Claim 1: Concepts and Procedures
Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Content Domain: **Expressions and Equations**

Target D [m]: Analyze and solve linear equations and pairs of simultaneous linear equations. (DOK Levels 1, 2)

Tasks for this target will ask students to solve linear equations in one variable and recognize when one, infinite, or no solutions exist. Some problems will require students to apply the distributive property and collect like terms.

Tasks for this target will also ask students to solve systems of two linear equations in two variables algebraically and estimate solutions graphically. Some problems will ask students to recognize simple cases of two equations that represent the same line or that have no solution. This target may be combined with 8.F Target F to create problems where students determine a point of intersection given an initial value and rate of change, including cases where no solution exists.

Real-world and mathematical problems that lead to two linear equations in two variables will be assessed in connection with targets from Claims 2 and 4.

Standards: 8.EE.C, 8.EE.7, 8.EE.8	**8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.** **8.EE.7** Solve linear equations in one variable. a. 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). 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.8** Analyze and solve pairs of simultaneous linear equations. a. Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously. b. Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.* c. Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line though the first pair of points intersects the line through and second pair.*
Related Below-Grade and Above-Grade Standards for Purposes of Planning for Vertical Scaling:	**Related Grade 7 Standards** **7.EE.A Use properties of operations to generate equivalent expressions.** **7.EE.1** Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational

7.EE.A, 7.EE.1, 7.EE.B, 7.EE.3, 7.EE.4 A-CED.A, A–CED.1, A–CED.2, A–CED.3, A–CED.4	coefficients. **7.EE.B Solve real-life and mathematical problems using numerical and algebraic expressions and equations.** **7.EE.3** Solve multi–step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.* **7.EE.4** Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. 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, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.* **Related High School Standards** **A-CED.A 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.* **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 nonviable 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.*

DOK Levels:	1, 2
Achievement Level Descriptors:	
RANGE Achievement Level Descriptor (Range ALD) Target D: Analyze and solve linear equations and pairs of simultaneous linear equations.	**Level 1** Students should be able to solve linear equations in one variable with integer coefficients.
	Level 2 Students should be able to analyze and solve systems of linear equations graphically by understanding that the solution of a system of linear equations in two variables corresponds to the point of intersection on a plane. They should be able to solve and produce examples of linear equations in one variable with rational coefficients with one solution, infinitely many solutions, or no solution.
	Level 3 Students should be able to classify systems of linear equations as intersecting, collinear, or parallel; solve linear systems algebraically and estimate solutions using a variety of approaches; and show that a particular linear equation has one solution, no solution, or infinitely many solutions 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). They should be able to solve and produce examples of linear equations in one variable, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
	Level 4 Students should be able to analyze and solve problems leading to two linear equations in two variables in multiple representations.
Evidence Required:	1. The student identifies and writes examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. 2. The student solves linear equations in in one variable with rational number coefficients, including equations with solutions that require expanding expressions using the distributive property and collecting like terms. 3. The student estimates solutions by graphing systems of two linear equations in two variables. 4. The student recognizes when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions. 5. The student solves a system of two linear equations in two variables algebraically, or solves real-world and mathematical problems leading to two linear equations in two variables.
Allowable Item Types:	Multiple Choice, single correct response; Multiple Choice, multiple correct response; Drag and Drop, Equation/Numeric, Graphing
Allowable Stimulus Materials:	Linear equations, solutions of linear equations, systems of linear equations (a single brace may be used to indicate a system), solutions of systems of linear equations, graphs of systems of linear equations, real-world scenarios that can be modeled by systems of linear equations, mathematical scenarios that can be modeled by systems of linear equations

Construct-Relevant Vocabulary:	Linear equation, y–intercept, slope, standard form, intersection, system, solution, coefficient, constant, ordered pair, x-coordinate, y–coordinate
Allowable Tools:	Calculator
Target–Specific Attributes	Equations must be linear with rational coefficients.
Non–Targeted Constructs:	
Accessibility Concerns:	Visual graphics may be difficult or not accessible for students who are blind or visually impaired. Reviewing tactile graphs may be time consuming but not prohibitive. The simplest graphics should be used to minimize this issue. Students with dyscalculia may have difficulty with the calculations. Students with visual perceptual disabilities may struggle with answer choices that contain complex number sentences. Students who are visually impaired or blind may need enlarged or brailled text. Students with reading disabilities may struggle with the reading load of word problems. All vocabulary should be at or below grade level to minimize this issue. Students with reading disabilities may need to read the text aloud, or have access to trackers or maskers to follow along. Students with visual processing impairments may benefit from using a tracker or masker when reading. Students with physical impairments may need to use an adapted mouse or others a computer with eye scanning capabilities. Drag and Drop response types may not be accessible for students who are visually impaired. Consider replacing these response types with multiple choice items for Braille versions. The accommodations listed here are suggestions and could be altered depending on what accommodations will be allowable.
Developmental Notes:	8.EE.8a will be assessed in connection with targets from Claims 2 and 3.

