Guide to the New York State Common Core Standards

ALGEBRA I

Revised November 1, 2017

INTRODUCTION

This document is designed to be a comprehensive resource for New York State Common Core Standards for Algebra I, released in 2015. It includes information compiled from various additional documents published by the New York State Education Department (NYSED) on the Common Core standards, including clarifications published after the standards were released. It also contains an unofficial interpretation of levels of knowledge proficiency for each standard. This document contains the following:

- Overview of all New York State Common Core standards (p. 3), which includes a summary of all standards and an approximate percentage breakdown on the Regents Exam for each of the major conceptual categories for the course:
    - Number and Quantity: 2-8% of Regents Exam
    - Algebra: 50-56% of Regents Exam
    - Functions: 32-38% of Regents Exam
    - Statistics: 5-10% of Regents Exam
- **STANDARD:** Complete text of each standard, grouped by cluster and domain
- **EMPHASIS:** Level of emphasis for each cluster in the course, as stipulated by NYSED:

■■■ Major content (58-73% of Regents)	■■□ Supporting content (18-30% of Regents)	■■□ Additional content (5-17% of Regents)

- **NOTES:** Clarifications for standards, written by NYSED or PARCC (all NYSED exams will follow the framework articulated by PARCC[1])
- **RELATED:** Standards that cover similar or related topics
- **LEVELS:** Unofficial interpretation of levels of knowledge proficiency for each standard, ranging from most proficient to least proficient. These levels are designed to provide guidance on how each standard could be taught. This represents my interpretation of the levels, not NYSED's or anyone else's, although some of the levels are based on NYSED's performance level descriptions (http://www.engageny.org/resource/performance-level-descriptions-for-ela-and-mathematics), which are used in the process of creating Regents Exams.
    - **Level 5:** Knowledge that exceeds what is required to meet the standard
    - **Level 4:** Minimum knowledge required to meet the standard
    - **Level 3:** Approaching minimum knowledge required to meet the standard
    - **Level 2:** Developing level of knowledge required to meet the standard, such as a direct application of a formula or theorem
    - **Level 1:** Prerequisite skills, such as definitions, needed in order to learn the standard
- **EXAMPLES:** Examples of each level for each standard. (These are illustrations of each standard, not necessarily the only possible questions for each level) Many of the examples are taken from previous Regents Exams.

Updated versions of this file and guides to New York State standards for other high school mathematics courses will be posted online at http://www.reachthesource.org .

Bobson Wong
Mathematics Teacher, New York City Department of Education

SOURCES

Algebra I (Common Core) Regents High School Examination, various dates, University of the State of New York.

Illustrative Mathematics, http://www.illustrativemathematics.org.

Integrated Algebra Regents High School Examination, various dates, University of the State of New York.

JMAP Regents by Common Core State Standard: Topic, http://www.jmap.org/JMAP_REGENTS_BOOKS.htm.

New York State Common Core Algebra I Standards Clarifications, http://www.engageny.org/resource/regents-exams-mathematics-algebra-i-standards-clarifications.

New York State P-12 Common Core Learning Standards for Mathematics, http://www.engageny.org/resource/new-york-state-p-12-common-core-learning-standards-for-mathematics .

New York State Regents Examination in Algebra I (Common Core): Performance Level Descriptors, August 2014, http://www.engageny.org/resource/performance-level-descriptions-for-ela-and-mathematics.

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[1] http://www.p12.nysed.gov/assessment/math/ccmath/parccmcf.pdf.

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OVERVIEW OF COMMON CORE ALGEBRA I STANDARDS

This overview contains all standards grouped by major conceptual categories for the course (Algebra, Functions, Number and Quantity, Statistics). Standards that are shared with Algebra I are labeled [I] below. Each standard is labeled below as major content (58-73% of Regents) (≡), supporting content (18-30% of Regents) (=), or additional content (5-17% of Regents) (−) to indicate its emphasis in the course as specified by the New York State Education Department (NYSED).

ALGEBRA (50-56% OF REGENTS EXAM)

Linear Equations and Inequalities

- ≡ Solve one-variable linear equations and inequalities (A-REI.B.3)
- ≡ Justify steps in solving equations (A-REI.A.1) [II]
- − Replace an equation in a system of equations with a multiple of the equation (A-REI.C.5)
- − Solve systems of linear equations (A-REI.C.6) [II]
- ≡ Relate an equation's graph to its solutions (A-REI.D.10)
- ≡ Approximate justify, interpret graphical solution to $f(x) = g(x)$ (A-REI.D.11) [II]
- ≡ Solve inequalities graphically (A-REI.D.12)

Quadratic Equations

- ≡ Interpret expressions and their parts in context (A-SSE.A.1)
- ≡ Add, subtract, multiply polynomials (A-APR.A.1)
- ≡ Rewrite expressions in equivalent forms (A-SSE.A.2) [II]
- = Write expressions in equivalent forms to reveal properties (A-SSE.B.3) [II]
- = Factor quadratic expressions (A-SSE.B.3a)
- = Complete the square in quadratic expressions (A-SSE.B.3b)
- ≡ Solve quadratic equations algebraically (i.e. completing the square, taking square roots, quadratic formula, factoring) (A-REI.B.4) [II]
- = Identify zeroes of quadratic and cubic polynomials and use them to sketch graphs (A-APR.B.3) [II]
- ≡ Rearrange formulas to highlight a variable (A-CED.A.4)

Algebra and Modeling

- ≡ Create one-variable equations and inequalities (A-CED.A.1) [II]
- ≡ Create two-variable equations (A-CED.A.2)
- ≡ Represent constraints by and interpret solutions to equations, inequalities, and systems (A-CED.A.3)

FUNCTIONS (32-38% OF REGENTS EXAM)

Exponential Functions

- = Distinguish between situations modeled with linear and with exponential functions (F-LE.A.1)
- = Construct linear and exponential functions (including arithmetic and geometric sequences) (F-LE.A.2) [II]
- = Observe that exponential growth outpaces linear and quadratic growth (F-LE.A.3)
- = Rewrite exponential expressions (A-SSE.B.3c) [II]

Properties of Functions

(linear, quadratic, square root, cube root, piecewise, and exponential functions)

- ≡ Identify relations as functions (F-IF.A.1)
- ≡ Evaluate functions, use and interpret function notation (F-IF.A.2)
- ≡ Identify explicit and recursive sequences as functions (F-IF.A.3) [II]
- ≡ Sketch graphs of functions given verbal description, interpret key features of graphs and tables (F-IF.B.4) [II]
- ≡ Relate a function's domain to its graph and quantitative relationship (F-IF.B.5)
- ≡ Calculate and interpret average rate of change of a function over an interval (F-IF.B.6) [II]
- = Graph functions and show key features (F-IF.C.7), e.g. intercepts, maxima, minima for linear and quadratic functions (F-IF.C.7a) [II]
- = Graph square root, cube root, piecewise functions (incl. step, absolute value) (F-IF.C.7b)
- = Write a function in different forms to reveal its properties (F-IF.C.8) [II]
- = Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a) [II]
- = Compare properties of two functions represented in different ways (F-IF.C.9) [II]

Functions and Modeling

- = Write a function to describe a relationship (F-BF.A.1) [II]
- − Transform functions (F-BF.B.3) [II]
- = Interpret parameters of linear or exponential function in context (F-LE.B.5) [II]

NUMBER & QUANTITY (2-8% OF REGENTS EXAM)

Sums and Products of Rational Numbers

- − Explain the rationality of the sum or product of two rational numbers, the sum of rational and irrational numbers, and the product of nonzero rational and irrational numbers (N-RN.B.3)

Quantities and Modeling

- = Convert quantities between units and interpret the result (N-Q.A.1)
- = Define appropriate quantities for modeling (N-Q.A.2) [II]
- = Choose a level of accuracy for measurement (N-Q.A.3)

STATISTICS (5-10% OF REGENTS EXAM)

Univariate Data

- − Represent data with dotplots, histograms, boxplots (S-ID.A.1)
- − Compare center (mean, median) and spread (IQR, standard deviation) for data sets (S-ID.A.2)
- − Interpret differences in shape, center, spread, outliers for data sets (S-ID.A.3)

Bivariate Data

- = Create two-way tables, interpret relative (including (joint, marginal, conditional) frequencies (S-ID.B.5)
- = Create scatterplots (S-ID.B.6) [II]
- = Fit linear, quadratic, exponential functions to data (S-ID.B6a) [II]
- = Fit a linear function to a scatterplot (S-ID.B.6c)
- = Plot and analyze residuals (S-ID.B.6b)

Linear Models

- ≡ Interpret slope and intercept of a linear model in context (S-ID.C.7)
- ≡ Calculate and interpret correlation coefficient for linear fit (S-ID.C.8)
- ≡ Distinguish between correlation and causation (S-ID.C.9)

NUMBER AND QUANTITY (2-8% OF REGENTS EXAM)

THE REAL NUMBER SYSTEM (N-RN)

B. Use properties of rational and irrational numbers.

(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.

Emphasis: ■□□ Additional content (19-33% of Regents)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Generalize and explain when the sums and products are rational or irrational using abstract representations. Justify the conjecture using concrete examples.	Show that the set of rational numbers is closed under multiplication.
LEVEL 4 *(meets standard)*	Explain when sums and products are rational and irrational using concrete examples.	(Jan. 2015 Alg. I, #25) Ms. Fox asked her class "Is the sum of 4.2 and 2 rational or irrational?" Patrick answered that the sum would be irrational. State whether Patrick is correct or incorrect. Justify your reasoning.
LEVEL 3	Calculate sums and products of two rational numbers, two irrational numbers, or a rational and irrational number. Determine whether sums and products are rational or irrational.	(Aug. 2014 Alg. I, #1) Which statement is *not* always true? (1) The product of two irrational numbers is irrational. (2) The product of two rational numbers is rational. (3) The sum of two rational numbers is rational. (4) The sum of a rational number and an irrational number is irrational. (Aug. 2015 Alg. I, #22) For which value of P and W is $P + W$ a rational number? (1) $P = \frac{1}{\sqrt{3}}$ and $W = \frac{1}{\sqrt{6}}$ (2) $P = \frac{1}{\sqrt{4}}$ and $W = \frac{1}{\sqrt{9}}$ (3) $P = \frac{1}{\sqrt{6}}$ and $W = \frac{1}{\sqrt{10}}$ (4) $P = \frac{1}{\sqrt{25}}$ and $W = \frac{1}{\sqrt{2}}$
LEVEL 2	Distinguish between rational and irrational numbers.	Explain how rational and irrational numbers are different. Give specific examples to support your reasoning.
LEVEL 1	Identify and order rational numbers on a number line.	Order the following numbers from least to greatest: 1/2, 2/3, 0.6, 2/5.

QUANTITIES (N-Q)

A. Reason quantitatively and use units to solve problems.

(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.

Emphasis: ■■□ Supporting content (18-30% of Regents)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Compare and interpret different representations of a quantity and justify choice of units and quantities.	(Adapted from Illus. Math. HSN-Q.A.1) On the way to driving to her cousin's house, Felicia notices that her car's gas tank is empty. Before running out of gas, she manages to pull into a gas station 80 miles from her cousin's house that charges \$3.25 per gallon. Assuming that Felicia spends no more than \$10 on gas and her car gets 25 miles per gallon, will she be able to drive to her cousin's house? Justify your answer.
LEVEL 4 *(meets standard)*	Convert quantities from one unit to another appropriate unit and interpret the result.	A Mazda car in the United States has a fuel efficiency rating of 25 miles per gallon. A Mazda car in Australia, where fuel efficiency is measured differently, has a fuel efficiency rating of 8.9 liters per 100 kilometers. Based on the ratings, determine which car is more efficient – the American car or the Australian car. Justify your answer.
LEVEL 3	Convert quantities from one unit to another appropriate unit.	(Jan. 2015 Alg. I Regents, #2) Peyton is a sprinter who can run the 40-yard dash in 4.5 seconds. He converts his speed into miles per hour, as shown below. $\frac{40\ yd}{4.5\ sec} \bullet \frac{3\ ft}{1\ yd} \bullet \frac{5280\ ft}{1\ mi} \bullet \frac{60\ sec}{1\ min} \bullet \frac{60\ min}{1\ hr}$ Which ratio is incorrectly written to convert his speed? (1) 3 ft/1 yd (2) 5280 ft/1 mi (3) 60 sec/1 min (4) 60 min/1 hr
LEVEL 2	Choose appropriate units to solve problems.	In 4.5 seconds, Peyton can run 40 yards. What units would express Peyton's speed?
LEVEL 1	Calculate a quantity based on given units.	In 4.5 seconds, Peyton can run 40 yards. To the nearest yard per second, calculate Peyton's speed.

(N-Q.A.2) Define appropriate quantities for the purpose of descriptive modeling.

Emphasis: ■■□ Supporting content (18-30% of Regents)
Notes: Shared with Algebra II.
Related: Choose a level of accuracy for measurement (N-Q.A.3)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given a real-world situation, define appropriate quantities to create a descriptive model and determine how each quantity could be measured.	(Illus. Math. N-Q) A small company wants to give raises to their 5 employees. They have $10,000 available to distribute. What are some variables you should consider? What information do you need to compute the raises for each employee?
LEVEL 4 *(meets standard)*	Given a real-world situation, define appropriate quantities to create a descriptive model.	A scientist wants to study the path of a projectile shot out of a cannon. Define appropriate variables to create a descriptive model of the projectile's path.
LEVEL 3	Determine if a given quantity affects the behavior of a real-world phenomenon.	A scientist wants to study the path of a projectile shot out of a cannon. Will the weight of the projectile affect its path? Explain.
LEVEL 2	Given a description of variables that model a real-world situation, substitute appropriate numbers and explain the result in context.	A small company wants to give raises to their 5 employees. They decide to distribute the money according to the employees' number of years of service with the company – $500 for each year of service up to five years. Calculate the raise for an employee who has worked for the company for six years.
LEVEL 1	Use an algebraic representation of a real-world phenomenon to calculate an appropriate output for a given input.	The growth of a dandelion over t weeks can be defined by the function $f(t) = (8)2^t$. Calculate the growth of a dandelion over 3 weeks.

