	Complete a partially filled in frequency table to summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data, including joint, and conditional relative frequencies.
Proficient	**Highly Proficient**

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.	Summarize categorical data for two categories in two-way frequency tables. Interpret and explain relative frequencies in the context of the data, including joint, marginal, and conditional relative frequencies. Explain possible associations and trends in the data.

A1.S-ID.B.6, **A1.S-ID.B.6a**, A1.S-ID.B.6b

Content Standards	A1.S-ID.B.6 Represent data on two quantitative variables on a scatter plot, and describe how the quantities are related. A1.S-ID.B.6a Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Focus on linear models. A1.S-ID.B.6b Informally assess the fit of a function by plotting and analyzing residuals.
Explanations	The residual in a regression model is the difference between the observed and the predicted *y* for some *x* (y the dependent variable and *x* the independent variable). So if we have a model $y = ax + b$ and a data point (xi, yi), the residual is for this point is $ri = yi - (axi + b)$. Students may use spreadsheets, graphing calculators, and statistical software to represent data, describe how the variables are related, fit functions to data, perform regressions, and calculate residuals.
Content Limits	Rational numbers; Bivariate data; Linear, quadratic, and exponential models
Context	Context is not allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to select a function that best represents the data given a set of data. (a)	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to plot and analyze residuals on a number line. (b)	
Students will be required to create a linear function that best represents the data given a scatter plot. (c)	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Represent data on two quantitative variables on a scatter plot, and describe how the quantities are related. a. Identify a linear function that best fits the data represented in a scatter plot. b. Informally assess the fit of a function when given a residual plot.	Represent data on two quantitative variables on a scatter plot, and describe how the quantities are related. a. Identify a linear function that best fits the data represented in a scatter plot; use functions fitted to data to identify the solutions to problems in the context of the data. Focus on linear models. b. Plot the residuals of a function.
Proficient	**Highly Proficient**
Represent data on two quantitative variables on a scatter plot, and describe how the quantities are related. a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Focus on linear models. b. Informally assess the fit of a function by plotting and analyzing residuals.	Represent data on two quantitative variables on a scatter plot, and describe how the quantities are related. a. Compare the fit of different functions to the data, including exponential functions with domains in the integers; use functions fitted to data to solve problems in the context of the data. b. Informally assess the fit of different functions by plotting and analyzing their residuals.

A1.S-ID.C.7

Content Standards	Interpret the slope as a rate of change and the constant term of a linear model in the context of the data.
Explanations	Interpret linear models.
Content Limits	This standard is aligned to Algebra I only. A linear model should be provided The model should not fit exactly a set of data, if given
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to interpret the rate of change and/or constant term of a linear model to identify valid conclusions.	• Equation Response • Multiple Choice Response • Multi-Select Response
Students will be required to identify the value in a linear model that represents a given interpretation.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Match the slope and the constant term of a linear model with their meaning in the context of the data.	Identify the slope of a linear model as a rate of change in the context of the data, and identify the constant term of a linear model in the context of the data.
Proficient	**Highly Proficient**

Content Standards	Interpret the slope as a rate of change and the constant term of a linear model in the context of the data.
Interpret the slope as a rate of change and the constant term of a linear model in the context of the data.	Define the meaning of the slope as a rate of change in the context of the data, and define the constant term of a linear model in the context of the data.

A1.S-ID.C.8

Content Standards	Compute and interpret the correlation coefficient of a linear relationship.
Explanations	Interpret linear models.
Content Limits	This standard is aligned to Algebra I only. Items should focus on interpreting a given correlation coefficient
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to interpret the correlation coefficient of a linear fit.	• Equation Response • Multiple Choice Response
Students will be required to identify another correlation coefficient that satisfies a given condition given a correlation coefficient (i.e., a coefficient that shows a better positive correlation than 0.7).	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Select the correlation coefficient of a linear relationship represented with a scatter plot where the correlation coefficient can be easily estimated.	Identity the correlation coefficient of a linear relationship.
Proficient	**Highly Proficient**
Compute and interpret the correlation coefficient of a linear relationship.	Explain the meaning of different correlation coefficients for linear relationships.

A1.S-ID.C.9

Content Standards	Distinguish between correlation and causation.
Explanations	Some data leads observers to believe that there is a cause and effect relationship when a strong relationship is observed. Students should be careful not to assume that correlation implies causation. The determination that one thing causes another requires a controlled randomized experiment.
Content Limits	This standard is aligned to Algebra I only. Bivariate, linear data Items should focus on the fact that causation cannot be determined from correlation, rather than asking the student to decide which relationships are causal and which are not.
Context	Context is required.

