Algebra 1 Math Standards and “I Can Statements”

Standard - CC.9-12.A.CED.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.

- I can solve linear and exponential equations in one variable
- I can solve inequalities in one variable
- I can describe the relationships between the quantities in the problem (for example, how the quantities are changing or growing with respect to each other); express these relationships using mathematical operations to create an appropriate equation or inequality to solve
- I can create equations (linear and exponential) and inequalities in one variable and use them to solve problems
- I can create equations and inequalities in one variable to model real-world situations
- I can compare and contrast problems that can be solved by different types of equations (linear and exponential)

Standard - CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

- I can identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent
- I can create at least two equations in two or more variables to represent relationships between quantities
- I can justify which quantities in a mathematical problem or real-world situation are dependent and independent of one another and which operations represent those relationships
- I can determine appropriate units for the labels and scale of a graph depicting the relationship between equations created in two or more variables
- I can graph one or more created equation on a coordinate axes with appropriate labels and scales
Standard - CC.9-12.A.CED.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.

- I can recognize when a modeling context involves constraints
- I can interpret solutions as viable or nonviable options in a modeling context
- I can determine when a problem should be represented by equations, inequalities, systems of equations and/or inequalities
- I can represent constraints by equations or inequalities, and by systems of equations and/or inequalities

Standard - CC.9-12.A.CED.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 \( R \).

- I can define a “quantity of interest” to mean any number or algebraic quantity (e.g. \( 2(a/b) = d \), in which \( 2 \) is the quantity of interest showing that \( d \) must be even; \( \pi r^2 h / 3 = V_{cone} \) and \( \pi r^2 h = V_{cylinder} \) showing that \( V_{cylinder} = 3 * V_{cone} \)
- I can rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. (e.g. \( \pi * r^2 \) can be re-written as \((\pi * r) * r \) which makes the form of this expression resemble \( b*h \))

Standard - CC.9-12.N.Q.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.

- I can calculate unit conversions
- I can recognize units given or need to solve problems
- I can use given units and the context of a problem as a way to determine if the solution to a multi-step problem is reasonable (e.g. length problems dictate different units than problems dealing with a measure such as slope)
- I can choose appropriate units to represent a problem when using formulas or graphing
- I can interpret units or scales used in formulas or represented in graphs
- I can use units as a way to understand problems and to guide the solution of multi-step problems
**Standard - CC.9-12.N.Q.2** Define appropriate quantities for the purpose of descriptive modeling.

- I can define descriptive modeling
- I can determine appropriate quantities for the purpose of descriptive modeling

**Standard - CC.9-12.N.Q.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

- I can identify appropriate units of measurement to report quantities
- I can determine the limitations of different measurement tools
- I can choose and justify a level of accuracy and/or precision appropriate to limitations on measurement when reporting quantities
- I can identify important quantities in a problem or real-world context

**Standard - CC.9-12.A.SSE.1a** Interpret expressions that represent a quantity in terms of its context.*(*Modeling standard).

A. Interpret parts of an expression, such as terms, factors, and coefficients.

- I can, for expressions that represent a contextual quantity, define and recognize parts of an expression, such as terms, factors, and coefficients
- I can, for expressions that represent a contextual quantity, interpret parts of an expression, such as terms, factors, and coefficients in terms of the context

**Standard - CC.9-12.A.SSE.1b** Interpret expressions that represent a quantity in terms of its context.*(*Modeling standard).

B. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of $P$ and a factor not depending on $P$.*

- I can, for expressions that represent a contextual quantity, interpret complicated expressions, in terms of the context, by viewing one or more of their parts as a single entity.
Standard - CC.9-12.A.REI.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.

- I can demonstrate that solving an equation means that the equation remains balanced during each step
- I can recall the properties of equality
- I can explain why, when solving equations, it is assumed that the original equation is equal
- I can determine if an equation has a solution
- I can choose an appropriate method for solving the equation
- I can justify solution(s) to equations by explaining each step in solving a simple equation using the properties of equality, beginning with the assumption that the original equation is equal
- I can construct a mathematically viable argument justifying a given, or self-generated, solution method

Standard - CC.9-12.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

- I can recall properties of equality
- I can solve multi-step equations in one variable
- I can solve multi-step inequalities in one variable
- I can determine the effect that rational coefficients have on the inequality symbol and use this to find the solution set
- I can solve equations and inequalities with coefficients represented by letters

Standard - CC.9-12.A.REI.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.