(N-Q.A.3) Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Emphasis: ■■□ Supporting content (18-30% of Regents)
Notes: Shared with Algebra II.
Related: Define appropriate quantities for modeling (N-Q.A.2)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Determine and justify an appropriate interval of reasonable values for a given measurement and use that interval to evaluate the accuracy of measurements.	In May, Gina measures the height of her sister as 73.5 inches. In June, Gina measures the height of her sister as 73 inches. What would be a reasonable interval for Gina's height? Provide a reasonable explanation for the decrease in Gina's height from May to June.
LEVEL 4 *(meets standard)*	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	(Illus. Math. N-Q) Quincy is a tour guide at a museum of science and history. During a tour of the museum, he tells some visitors about a fossilized dinosaur bone that is on display in the museum. He says, "Twenty years ago, a group of paleontologists donated this dinosaur bone to our museum. At the time, they told us that they had estimated the age of the bone to be approximately 90 million years. So now, the bone is about 90 million and 20 years old." Evaluate the validity of Quincy's statement.
LEVEL 3	Determine whether a reported quantity is reasonable given information about limitations on the accuracy of the measurement.	According to Wikipedia, carbon-14 has a half-life of 5,730 ± 40 years. (A half-life is the amount of time required for half of that substance to decay.) If a scientist determines that half of the carbon-14 in a sample has decayed, can she reasonably conclude that the sample is 5,700 years old? Explain.
LEVEL 2	Multiply and divide numbers and report the result to the correct number of significant digits.	Calculate 3.87 • 4.1 • 3.225 to the correct number of significant digits.
LEVEL 1	Add and subtract numbers and report the result to the correct number of significant digits.	Calculate 3.87 + 4.1 + 3.225 to the correct number of significant digits.

ALGEBRA (50%-56% OF REGENTS EXAM)

SEEING STRUCTURE IN EXPRESSIONS (A-SSE)

A. Interpret the structure of expressions.

(A-SSE.A.1) Interpret expressions that represent a quantity in terms of its context.
(A-SSE.A.1a) Interpret parts of an expression, such as terms, factors, and coefficients.
(A-SSE.A.1b) Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1 + r)^n$ as the product of P and a factor not depending on P.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	The parts of an expression that students are expected to know include, but are not limited to, degree of a polynomial, leading coefficient, constant term, and the standard form of a polynomial (descending exponents). (NYSED)
Related:	Interpret parameters of linear or exponential function in context (F-LE.B.5)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Rewrite expressions to reveal information about their context.	(Illus. Math. A-SSE) Consider the expression $\frac{R_1 + R_2}{R_1 R_2}$ where R_1 and R_2 are positive. Suppose we increase the value of R_1 while keeping R_2 constant. Find an equivalent expression whose structure makes clear whether the value of the expression increases, decreases, or stays the same.
LEVEL 4 *(meets standard)*	Interpret parts of an expression in terms of its context.	(Illus. Math. A-SSE) Explain in terms of the structure of the expression $\frac{s}{\sqrt{n}}$, why it halves in value when n is quadrupled.
LEVEL 3	Identify key features of a function from its equation.	In the function $f(x) = 3x + 5$, identify the rate of change and y-intercept. In the function $f(x) = 200(0.05)^x$, identify the growth factor.
LEVEL 2	Identify terms, variables, and factors of an expression.	State the leading coefficient and the degree of the polynomial $x^4 - 2x^2 + 6x^2 - 7$.
LEVEL 1	Define terms that are relevant to expressions.	Define the standard form of a polynomial.

(A-SSE.A.2) Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

Emphasis: ■■■ Major content (58-73% of Regents)

Notes: Shared with Algebra II. Tasks limited to numerical and polynomial expressions in one variable. (PARCC) In Algebra I, this standard focuses on factoring polynomials with degree greater than 2 by rewriting them in terms of quadratic expressions. This is often called "factoring completely." Algebra I does not include factoring by grouping and factoring the sum and difference of cubes (covered in Algebra II).

Related: Factor quadratic expressions (A-SSE.B.3a)

	TASK	**EXAMPLE**
LEVEL 5 *(exceeds standard)*	Find the zeroes of a polynomial function with degree greater than 2 by rewriting them as equivalent quadratic expressions.	Find the zeroes of the function $f(x) = x^4 - 13x^2 + 36$.
LEVEL 4 *(meets standard)*	Factor a polynomial expression with degree greater than 2 by rewriting them as equivalent expressions with quadratic factors. Factor a polynomial expression with degree greater than 2 into prime polynomial factors.	(Jun. 2014 Alg. I, #31) Factor the expression $x^4 + 6x^2 - 7$ completely. (Jan. 2016 Alg. I, #12) When factored completely, $x^3 - 13x^2 - 30x$ is (1) $x(x + 3)(x - 10)$ (2) $x(x - 3)(x - 10)$ (3) $x(x + 2)(x - 15)$ (4) $x(x - 2)(x + 15)$
LEVEL 3	Rewrite a polynomial expression with degree greater than 2 as an equivalent quadratic expression.	Rewrite $x^4 + 6x^2 - 7$ as a quadratic expression in terms of x^2.
LEVEL 2	Use appropriate arithmetic operations of polynomials to determine if two expressions are equivalent.	Simplify the product $(x + y)(x - y)$ and determine whether it is equivalent to $x^2 - y^2$.
LEVEL 1	Provide evidence that two expressions are equivalent by substituting numerical values for variables.	Provide evidence that $(x + y)(x - y)$ is equivalent to $x^2 - y^2$ by substituting $x = 3$ and $y = 4$ into each expression.

B. Write expressions in equivalent forms to solve problems.

(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-SSE.B.3a) Factor a quadratic expression to reveal the zeros of the function it defines.

Emphasis:	■■□ Supporting content (18-30% of Regents)
Notes:	Shared with Algebra II. Includes trinomials with leading coefficients greater than 1. (NYSED)
Related:	Write a function in different forms to reveal its properties (F-IF.C.8) Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Find the zeroes of a polynomial function with degree greater than 2 by factoring appropriate quadratic expressions.	Find the zeroes of the function $f(x) = x^3 - 13x^2 - 30x$.
LEVEL 4 *(meets standard)*	Find the zeroes of a quadratic function by factoring a quadratic expression.	Find the zeroes of the function $f(x) = 2x^2 + 11x - 6$.
LEVEL 3	Factor a quadratic expression whose leading coefficient is not 1.	Factor $2x^2 + 11x - 6$.
LEVEL 2	Factor a quadratic expression with a leading coefficient of 1.	Factor $x^2 - 13x + 36$.
LEVEL 1	Find the prime factorization of a number.	Write the prime factorization of 48.

(A-SSE.B.3b) Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

Emphasis:	■■□ Supporting content (18-30% of Regents)
Related:	Solve quadratic equations algebraically (i.e. completing the square, taking square roots, quadratic formula, factoring) (A-REI.B.4) Graph functions and show key features (F-IF.C.7) Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Determine the maximum or minimum of a quadratic function with a leading coefficient greater than one by completing the square.	Determine algebraically the vertex of the function $f(x) = 2x^2 - 8x - 6$ and determine algebraically whether the vertex is a minimum or maximum.
LEVEL 4 *(meets standard)*	Determine the maximum or minimum of a quadratic function with a leading coefficient of one by completing the square.	Determine algebraically the vertex of the function $f(x) = x^2 + 6x - 2$ and determine algebraically whether the vertex is a minimum or maximum.
LEVEL 3	Given a quadratic expression, identify an equivalent expression in completed-square form.	Write an expression equivalent to $x^2 + 4x + 5$ in completed-square form.
LEVEL 2	Given a quadratic function in vertex form, identify its vertex and axis of symmetry.	Identify the vertex and axis of symmetry of the function $f(x) = (x - 2)^2 + 1$
LEVEL 1	Determine whether a quadratic function is written in vertex form.	Is the function $f(x) = (x - 2)^2 + 2x$ in vertex form?

(A-SSE.B.3c) Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.01212^t$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Emphasis: ■■□ Supporting content (18-30% of Regents)

Notes: Shared with Algebra II. Tasks are limited to exponential expressions with integer exponents. Tasks have a real-world context. (PARCC) Algebra I does not discuss continuous exponential growth or decay (this is reserved for Algebra II). This standard does not appear to include solving exponential equations in Algebra I (this appears to be reserved for Algebra II), but this has not been officially confirmed.

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Transform and compare exponential functions with different compounding periods.	Federal Savings Bank has a savings account that pays 2% interest compounded annually. State Savings Bank has a savings account that pays 1% interest compounded monthly. If an equal amount of money is invested in each account and no other deposits or withdrawals are made, which account will have more money after five years?
LEVEL 4 *(meets standard)*	Transform exponential functions to show that they are equivalent and interpret the transformations in context.	(Jan. 2016 Alg. I Regents, #32) Jacob and Jessica are studying the spread of dandelions. Jacob discovers that the growth over t weeks can be defined by the function $f(t) = (8)2^t$. Jessica finds that the growth function over t weeks is $g(t) = 2^{t+3}$. Calculate the number of dandelions that Jacob and Jessica will each have after 5 weeks. Based on the growth from both functions, explain the relationship between $f(t)$ and $g(t)$.
LEVEL 3	Use the properties of exponents to show that two exponential variable expressions with different bases are equivalent.	Is $(8)2^t$ equivalent to 2^{t+3}? Explain.
LEVEL 2	Use the properties of exponents to determine if two exponential variable expressions with the same base are equivalent.	Is $(2^{3a})(2^b)$ equivalent to 2^{3a+b}? Explain.
LEVEL 1	Determine if two exponential expressions without variables are equivalent.	(Jan. 2010 Int. Alg. Regents, #20) Which expression is equivalent to $3^3 \cdot 3^4$? (1) 9^{12} (2) 9^7 (3) 3^{12} (4) 3^7

ARITHMETIC WITH POLYNOMIALS AND RATIONAL EXPRESSIONS (A-APR)

A. Perform arithmetic operations on polynomials.

(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.

Emphasis: ■■■ Major content (58-73% of Regents)

Related: Explain the rationality of the sum or product of two rational numbers, the sum of rational and irrational numbers, and the product of nonzero rational and irrational numbers (N-RN.B.3)

	TASK	**EXAMPLE**
LEVEL 5 *(exceeds standard)*	Explain and/or show generally that polynomials are closed under addition, subtraction, and multiplication but not division.	Explain why polynomials are not closed under division.
LEVEL 4 *(meets standard)*	Add, subtract, and multiply polynomials of degree greater than 1. Show that polynomials are closed under addition, subtraction, and multiplication.	(Aug. 2014 Alg. I Regents, #28) Express the product of $2x^2 + 7x - 10$ and $x + 5$ in standard form.
LEVEL 3	Add, subtract, and multiply linear polynomials.	Simplify $(3a + 2b)(5a - 6b)$.
LEVEL 2	Add and subtract linear expressions.	Simplify $(3a + 2b) - (5a - 6b)$.
LEVEL 1	Add linear expressions.	Simplify $(3a + 2b) + (5a - 6b)$.

B. Understand the relationship between zeros and factors of polynomials.

(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.

Emphasis: ■■□ Supporting content (18-30% of Regents)

Notes: Shared with Algebra II. Tasks are limited to quadratic and cubic polynomials in which linear and quadratic factors are available. (PARCC)

Related: Factor quadratic expressions (A-SSE.B.3a)
Solve quadratic equations algebraically (i.e. completing the square, taking square roots, quadratic formula, factoring) (A-REI.B.4)
Graph functions and show key features (F-IF.C.7)
Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Identify zeros of quadratic, cubic, and quartic polynomials and polynomials for which factors are not provided, and use the factors to graph the function in context.	Part of the design for a company logo for an outdoor sports gear company contains a green curve that intersects a horizontal brown line. The curve is generated using the cubic function $f(x) = x^3 - 33x^2 + 272x - 240$ and the horizontal line used is $y = 0$. The company logo will be printed on a large banner using the scale 1 unit = 1 foot. If the curve intersects the brown line at $x = 1$, sketch a graph of $f(x)$.
LEVEL 4 *(meets standard)*	Identify zeros of a quadratic or cubic polynomial given its factorization and use the zeros to graph the function. Explain the relationship between a function and its zeros.	(Jan. 2015 Alg. I Regents, #24) A polynomial function contains the factors x, $x - 2$, and $x + 5$. Which graph(s) below could represent the graph of this function?
LEVEL 3	Identify zeros of a quadratic polynomial by factoring and use the zeros to graph the function.	Find the zeroes of $f(x) = 6x^2 - 13x - 5$ algebraically. Using the zeroes that you found, sketch a graph of $y = f(x)$.
LEVEL 2	Given a linear polynomial, construct a graph of the function and identify its zero.	Graph the function $f(x) = 6x - 5$ and find its zeroes.
LEVEL 1	Define zeros and factors of polynomials.	What is a zero of a polynomial?