Sample Task Demands	**Common Item Formats**
Students will be required to distinguish information that a correlation coefficient provides (fit, trend) to information it does not (causation).	• Multiple Choice Response • Multi-Select Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Define correlation and causation.	Identify examples of correlation and causation.
Proficient	**Highly Proficient**
Distinguish between correlation and causation.	Supports or refutes claims of causation, distinguishing between correlation and causation.

Statistics and Probability- Conditional Probability and the Rules of Probability(S-CP)

A1.S-CP.A.1

Content Standards	Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.
Explanations	Intersection: The intersection of two sets *A* and *B* is the set of elements that are common to both set *A* and set *B*. It is denoted by $A \cap B$ and is read '*A* intersection *B*.' Union: The union of two sets *A* and *B* is the set of elements, which are in *A* or in *B* or in both. It is denoted by $A \cup B$ and is read '*A* union *B*.' Complement: The complement of the set $A \cup B$ is the set of elements that are members of the universal set U but are not in $A \cup B$. It is denoted by '$(A \cup B)'$
Content Limits	This standard is aligned to Algebra I only. Positive rational numbers
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify events as outcomes of a trial.	• Multiple Choice Response • Multi-Select Response
Students will be required to identify multiple events as subsets of the sample space, including unions, intersections, and complements.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify an event as a subset of a sample space.	

Content Standards	Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.
	Identify events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events, as shown in a visual model.
Proficient	**Highly Proficient**
Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.	Using complex representations, explain how specific events are subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events.

A1.S-CP.A.2

Content Standards	Use the Multiplication Rule for independent events to 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.
Explanations	Understand independence and conditional probability and use them to interpret data.
Content Limits	Positive rational numbers
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify independent events given their probabilities.	• Equation Response • Multiple Choice Response • Multi-Select Response
Students will be required to determine the probability of the other event given that two events are independent and the probability of one event.	
Students will be required to interpret two events in terms of independence given the probabilities of the two events.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use the Multiplication Rule for independent events to calculate the probability of 2 independent events.	Use the Multiplication Rule for independent events to determine if two events *A* and *B* are independent, given the probability of *A*, the probability of *B*, and the probability of *A* and *B* occurring together.

Content Standards	Use the Multiplication Rule for independent events to 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.
Proficient	**Highly Proficient**
Use the Multiplication Rule for independent events to 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.	Use the Multiplication Rule for independent events to 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 several events in a sample space are dependent or independent.

Arizona Mathematics Standards Geometry

Number and Quantity - N		
Quantities (N-Q)		
G.N-Q.A **Reason quantitatively and use units to solve problems.**	**G.N-Q.A.1**	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays, include utilizing real-world context.
	G.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling. Include problem-solving opportunities utilizing real-world context.
	G.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities utilizing real-world context.
Geometry - G		
Congruence (G-CO)		
G.G-CO.A **Experiment with transformations in the plane.**	**G.G-CO.A.1**	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
	G.G-CO.A.2	Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.
	G.G-CO.A.3	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
	G.G-CO.A.4	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
	G.G-CO.A.5	Given a geometric figure and a rotation, reflection, or translation draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.
G.G-CO.B **Understand congruence in terms of rigid motions.**	**G.G-CO.B.6**	Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

	G.G-CO.B.7	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
	G.G-CO.B.8	Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
G.G-CO.C **Prove geometric theorems.**	**G.G-CO.C.9**	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
	G.G-CO.C.10	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
	G.G-CO.C.11	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
G.G-CO.D **Make geometric constructions.**	**G.G-CO.D.12**	Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
	G.G-CO.D.13	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle; with a variety of tools and methods.
Similarity, Right Triangles, and Trigonometry (G-SRT)		
G.G-SRT.A **Understand similarity in terms of similarity transformations.**	**G.G-SRT.A.1**	Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
	G.G-SRT.A.2	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for

		triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
	G.G-SRT.A.3	Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.
G.G-SRT.B **Prove theorems involving similarity.**	**G.G-SRT.B.4**	Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
	G.G-SRT.B.5	Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.
G.G-SRT.C **Define trigonometric ratios and solve problems involving right triangles.**	**G.G-SRT.C.6**	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
	G.G-SRT.C.7	Explain and use the relationship between the sine and cosine of complementary angles.
	G.G-SRT.C.8	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.
Circles (G-C)		
G.G-C.A **Understand and apply theorems about circles.**	**G.G-C.A.1**	Prove that all circles are similar.
	G.G-C.A.2	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
	G.G-C.A.3	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
G.G-C.B **Find arc lengths and areas of sectors of circles.**	**G.G-C.B.5**	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.
Expressing Geometric Properties with Equations (G-GPE)		
G.G-GPE.A	**G.G-GPE.A.1**	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Translate between the geometric description and the equation for a conic section.		
G.G-GPE.B **Use coordinates to prove geometric theorems algebraically.**	**G.G-GPE.B.4**	Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
	G.G-GPE.B.5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
	G.G-GPE.B.6	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
	G.G-GPE.B.7	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
Geometric Measurement and Dimension (G-GMD)		
G.G-GMD.A **Explain volume formulas and use them to solve problems.**	**G.G-GMD.A.1**	Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.
	G.G-GMD.A.3	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.
G.G-GMD.B **Visualize relationships between two-dimensional and three-dimensional objects.**	**G.G-GMD.B.4**	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
Modeling with Geometry (G-MG)		
G.G-MG-A **Apply geometric concepts in modeling situations.**	**G.G-MG.A.1**	Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.
	G.G-MG.A.2	Apply concepts of density based on area and volume in modeling situations utilizing real-world context.
	G.G-MG.A.3	Apply geometric methods to solve design problems utilizing real-world context.

Geometry Item Specifications

Congruence (G-CO)

G.G-CO.A.1

Content Standards	Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Item writers should take care that the key does not stand out compared to the distractor options.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to select a definition for a geometric object.	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	Informally define angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.
Proficient	**Highly Proficient**
Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.	Create precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G.G-CO.A.2

Content Standards	Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify a correct transformation given a starting shape and an ending shape.	• Graphic Response • Multiple Choice Response
Students will be required to construct a transformation given a starting shape and a sequence of steps.	
Students will be required to explain the difference between two transformations or a transformation and a stretch in terms of preservation of properties.	
Students will be required to given a transformation, describe a rule that maps the coordinates of a starting shape to an ending shape.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify transformations in the plane as functions that take points in the plane as inputs and give other points as outputs.	Interpret transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Identify transformations that preserve distance and angle to those that do not.
Proficient	**Highly Proficient**
Represent and describe transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not.	Create and rewrite transformations in the plane as functions that take points in the plane as inputs and give other points as outputs. Evaluate and compare transformations that preserve distance and angle to those that do not.

G.G-CO.A.3

Content Standards	Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Shapes should be given on a coordinate grid
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe rotations and/or reflections that carry a figure onto itself.	• Multiple Choice Response • Multi-Select Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Given a rectangle, parallelogram, trapezoid, or regular polygon, identify a rotation or reflection that could carry it onto itself.	Given a rectangle, parallelogram, trapezoid, or regular polygon, identify the rotations and reflections that carry it onto itself.
Proficient	**Highly Proficient**
Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.	Given a rectangle, parallelogram, trapezoid, or regular polygon, create and justify the rotations and reflections that carry it onto itself.

G.G-CO.A.4

Content Standards	Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
Explanations	Students may observe patterns and develop definitions of rotations, reflections, and translations.
Content Limits	This standard is aligned to Geometry only. Items should focus on formal definitions of these concepts, i.e. what makes a definition complete or incomplete. Simply recognizing a description of a rotation compared with ones for reflections or rotations is a middle-school skill.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe definitions for a given transformation.	• Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Interpret definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.
Proficient	**Highly Proficient**
Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.	Create and evaluate definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.G-CO.A.5

Content Standards	Given a geometric figure and a rotation, reflection, or translation draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.
Explanations	Experiment with transformations in the plane.
Content Limits	This standard is aligned to Geometry only. Two-dimensional figures
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to recognize and identify transformations of a given figure.	• Graphic Response • Multiple Choice Response
Students will be required to construct a transformation of a figure from given information.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Given a geometric figure and a rotation, reflection, or translation, identify the transformed figure.	Given a geometric figure and a rotation, reflection, or translation, describe the transformed figure. Identify a sequence of transformations that will carry a given figure onto another.
Proficient	**Highly Proficient**
Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify a sequence of transformations that will carry a given figure onto another.	Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure. Specify sequences of transformations that will carry a given figure onto another.

