Algebra 1

ELG HS.A.7: Create equations that describe numbers or relationships.

Vertical Progression:

7th Grade	**7.EE.B Solve real-life and mathematical problems using numerical and algebraic expressions and equations.** ○ **7.EE.B.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations to solve problems by reasoning about the quantities. ○ **7.EE.B.4.a** Solve word problems leading to equations of the form px + q = r and p(x + q) = r, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution.
8th Grade	**8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.** ○ **8.EE.C.7** Solve linear equations in one variable ○ **8.EE.C.7a** Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form x = a, a = a, or a = b results (where a and b are different numbers.) ○ **8.EE.C.7.b** Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms. ○ **8.EE.C.8** Analyze and solve pairs of simultaneous linear equations. ○ **8.EE.C.8c**- Solve real-world and mathematical problems leading to two linear equations in two variables. **8.F.B Use functions to model relationships between quantities.** ○ **8.F.B.4** Construct a function to model a linear relationship between two quantities. Determine a rate of change and initial value of the function from a description of a relationship or two (x, y) values including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models and in terms of its graph or a table of values.
Algebra 1	**ELG.MA.HS.A.7: Create equations that describe numbers or relationships.** ○ **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 exponential functions.* ○ **A-CED.2** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. ○ **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.* ○ **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.* Note: Functions may include linear, quadratic, exponential, polynomial (quadratic or cubic), square root, cube root, and piecewise-defined functions (including step and absolute value).
Algebra 2	**ELG.MA.HS.A.7: Create equations that describe numbers or relationships.** ○ **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.* Note: Functions may include linear, quadratic, exponential, polynomial, square root, cube root, piecewise defined (including step and absolute value), **rational, trigonometric, and logarithmic.**

Students will demonstrate command of the ELG by:

- Determining the best model and equation for the real-world problem.
- Defining the variable(s).
- Creating equations and inequalities in one variable and using them to solve problems.
- Creating equations in two or more variables to represent relationships between quantities.
- Graphing equations on coordinate axes with labels and scales.
- Representing constraints by equations or inequalities and interpreting solutions as viable or non-viable options in a modeling context.
- Representing constraints by systems of equations and/or inequalities and interpreting solutions as viable or non-viable options in a modeling context.
- Rearranging formulas to highlight a quantity of interest.

Vocabulary:

- constraints
- coordinate axes
- equation
- exponential function
- inequality
- linear function
- quadratic function
- scale
- solutions
- system of equations
- system of inequalities
- viable region/option

Sample Instructional/Assessment Tasks:

1) **Standard(s):** A.CED.A.3, A.CED.A.1

Bernardo and Sylvia Play a Game

Source: Illustrative Mathematics
https://www.illustrativemathematics.org/content-standards/HSA/CED/A/3/tasks/1010

Item Prompt:

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?

Correct Answer:

The smallest initial number for which Bernardo wins after one round is the smallest integer solution of $2n+50 \geq 1000$, which is 475. The smallest initial number for which he wins after two rounds is the smallest integer solution of $2n+50 \geq 475$, which is 213. Similarly, the smallest initial numbers for which he wins after three and four rounds are 82 and 16, respectively. There is no initial number for which Bernardo wins after more than four rounds. Thus the smallest integer where Bernardo wins is 16.

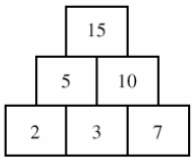
2) Standard(s): A-CED.A.2, A-CED.A.3

Number Towers

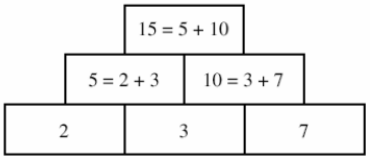
Source: *http://www.insidemathematics.org/assets/common-core-math-tasks/number%20towers.pdf*

Item Prompt:

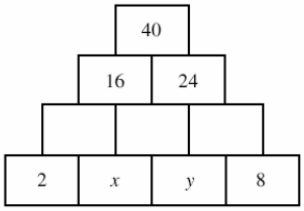
An addition number tower is shown below.



In this tower, each number is the sum of the two numbers just below it.



Marcie makes a bigger number tower:



1. Compete the number tower by writing algebraic expressions in the empty boxes.
2. Use the completed number tower to show that 2x + y = 14 and x + 2y = 16.
3. Find values of x and y that satisfy both equations: 2x + y = 14 and x + 2y = 16.

Solution:

1. 2 + x, x + y, y + 8
2. 2 + 2x + y = 16 therefore 2x + y = 14; and x + 2y + 8 = 24 therefore x + 2y = 16
3. x = 4, y = 6

Note: Extension, student work exemplars, and explanations can be found via link (http://www.insidemathematics.org/assets/common-core-math-tasks/number%20towers.pdf)