CREATING EQUATIONS (A-CED)

A. Create equations that describe numbers or relationships.

(A-CED.A.1) Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	Shared with Algebra II. Tasks are limited to linear, quadratic, or exponential equations with integer exponents. (PARCC)
Related:	Create two-variable equations (A-CED.A.2) Solve one-variable linear equations and inequalities (A-REI.B.3) Solve quadratic equations algebraically (i.e. completing the square, taking square roots, quadratic formula, factoring) (A-REI.B.4)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Explain how a created equation or inequality models a context.	(Jun. 2014 Alg I Regents, #34) A rectangular garden measuring 12 meters by 16 meters is to have a walkway installed around it with a width of x meters, as shown in the diagram below. Together, the walkway and the garden have an area of 396 square meters. Write an equation that can be used to find x, the width of the walkway. Describe how your equation models the situation. Determine and state the width of the walkway, in meters.
LEVEL 4 *(meets standard)*	Create an equation or inequality in one variable and use it to solve a problem.	(Jun. 2015 Alg. I Regents, #29) Dylan invested \$600 in a savings account at a 1.6% annual interest rate. He made no deposits or withdrawals on the account for 2 years. The interest was compounded annually. Find, to the *nearest cent*, the balance in the account after 2 years.
LEVEL 3	Create an equation or inequality in one variable to represent a problem.	(Aug. 2015 Alg. I Regents, #5) The cost of a pack of chewing gum in a vending machine is \$0.75. The cost of a bottle of juice in the same machine is \$1.25. Julia has \$22.00 to spend on chewing gum and bottles of juice for her team and she must buy seven packs of chewing gum. If b represents the number of bottles of juice, which inequality represents the maximum number of bottles she can buy? (1) $0.75b + 1.25(7) \geq 22$ (2) $0.75b + 1.25(7) \leq 22$ (3) $0.75(7) + 1.25b \geq 22$ (4) $0.75(7) + 1.25b \leq 22$
LEVEL 2	Identify an unknown quantity from a context.	A typical cell phone plan has a fixed base fee that includes a certain amount of data and an overage charge for data use beyond the plan. A cell phone plan charges a base fee of \$62 and an overage charge of \$30 per gigabyte of data that exceed 2 gigabytes. Define the variables in this problem.
LEVEL 1	Solve an equation or inequality in one variable.	Solve $0.75b + 8 \geq 22$ for b.

(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.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	Algebra I equations have no more than two variables.
Related:	Create one-variable equations and inequalities (A-CED.A.1) Solve one-variable linear equations and inequalities (A-REI.B.3) Solve systems of linear equations (A-REI.C.6) Graph functions and show key features (F-IF.C.7)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Create an equation in three variables that represents the relationship between three real-world quantities.	A parabola passes through the points (1, 6), (3, 20), and (-2, 15). Substitute the ordered pairs into the standard form of a parabola $y = ax^2 + bx + c$ to write three linear equations in terms of a, b, and c. Then use those equations to write an equation of the parabola.
LEVEL 4 *(meets standard)*	Use contextual information about two quantities to create an equation in two variables that represent the relationship between them.	(Fall 2013 Alg. I Test Sampler, #8) Max purchased a box of green tea mints. The nutrition label on the box stated that a serving of three mints contains a total of 10 Calories. On the axes below, graph the function, C, where $C(x)$ represents the number of Calories in x mints. Write an equation that represents $C(x)$. A full box of mints contains 180 Calories. Use the equation to determine the total number of mints in the box.
LEVEL 3	Identify an equation in two variables that could be used to represent the relationship between quantities.	(Jun. 2014 Alg. I Regents, #16) John has four more nickels than dimes in his pocket, for a total of $1.25. Which equation could be used to determine the number of dimes, x, in his pocket?
LEVEL 2	Use an equation or inequality in two variables that represents a problem to find an appropriate quantity in context.	The monthly cost C of a cell phone plan can be modeled by the equation $C = 59 + 30g$, where g represents the number of gigabytes used. To the nearest cent, find the monthly cost of the plan if 2.5 gigabytes are used that month.
LEVEL 1	Graph an equation in two variables and label coordinate axes with appropriate labels and scales.	Graph the equation $y = 2x^2 + 4x - 10$.

(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. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	This standard does not require that equations, inequalities, or systems be solved. It focuses on recognizing constraints to their solutions based on real-life situations.
Related:	Create one-variable equations and inequalities (A-CED.A.1) Create two-variable equations (A-CED.A.2) Solve one-variable linear equations and inequalities (A-REI.B.3) Solve systems of linear equations (A-REI.C.6)

	TASK	**EXAMPLE**
LEVEL 5 *(exceeds standard)*	Represent a constraint by a system of equations or inequalities in two variables and find the appropriate solution set in context.	Bernardo and Silvia play the following game. An integer between 0 and 999, inclusive, is selected and given to Bernardo. Whenever Bernardo receives a number, he doubles it and passes the result to Silvia. Whenever Silvia receives a number, she adds 50 to it and passes the result to Bernardo. The winner is the last person who produces a number less than 1000. What is the smallest initial number that results in a win for Bernardo?
LEVEL 4 *(meets standard)*	Represent a constraint by an equation or inequality in two variables. Determine if a solution to a system of equations or inequalities in two variables is viable in context.	(Illus. Math. A-CED) Write an equation that represents the relation between quantity of chicken and quantity of steak if chicken costs \$1.29/lb, steak costs \$3.49/lb, and you have \$100 to spend on a barbecue. Determine two solutions.
LEVEL 3	Write an equation or inequality in terms of one variable that represents a constraint on a real-life situation.	(Jun. 2008 Int. Alg. Regents, #21) Students in a ninth grade class measured their heights, h, in centimeters. The height of the shortest student was 155 cm, and the height of the tallest student was 190 cm. Which inequality represents the range of heights? (1) $155 < h < 190$ (2) $155 \leq h \leq 190$ (3) $h \geq 155$ or $h \leq 190$ (4) $h > 155$ or $h < 190$
LEVEL 2	Given constraints on a real-life situation, identify possible solutions.	(Aug. 2012 Int. Alg. Regents, #6) Jason's part-time job pays him \$155 a week. If he has already saved \$375, what is the minimum number of weeks he needs to work in order to have enough money to buy a dirt bike for \$900?
LEVEL 1	Determine if a given value is viable in a modeling context.	Jason's part-time job pays him \$155 a week. If he has already saved \$375 and he works eight weeks, will he have enough money to buy a dirt bike for \$900?

(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.

Emphasis: ■■■ Major content (58-73% of Regents)
Related: Solve one-variable linear equations and inequalities (A-REI.B.3)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Solve a quadratic equation in two or more variables with variable coefficients for the squared variable and use the resulting equation to find an appropriate value.	(Aug. 2015 Alg. I Regents, #35) The volume of a large can of tuna fish can be calculated using the formula $V = \pi r^2 h$. Write an equation to find the radius, r, in terms of V and h. Determine the diameter, to the *nearest inch*, of a large can of tuna fish that has a volume of 66 cubic inches and a height of 3.3 inches.
LEVEL 4 *(meets standard)*	Solve a quadratic equation in two or more variables with variable coefficients for the squared variable.	(Jun. 2014 Alg. I Regents, #23) The formula for the volume of a cone is $V = \frac{1}{3}\pi r^2 h$. Express the radius, r, of the cone in terms of the other variables.
LEVEL 3	Solve a linear equation in three or more variables with variable coefficients.	(Jan. 2016 Alg. I Regents, #6) Michael borrows money from his uncle, who is charging him simple interest using the formula $I = Prt$. To figure out what the interest rate, r, is, Michael rearranges the formula to find r. What is his new formula?
LEVEL 2	Solve a linear equation in two variables with numerical coefficients.	Solve the equation $y = 2 + 6x$ for x.
LEVEL 1	Solve a linear equation in one variable with numerical coefficients.	Solve the equation $12 = 2 + 6x$ for x.

REASONING WITH EQUATIONS AND INEQUALITIES (A-REI)

A. Understand solving equations as a process of reasoning and explain the reasoning.

(A-REI.A.1) Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Emphasis: ■■■ Major content (58-73% of Regents)
Notes: Shared with Algebra II. Tasks are limited to quadratic equations.

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Determine which method of solving an equation is more efficient.	Given the equation $4(3x^2 + 2) - 9 = 8x^2 + 7$, determine whether using the distributive property first is more efficient.
LEVEL 4 *(meets standard)*	Justify all steps in the solution of a linear equation using appropriate properties of equality.	Solve the equation $4(3x^2 + 2) - 9 = 8x^2 + 7$ and justify each step using an appropriate property of equality.
LEVEL 3	Justify a step in the solution of a linear equation with an appropriate property of equality.	(June 2014 Alg. I Regents, #1) When solving the equation $4(3x^2 + 2) - 9 = 8x^2 + 7$, Emily wrote $4(3x^2 + 2) = 8x^2 + 16$ as her first step. Which property justifies Emily's first step? (1) addition property of equality (2) commutative property of addition (3) multiplication property of equality (4) distributive property of multiplication over addition
LEVEL 2	Write an equation that illustrates a given property of equality.	Write an equation that illustrates the addition of property.
LEVEL 1	State a property of equality.	State the addition property of equality.

B. Solve equations and inequalities in one variable.

(A-REI.B.3) Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Emphasis: ■■■ Major content (58-73% of Regents)

Related: Justify steps in solving equations (A-REI.A.1)
Rearrange formulas to highlight a variable (A-CED.A.4)
Solve systems of linear equations (A-REI.C.6)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Solve linear equations and inequalities with nonintegral coefficients in one variable and state the solution that fits given conditions.	(Jun. 2015 Alg. I Regents, #30) Determine the smallest integer that makes $-3x + 7 - 5x < 15$ true.
LEVEL 4 *(meets standard)*	Solve linear equations and inequalities with nonintegral coefficients in one variable.	(Jan. 2016 Alg. I Regents, #31) Given that $a > b$, solve for x in terms of a and b: $b(x - 3) \geq ax + 7b$. (Aug. 2011 Int. Alg., #39) Solve for m: $\frac{m}{5} + \frac{3(m-1)}{2} = 2(m-3)$.
LEVEL 3	Solve multi-step linear equations and inequalities with integral coefficients in one variable.	(Jun. 2013 Int. Alg. Regents, #31) Solve the inequality $-5(x - 7) < 15$ algebraically for x. (Jun. 2012 Int. Alg. Regents, #38) Solve algebraically for x: $3(x + 1) - 5x = 12 - (6x - 7)$.
LEVEL 2	Solve one- and two-step linear equations in one variable.	(Fall 2007 Int. Alg. Regents, #32) Solve for g: $3 + 2g = 5g - 9$.
LEVEL 1	Verify a solution to one- and two-step linear equations in one variable.	(Jun. 2014 Alg. I Regents, #5) Which value of x satisfies the equation $\frac{7}{3}\left(x + \frac{9}{28}\right) = 20$? (1) 8.25 (2) 8.89 (3) 19.25 (4) 44.92

(A-REI.B.4) Solve quadratic equations in one variable.

(A-REI.B.4a) Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x-p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

(A-REI.B.4b) Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	Shared with Algebra II. Solutions may involve simplifying radicals. (NYSED) Tasks do not require students to write solutions for quadratic equations that have roots with non-zero imaginary parts. However, tasks can require the student to recognize cases in which a quadratic equation has no real solutions. (PARCC)
Related:	Factor quadratic expressions (A-SSE.B.3a) Complete the square in quadratic expressions (A-SSE.B.3b) Identify zeroes of quadratic and cubic polynomials and use them to sketch graphs (A-APR.B.3) Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Predict, without solving, when a quadratic equation will have no real solutions and explain reasoning with algebraic or graphical evidence. Construct a viable argument to justify the advantages of one particular method over another. Derive the quadratic formula.	Given the equation $ax^2 + bx + c = 0$, where $a \neq 0$, show that $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.
LEVEL 4 *(meets standard)*	Solve quadratic equations in one variable and recognize cases in which a quadratic equation has no real solutions.	(Jan. 2015 Alg. I Regents, #29) Solve the equation $4x^2 - 12x = 7$ algebraically for x.
LEVEL 3	Factor quadratic expressions in one variable. Given a quadratic expression, identify an equivalent expression in completed-square form.	Write an expression equivalent to $x^2 + 4x + 5$ in completed-square form.
LEVEL 2	Solve quadratic equations in the form $x^2 = a$.	Solve $x^2 = 49$ for x.
LEVEL 1	Verify that a number is a solution to a quadratic equation.	Determine if $x = -4$ is a solution to the equation $x^2 + 7x + 12 = 0$.

Revised November 1, 2017. Updated versions at http://www.reachthesource.org.

C. Solve systems of equations.

(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.

Emphasis: ■□□ Additional content (5-17% of Regents)
Related: Solve systems of linear equations (A-REI.C.6)
Approximate justify, interpret graphical solution to $f(x) = g(x)$ (A-REI.D.11)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Prove that, given a system of three equations in three variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.	Write a system of equations that has the same solution as the following system of equations: $3x + 2y - z = 1$ $2x - 2y + 4z = -2$ $-x + 0.5y - z = 0$
LEVEL 4 *(meets standard)*	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.	(Jun. 2014 Alg. I Regents, #14) Which system of equations has the same solution as the system below? $2x + 2y = 16$ $3x - y = 4$ (1) $2x + 2y = 16$, $6x - 2y = 4$ (3) $x + y = 16$, $3x - y = 4$ (2) $2x + 2y = 16$, $6x - 2y = 8$ (4) $6x + 6y = 48$, $6x + 2y = 8$
LEVEL 3	Find the least common multiple of the coefficients of one variable in a system of two equations in two variables.	Find the least common multiple of the coefficients of x in the following system of equations: $2x + 2y = 16$ $3x - y = 4$
LEVEL 2	Verify that a given ordered pair is a solution to a given system of two equations in two variables.	Determine if (2, 1) is a solution to the system of equations $2x + 3y = 7$ $x + y = 3$
LEVEL 1	Multiply a linear equation in two variables by the same real number.	Write the equation that results when the equation $2x + 3y = 7$ is multiplied by -3.