- I can recognize and use properties of equality to maintain equivalent systems of equations
- I can justify that replacing one equation in a two-equation system with the sum of that equation and a multiple of the other will yield the same solutions as the original system
**Standard - CC.9-12.A.REI.6** Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

- I can solve systems of linear equations by any method
- I can justify the method used to solve systems of linear equations exactly and approximately focusing on pairs of linear equations in two variables

**Standard - CC.9-12.A.REI.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).

- I can recognize that the graphical representation of an equation in two variables is a curve, which may be a straight line
- I can explain why each point on a curve is a solution to its equation

**Standard - CC.9-12.A.REI.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.* (Modeling Standard)

- I can recognize and use function notation to represent linear and exponential equations
- I can recognize that if \((x_1, y_1)\) and \((x_2, y_2)\) share the same location in the coordinate plane that \(x_1 = x_2\) and \(y_1 = y_2\)
- I can recognize that \(f(x) = g(x)\) means that there may be particular inputs of \(f\) and \(g\) for which the outputs of \(f\) and \(g\) are equal
- I can explain why the x-coordinates of the points where the graph of the equations \(y=f(x)\) and \(y=g(x)\) intersect are the solutions of the equations \(f(x) = g(x)\). (Include cases where \(f(x)\) and/or \(g(x)\) are linear and exponential equations)
- I can approximate/find the solution(s) using an appropriate method for example, 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 and exponential equations)
**Standard - CC.9-12.A.REI.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.

- I can identify characteristics of a linear inequality and system of linear inequalities, such as: boundary line (where appropriate), shading, and determining appropriate test points to perform tests to find a solutions set
- I can explain the meaning of the intersection of the shaded regions in a system of linear inequalities
- I can graph a line, or boundary line, and shade the appropriate region for a two variable linear inequality
- I can graph a system of linear inequalities and shade the appropriate overlapping region for a system of linear inequalities

**Standard - CC.9-12.F.LE.1a** Distinguish between situations that can be modeled with linear functions and with exponential functions. Prove that linear functions grow by equal differences over equal intervals and that exponential functions grow by equal factors over equal intervals.

- I can recognize that linear functions grow by equal differences over equal intervals
- I can recognize that exponential functions grow by equal factors over equal intervals
- I can distinguish between situations that can be modeled with linear functions and with exponential functions to solve mathematical and real-world problems
- I can prove that linear functions grow by equal differences over equal intervals
- I can prove that exponential functions grow by equal factors over equal intervals

**Standard - CC.9-12.F.LE.1b.** Distinguish between situations that can be modeled with linear functions and with exponential functions. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

- I can recognize situations in which one quantity changes at a constant rate per unit (equal differences) interval relative to another to solve mathematical and real-world problems

**Standard - CC.9-12.F.LE.1c** Distinguish between situations that can be modeled with linear functions and with exponential functions. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
I can recognize situations in which a quantity grows or decays by a constant percent rate per unit (equal factors) interval relative to another to solve mathematical and real-world problems.

Standard - CC.9-12.F.LE.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).

- I can recognize arithmetic sequences can be expressed as linear functions
- I can recognize geometric sequences can be expressed as exponential functions
- I can construct linear functions, including arithmetic sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)
- I can construct exponential functions, including geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table)
- I can determine when a graph, a description of a relationship, or two input-output pairs (include reading these from a table) represents a linear or exponential function in order to solve problems

Standard - CC.9-12.F.LE.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.