G.G-CO.B.6

Content Standards	Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.
Explanations	A rigid motion is a transformation of points in space consisting of a sequence of one or more translations, reflections, and/or rotations. Rigid motions are assumed to preserve distances and angle measures.
Content Limits	This standard is aligned to Geometry only. Two-dimensional figures
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe rigid motions involved in a given transformation in terms of size and orientation.	• Multiple Choice Response • Multi-Select Response
Students will be required to describe how rigid motions can be used to show congruence.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use geometric definitions of rigid motions to transform a figure; given two figures, use the definition of congruence in terms of rigid motions to identify if they are congruent.	Use geometric definitions of rigid motions to transform a figure or to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to identify if they are congruent.
Proficient	**Highly Proficient**
Use geometric definitions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.	Use geometric definitions of rigid motions to transform figures and to predict and describe the effect of a sequence of rigid motions on a given figure; given two figures, use the definition of congruence in terms of rigid motions to describe if and why they are congruent.

G.G-CO.B.7

Content Standards	Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
Explanations	A rigid motion is a transformation of points in space consisting of a sequence of one or more translations, reflections, and/or rotations. Rigid motions are assumed to preserve distances and angle measures. Two triangles are said to be congruent if one can be exactly superimposed on the other by a rigid motion, and the congruence theorems specify the conditions under which this can occur.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to show/explain that if two triangles are congruent, their corresponding sides and angles are congruent.	• Graphic Response • Multiple Choice Response
Students will be required to show/explain that if two triangles' corresponding sides and angles are congruent, then the figures are congruent.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use the definition of congruence in terms of rigid motions to understand that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	Use the definition of congruence in terms of rigid motions to identify that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.
Proficient	**Highly Proficient**
Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	Use the definition of congruence in terms of rigid motions to justify that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G.G-CO.B.8

Content Standards	Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
Explanations	Understand congruence in terms of rigid motions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to explain how, given that rigid motions preserve congruence, the criteria ASA, SAS, and/or SSS are true.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Understand how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	Show how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.
Proficient	**Highly Proficient**
Explain how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	Justify how the criteria for triangle congruence (ASA, AAS, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

G.G-CO.C.9

Content Standards	Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about lines and angles.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Interpret theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.
Proficient	**Highly Proficient**
Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.	Construct and evaluate proofs for theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.

G.G-CO.C.10

Content Standards	Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about triangles.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	Interpret theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.
Proficient	**Highly Proficient**
Prove theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.	Construct and evaluate proofs for theorems about triangles. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of an isosceles triangle are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.

G.G-CO.C.11

Content Standards	Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
Explanations	Prove geometric theorems.
Content Limits	This standard is aligned to Geometry only. Theorems are not limited to only those in the "include" list, however they must be about parallelograms
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.	Interpret theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.
Proficient	**Highly Proficient**
Prove theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.	Construct and evaluate proofs for theorems about parallelograms. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and rectangles are parallelograms with congruent diagonals.

G.G-CO.D.12

Content Standards	Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Explanations	Make geometric constructions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to draw a shape within a construction framework (item must require or at least refer student to use common construction techniques).	• Graphic Response • HotText Response • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	Complete formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.
Proficient	**Highly Proficient**
Make formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.	Critique formal geometric constructions with a variety of tools and methods. Constructions include: copying segments; copying angles; bisecting segments; bisecting angles; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.

G.G-CO.D.13

Content Standards	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle; with a variety of tools and methods.
Explanations	Make geometric constructions.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to construct a figure or show the vertices of the figure inscribed in a circle.	• Graphic Response • Multiple Choice Response
Students will be required to explain the reason(s) points on a circle are vertices of a figure.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify steps needed to construct an equilateral triangle, a square, or a regular hexagon inscribed in a circle.	Identify steps needed to construct an equilateral triangle, a square, or a regular hexagon inscribed in a circle with a variety of tools and methods.
Proficient	**Highly Proficient**
Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle with a variety of tools and methods.	Make observations about a constructed equilateral triangle, square, and regular hexagon inscribed in a circle with a variety of tools and methods.