(A-REI.C.6) Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

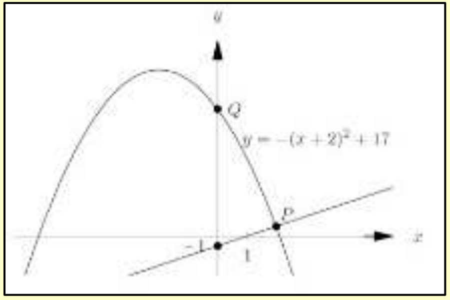
Emphasis:	■□□ Additional content (19-33% of Regents)
Notes:	Shared with Algebra II. Solving a quadratic-linear system of equations (A-REI.C.7) are discussed in Algebra II. Tasks have a real-world context. Tasks have hallmarks of modeling as a mathematical practice (less defined tasks, more of the modeling cycle, etc.). (PARCC)
Related:	Create two-variable equations (A-CED.A.2) Replace an equation in a system of equations with a multiple of the equation (A-REI.C.5) Relate an equation's graph to its solutions (A-REI.D.10) Approximate justify, interpret graphical solution to $f(x) = g(x)$ (A-REI.D.11) Graph functions and show key features (F-IF.C.7)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Solve a quadratic-linear system of equations.	(Aug. 2012 Int. Alg. Regents, #36) Solve the following system of equations algebraically for *all* values of x and y. $y = x^2 + 2x - 8$ $y = 2x + 1$
LEVEL 4 *(meets standard)*	Create a system of linear equations to model a real-life situation and solve the resulting system.	(Jan. 2015 Alg. I Regents, #33) Jacob and Zachary go to the movie theater and purchase refreshments for their friends. Jacob spends a total of $18.25 on two bags of popcorn and three drinks. Zachary spends a total of $27.50 for four bags of popcorn and two drinks. Write a system of equations that can be used to find the price of one bag of popcorn and the price of one drink. Using these equations, determine and state the price of a bag of popcorn and the price of a drink, to the *nearest cent.*
LEVEL 3	Solve a given system of linear equations in two variables graphically or algebraically.	(Jun. 2012 Int. Alg. Regents, #31) Solve the following system of equations algebraically for y: $2x + 2y = 9$ $2x - y = 3$ Solve the following system of equations for x and y: $y = 4x$ $2x + y = 18$
LEVEL 2	Use addition only to solve a system of linear equations.	Solve the following system of equations for x and y: $4x - 3y = 6$ $2x + 3y = 12$
LEVEL 1	Verify that a given ordered pair is a solution to a given system of two equations in two variables.	Determine if (2, 1) is a solution to the system of equations $2x + 3y = 7$ $x + y = 3$

D. Represent and solve equations and inequalities graphically.

(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).

Emphasis:	■■■ Major content (58-73% of Regents)
Related:	Create two-variable equations (A-CED.A.2) Solve systems of linear equations (A-REI.C.6) Graph functions and show key features (F-IF.C.7)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Use the relationship between the solutions of an equation in two variables and its graph to identify points on the graph that meet other criteria.	(Illus. Math. HSA-REI.10) The figure shows graphs of a linear and a quadratic function. What are the coordinates of point *Q*? What are the coordinates of point *P*? 
LEVEL 4 *(meets standard)*	Identify solutions to a given equation in two variables from its graph and justify that they are solutions.	(Jun. 2014 Alg. I Regents, #29) On the set of axes below, draw the graph of the equation $y = -\frac{3}{4}x + 3$. Is the point (3, 2) a solution to the equation? Explain your answer based on the graph drawn.
LEVEL 3	Graph on the coordinate plane an equation in two variables and use the graph to identify some of the solutions to the equation.	(Aug. 2014 Alg. I Regents, #5) Which point is *not* on the graph represented by $y = x^2 + 3x - 6$? (1) (−6,12) (2) (−4,−2) (3) (2,4) (4) (3,−6)
LEVEL 2	Graph on the coordinate plane an equation in two variables.	Graph the equation $y = x^2 + 3x - 6$ on the coordinate plane.
LEVEL 1	Create a table of solutions to a given equation in two variables.	Create a table that lists three points on the graph of the equation $y = x^2 + 3x - 6$.

(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. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Emphasis: ■■■ Major content (58-73% of Regents)

Notes: Shared with Algebra II. Algebra I is limited to linear, polynomial, rational, or absolute value functions. Finding the solutions approximately is limited to cases where f(x) and g(x) are polynomial functions. (PARCC)

Related: Create two-variable equations (A-CED.A.2)
Solve systems of linear equations (A-REI.C.6)
Relate an equation's graph to its solutions (A-REI.D.10)
Graph functions and show key features (F-IF.C.7)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Solve an equation in one variable graphically and justify the solution.	Solve the equation $x^2 = (2x - 9)^2$ graphically. Justify your solution using the graph.
LEVEL 4 *(meets standard)*	Approximate the solutions to $f(x) = g(x)$, where $f(x)$ and $g(x)$ are linear, polynomial, rational, or absolute value functions. 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 $f(x) = g(x)$.	Given the function $h(x) = \frac{1}{2}x + 3$ and $j(x) = \lvert x \rvert$, which value of x makes $h(x) = j(x)$? (1) -2 (3) 3 (2) 2 (4) -6
LEVEL 3	Graph a system of two linear, polynomial, rational, or absolute value functions and determine the number of points of intersection.	Graph the functions $f(x) = 2x + 3$ and $g(x) = \lvert x \rvert$ on the coordinate plane and determine the number of points of intersection.
LEVEL 2	Graph a system of two linear, polynomial, rational, or absolute value functions.	Graph $f(x) = x^2 + 6x + 8$ and $g(x) = \lvert x \rvert$ on the coordinate plane.
LEVEL 1	Make a table of values for a given function.	Make a table for values for the function $f(x) = x^2 + 6x + 8$ for $x = \{-5, -4, -3, -2, -1\}$.

(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.

Emphasis:	■■■ Major content (58-73% of Regents)
Related:	Create two-variable equations (A-CED.A.2)
	Solve systems of linear equations (A-REI.C.6)
	Relate an equation's graph to its solutions (A-REI.D.10)
	Graph functions and show key features (F-IF.C.7)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Graph the solution set to a non-linear inequality or a system of non-linear inequalities in two variables. Explain why there are multiple solutions to a system of inequalities.	Graph the inequality $y > x^2 + x - 12$ on the coordinate plane.
LEVEL 4 *(meets standard)*	Graph the solutions to a linear inequality in two variables as a half-plane. Graph the solution set to a system of linear inequalities in two variables.	(Aug. 2015 Alg. I Regents, #26) On the set of axes below, graph the inequality $2x + y > 1$. (Aug. 2012 Int. Alg. Regents, #39) On the set of axes below, graph the following system of inequalities. $y + x \geq 3$ $5x - 2y > 10$ State the coordinates of *one* point that satisfies $y + x \geq 3$, but does *not* satisfy $5x - 2y > 10$.
LEVEL 3	Graph the solution to a linear inequality in one variable on the coordinate plane.	Graph the inequality $x \geq 3$ on the coordinate plane.
LEVEL 2	Determine whether a point is in the solution set of a linear inequality in two variables.	Determine whether the point (3, 1) is in the solution set of the inequality $2x + y > 1$.
LEVEL 1	Graph a system of two linear equations in two variables on the coordinate plane and state the solution set.	(Aug. 2009 Int. Alg. Regents, #38) On the grid below, solve the system of equations graphically for x and y. $4x - 2y = 10$ $y = -2x - 1$

FUNCTIONS (32%-38% OF REGENTS EXAM)

INTERPRETING FUNCTIONS (F-IF)

A. Understand the concept of a function and use function notation

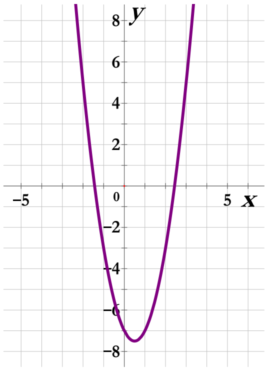
(F-IF.A.1) Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f*(*x*) denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y* = *f*(*x*).

Emphasis: ■■■ Major content (58-73% of Regents)
Related: Evaluate functions, use and interpret function notation (F-IF.A.2)
Relate a function's domain to its graph and quantitative relationship (F-IF.B.5)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Identify the domain and range of a function given its context.</td><td>An insurance company assigns each of its customers an identification number consisting of the customer's Social Security number. Does this method represent a function? If so, identify its domain and range.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Describe a function as a rule that assigns to each element of the domain a unique element of the range and use proper function notation.</td><td>(Jan. 2015 Alg. I Regents, #27) A function is shown in the table below.
<table>
<tr><td><i>x</i></td><td>-4</td><td>-1</td><td>0</td><td>3</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>2</td><td>-4</td><td>-2</td><td>16</td></tr>
</table>
If included in the table, which ordered pair, (-4, 1) or (1, -4), would result in a relation that is no longer a function? Explain your answer.</td></tr>
<tr><td>LEVEL 3</td><td>Determine from a graph, set of ordered pairs, or table whether a relation is a function.
Evaluate linear, exponential, and quadratic functions.</td><td>(Jun. 2015 Alg. I Regents, #4) Which table represents a function?
(1)
<table>
<tr><td><i>x</i></td><td>2</td><td>4</td><td>2</td><td>4</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>3</td><td>5</td><td>7</td><td>9</td></tr>
</table>
(2)
<table>
<tr><td><i>x</i></td><td>0</td><td>-1</td><td>0</td><td>1</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>0</td><td>1</td><td>-1</td><td>0</td></tr>
</table>
(3)
<table>
<tr><td><i>x</i></td><td>3</td><td>5</td><td>7</td><td>9</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>2</td><td>4</td><td>2</td><td>4</td></tr>
</table>
(4)
<table>
<tr><td><i>x</i></td><td>0</td><td>1</td><td>-1</td><td>0</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>0</td><td>-1</td><td>0</td><td>1</td></tr>
</table></td></tr>
<tr><td>LEVEL 2</td><td>Use function notation to express inputs, outputs, and the relationship between them.</td><td>A partial table of values for a function is given below:
<table>
<tr><td><i>x</i></td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>1</td><td>3</td><td>5</td><td>7</td></tr>
</table>
Use function notation to express the output value when the input value is 1. Use function notation to write an equation expressing the relationship between the inputs and outputs.</td></tr>
<tr><td>LEVEL 1</td><td>Generate a graph of a linear function given a table of inputs and outputs</td><td>Generate a graph of the linear function represented by the following partial table of inputs and outputs:
<table>
<tr><td><i>x</i></td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td><i>f</i>(<i>x</i>)</td><td>1</td><td>3</td><td>5</td><td>7</td></tr>
</table></td></tr>
</table>

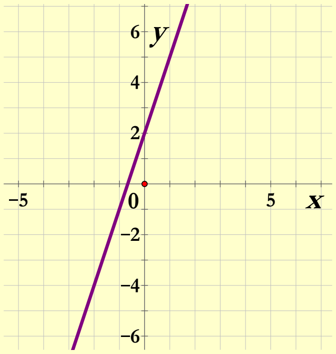
(F-IF.A.2) Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

Emphasis: ■■■ Major content (58-73% of Regents)
Related: Identify relations as functions (F-IF.A.1)
Relate a function's domain to its graph and quantitative relationship (F-IF.B.5)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Given a real-world situation, and a function rule, determine the appropriate input and output values and use function notation to express the result.</td><td>The height of a projectile fired from a cannon can be modeled by the function $h(t) = -t^2 + 80t + 60$, where t is the time in seconds. Find the height of the projectile after one minute and use function notation to express the result.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Using function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in context.</td><td>(Illus. Math F-IF) Let $f(t)$ be the number of people, in millions, who own cell phones t years after 1990. Explain in context the meaning of the statement $f(10) = 100.3$.</td></tr>
<tr><td>LEVEL 3</td><td>Given the equation of a function, state the output value that corresponds to an input value.</td><td>For $f(x)= 2x^2 - 2x - 7$, find the output value when $x = -2$.</td></tr>
<tr><td>LEVEL 2</td><td>Given a graph of a function, state the output value that corresponds to an input value.</td><td>Given the graph below, find the output value when $x = -2$.

</td></tr>
<tr><td>LEVEL 1</td><td>Given a table of input and output values, state the output value that corresponds to an input value.</td><td>Given the table below, state the output value when $x = -2$.
<table>
<tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr>
<tr><td>$f(x)$</td><td>5</td><td>-3</td><td>-7</td><td>-3</td></tr>
</table></td></tr>
</table>

(F-IF.A.3) Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n + 1) = f(n) + f(n - 1)$ for $n \geq 1$.

Emphasis: ■■■ Major content (58-73% of Regents)
Notes: Shared with Algebra II. Translating between explicit and recursive forms of a sequence (F-IF.A.2) is discussed in Algebra II.
Related: Construct linear and exponential functions (including arithmetic and geometric sequences) (F-LE.A.2)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Differentiate between sequences and corresponding functions whose domains are real numbers.	Explain why the sequence {…, –4, –1, 2, 5, …} cannot be represented by the graph below: 
LEVEL 4 *(meets standard)*	Given a sequence written as a function rule, evaluate the function for a given input. Given two terms in a sequence, find a formula for the *n*th term.	If $f(1) = 3$ and $f(n) = -2f(n - 1) + 1$, then $f(5) =$ (1) –5 (3) 21 (2) 11 (4) 43
LEVEL 3	Identify an explicitly or recursively defined sequence as a function.	A sequence is defined recursively as follows: the first term is 4 and each subsequent term is 3 more than twice the previous term. Is this a function? Explain.
LEVEL 2	State the definition of a function.	State the definition of a function.
LEVEL 1	Identify and continue patterns of arithmetic or geometric sequences.	Write the next three numbers that follow the pattern of the sequence 3, 6, 12, 24, ….