- I can informally define the concept of “end behavior”
- I can compare tables and graphs of linear and exponential functions to observe that a quantity increasing exponentially exceeds all others to solve mathematical and real-world problems

Standard - CC.9-12.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

- I can recognize the parameters in a linear or exponential function including: vertical and horizontal shifts, vertical and horizontal dilations
- I can recognize rate of change and intercept as “parameters” in linear or exponential functions
- I can interpret the parameters in a linear or exponential function in terms of a context
Standard - CC.9-12.N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define \(5^{(1/3)}\) to be the cube root of 5 because we want \((5^{(1/3)})^3 = 5^{[(1/3) \times 3]}\) to hold, so \((5^{(1/3)})^3\) must equal 5.

- I can define radical notation as a convention used to represent rational exponents
- I can explain the properties of operations of rational exponents as an extension of the properties of integer exponents
- I can explain how radical notation, rational exponents, and properties of integer exponents relate to one another

Standard - CC.9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

- I can, using the properties of exponents, rewrite a radical expression as an expression with a rational exponent
- I can, using the properties of exponents, rewrite an expression with rational exponent as a radical expression

Standard - CC.9-12.F.IF.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 \(y = f(x)\).

- I can identify the domain and range of a function
- I can determine if a relation is a function
- I can determine the value of the function with proper notation (i.e. \(f(x) = y\), the \(y\) value is the value of the function at a particular value of \(x\))
- I can evaluate functions for given values of \(x\)

Standard - CC.9-12.F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

- I can identify mathematical relationships and express them using function notation
- I can define a reasonable domain, which depends on the context and/or mathematical situation, for a function focusing on linear and exponential functions
- I can evaluate functions at a given input in the domain, focusing on linear and exponential functions

- I can interpret statements that use functions in terms of real world situations, focusing on linear and exponential functions

**Standard - CC.9-12.F.IF.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 \( n \geq 1 \) (\( n \) is greater than or equal to 1).

- I can recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the *Fibonacci sequence is defined by* \( f(0)=f(1)=1, f(n+1) = f(n) + f(n-1) \) for \( n \geq 1 \)

**Standard - CC.9-12.F.IF.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.* (Modeling Standard)

- I can define and recognize the key features in tables and graphs of linear and exponential functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, and end behavior

- I can identify whether the function is linear or exponential, given its table or graph

- I can interpret key features of graphs and tables of function in the terms of the contextual quantities the function represents

- I can sketch graphs showing key features of a function that models a relationship between two quantities from a given verbal description of the relationship

**Standard - CC.9-12.F.IF.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.* (Modeling Standard)

- I can, given the graph or a verbal/written description of a function, identify and describe the domain of the function

- I can identify an appropriate domain based on the unit, quantity, and type of the function it describes

- I can relate the domain of the function to its graph and, where applicable, to the quantitative relationship it describes

- I can explain why a domain is appropriate for a given situation
Standard - CC.9-12.F.IF.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. *(Modeling Standard)

- I can recognize slope as an average rate of change
- I can calculate the average rate of change of a function (presented symbolically or as a table) over a specified interval
- I can estimate the rate of change from a linear or exponential graph
- I can interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval

Standard - CC.9-12.F.IF.7a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *(Modeling standard).

A. Graph linear and quadratic functions and show intercepts, maxima, and minima.

- I can graph linear functions by hand in simple cases or using technology for more complicated cases and show/label intercepts of the graph

Standard - CC.9-12.F.IF.7e Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. *(Modeling standard).

E. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

- I can graph exponential functions by hand in simple cases or using technology for more complicated cases, and show intercepts and end behavior
- I can determine the difference between simple and complicated linear and exponential functions and know when the use of technology is appropriate

Standard - CC.9-12.F.IF.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.

- I can identify types of functions based on verbal, numerical, algebraic, and graphical descriptions and state key properties (e.g. intercepts, growth rates, average rates of change, and end behaviors)
• I can differentiate between exponential and linear functions using a variety of descriptors (graphically, verbally, numerically, and algebraically)

• I can use a variety of function representations algebraically, graphically, numerically in tables, or by verbal descriptions) to compare and contrast properties of two functions

**Standard - CC.9-12.F.BF.1a** Write a function that describes a relationship between two quantities.*(Modeling standard).