Similarity, Right Triangles, and Trigonometry (G-SRT)

G.G-SRT.A.1, G.G-SRT.A.1a, G.G-SRT.A.1b

Content Standards	G.G-SRT.A.1 Verify experimentally the properties of dilations given by a center and a scale factor: G.G-SRT.A.1a Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. G.G-SRT.A.1b The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
Explanations	Dilation is a transformation that moves each point along the ray through the point emanating from a fixed center, and multiplies distances from the center by a common scale factor. Students may observe patterns and verify experimentally the properties of dilations.
Content Limits	This standard is aligned to Geometry only. For 1a, limited to polygons with an emphasis on line segments and right triangles Items should include centers of dilation on a line segment, and not just in the middle of a figure For 1b, limit figures to points, triangles, or rectangles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify the slope of a given side of a dilation, based on the slope of the corresponding side of the original figure.	• Equation Response • Graphic Response • Multiple Choice Response
Students will be required to understand a given scale factor and construct a dilation.	
Students will be required to describe and relate properties of dilations.	
Students will be required to find the length of one side of a dilated figure, given the original figure and a scale factor.	
Students will be required to describe how a scale factor relates to side lengths, and use this relationship to solve problems.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Interpret examples demonstrating the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
Proficient	**Highly Proficient**
Verify experimentally the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	Explain quantitatively the properties of dilations given by a center and a scale factor: a. Dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

G.G-SRT.A.2

Content Standards	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
Explanations	A similarity transformation is a rigid motion followed by dilation.
Content Limits	This standard is aligned to Geometry only. Figures should be given on a coordinate plane Items for task demand 3 should assess knowledge of this line of reasoning - "Two shapes are similar if one can be obtained using reflections, rotations, translations, and/or dilations on the other. All of these transformations maintain angle measure and ratios of side lengths. Therefore, similar figures have equal corresponding angle measures and corresponding pairs of sides are proportional."
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify similar figures.	• Equation Response • Multiple Choice Response
Students will be required to identify a transformation or series of transformations, including dilations (including scale factors of dilations), that show that two figures are similar.	
Students will be required to describe the connection between similarity and transformations.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; identify the meaning of similarity for triangles as the equality of all corresponding pairs of angles or the proportionality of all corresponding pairs of sides.	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; qualitatively describe the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
Proficient	**Highly Proficient**
Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; make observations using similarity transformations on the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

G.G-SRT.A.3

Content Standards	Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.
Explanations	Understand similarity in terms of similarity transformations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required toidentify similar triangles based on AA.	• Multiple Choice Response
Students will be required to informally describe why the AA criterion is true.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use the properties of similarity transformations to identify the AA, SAS, and SSS criterion for two triangles to be similar.	Use the properties of similarity transformations to interpret the AA, SAS, and SSS criterion for two triangles to be similar.
Proficient	**Highly Proficient**
Use the properties of similarity transformations to establish the AA, SAS, and SSS criterion for two triangles to be similar.	Use the properties of similarity transformations to develop definitions for the AA, SAS, and SSS criterion for two triangles to be similar.

G.G-SRT.B.4

Content Standards	Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
Explanations	Prove theorems involving similarity
Content Limits	This standard is aligned to Geometry only. Theorems about triangles are restricted to the following: Prove that a line constructed parallel to one side of a triangle intersecting the other two sides of the triangle divides the intersected side proportionally. Prove that a line that divides two sides of a triangle proportionally is parallel to the third side. Prove that if three sides of one triangle are proportional to the corresponding sides of another triangle, the triangles are similar. Prove the Pythagorean Theorem using similarity.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to complete a proof.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.	Interpret theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.
Proficient	**Highly Proficient**
Prove theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.	Construct and evaluate proofs of theorems about triangles. Theorems include: an interior line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.

G.G-SRT.B.5

Content Standards	Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.
Explanations	Similarity postulates include SSS, SAS, and AA. Congruence postulates include SSS, SAS, ASA, AAS, and H-L.
Content Limits	This standard is aligned to Geometry only. Items use SSS, SAS, ASA, and/or AAS for congruence Items use AA, SAS (ratios) and/or SSS (ratios) for similarity
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to solve a problem that uses congruence and/or similarity criteria.	• Equation Response • HotText Response • Multiple Choice Response
Students will be required to construct, analyze, and/or critique a proof that uses congruence and/or similarity criteria to shows a relationship between two figures.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use congruence and similarity criteria to interpret problems.	Use congruence and similarity criteria to identify relationships in geometric figures and solve problems utilizing real-world context.
Proficient	**Highly Proficient**
Use congruence and similarity criteria to prove relationships in geometric figures and solve problems utilizing real-world context.	Use congruence and similarity criteria to construct and evaluate proofs for relationships in geometric figures and solve complex problems utilizing real-world context.