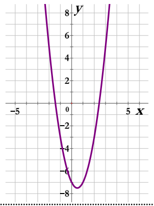
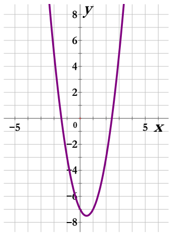
B. Interpret functions that arise in applications in terms of the context

(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. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Emphasis: ■■■ Major content (58-73% of Regents)

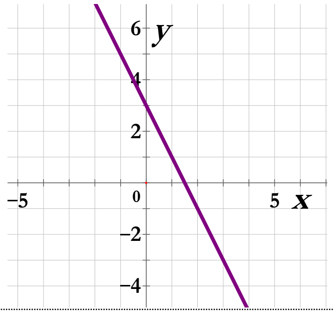
Notes: Shared with Algebra II. Tasks have a real-world context. Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piece-wise defined functions (including step functions and absolute value functions) and exponential functions with domains in the integers. (PARCC)

Related: Graph functions and show key features (F-IF.C.7)
Write a function in different forms to reveal its properties (F-IF.C.8)
Factor and complete the square in a quadratic function to show and interpret zeros, extrema, and symmetry (F-IF.C.8a)
Compare properties of two functions represented in different ways (F-IF.C.9)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given a verbal description of the relationship between two quantities, sketch a graph of the step function that models it. Given a step function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities.	New York City taxicab fares consist of an initial charge of \$2.50 and an additional charge of \$0.50 per 1/5 mile. Sketch a graph of New York City taxicab fares as a function of distance in miles.
LEVEL 4 *(meets standard)*	Given a verbal description of the relationship between two quantities, sketch a graph of the function that models it. Given a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities.	(Aug. 2015 Algebra I Regents, #28) A driver leaves home for a business trip and drives at a constant speed of 60 miles per hour for 2 hours. Her car gets a flat tire, and she spends 30 minutes changing the tire. She resumes driving and drives at 30 miles per hour for the remaining one hour until she reaches her destination. On the set of axes below, draw a graph that models the driver's distance from home.
LEVEL 3	Given a graph of a linear, quadratic, or exponential function, determine its key features.	Identify the x-and y-intercepts of the function below. 
LEVEL 2	Given a verbal description of the relationship between two quantities, determine whether the relationship is linear, quadratic, or exponential.	The number of bacteria in a Petri dish doubles every hour. Is this bacteria's growth rate linear, quadratic, or exponential?
LEVEL 1	Given a graph of a function, determine whether it is linear, quadratic, or exponential.	Is this function linear, quadratic, or exponential? 

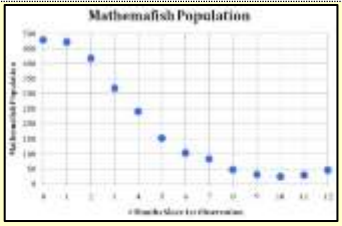
(F-IF.B.5) Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function *h*(*n*) gives the number of person-hours it takes to assemble *n* engines in a factory, then the positive integers would be an appropriate domain for the function.

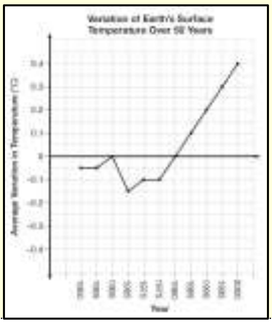
Emphasis: ■■■ Major content (58-73% of Regents)
Related: Identify relations as functions (F-IF.A.1)
Evaluate functions, use and interpret function notation (F-IF.A.2)

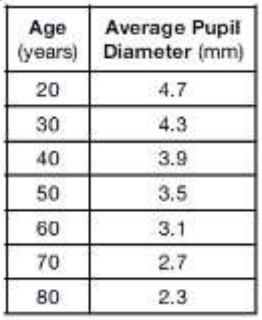
<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Justify a reasonable domain for a function given a graph or a description of the relationship it describes.</td><td>A construction company uses the function <i>f</i>(<i>p</i>), where <i>p</i> is the number of people working on a project, to model the amount of money it spends to complete a project. State a reasonable domain for this function and justify your answer.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Find a reasonable domain for a function given a graph or a description of the relationship it describes.</td><td>(Jan. 2016 Alg. I Regents, #15) A construction company uses the function <i>f</i>(<i>p</i>), where <i>p</i> is the number of people working on a project, to model the amount of money it spends to complete a project. A reasonable domain for this function would be
(1) positive integers
(2) positive real numbers
(3) both positive and negative integers
(4) both positive and negative real numbers</td></tr>
<tr><td>LEVEL 3</td><td>Given a graph of a function, state the coordinates of points on the graph and identify the input values for those points.</td><td>State three points on the graph of the linear function below. Identify the input values for those points.
 </td></tr>
<tr><td>LEVEL 2</td><td>Given a table of values for a function, state its domain.</td><td>State the domain for the function outlined in the table of values below:<table><tr><td><i>x</i></td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr><tr><td><i>f</i>(<i>x</i>)</td><td>5</td><td>-3</td><td>-7</td><td>-3</td></tr></table></td></tr>
<tr><td>LEVEL 1</td><td>State the definition of the domain of a function.</td><td>What is the domain of a function?</td></tr>
</table>

(F-IF.B.6) Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Emphasis:	■■■ Major content (58-73% of Regents)
Notes:	Shared with Algebra II. Tasks have a real-world context. Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piece-wise defined functions (including step functions and absolute value functions) and exponential functions with domains in the integers. (PARCC)
Related:	Evaluate functions, use and interpret function notation Evaluate functions, use and interpret function notation (F-IF.A.2)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Interpret average rates of change in context for linear, quadratic, square root, cube root, piece-wise defined, and exponential functions with domains in the integers.</td><td>

(Illus. Math. F-IF) The rare coral mathemafish is being threatened by an invasive shark. The graph below shows the population of mathemafish over the last year. A biologist is trying to determine if government intervention to reduce the shark population in the last year was effective. Determine whether the government intervention was successful. Include appropriate average rate of change calculations in your justification.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Compare rates of change over specified intervals, including linear, quadratic, square root, cube root, piece-wise defined and exponential functions with domains in the integers.</td><td>

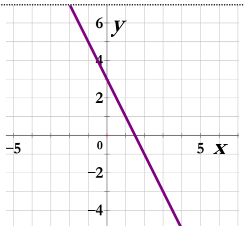
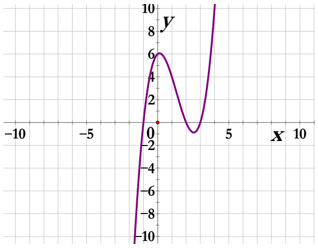
(Jan. 2016 Alg. I Regents, #28) The graph below shows the variation in the average temperature of Earth's surface from 1950-2000, according to one source. During which years did the temperature variation change the most per unit time? Explain how you determined your answer.</td></tr>
<tr><td>LEVEL 3</td><td>Calculate the average rate of change over a specified interval from a graph, including linear, quadratic, and exponential functions with domains in the integers.</td><td>(Jan. 2015 Alg. I Regents, #21) An astronaut drops a rock off the edge of a cliff on the Moon. The distance, $d(t)$, in meters, the rock travels after t seconds can be modeled by the function $d(t) = 0.8t^2$. What is the average speed, in meters per second, of the rock between 5 and 10 seconds after it was dropped?</td></tr>
<tr><td>LEVEL 2</td><td>Calculate the rate of change of a linear function from a graph or table.</td><td>(Aug. 2014 Alg. I Regents, #14) The table below shows the average diameter of a pupil in a person's eye as he or she grows older. What is the average rate of change, in millimeters per year, of a person's pupil diameter from age 20 to age 80?

<table>
<tr><th>Age (years)</th><th>Average Pupil Diameter (mm)</th></tr>
<tr><td>20</td><td>4.7</td></tr>
<tr><td>30</td><td>4.3</td></tr>
<tr><td>40</td><td>3.9</td></tr>
<tr><td>50</td><td>3.5</td></tr>
<tr><td>60</td><td>3.1</td></tr>
<tr><td>70</td><td>2.7</td></tr>
<tr><td>80</td><td>2.3</td></tr>
</table>
(1) 2.4
(2) 0.04
(3) −2.4
(4) −0.04</td></tr>
<tr><td>LEVEL 1</td><td>Identify the rate of change given the symbolic representation of a linear function.
Distinguish between graphs of increasing and decreasing linear functions.</td><td>If $f(x) = -3x + 6$, what is the rate of change of the function?</td></tr>
</table>

C. Analyze functions using different representations

(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.

(F-IF.C.7a) Graph linear and quadratic functions and show intercepts, maxima, and minima.

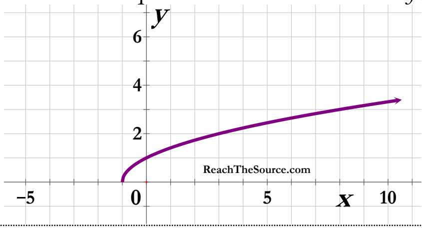
Emphasis: ■■□ Supporting content (18-30% of Regents)
Notes: F-IF.C.7 is shared with Algebra II.
Related: Write expressions in equivalent forms to reveal properties (A-SSE.B.3)
Identify zeroes of quadratic and cubic polynomials and use them to sketch graphs (A-APR.B.3)
Relate an equation's graph to its solutions (A-REI.D.10)
Approximate justify, interpret graphical solution to $f(x) = g(x)$ (A-REI.D.11)
Sketch graphs of functions given verbal description, interpret key features of graphs and tables (F-IF.B.4)
Write a function in different forms to reveal its properties (F-IF.C.8)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given a verbal description of the key features of the graph of a function, sketch the graph accurately and express it symbolically.	Graph and write an equation for the quadratic function whose roots are 1 and -5 and whose graph passes through the point (-4, -5).
LEVEL 4 *(meets standard)*	Graph a linear or quadratic function expressed symbolically and identify its intercepts, maxima, and minima from the graph.	Graph $f(x) = x^2 - 6x + 7$ on the coordinate plane and identify its intercepts, maxima, and minima from the graph.
LEVEL 3	Identify the intercepts, maxima, and minima from the equation of a function.	Identify the intercepts and maximum or minimum of the function $f(x) = x^2 - 6x + 7$.
LEVEL 2	Identify the intercepts, maxima, and minima from a graph of a function.	Identify the x-and y-intercepts of the graph below. 
LEVEL 1	Identify a function as linear or quadratic given its graph.	Does the following graph represent a linear or quadratic function? 

(F-IF.C.7b) Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

Emphasis: ■■□ Supporting content (18-30% of Regents)

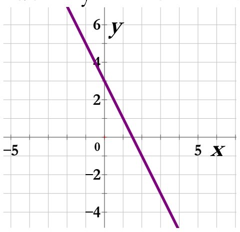
Related: Write expressions in equivalent forms to reveal properties (A-SSE.B.3)
Relate an equation's graph to its solutions (A-REI.D.10)
Approximate justify, interpret graphical solution to $f(x) = g(x)$ (A-REI.D.11)
Graph functions and show key features (F-IF.C.7)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Given a verbal description of the key features of the graph of a square root, cube root, or piecewise-defined function, sketch the graph accurately and express it symbolically.
State the relationship between the graph of a square root or cube root function and its inverse.</td><td>A shipping company charges the rates illustrated by the table below. Sketch a graph that models the shipping cost $C(x)$ as a function of x, the weight of a package in pounds. Write an equation for $C(x)$.
<table>
<tr><th>Weight</th><th>Shipping cost</th></tr>
<tr><td>Up to 1 lb.</td><td>$4</td></tr>
<tr><td>1 lbs. up to 2 lbs.</td><td>$5</td></tr>
<tr><td>2 lbs. up to 3 lbs.</td><td>$6</td></tr>
<tr><td>3 lbs. up to 4 lbs.</td><td>$7</td></tr>
<tr><td>4 lbs. up to 5 lbs.</td><td>$8</td></tr>
<tr><td>…</td><td>…</td></tr>
</table>
What appears to be the relationship between the graph of $y = x^2$ and $y=\sqrt{x}$?</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Graph square root, cube root, and piecewise-defined functions expressed symbolically and identify its key features from the graph.</td><td>(Jan. 2015 Alg. I Regents, #30) Graph the following on the set of axes below:
$f(x)=\begin{cases}|x|, -3\le x<1\\ 4, 1\le x\le 8\end{cases}$</td></tr>
<tr><td>LEVEL 3</td><td>Given a graph of a square root, cube root, or piecewise-defined function, identify its equation.</td><td>Write the equation for the function $f(x)$ whose graph is shown below.

</td></tr>
<tr><td>LEVEL 2</td><td>Create a table of values for a square root, cube root, or piecewise-defined function.</td><td>If $f(x)=\begin{cases}|x|, -3\le x<1\\ 4, 1\le x\le 8\end{cases}$, create a table of values for the integers in the interval $-2 \le x \le 2$.</td></tr>
<tr><td>LEVEL 1</td><td>Find the output for a given input of a square root, cube root, or piecewise-defined function.</td><td>If $f(x)=\begin{cases}|x|, -3\le x<1\\ 4, 1\le x\le 8\end{cases}$, find $f(-2)$.</td></tr>
</table>

(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.