A. Determine an explicit expression, a recursive process, or steps for calculation from a context.

• I can define “explicit function” and “recursive process”

• I can write a function that describes a relationship between two quantities by determining an explicit expression, a recursive process, or steps for calculation from a context

**Standard - CC.9-12.F.BF.1b** Write a function that describes a relationship between two quantities.*(Modeling standard). Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

• I can combine two functions using the operations of addition, subtraction, multiplication, and division

• I can evaluate the domain of the combines function

• I can build standard functions to represent relevant relationships/quantities given a real-world situation or mathematical process

• I can determine which arithmetic operation should be performed to build the appropriate combined function given a real-world situation or mathematical process

• I can relate the combined function to the context of the problem
Standard - CC.9-12.F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.* (*Modeling standard)

- I can identify arithmetic and geometric patterns in given sequences
- I can generate arithmetic and geometric sequences from recursive and explicit formulas
- I can, given an arithmetic or geometric sequence in recursive form, translate into the explicit formula
- I can, given an arithmetic or geometric sequence as an explicit formula, translate into the recursive form
- I can use given and constructed arithmetic and geometric sequences, expresses both recursively and with explicit formulas, to model real-life situations
- I can determine the recursive rule given arithmetic and geometric sequences
- I can determine the explicit formula given arithmetic and geometric sequences
- I can justify the translation between the recursive form and explicit formula for arithmetic and geometric sequences

Standard - CC.9-12.F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, kf(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

- I can identify the effect a single transformation will have on the function (symbolic or graphic)
- I can use technology to identify effects of single transformations on graphs of functions
- I can graph a given function by replacing f(x) with f(x)+k, kf(x), f(kx), or f(x+k) for specific values of k (both positive and negative)
- I can describe the differences and similarities between a parent function and the transformed function
- I can find the value of k, given the graphs of a parent function, f(x), and the transformed function: f(x)+k, kf(x), f(kx), or f(x+k)
- I can recognize even and odd functions from their graphs and from their equations
- I can experiment with cases and illustrate an explanation of the effects on the graph using technology

**Standard - CC.9-12.S.ID.1** Represent data with plots on the real number line (dot plots, histograms, and box plots).* (Statistics and Probability is a Modeling Conceptual Category)
- I can represent data with plots on the real number line using various display types by creating dot plots, histograms and box plots

**Standard - CC.9-12.S.ID.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.* (Statistics and Probability is a Modeling Conceptual Category)
- I can choose the appropriate measure for center (mean, median) and spread (interquartile range, standard deviation) based on the shape of a data distribution
- I can use appropriate statistics for center and spread to compare two or more data sets

**Standard - CC.9-12.S.ID.3** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). (Statistics and Probability is a Modeling Conceptual Category)
- I can define “the context of data sets” as measuring the specific nature of the attributes under investigation
- I can interpret differences in shape, center and spread in the context of data sets
- I can describe the possible effects the presence of outliers in a set of data can have on shape, center, and spread in the context of the data sets

**Standard - CC.9-12.S.ID.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. (Statistics and Probability is a Modeling Conceptual Category)
- I can recognize the differences between joint, marginal and conditional relative frequencies
- I can calculate relative frequencies including joint, marginal and conditional relative frequencies
- I can summarize categorical data for two categories in two-way frequency tables
- I can interpret relative frequencies in the context of the data
- I can recognize possible associations and trends in the data
**Standard - CC.9-12.S.ID.6a** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. 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. (Statistics and Probability is a Modeling Conceptual Category)

- I can represent data on a scatter plot (2 quantitative variables)
- I can fit a given function class (e.g. linear, exponential) to data
- I can, using given scatter plot data represented on the coordinate plane, informally describe how the two quantitative variables are related
- I can determine which function best models scatter plot data represented on the coordinate plane, and describe how the two quantitative variables are related
- I can use functions fitted to data to solve problems in the context of the data

**Standard - CC.9-12.S.ID.6b** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Informally assess the fit of a function by plotting and analyzing residuals. (Statistics and Probability is a Modeling Conceptual Category)

- I can represent the residuals from a function and the data set it models numerically and graphically
- I can informally assess the fit of a function by analyzing residuals from the residual plot