G.G-SRT.C.6

Content Standards	Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only. The trigonometric ratios are limited to sine, cosine, and tangent.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to define the trigonometric ratios: sine, cosine, and tangent.	• Equation Response • Multiple Choice Response • Matching Item Response
Students will be required to identify the sine, cosine, and/or tangent ratio of a given triangle.	
Students will be required to use the trigonometric ratios to find the length of an unknown side.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	Specify that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
Proficient	**Highly Proficient**
Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	Explain that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

G.G-SRT.C.7

Content Standards	Explain and use the relationship between the sine and cosine of complementary angles.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the relationship between the sine and cosine of acute angles in a right triangle: the sine of an angle is equal to the cosine of its complement and vice versa.	• Equation Response • Multiple Choice Response
Students will be required to use the sine and cosine functions to find the measure of an unknown angle given the measure of its complementary angle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the relationship between the sine and cosine of complementary angles.	Interpret and use the relationship between the sine and cosine of complementary angles.
Proficient	**Highly Proficient**
Explain and use the relationship between the sine and cosine of complementary angles.	Prove the relationship between the sine and cosine of complementary angles.

G.G-SRT.C.8

Content Standards	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.
Explanations	Define trigonometric ratios and solve problems involving right triangles.
Content Limits	This standard is aligned to Geometry only. Items at this standard must require the student to solve real-life problems (e.g., use Pythagorean to find distance traveled on a map), and not simply find side lengths or angles of given triangles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to use the Pythagorean Theorem and/or trigonometric ratios to solve problems involving right triangles.	• Equation Response • Graphic Response

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Use trigonometric ratios and the Pythagorean Theorem to identify unknown measurements in right triangles.	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles.
Proficient	**Highly Proficient**
Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to find unknown measurements in right triangles utilizing real-world context.	Use trigonometric ratios (including inverse trigonometric ratios) and the Pythagorean Theorem to describe a solution process to find unknown measurements in right triangles utilizing real-world context.

Circles (G-C)

G.G-C.A.1

Content Standards	Prove that all circles are similar.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only. Aside from items that ask the student to find the ratio of dilation between circles, items should focus on the fact that any circle can be obtained by a translation and dilation of any other circle - thus, they are similar (this is related to many of the SRT standards).
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to use transformations between two or more circles to show similarity.	• Equation Response • Graphic Response • Multiple Choice Response • Matching Item Response
Students will be required to show that the ratios of the circumference to the diameter of any circle are the same.	
Students will be required to graph the resulting circle from a transformed circle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Recognize that all circles are similar.	Explain qualitatively that all circles are similar.
Proficient	**Highly Proficient**
Prove that all circles are similar.	Construct and evaluate proofs that all circles are similar.

G.G-C.A.2

Content Standards	Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to describe the relationship between inscribed angles, radius, and chords of a circle.	• Equation Response • Graphic Response • Multiple Choice Response • Proposition Response
Students will be required to find measures of central, inscribed and circumscribed angles.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Find relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.
Proficient	**Highly Proficient**
Identify and describe relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.	Prove relationships among inscribed angles, radii, and chords. Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.

G.G-C.A.3

Content Standards	Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.
Explanations	Understand and apply theorems about circles.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct an inscribed/circumscribed circle of a triangle.	• Graphic Response • HotText Response • Multiple Choice Response • Proposition Response
Students will be required to explain the validity of proofs using properties of angles for a quadrilateral inscribed in a circle.	
Students will be required to complete a two-column proof proving properties of angles for a quadrilateral inscribed in a circle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify inscribed and circumscribed circles of a triangle.	Construct the inscribed and circumscribed circles of a triangle, and use properties of angles for a quadrilateral inscribed in a circle.
Proficient	**Highly Proficient**
Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	Evaluate constructions of inscribed and circumscribed circles of a triangle, and prove unique relationships between the angles for a quadrilateral inscribed in a circle.