(F-IF.C.8a) Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

Emphasis: ■■□ Supporting content (18-30% of Regents)
Notes: F-IF.C.8 is shared with Algebra II.
Related: Interpret expressions and their parts in context (A-SSE.A.1)
Rewrite expressions in equivalent forms (A-SSE.A.2)
Write expressions in equivalent forms to reveal properties (A-SSE.B.3)

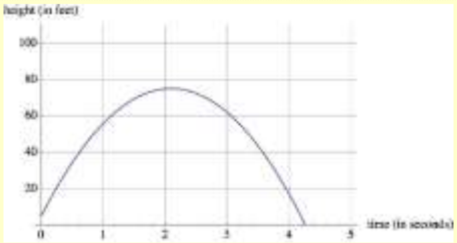
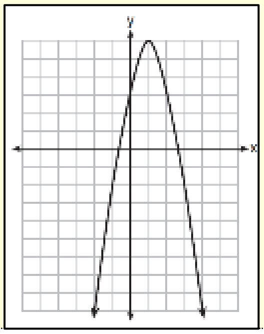
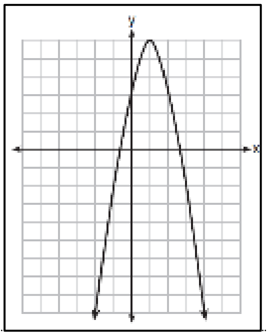
	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given key features of a graph of a function, sketch its graph and express the function symbolically.	Sketch the graph of the quadratic function that has roots of 1 and -5 and passes through the point (-4, -5). Express the function symbolically.
LEVEL 4 *(meets standard)*	Use the process of factoring or completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph and interpret these in terms of a context.	(Jan. 2015 Alg. I Regents, #36) Given the function $f(x) = -x^2 + 8x + 9$, state whether the vertex represents a maximum or minimum point for the function. Explain your answer. Rewrite $f(x)$ in vertex form by completing the square.
LEVEL 3	Use the process of factoring to show zeros and symmetry of a graph.	Find the zeroes and axis of symmetry for the graph of $f(x) = -x^2 + 8x + 9$ by factoring.
LEVEL 2	Graph quadratic functions using technology and identify their roots.	Find the zeroes for the graph of $f(x) = -x^2 + 8x + 9$ using technology.
LEVEL 1	Identify the x-and y-intercepts of a linear or quadratic function, given its graph.	Identify the x-and y-intercepts of the graph below. 

(F-IF.C.9) Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Emphasis: ■■□ Supporting content (18-30% of Regents)

Notes: Shared with Algebra II. Tasks have a real-world context. Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piece-wise defined functions (including step functions and absolute value functions) and exponential functions with domains in the integers. (PARCC)

Related: Write a function in different forms to reveal its properties (F-IF.C.8)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given two functions represented in different ways, create a common representation that best illustrates similarities or differences in their properties.	(Illus. Math HSF-IF.C.9) Brett and Andre each throw a baseball into the air. The height of Brett's baseball is given by the function $h(t) = -16t^2 + 79t + 6$, where h is in feet and t is in seconds. The height of Andre's baseball is given by the graph at right. Brett claims that his baseball went higher than Andre's, and Andre says that his baseball went higher. Who is right? How long is each baseball airborne? Construct a graph of the height of Brett's throw as a function of time on the same set of axes as the graph of Andre's throw (if not done already), and explain how this can confirm your claims. 
LEVEL 4 *(meets standard)*	Compare properties of two functions with each represented in a different way.	(Aug. 2014 Alg. I Regents, #29) Let f be the function represented by the graph at right. Let g be a function such that $g(x) = -\frac{1}{2}x^2 + 4x + 3$. Determine which function has the larger maximum value. Justify your answer. 
LEVEL 3	Given two functions with each represented in a different way, state the properties of each.	Let f be the function represented by the graph below. Let g be a function such that $g(x) = -\frac{1}{2}x^2 + 4x + 3$. State the roots of each function. 
LEVEL 2	Given a verbal description of a function, represent it graphically and symbolically.	A quadratic function has roots of 1 and -5 and has a vertex at (-2, -9). Sketch a graph of the function and express it symbolically.
LEVEL 1	Given a verbal description of a function, represent it graphically.	A quadratic function has roots of 1 and -5 and has a vertex at (-2, -9). Sketch a graph of the function.

BUILDING FUNCTIONS (F-BF)

A. Build a function that models a relationship between two quantities

(F-BF.A.1) Write a function that describes a relationship between two quantities.

(F-BF.A.1a) Determine an explicit expression, a recursive process, or steps for calculation from a context.

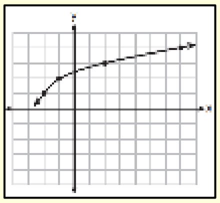
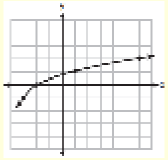
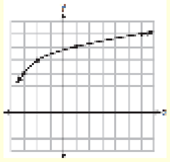
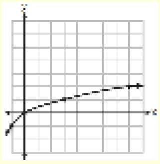
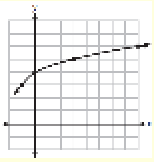
Emphasis:	■■□ Supporting content (18-30% of Regents)
Notes:	Shared with Algebra II. Tasks have a real-world context. Tasks are limited to linear functions, quadratic functions, and exponential functions with domains in the integers. (PARCC)
Related:	Evaluate functions, use and interpret function notation (F-IF.A.2)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Determine a recursive representation for a linear, quadratic, or exponential function.	Write a recursive representation for the function $f(x) = 2x + 3$ for $x \geq 0$.
LEVEL 4 *(meets standard)*	Determine and write the appropriate linear, quadratic, or exponential function that describes a relationship between two quantities.	(Jan. 2015 Alg. I Regents, #23) In 2013, the United States Postal Service charged \$0.46 to mail a letter weighing up to 1 oz. and \$0.20 per ounce for each additional ounce. Which function would determine the cost, in dollars, $c(z)$, of mailing a letter weighing z ounces where z is an integer greater than 1? (1) $c(z) = 0.46z + 0.20$ (2) $c(z) = 0.20z + 0.46$ (3) $c(z) = 0.46(z - 1) + 0.20$ (4) $c(z) = 0.20(z - 1) + 0.46$
LEVEL 3	Write a qualitative or narrative description of a function that describes the behavior and/or relationship between two quantities.	The cost in dollars of mailing a letter weighing z ounces, where z is an integer greater than 1, is determined by the function $c(z) = 0.20(z - 1) + 0.46$. Explain in words how the cost of mailing the letter is determined.
LEVEL 2	Determine intermediate steps or calculations for a given function.	For the linear function $c(z) = 0.20z + 0.46$, explain how the output is calculated for a given input z.
LEVEL 1	Given a verbal description of a relationship between two quantities, create a table of input and output values.	In 2013, the United States Postal Service charged \$0.46 to mail a letter weighing up to 1 oz. and \$0.20 per ounce for each additional ounce. Create a table showing the costs of mailing letters that weigh 1, 2, 3, and 4 ounces.

B. Build new functions from existing functions

(F-BF.B.3) Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k \cdot f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Emphasis:	■□□ Additional content (19-33% of Regents)
Notes:	Shared with Algebra II. Identifying the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, and $f(x + k)$ for specific values of k (both positive and negative) is limited to linear and quadratic functions. Experimenting with cases and illustrating an explanation of the effects on the graph using technology is limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. Tasks do not involve recognizing even and odd functions. (PARCC)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Given a verbal description of the transformations that map the function $f(x)$ to $af(x + b) + c$, write an equation for the function.	Write the equation of the function that translates $y = \sqrt[3]{x}$ 3 units up and 4 units to the right.
LEVEL 4 *(meets standard)*	Describe in words or identify the graph of the transformations that map the function $f(x)$ to $af(x + b) + c$. Given the graph of the transformation $af(x + b) + c$ of the function $f(x)$, find the values of a, b, and c.	(Jan. 2016 Alg. I Regents, #20) The graph of $y = f(x)$ is shown below.  What is the graph of $y = f(x + 1) - 2$? (1)  (2)  (3)  (4) 
LEVEL 3	Given the graph of the transformation $kf(x)$, $kf(x)$, or $f(x + k)$ of $f(x)$, find the value of k.	Describe in words the transformation that maps $f(x) = x^2$ to $f(x) = 3x^2$.
LEVEL 2	Describe in words the transformations that map the function $kf(x)$ to $kf(x)$ or $f(x + k)$, where k is a real number.	Describe in words the transformation that maps $f(x) = x^2$ to $f(x) = 3x^2$.
LEVEL 1	Identify the effect on a graph of replacing $f(x)$ with $f(x) + k$ where k is a nonzero integer.	Explain how the graphs of $f(x) = 2x$ and $f(x) = 2x + 5$ compare.

LINEAR, QUADRATIC, AND EXPONENTIAL MODELS (F-LE)

A. Construct and compare linear, quadratic, and exponential models and solve problems

(F-LE.A.1) Distinguish between situations that can be modeled with linear functions and with exponential functions.

(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.

(F-LE.A.1b) Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

(F-LE.A.1c) Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Emphasis: ■■□ Supporting content (18-30% of Regents)

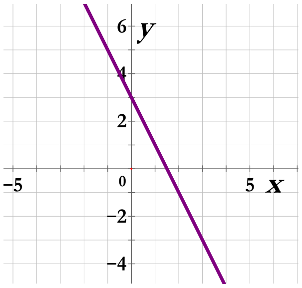
Related: Evaluate functions, use and interpret function notation (F-IF.A.2)

Calculate and interpret average rate of change of a function over an interval (F-IF.B.6)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Prove that the general linear function $f(x) = ax + b$ grows by equal differences over equal intervals and the general exponential function $g(x) = ab^x$ grows by equal factors over equal intervals (where differences and factors are integers).</td><td>Using a table of values with integral outputs from $x = 0$ to $x = 4$, calculate the average rate of change for the exponential function $g(x) = ab^x$ and show that it grows by equal factors over equal intervals.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Distinguish between situations that can be modeled with linear functions and with exponential functions.
Demonstrate that a given linear function grows by equal differences over equal intervals and an exponential function grows by equal factors over equal intervals (where differences and factors are integers).</td><td>(Aug. 2015 Alg. I Regents, #27) Rachel and Marc were given the information shown at right about the bacteria growing in a Petri dish in their biology class. Rachel wants to model this information with a linear function. Marc wants to use an exponential function. Which model is the better choice? Explain why you chose this model.
<table>
<tr><th>Number of Hours, x</th><th>Number of Bacteria, $B(x)$</th></tr>
<tr><td>1</td><td>220</td></tr>
<tr><td>2</td><td>280</td></tr>
<tr><td>3</td><td>350</td></tr>
<tr><td>4</td><td>440</td></tr>
<tr><td>5</td><td>550</td></tr>
<tr><td>6</td><td>690</td></tr>
<tr><td>7</td><td>860</td></tr>
<tr><td>8</td><td>1070</td></tr>
<tr><td>9</td><td>1340</td></tr>
<tr><td>10</td><td>1680</td></tr>
</table></td></tr>
<tr><td>LEVEL 3</td><td>Calculate the rates of change for linear and exponential functions over multiple intervals.</td><td>Given the following partial tables for two functions $f(x)$ and $g(x)$:
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>…</td></tr>
<tr><td>$f(x)$</td><td>1</td><td>3</td><td>5</td><td>7</td><td>…</td></tr>
</table>
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>…</td></tr>
<tr><td>$g(x)$</td><td>1</td><td>2</td><td>4</td><td>8</td><td>…</td></tr>
</table>
Calculate the average rate of change for each function from $x = 0$ to $x = 1$, from $x = 1$ to $x = 2$, and from $x = 2$ and $x = 3$.</td></tr>
<tr><td>LEVEL 2</td><td>Calculate the average rate of change for a linear or exponential function over a given interval.</td><td>Given the following partial table for a function $g(x)$, calculate the average rate of change for $g(x)$ over the intervals $x = 0$ to $x = 1$, from $x = 1$ to $x = 2$, and from $x = 2$ and $x = 3$.
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>…</td></tr>
<tr><td>$g(x)$</td><td>1</td><td>2</td><td>4</td><td>8</td><td>…</td></tr>
</table></td></tr>
<tr><td>LEVEL 1</td><td>Identify words and phrases that are associated with situations that can be modeled with linear functions and exponential functions.</td><td>List words and phrases associated with situations that can be modeled with an exponential function.</td></tr>
</table>

(F-LE.A.2) Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

Emphasis:	■■☐ Supporting content (18-30% of Regents)
Notes:	Shared with Algebra II. Tasks are limited to constructing linear and exponential functions in simple context (not multi-step). (PARCC)
Related:	Identify explicit and recursive sequences as functions (F-IF.A.3) Graph functions and show key features (F-IF.C.7) Distinguish between situations modeled with linear and with exponential functions (F-LE.A.1) Observe that exponential growth outpaces linear and quadratic growth (F-LE.A.3)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Describe a general method for constructing linear and exponential functions given two input-output pairs.</td><td>Describe how to write an equation for the exponential function $f(x) = ab^x$ given that it passes through the points (x_1, y_1) and (x_2, y_2).</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Construct linear and exponential functions, including arithmetic and geometric sequences, given a description of a relationship or two input-output pairs.</td><td>(Aug. 2014 Alg. I Regents, #26) Rhonda deposited $3000 in an account in the Merrick National Bank, earning 4.2% interest, compounded annually. She made no deposits or withdrawals. Write an equation that can be used to find B, her account balance after t years.</td></tr>
<tr><td>LEVEL 3</td><td>Construct linear and exponential functions given a table of values.</td><td>Write an equation for the linear function $f(x)$ represented by the table of values below:
<table>
<tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>…</td></tr>
<tr><td>$f(x)$</td><td>1</td><td>3</td><td>5</td><td>7</td><td>…</td></tr>
</table></td></tr>
<tr><td>LEVEL 2</td><td>Construct linear functions given their graphs or two input-output pairs.</td><td>Write an equation for the linear function $f(x)$ whose graph is shown below:

</td></tr>
<tr><td>LEVEL 1</td><td>Graph linear and exponential function given their equations.</td><td>Graph $f(x) = 5(2^x)$ for $x \geq 0$ on the coordinate plane.</td></tr>
</table>

(F-LE.A.3) Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Emphasis: ■■□ Supporting content (18-30% of Regents)
Related: Distinguish between situations modeled with linear and with exponential functions (F-LE.A.1)
Evaluate functions, use and interpret function notation (F-IF.A.2)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Explain, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically.	Explain, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically.
LEVEL 4 *(meets standard)*	Show, using graphs and tables, that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically.	(Aug. 2015 Alg. I Regents, #33) Graph $f(x) = x^2$ and $g(x) = 2^x$ for $x \geq 0$ on the set of axes below. State which function, $f(x)$ or $g(x)$, has a greater value when $x = 20$. Justify your reasoning.
LEVEL 3	Given a graphs of a linear (or quadratic) and exponential function, determine the point at which the exponential function output exceeds the output of the other function.	If $f(x) = x^2$ and $g(x) = 2^x$ for $x \geq 0$ on the set of axes below, use a table of values or a graph to determine the point at which $g(x)$ has a greater value than $f(x)$.
LEVEL 2	Graph a linear or exponential function given a partial table of values or a function rule.	Graph $f(x) = 5(2^x)$ for $x \geq 0$ on the coordinate plane.
LEVEL 1	Calculate outputs for a linear or exponential function.	If $f(x) = -7x - 3$, find $f(-2)$.