**Standard - CC.9-12.S.ID.6c** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. Fit a linear function for a scatter plot that suggests a linear association. (Statistics and Probability is a Modeling Conceptual Category)

- I can fit a linear function for a scatter plot that suggests a linear association

**Standard - CC.9-12.S.ID.7** Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (Statistics and Probability is a Modeling Conceptual Category)

- I can interpret the slope (rate of change) and model the intercept (constant term) of a linear model in the context of the data

**Standard - CC.9-12.S.ID.8** Compute (using technology) and interpret the correlation coefficient of a linear fit. (Statistics and Probability is a Modeling Conceptual Category)
• I can compute (using technology) the correlation coefficient of a linear fit

• I can define the correlation coefficient

• I can interpret the correlation coefficient of a linear fit as a measure of how well the data fit the relationship

**Standard - CC.9-12.S.ID.9** Distinguish between correlation and causation. (Statistics and Probability is a Modeling Conceptual Category)

• I can define positive, negative, and no correlation and explain why correlation does not imply causation

• I can define causation

• I can distinguish between correlation and causation

**Standard - CC.9-12.A.APR.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.

• I can identify that the sum, difference, or product of two polynomials will always be a polynomial, which means that polynomials are closed under the operations of addition, subtraction, and multiplication

• I can define “closure”

• I can apply arithmetic operations of addition, subtraction, and multiplication to polynomials

**Standard - CC.9-12.A.REI.4a** Solve quadratic equations in one variable. 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.

• I can 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

• I can solve quadratic equations in one variable

• I can derive the quadratic formula by completing the square on a quadratic equation in x

**Standard - CC.9-12.A.REI.4b** Solve quadratic equations in one variable. 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.
- I can solve quadratic equations by inspection (e.g., for \( x^2 = 49 \)), taking square roots, completing the square, the quadratic formula and factoring

- I can determine appropriate strategies (see first knowledge target listed) to solve problems involving quadratic equations, as appropriate to the initial form of the equation

- I can recognize when the quadratic formula gives complex solutions

**Standard - CC.9-12.A.REI.7** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line \( y = -3x \) and the circle \( x^2 + y^2 = 3 \).

- I can transform a simple system consisting of a linear equation and quadratic equation in 2 variables so that a solution can be found algebraically and graphically

- I can explain the correspondence between the algebraic and graphical solutions to a simple system consisting of a linear equation and a quadratic equation in 2 variables

**Standard - CC.9-12.A.CED.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.

- I can solve quadratic equations in one variable

- I can solve quadratic inequalities in one variable

- I can create quadratic equations and inequalities in one variable and use them to solve problems

- I can create quadratic equations and inequalities in one variable to model real-world situations

**Standard - CC.9-12.A.CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

- I can identify the quantities in a mathematical problem or real-world situation that should be represented by distinct variables and describe what quantities the variables represent

- I can graph one or more created equation on a coordinate axes with appropriate labels and scales

- I can create at least two equations in two or more variables to represent relationships between quantities

- I can justify which quantities in a mathematical problem or real-world situation are dependent and independent of one another and which operations represent those relationships
• I can determine appropriate units for the labels and scale of a graph depicting the relationship between equations created in two or more variables.

**Standard - CC.9-12.A.CED.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.*

• I can define a “quantity of interest” to mean any numerical or algebraic quantity (e.g. \(2(a/b)\) = d, in which 2 is the quantity of interest showing that d must be even; \(\pi r^2h/3 = V_{cone}\) and \(\pi r^2h = V_{cylinder}\) showing that \(V_{cylinder} = 3*V_{cone}\))

• I can rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations (e.g. \(\pi r^2\) can be re-written as \((\pi r)^*r\) which makes the form of this expression resemble \(b*h\))

**Standard - CC.9-12.A.SSE.1a** Interpret expressions that represent a quantity in terms of its context.*(Modeling standard)

A. Interpret parts of an expression, such as terms, factors, and coefficients.*

• I can define and recognize parts of an expression, such as terms, factors, and coefficients for expressions that represent a contextual quantity

• I can interpret parts of an expression, such as terms, factors, and coefficients in terms of the context for expressions that represent a contextual quantity

**Standard - CC.9-12.A.SSE.1b** Interpret expressions that represent a quantity in terms of its context.*(Modeling standard) 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 \(P\).