G.G-C.B.5

Content Standards	Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.
Explanations	Find arc lengths and areas of sectors of circles.
Content Limits	This standard is aligned to Geometry only. Emphasize the similarity of all circles. Note that by similarity of sectors with the same central angle, arc lengths are proportional to the radius. Use this as a basis for introducing radian as a unit of measure. It is not intended that it be applied to Use radian measures for all angles
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to understand that sectors with different arcs have arc lengths that are proportional.	• Equation Response • Multiple Choice Response
Students will be required to understand that sectors with the same arc of two different circles are proportional.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify that the length of the arc intercepted by an angle is proportional to the radius and that the radian measure of the angle is the constant of proportionality; define the formula for the area of a sector. Identify the relationship between degrees and radians.	Solves problems using the fact that the length of the arc intercepted by an angle is proportional to the radius and that the radian measure of the angle is the constant of proportionality; solve problems using the formula for the area of a sector. Convert between degrees and radians.
Proficient	**Highly Proficient**
Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector. Convert between degrees and radians.	Prove using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; prove the formula for the area of a sector. Derive the formula to convert between degrees and radians.

Expressing Geometric Properties with Equations (G-GPE)

G.G-GPE.A.1

Content Standards	Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
Explanations	Translate between the geometric description and the equation for a conic section.
Content Limits	This standard is aligned to Geometry only. All four quadrants of the coordinate plane, whole number coordinates, and a perfect square radius.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct an equation of a circle given information about the center and radius.	• Equation Response • Multiple Choice Response
Students will be required to find the center and/or radius of a circle given an equation not in standard form.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the center and radius of a circle given by an equation of the form $(x-h)^2 + (y-k)^2 = r^2$.	Create the equation of a circle of given center and radius; find the center and radius of a circle given by an equation of the form $(x-h)^2 + (y-k)^2 = r^2$.
Proficient	**Highly Proficient**
Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	Explain the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

G.G-GPE.B.4

Content Standards	Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. All four quadrants, may use radical values
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to rearrange statements to form a proof.	• Equation Response • Hot Text Response • Multiple Choice Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use coordinates to identify geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.	Use coordinates to algebraically solve problems involving geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.
Proficient	**Highly Proficient**
Use coordinates to algebraically prove or disprove geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.	Use coordinates to algebraically justify statements about geometric relationships. Relationships include: proving or disproving geometric figures given specific points in the coordinate plane; and proving or disproving if a specific point lies on a given circle.

G.G-GPE.B.5

Content Standards	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
Explanations	Lines can be horizontal, vertical, or neither.
Content Limits	This standard is aligned to Geometry only. All four quadrants of the coordinate plane; coordinates are restricted to whole numbers.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to construct an equation of a line parallel or perpendicular to another line and containing a specific point.	• Equation Response • Multiple Choice Response • Proposition Response
Students will be required to solve a problem using slope criteria for parallel and perpendicular lines.	
Students will be required to describe aspects of why parallel lines have the same slope and why perpendicular lines have slopes that are negative reciprocals.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use the slope criteria for parallel or perpendicular lines to solve simple geometric problems, including finding the equation of a line parallel or perpendicular to a given line.	Use the slope criteria for parallel and perpendicular lines to solve simple geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.
Proficient	**Highly Proficient**
Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.	Prove and explain the slope criteria for parallel and perpendicular lines and use them to solve geometric problems, including finding the equation of a line parallel or perpendicular to a given line that passes through a given point.

G.G-GPE.B.6

Content Standards	Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. Rational numbers
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the ratio a point divides a line segment into.	• Equation Response • Multiple Choice Response
Students will be required to identify points on a line segment that partition it based on a given ratio.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the point on a directed horizontal or vertical line segment between two given points that partitions the segment in a given ratio, given visual representation.	Identify the point on a directed line segment between two given points that partitions the segment in a given ratio, given visual representation.
Proficient	**Highly Proficient**
Find the point on a directed line segment between two given points that partitions the segment in a given ratio.	Construct a line segment that partitions the segment in a given ratio.

G.G-GPE.B.7

Content Standards	Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.
Explanations	Use coordinates to prove geometric theorems algebraically.
Content Limits	This standard is aligned to Geometry only. At least part of the computation must require the distance formula. Coordinates of all points must be given.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to identify the perimeter of a polygon.	• Equation Response
Students will be required to identify the area of a triangle or rectangle.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use coordinates to compute perimeters and areas of right triangles and rectangles.	Use coordinates to compute perimeters of regular polygons and areas of right triangles and rectangles.
Proficient	**Highly Proficient**
Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.	Use coordinates to justify perimeters of polygons and areas of triangles and rectangles.