B. Interpret expressions for functions in terms of the situation they model

(F-LE.B.5) Interpret the parameters in a linear or exponential function in terms of a context.

Emphasis: ■■□ Supporting content (18-30% of Regents)

Notes: Shared with Algebra II. Tasks have a real-world context. Exponential functions are limited to those with domains in the integers. (PARCC)

Related: Interpret expressions and their parts in context (A-SSE.A.1)
Sketch graphs of functions given verbal description, interpret key features of graphs and tables (F-IF.B.4)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Interpret changes in parameters of functions in terms of a real-world context.	The breakdown of samples of two chemical compounds is represented by the functions $p(t) = 300(0.5)^t$ and $q(t) = 300(0.4)^t$, where $p(t)$ and $q(t)$ represent, respectively, the number of milligrams of each substance and t represents the time, in years. Explain what the numbers 0.4 and 0.5 represent and what they show about how the behaviors of the compounds differ.
LEVEL 4 *(meets standard)*	Identify the parameters in a linear or exponential function given its equation.	(Jun. 2014 Alg. I Regents, #26) The breakdown of a sample of a chemical compound is represented by the function $p(t) = 300(0.5)^t$, where $p(t)$ represents the number of milligrams of the substance and t represents the time, in years. In the function $p(t)$, explain what 0.5 and 300 represent.
LEVEL 3	Explain the effect that a parameter of a linear or exponential function has on the function's behavior.	How does the slope of a linear function affect its behavior?
LEVEL 2	Identify the parameters in an exponential function given its equation.	If $p(t) = 300(0.5)^t$, identify the growth factor.
LEVEL 1	Identify the parameters in a linear function given its equation.	If $f(x) = -7x - 3$, find the slope and y-intercept.

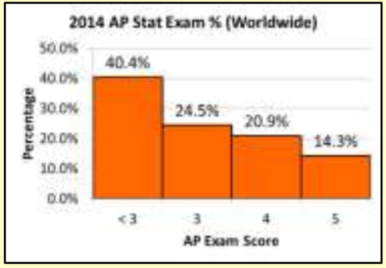
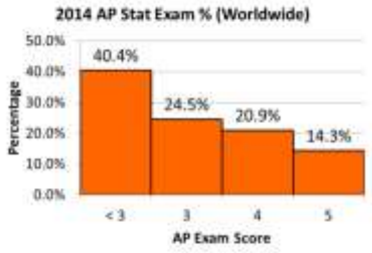
STATISTICS AND PROBABILITY (5%-10% OF REGENTS EXAM)

INTERPRETING CATEGORICAL AND QUANTITATIVE DATA (S-ID)

A. Summarize, represent, and interpret data on a single count or measurement variable

(S-ID.A.1) Represent data with plots on the real number line (dot plots, histograms, and box plots).

Emphasis: ■□□ Additional content (19-33% of Regents)
Related: Compare center (mean, median) and spread (IQR, standard deviation) for data sets (S-ID.A.2)
Interpret differences in shape, center, spread, outliers for data sets (S-ID.A.3)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Interpret a data plot for a data set. Determine the best plot for a given data set and justify the answer.</td><td>The following plot shows the distribution of scores for the 2014 AP Statistics exam. Interpret the findings shown in the graph.

</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Create a dotplot, histogram, or boxplot for a data set with appropriate labels.</td><td>(Jun. 2014 Alg. I, #32) Robin collected data on the number of hours she watched television on Sunday through Thursday nights for a period of 3 weeks. The data are shown in the table below.
<table>
<tr><th></th><th>S</th><th>M</th><th>T</th><th>W</th><th>H</th></tr>
<tr><td>Wk. 1</td><td>4</td><td>3</td><td>3.5</td><td>2</td><td>2</td></tr>
<tr><td>Wk. 2</td><td>4.5</td><td>5</td><td>2.5</td><td>3</td><td>1.5</td></tr>
<tr><td>Wk. 3</td><td>4</td><td>3</td><td>1</td><td>1.5</td><td>2.5</td></tr>
</table>
Using an appropriate scale on the number line below, construct a box plot for the 15 values.</td></tr>
<tr><td>LEVEL 3</td><td>Create a five-number summary for a given data set.</td><td>The following sample data set lists the ages of viewers of the <i>American Idol</i> television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Create a five-number summary for the data.</td></tr>
<tr><td>LEVEL 2</td><td>Create a frequency table using predetermined intervals for a given data set.</td><td>The following sample data set lists the ages of viewers of the <i>American Idol</i> television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Create a frequency table using intervals of five years.</td></tr>
<tr><td>LEVEL 1</td><td>Given a data plot, determine if it is a dotplot, a histogram, or a boxplot.</td><td>Is the following a dotplot, histogram, or boxplot?

</td></tr>
</table>

(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.

Emphasis: ■□□ Additional content (19-33% of Regents)
Related: Represent data with dotplots, histograms, boxplots (S-ID.A.1)
Interpret differences in shape, center, spread, outliers for data sets (S-ID.A.3)

	TASK	**EXAMPLE**
LEVEL 5 *(exceeds standard)*	Choose and justify the most appropriate measures of center and spread of the data distribution in two or more data sets.	(Jun. 2014 Alg. I Regents, #19) Christopher looked at his quiz scores shown below for the first and second semester of his Algebra class. Semester 1: 78, 91, 88, 83, 94 Semester 2: 91, 96, 80, 77, 88, 85, 92 What measure of center and spread best describes his grades for each semester?
LEVEL 4 *(meets standard)*	Choose and interpret the most appropriate measures of center and spread of the data distribution in two or more data sets.	(Jun. 2014 Alg. I Regents, #19) Christopher looked at his quiz scores shown below for the first and second semester of his Algebra class. Semester 1: 78, 91, 88, 83, 94 Semester 2: 91, 96, 80, 77, 88, 85, 92 Which statement about Christopher's performance is correct? (1) The interquartile range for semester 1 is greater than the interquartile range for semester 2. (2) The median score for semester 1 is greater than the median score for semester 2. (3) The mean score for semester 2 is greater than the mean score for semester 1. (4) The third quartile for semester 2 is greater than the third quartile for semester 1.
LEVEL 3	Calculate the interquartile range or standard deviation for a data set.	The following sample data set lists the ages of viewers of the *American Idol* television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Calculate the interquartile range of the data.
LEVEL 2	Calculate the mean and median for a data set.	The following sample data set lists the ages of viewers of the *American Idol* television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Calculate the mean and median of the data.
LEVEL 1	State the definition of the mean, median, interquartile range, and standard deviation.	What is the definition of the interquartile range for a set of data?

(S-ID.A.3) Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Emphasis: ■□□ Additional content (19-33% of Regents)
Related: Represent data with dotplots, histograms, boxplots (S-ID.A.1)
Compare center (mean, median) and spread (IQR, standard deviation) for data sets (S-ID.A.2)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Identify and explain errors in inferences made based on assumptions about the data.	Five stores charge the following prices for the iPod nano: \$89, \$95, \$19, \$95, \$92. A reporter says that since the average price is \$78 (well below the list price of \$99), then the stores are offering substantial discounts on iPods. Is this reasoning correct? Explain your answer.
LEVEL 4 *(meets standard)*	Interpret measures of shape, center, and spread in the context of the data, including the effects of outliers.	(Jun. 2015 Alg. I Regents, #20) The following data represents the annual salaries for the 24 members of a professional sports team in terms of millions of dollars: 0.5, 0.5, 0.6, 0.7, 0.75, 0.8, 1.0, 1.0, 1.1, 1.25, 1.3, 1.4, 1.4, 1.8, 2.5, 3.7, 3.8, 4, 4.2, 4.6, 5.1, 6, 6.3, 7.2. The team signs an additional player to a contract worth 10 million dollars per year. Which statement about the median and mean is true? (1) Both will increase. (2) Only the median will increase. (3) Only the mean will increase. (4) Neither will change.
LEVEL 3	Calculate measures of spread for a data set.	The following sample data set lists the ages of viewers of the *American Idol* television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Calculate the interquartile range of the data.
LEVEL 2	Calculate measures of center for a data set.	The following sample data set lists the ages of viewers of the *American Idol* television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Calculate the mean and median of the data.
LEVEL 1	Identify outliers in a data set.	The following sample data set lists the ages of viewers of the *American Idol* television show: 22, 23, 9, 26, 18, 19, 23, 19, 20, 29, 47, 44, 14, 20, 21, 21, 48, 22, 23, 24, 24, 25, 30, 31, 20, 34, 38, 40, 15, 15, 16. Identify any outliers in the data.

B. Summarize, represent, and interpret data on two categorical and quantitative variables

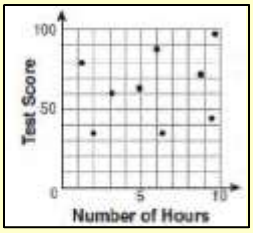
(S-ID.B.5) Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

Emphasis: ■■□ Supporting content (18-30% of Regents)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Provide evidence to show possible associations and trends in the data.</td><td>Jan. 2016 Alg. I Regents, #30) A statistics class surveyed some students during one lunch period to obtain opinions about television programming preferences. The results of the survey are summarized in the table below.
Programming Preferences<table><tr><th></th><th>Comedy</th><th>Drama</th></tr><tr><td>Male</td><td>70</td><td>35</td></tr><tr><td>Female</td><td>48</td><td>42</td></tr></table>Based on the sample, is there evidence to suggest that student gender affects the type of television programming that they prefer? Justify your answer.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>List and interpret possible associations and trends in the data in a two-way frequency table. Interpret marginal, joint, and conditional relative frequencies in the context of the data.</td><td>(Jan. 2016 Alg. I Regents, #30) A statistics class surveyed some students during one lunch period to obtain opinions about television programming preferences. The results of the survey are summarized in the table below.
Programming Preferences<table><tr><th></th><th>Comedy</th><th>Drama</th></tr><tr><td>Male</td><td>70</td><td>35</td></tr><tr><td>Female</td><td>48</td><td>42</td></tr></table>Based on the sample, predict how many of the school's 351 males would prefer comedy. Justify your answer.</td></tr>
<tr><td>LEVEL 3</td><td>Calculate relative frequencies in a two-way frequency table and use them to summarize categorical data.</td><td>A statistics class surveyed some students during one lunch period to obtain opinions about television programming preferences. The results of the survey are summarized in the table below.
Programming Preferences<table><tr><th></th><th>Comedy</th><th>Drama</th></tr><tr><td>Male</td><td>70</td><td>35</td></tr><tr><td>Female</td><td>48</td><td>42</td></tr></table>Calculate the relative frequencies of men and women who prefer comedy and drama.</td></tr>
<tr><td>LEVEL 2</td><td>Given a two-way frequency table, calculate the marginal frequencies.</td><td>A statistics class surveyed some students during one lunch period to obtain opinions about television programming preferences. The results of the survey are summarized in the table below.
Programming Preferences<table><tr><th></th><th>Comedy</th><th>Drama</th></tr><tr><td>Male</td><td>70</td><td>35</td></tr><tr><td>Female</td><td>48</td><td>42</td></tr></table>Calculate the marginal frequencies for gender and television programming preferences.</td></tr>
<tr><td>LEVEL 1</td><td>From a two-way frequency table, state relative frequencies.</td><td>A statistics class surveyed some students during one lunch period to obtain opinions about television programming preferences. The results of the survey are summarized in the table below.
Programming Preferences<table><tr><th></th><th>Comedy</th><th>Drama</th></tr><tr><td>Male</td><td>70</td><td>35</td></tr><tr><td>Female</td><td>48</td><td>42</td></tr></table>State the number of men who prefer comedy and the number of men who prefer drama.</td></tr>
</table>

(S-ID.B.6) Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
(S-ID.B.6a) Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
(S-ID.B.6c) Fit a linear function for a scatter plot that suggests a linear association.