• I can interpret complicated expressions, in terms of the context, by viewing one or more of their parts as a single entity for expressions that represent a contextual quantity

**Standard - CC.9-12.A.SSE.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 \((x^2 - y^2)(x^2 + y^2)\).

• I can identify ways to rewrite expressions, such as difference of squares, factoring out a common monomial, regrouping, etc

• I can identify ways to rewrite expressions based on the structure of the expression

• I can use the structure of an expression to identify ways to rewrite it.
I can classify expression by structure and develop strategies to assist in classification

Standard - CC.9-12.A.SSE.3a Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*(Modeling standard)  
A. Factor a quadratic expression to reveal the zeros of the function it defines.

- I can factor a quadratic expression to produce an equivalent form of the original expression
- I can explain the connection between the factored form of a quadratic expression and the zeros of the function it defines
- I can explain the properties of the quantity represented by the quadratic expression
- I can choose and produce an equivalent form of a quadratic expression to reveal and explain properties of the quantity represented by the original expression

Standard - CC.9-12.A.SSE.3b Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*(Modeling standard)  
B. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.*

- I can complete the square on a quadratic expression to produce an equivalent form of an expression
- I can explain the connection between the completed square form of a quadratic expression and the maximum or minimum value of the function it defines
- I can explain the properties of the quantity represented by the expression
- I can choose and produce an equivalent form of a quadratic expression to reveal and explain properties of the quantity represented by the original expression

Standard - CC.9-12.A.SSE.3c Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*(Modeling standard)  
Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as \([1.15^{(1/12)}]^{12t} \approx 1.012^{(12t)}\) to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

- I can use the properties of exponents to transform simple expressions for exponential functions
- I can use the properties of exponents to transform expressions for exponential functions.

- I can choose and produce an equivalent form of an exponential expression to reveal and explain properties of the quantity represented by the original expression.

- I can explain the properties of the quantity or quantities represented by the transformed exponential expression.

**Standard - CC.9-12.F.BF.1a** Write a function that describes a relationship between two quantities.* (Modeling Standard)

A. Determine an explicit expression, a recursive process, or steps for calculation from a context.

- I can define “explicit function” and “recursive process”

- I can write a function that describes a relationship between two quantities by determining an explicit expression, a recursive process, or steps for calculation from a context.

**Standard - CC.9-12.F.BF.1b** Write a function that describes a relationship between two quantities.* (Modeling Standard)

B. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

- I can combine two functions using the operations of addition, subtraction, multiplication, and division.

- I can evaluate the domain of the combined function.

- I can build standard functions to represent relevant relationships/quantities.

- I can determine which arithmetic operation should be performed to build the appropriate combined function.

- I can relate the combined function to the context of the problem.
**Standard - CC.9-12.F.BF.3** Identify the effect on the graph of replacing \( f(x) \) by \( f(x) + k \), \( k f(x) \), \( f(kx) \), 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

- I can identify the effect on the graph given a single transformation on a function (symbolic or graphic)

- I can identify effects of single transformations on graphs of functions using technology

- I can graph a given function by replacing \( f(x) \) by \( f(x) + k \), \( kf(x) \), \( f(kx) \), and \( f(x + k) \) for specific values of \( k \) (both positive and negative)

- I can describe the differences and similarities between a parent function and the transformed function

- I can find the value of \( k \), given the graphs of a parent function, \( f(x) \), and the transformed function: \( f(x) + k \), \( kf(x) \), \( f(kx) \), and \( f(x + k) \)

- I can recognize even and odd functions from their graphs and from their equations

- I can experiment with cases and illustrate an explanation of the effects on the graph using technology

**Standard - CC.9-12.F.BF.4a** Find the inverse functions.
Solve an equation of the form \( f(x) = c \) for a simple function \( f \) that has an inverse and write an expression for the inverse. For example, \( f(x) = 2(x^3) \) or \( f(x) = (x + 1)/(x - 1) \) for \( x \neq 1 \) (\( x \) not equal to 1).