Geometric Measurement and Dimensions (G-GMD)

G.G-GMD.A.1

Content Standards	Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.
Explanations	Cavalieri's principle is if two solids have the same height and the same cross-sectional area at every level, then they have the same volume.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to complete an informal argument.	• HotText Response • Multiple Choice Response • Proposition Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify the formulas for the volume of a cylinder, pyramid, and cone.	Informally describe the formulas for the volume of a cylinder, pyramid, and cone.
Proficient	**Highly Proficient**
Analyze and verify the formulas for the volume of a cylinder, pyramid, and cone.	Create and interpret the relationships between the formulas for the volume of a cylinder, pyramid, and cone.

G.G-GMD.A.3

Content Standards	Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.
Explanations	Missing measures can include but are not limited to slant height, altitude, height, diagonal of a prism, edge length, and radius.
Content Limits	This standard is aligned to Geometry only. Focus should be on solving problems, not simply finding the volume of given figures.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to solve problems based on the volume of cylinders, pyramids, cones, or spheres.	• Equation Response
Students will be required to solve problems based on the volumes of compositions or parts of cylinders, pyramids, cones, or spheres.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Substitute given measures into volume formulas for cylinders, pyramids, cones, and spheres to solve simple problems.	Use volume formulas for cylinders, pyramids, cones, and spheres to solve simple problems.
Proficient	**Highly Proficient**
Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems utilizing real-world context.	Compare volume formulas for cylinders, pyramids, cones, and spheres.

G.G-GMD.B.4

Content Standards	Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.
Explanations	Visualize relationships between two-dimensional and three-dimensional objects.
Content Limits	This standard is aligned to Geometry only. The focus for the first part of the standard should be on diagonal (not horizontal or vertical) cross-sections.
Context	Context is allowed.

Sample Task Demands	**Common Item Formats**
Students will be required to identify cross-sections of three-dimensional objects to two-dimensional shapes.	• Multiple Choice Response • Matching Item Response
Students will be required to identify the three-dimensional object generated by a rotation of a given two-dimensional object.	

Performance Level Descriptors

Minimally Proficient	**Partially Proficient**
Identify the shapes of two-dimensional horizontal or vertical cross-sections of three-dimensional objects.	Identify three-dimensional objects generated by rotations of two-dimensional objects about a line of symmetry.
Proficient	**Highly Proficient**
Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	Describe or create the shapes of two-dimensional cross-sections of three-dimensional objects, and describe three-dimensional objects generated by rotations of two-dimensional objects.

Modeling with Geometry (G-MG)

G.G-MG.A.1

Content Standards	Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to explain how a real-life object can be modeled by three-dimensional geometric objects.	• Equation Response • Multiple Choice Response
Students will be required to construct an equation that models an object and can be used to find its unknown measure (i.e., the object's volume, area).	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Use simple geometric shapes to qualitatively describe objects utilizing real-world context.	Use geometric shapes and their properties to qualitatively describe objects utilizing real-world context.
Proficient	**Highly Proficient**
Use geometric shapes, their measures, and their properties to describe objects utilizing real-world context.	Use geometric shapes, their measures, and their properties to model complex objects utilizing real-world context.

G.G-MG.A.2

Content Standards	Apply concepts of density based on area and volume in modeling situations utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only. Only some of these items should deal with density of an object, etc. Others should deal with broader applications of the word density, like wolves per square mile.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to calculate a density.	• Equation Response • Multiple Choice Response
Students will be required to draw conclusions based on a density.	

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Calculate density based on area and volume.	Calculate density based on area and volume in modeling situations utilizing real-world context.
Proficient	**Highly Proficient**
Apply concepts of density based on area and volume in modeling situations utilizing real-world context.	Apply concepts of density based on area and volume in comparative modeling situations utilizing real-world context.

G.G-MG.A.3

Content Standards	Apply geometric methods to solve design problems utilizing real-world context.
Explanations	Apply geometric concepts in modeling situations.
Content Limits	This standard is aligned to Geometry only.
Context	Context is allowed.

Sample Task Demands	Common Item Formats
Students will be required to satisfy a constraint given parameters in a geometric context.	• Equation Response

Performance Level Descriptors

Minimally Proficient	Partially Proficient
Identify relevant geometric models to solve design problems utilizing real-world context.	Apply geometric methods to identify solutions for design problems utilizing real-world context.
Proficient	**Highly Proficient**
Apply concepts of density based on area and volume in modeling situations utilizing real-world context.	Apply geometric methods to create composite structures as solutions for design problems utilizing real-world context.