Emphasis:	■■☐ Supporting content (18-30% of Regents)
Notes:	Shared with Algebra II. Tasks have real world context. Exponential functions are limited to those with domains in the integers. (PARCC) Includes the regression capabilities of the calculator. Both correlation coefficient and residuals will be addressed in this standard. (NYSED)
Related:	Plot and analyze residuals (S-ID.B.6b) Interpret slope and intercept of a linear model in context (S-ID.C.7) Calculate and interpret correlation coefficient for linear fit (S-ID.C.8) Distinguish between correlation and causation (S-ID.C.9)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Make inferences about data based on scatter plots and functions that fit data set.</td><td>A teacher surveyed the number of hours of television that students watched the week before the final exam and the final exam score. The teacher plotted the data on a scatterplot, shown at right. The teacher concludes that students who watched more television generally received lower scores. Is this conclusion justified? Explain.
 </td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Explain in context the relationship between the variables.
Fit a linear, quadratic, or exponential model to a given data set.
Write a regression equation and use it to solve problems in context.</td><td>(Jun. 2015 Alg. I Regents, #36) An application developer released a new app to be downloaded. The table below gives the number of downloads for the first four weeks after the launch of the app.
<table>
<tr><td>Number of Weeks</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Number of Downloads</td><td>120</td><td>180</td><td>270</td><td>405</td></tr>
</table>
Write an exponential equation that models these data. Use this model to predict how many downloads the developer would expect in the 26th week if this trend continues. Round your answer to the nearest download. Would it be reasonable to use this model to predict the number of downloads past one year? Explain your reasoning.</td></tr>
<tr><td>LEVEL 3</td><td>Represent quantitative variables on a scatter plot.
Given a function that fits a data set, interpret an input and output value in context. Predict an output value for a given input.</td><td>A nutritionist collected information about different brands of beef hot dogs. She made a table, shown here, showing the number of Calories and the amount of sodium in each hot dog. Construct a scatter plot for the data.
<table>
<tr><th>Calories per Beef Hot Dog</th><th>Milligrams of Sodium per Beef Hot Dog</th></tr>
<tr><td>186</td><td>495</td></tr>
<tr><td>181</td><td>477</td></tr>
<tr><td>176</td><td>425</td></tr>
<tr><td>149</td><td>322</td></tr>
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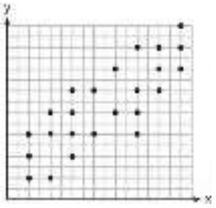
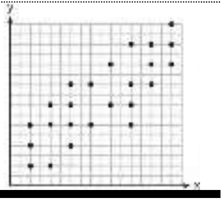
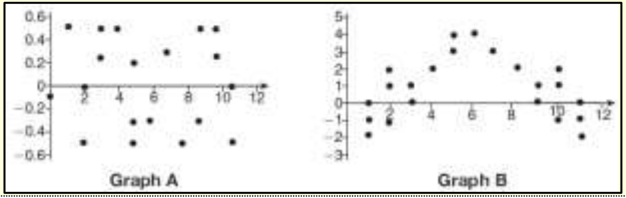
<tr><td>190</td><td>587</td></tr>
<tr><td>158</td><td>370</td></tr>
<tr><td>139</td><td>322</td></tr>
</table></td></tr>
<tr><td>LEVEL 2</td><td>Given a scatterplot for a data set, determine the direction of the association.</td><td>(Aug. 2012 Int. Alg. Regents, #4) The scatter plot shown represents a relationship between <i>x</i> and <i>y</i>. This type of relationship is
(1) a positive correlation
(2) a negative correlation
(3) a zero correlation
(4) not able to be determined
 </td></tr>
<tr><td>LEVEL 1</td><td>Given a scatter plot for a data set, determine whether the association is linear, quadratic, or exponential.</td><td>The scatter plot shown below represents a relationship between <i>x</i> and <i>y</i>. Is this type of relationship linear, quadratic, or exponential?
 </td></tr>
</table>

(S-ID.B.6b) Informally assess the fit of a function by plotting and analyzing residuals.

Emphasis:	■■□ Supporting content (18-30% of Regents)
Notes:	Includes creating residual plots using the capabilities of the calculator (not manually). (NYSED)
Related:	Create scatterplots (S-ID.B.6) Fit linear, quadratic, exponential functions to data (S-ID.B6a) Fit a linear function to a scatterplot (S-ID.B.6c) Interpret slope and intercept of a linear model in context (S-ID.C.7) Calculate and interpret correlation coefficient for linear fit (S-ID.C.8) Distinguish between correlation and causation (S-ID.C.9)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Interpret residuals in context</td><td>A data set contains the number of hours of tutoring that students received (<i>x</i>) and their raw test scores (<i>y</i>). One of the points on the residual plot is (5, 7). Interpret this point in context.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Use residuals to assess the fit of a linear, quadratic, or exponential function.</td><td>(June 2015 Alg. I Regents, #31) The residual plots from two different sets of bivariate data are graphed below. Explain, using evidence from graph <i>A</i> and graph <i>B</i>, which graph indicates that the model for the data is a good fit.

</td></tr>
<tr><td>LEVEL 3</td><td>Given a data set and a line of best fit, calculate residuals and create a residual plot.</td><td>Calculate the residuals and create a residual plot for the following data, which shows the number of hours of tutoring that students received and their raw test scores. (Table from Fall 2014 Alg. I Test Sampler, #14)
<table>
<tr><th>Tutor Hours, x</th><th>Raw Test Score</th></tr>
<tr><td>1</td><td>30</td></tr>
<tr><td>2</td><td>37</td></tr>
<tr><td>3</td><td>35</td></tr>
<tr><td>4</td><td>47</td></tr>
<tr><td>5</td><td>56</td></tr>
<tr><td>6</td><td>67</td></tr>
<tr><td>7</td><td>62</td></tr>
</table></td></tr>
<tr><td>LEVEL 2</td><td>Given a data set and a line of best fit, calculate residuals.</td><td>Calculate the residuals for the following data, which shows the number of hours of tutoring that students received and their raw test scores. (Table from Fall 2014 Alg. I Test Sampler, #14)
<table>
<tr><th>Tutor Hours, x</th><th>Raw Test Score</th></tr>
<tr><td>1</td><td>30</td></tr>
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<tr><td>5</td><td>56</td></tr>
<tr><td>6</td><td>67</td></tr>
<tr><td>7</td><td>62</td></tr>
</table></td></tr>
<tr><td>LEVEL 1</td><td>Given a set of residuals, create a residual plot.</td><td>Create a residual plot for the following data, which shows the number of hours of tutoring that students received and their raw test scores.
<table>
<tr><th>Tutor Hours, x</th><th>Raw Test Score</th><th>Residual (Actual – Predicted)</th></tr>
<tr><td>1</td><td>30</td><td>1.3</td></tr>
<tr><td>2</td><td>37</td><td>1.9</td></tr>
<tr><td>3</td><td>35</td><td>−6.4</td></tr>
<tr><td>4</td><td>47</td><td>−0.7</td></tr>
<tr><td>5</td><td>56</td><td>2.0</td></tr>
<tr><td>6</td><td>67</td><td>6.6</td></tr>
<tr><td>7</td><td>62</td><td>−4.7</td></tr>
</table></td></tr>
</table>

C. Interpret linear models

(S-ID.C.7) Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Emphasis: ■■■ Major content (58-73% of Regents)

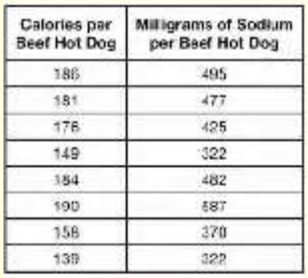
Related: Create scatterplots (S-ID.B.6)
Fit linear, quadratic, exponential functions to data (S-ID.B6a)
Plot and analyze residuals (S-ID.B.6b)
Fit a linear function to a scatterplot (S-ID.B.6c)
Calculate and interpret correlation coefficient for linear fit (S-ID.C.8)
Distinguish between correlation and causation (S-ID.C.9)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Interpret differences between the slope and intercept of linear models in the context of the data.	To explore the relationship between text messaging and academic achievement, Medhavi asks a random sample of 52 students at her school how many text messages they sent yesterday and what their grade point average (GPA) was during the most recent marking period. After gathering data and representing it on a scatterplot, she calculates the line of best fit to be $GPA = 3.8 - 0.005(Texts)$. Gabriel did a similar sample at his school and found the line of best fit for his data to be $GPA = 3.6 - 0.012(Texts)$. Explain what the differences in the slopes and intercepts say about the relationship between texting and GPA at both schools.
LEVEL 4 *(meets standard)*	Interpret the slope and the intercept of a linear model in the context of the data.	(Illus. Math. S-ID.7) To explore the relationship between text messaging and academic achievement, Medhavi asks a random sample of 52 students at her high school how many text messages they sent yesterday and what their grade point average (GPA) was during the most recent marking period. After gathering data and representing it on a scatterplot, she calculates the line of best fit to be $GPA = 3.8 - 0.005(Texts)$. Interpret the quantities 3.8 and -0.005 in context.
LEVEL 3	Interpret the intercept of a linear model in the context of the data.	To explore the relationship between text messaging and academic achievement, Medhavi asks a random sample of 52 students at her school how many text messages they sent yesterday and what their grade point average (GPA) was during the most recent marking period. After gathering data and representing it on a scatterplot, she calculates the line of best fit to be $GPA = 3.8 - 0.005(Texts)$. Interpret the quantity 3.8 in context.
LEVEL 2	Identify the slope and intercept of a given linear equation.	State the slope and y-intercept of the equation $y = 4.1 - 5.2x$.
LEVEL 1	State the definition of slope and intercept of a line.	State the definition of slope and intercept of a line.

(S-ID.C.8) Compute (using technology) and interpret the correlation coefficient of a linear fit.

Emphasis: ■■■ Major content (58-73% of Regents)

Related: Create scatterplots (S-ID.B.6)
Fit linear, quadratic, exponential functions to data (S-ID.B6a)
Plot and analyze residuals (S-ID.B.6b)
Fit a linear function to a scatterplot (S-ID.B.6c)
Interpret slope and intercept of a linear model in context (S-ID.C.7)
Distinguish between correlation and causation (S-ID.C.9)

<table>
<tr><th></th><th>TASK</th><th>EXAMPLE</th></tr>
<tr><td>LEVEL 5
<i>(exceeds standard)</i></td><td>Compare and contrast the strength of the fit for a variety of functions.</td><td>
<table>
<tr><th>Teacher</th><th><i>r</i></th></tr>
<tr><td>Mr. Abel</td><td>-0.25</td></tr>
<tr><td>Ms. Bing</td><td>-0.57</td></tr>
<tr><td>Ms. Chang</td><td>-0.03</td></tr>
</table>
Three teachers gathered data from students on the number of hours of television watched in the week before the Regents exam and the Regents exam score. They plotted their data on scatterplots and calculated the correlation coefficient. The results are shown here. Interpret the differences in the correlation coefficients for each teacher in context.</td></tr>
<tr><td>LEVEL 4
<i>(meets standard)</i></td><td>Use the graphing calculator to determine the correlation coefficient of a linear model and assess the strength and direction of the fit.</td><td>(Jan. 2015 Alg. I Regents, #35) A nutritionist collected information about different brands of beef hot dogs. She made a table showing the number of Calories and the amount of sodium in each hot dog. Write the correlation coefficient for the line of best fit. Round your answer to the <i>nearest hundredth</i>. Explain what the correlation coefficient suggests in the context of this problem.

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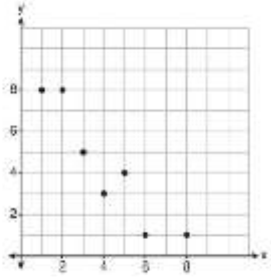
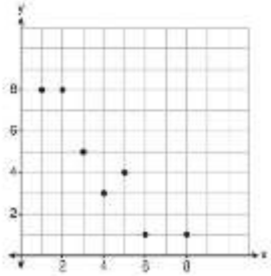
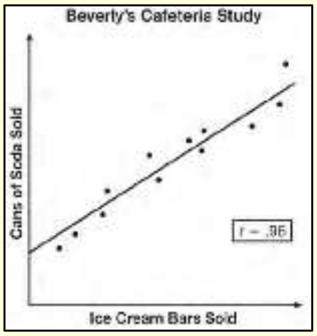
<tr><td>158</td><td>370</td></tr>
<tr><td>139</td><td>322</td></tr>
</table></td></tr>
<tr><td>LEVEL 3</td><td>Use the graphing calculator to determine the correlation coefficient and direction of a linear model.</td><td>(June 2014 Alg. I Regents, #11) What is the correlation coefficient of the linear fit of the data shown here, to the <i>nearest hundredth</i>?
(1) 1.00
(2) 0.93
(3) −0.93
(4) −1.00
 </td></tr>
<tr><td>LEVEL 2</td><td>Identify a strong or weak association given a correlation coefficient.</td><td>A bivariate quantitative data set with a roughly linear association has a correlation coefficient of <i>r</i> = -0.81. Comment on the strength of the association.</td></tr>
<tr><td>LEVEL 1</td><td>Distinguish between scatterplots that show a negative correlation and scatterplots that show a positive correlation.</td><td>A bivariate quantitative data set is represented on the accompanying scatterplot. Is the correlation for this data positive, negative, or approximately zero?
 </td></tr>
</table>

(S-ID.C.9) Distinguish between correlation and causation.

Emphasis:	■■■ Major content (58-73% of Regents)
Related:	Create scatterplots (S-ID.B.6) Fit linear, quadratic, exponential functions to data (S-ID.B6a) Plot and analyze residuals (S-ID.B.6b) Fit a linear function to a scatterplot (S-ID.B.6c) Interpret slope and intercept of a linear model in context (S-ID.C.7) Calculate and interpret correlation coefficient for linear fit (S-ID.C.8)

	TASK	EXAMPLE
LEVEL 5 *(exceeds standard)*	Generate and explain examples of relationships that are correlated and causal or correlated but not causal.	Give an example of relationships that are correlated but not causal.
LEVEL 4 *(meets standard)*	Distinguish between relationships that are correlated and relationships that are causal.	Beverly did a study this past spring using data she collected from a cafeteria. She recorded data weekly for ice cream sales and soda sales. Beverly found the line of best fit and the correlation coefficient, as shown in the diagram below.  Given this information, which statement(s) can correctly be concluded? I. Eating more ice cream causes a person to become thirsty. II. Drinking more soda causes a person to become hungry. III. There is a strong correlation between ice cream sales and soda sales. (1) I, only (2) III, only (3) I and III (4) II and III
LEVEL 3	Recognize relationships that are correlated and explain why they are correlated.	Is there a correlation between the pace of a runner and the amount of time spent running? Justify your answer.
LEVEL 2	Recognize relationships that are causal.	Is the relationship between the pace of a runner and the amount of time spent running causal?
LEVEL 1	Define a causal relationship and a correlated relationship.	Define a causal relationship.