- I can define inverse function

- I can solve an equation of the form \( f(x) = c \) for a simple function \( f \) that has an inverse and write an expression for the inverse
Standard - CC.9-12.F.IF.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.* (Modeling Standard)

- I can define and recognize the key features in tables and graphs of linear, exponential, and quadratic functions: intercepts; intervals where the function is increasing, decreasing, positive, or negative, relative maximums and minimums, symmetries, and end behavior
- I can identify whether the function is linear, exponential, or quadratic, given its table or graph
- I can interpret key features of graphs and tables of functions in the terms of the contextual quantities the function represents
- I can sketch graphs showing key features that models a relationship between two quantities from a given verbal description of the relationship

Standard - CC.9-12.F.IF.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.* (Modeling Standard)

- I can identify and describe the domain of the function given the graph or a verbal/written description of a function
- I can identify an appropriate domain based on the unit, quantity, and type of function it describes
- I can relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes
- I can explain why a domain is appropriate for a given real-world situation

Standard - CC.9-12.F.IF.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.* (Modeling Standard)

- I can recognize slope as an average rate of change
• I can calculate the average rate of change of a function (presented symbolically or as a table) over a specified interval

• I can estimate the rate of change from a linear, exponential, or quadratic graph

• I can interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval

Standard - CC.9-12.F.IF.7a Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (Modeling standard)

Graph linear and quadratic functions and show intercepts, maxima, and minima.

• I can graph linear and quadratic functions, by hand in simple cases or using technology for more complicated cases, and show/label intercepts, maxima, and minima of the graph

• I can determine the differences between simple and complicated linear, exponential and quadratic functions and know when the use of technology is appropriate

Standard - CC.9-12.F.IF.7b Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* (Modeling standard)

C. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.*

• I can graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions, by hand in simple cases or using technology for more complicated cases, and show/label key features of the graph

• I can determine the difference between simple and complicated linear, quadratic, square root, cube root, and piecewise-defined functions, including step functions and absolute value functions and know when the use of technology is appropriate

• I can compare and contrast the domain and range of absolute value, step and piece-wise defined functions with linear, quadratic, and exponential

Standard - CC.9-12.F.IF.8a Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

A. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

• I can identify different forms of a quadratic expression

• I can write functions in equivalent forms using the process of factoring

• I can identify zeros, extreme values, and symmetry of the graph of a quadratic function
• I can interpret different but equivalent forms of a function defined by an expression in terms of context

• I can use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and intercept these in terms of a context

**Standard - CC.9-12.F.IF.8b** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

B. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as \( y = (1.02)^t, y = (0.97)^t, y = (1.01)^{(12t)}, y = (1.2)^{(t/10)}, \) and classify them as representing exponential growth and decay.

• I can classify the exponential function as exponential growth or decay by examining the base

• I can use the properties of exponents to interpret expressions for exponential functions in a real-world context

**Standard - CC.9-12.F.IF.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.

• I can identify types of functions based on verbal, numerical, algebraic, and graphical descriptions and state key properties (e.g. intercepts, minima, minima, growth rates, average rates of change, and end behaviors)

• I can differentiate between exponential, linear, and quadratic functions using a variety of descriptors (graphically, verbally, numerically, and algebraically)

• I can use a variety of function representations (algebraically, graphically, numerically in tables, or by verbal descriptions) to compare and contrast properties of two functions

**Standard - CC.9-12.N.RN.3** Explain why the sum or product of 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

• I can find the sums and products of rational and irrational numbers

• I can recognize that the sum of a rational number and an irrational number is irrational

• I can recognize that the product of a nonzero rational number and irrational number is irrational
• I can explain why rational numbers are closed under addition or multiplication

**Standard - CC.9-12.F.LE.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.

• I can fluently compute growth rates for linear, exponential and quadratic functions

• I can compare tables and graphs of exponential and other polynomial functions to observe that a quantity increasing exponentially exceeds all others to solve mathematical and real-world problems