Task Model 1 **Response Type: Drag and Drop** **DOK Level 2** **8.EE.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). **Evidence Required:** 1. The student identifies and writes examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. **Tools:** Calculator	**Prompt Features:** The student is prompted to recognize and solve linear equations in one variable that results in exactly one solution, infinitely many solutions, or no solutions. **Stimulus Guidelines:** Item difficulty can be adjusted via these example methods: • Equations will have one operation on each side. Integer coefficients only. • Equations require collecting like terms. Integer coefficients only. • Equations require distribution and collecting like terms. Integer coefficients only. • Equations have fraction coefficients and require students to collect like terms. Missing term cannot have a fraction coefficient. • Equations have fraction coefficients and require students to distribute and collect like terms. Missing term cannot have a fraction coefficient. **TM1a** **Stimulus:** The student is presented with linear equations in one variable with missing numbers. **Example Stem 1:** Drag a number into each box that would create an equation that has exactly one real solution. $3(2x+5)-x=\square x+\square$ **Rubric:** (1 point) Correct answer is any number that does not have a coefficient of 5 and any number as the constant. **Example Stem 2:** Drag a number into each box that would create an equation that has no real solution. $3(2x+5)-x=\square x+\square$ **Rubric:** (1 point) Correct answer has a coefficient of 5 with any number as the constant. **Example Stem 3:** Drag a number into each box that would create an equation that has an infinite number of solutions. $3(2x+5)-x=\square x+\square$ **Rubric:** (1 point) Correct answer has a coefficient of 5 and a constant of 5. **Response Type:** Drag and Drop

Task Model 1 **Response Type: Multiple Choice, multiple correct response** **DOK Level 2** **8.EE.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). **Evidence Required:** 1. The student identifies and writes examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. **Tools:** Calculator	**Prompt Features:** The student is prompted to recognize and solve linear equations in one variable that results in exactly one solution, infinitely many solutions, or no solutions. **Stimulus Guidelines:** Item difficulty can be adjusted via these example methods: • Equations will have one operation on each side. Integer coefficients only. • Equations require collecting like terms. Integer coefficients only. • Equations require distribution and collecting like terms. Integer coefficients only. • Equations have fraction coefficients and require students to collect like terms. Missing term cannot have a fraction coefficient. • Equations have fraction coefficients and require students to distribute and collect like terms. Missing term cannot have a fraction coefficient. **TM1b** **Stimulus:** The student is presented with linear equations in one variable with missing numbers. **Example Stem:** Select **all** equations that have no solution. A. $6x - 2 - 3x = 3x - 2$ B. $6x - (3x + 8) = 16x$ C. $10 + 6x = 15 + 9x - 3x$ D. $11 + 3x - 7 = 6x + 5 - 3x$ **Answer Choices:** Each answer choice is a linear equation with one solution, infinitely many solutions, or no solutions. **Rubric:** (1 point) Student selects all the correct equations and no incorrect equations (e.g., C and D). **Response Type:** Multiple Choice, multiple correct response

Task Model 1 **Response Type: Multiple Choice, single select response** **DOK Level 2** **8.EE.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). **Evidence Required:** 1. The student identifies and writes examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. **Tools:** Calculator	**Prompt Features:** The student is prompted to analyze linear equations in one variable that result in exactly one solution, infinitely many solutions, or no solutions. **Stimulus Guidelines:** Item difficulty can be adjusted via these example methods: • Equations will have one operation on each side. Integer coefficients only. • Equations require collecting like terms. Integer coefficients only. • Equations require distribution and collecting like terms. Integer coefficients only. • Equations have fraction coefficients and require students to collect like terms. Missing term cannot have a fraction coefficient. • Equations have fraction coefficients and require students to distribute and collect like terms. Missing term cannot have a fraction coefficient. **TM1c** **Stimulus:** The student is presented with linear equations in one variable with missing numbers. **Example Stem:** Kim is solving the following linear equation. $11 + 3x - 7 = 6x + 5 - 3x$ Her final two steps are: $4 + 3x = 3x + 5$ $4 = 5$ Select the statement that correctly interprets Kim's solution. A. The solution is $x = 0$. B. The solution is the ordered pair (4, 5). C. There is no solution since $4 = 5$ is a false statement. D. There are infinitely many solutions since $4 = 5$ is a false statement. **Answer Choices:** Distractors are incorrect statements about the interpretation of the solution. If $x = 0$, students may incorrectly identify that as an equation that has no solution. **Rubric:** (1 point) Correct answer is the statement that describes the solution to the system of equations (e.g., C). **Response Type:** Multiple Choice, single correct response

Task Model 2
 	
Response Type: Equation/Numeric
 	
DOK Level 2
 	
8.EE.7b
Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.
 	
Evidence Required:
2. The student solves linear equations in in one variable with rational number coefficients, including equations with solutions that require expanding expressions using the distributive property and collecting like terms.
 	
Tools: Calculator
	Prompt Features: The student is prompted to solve linear equations that require expanding expressions and collecting like terms.
	
	Stimulus Guidelines:
	• Equation requires student to collect like terms or use the distributive property.
	• Item difficulty can be adjusted via these example methods:
	  ○ Collecting like terms
	  ○ Use of the distributive property
	  ○ integer coefficients
	  ○ Rational coefficients
	  ○ Variables on one side of the equation
	  ○ Variables on both sides of the equation.
	
	TM2
	Stimulus: The student is presented with a linear equation in one variable.
	
	Example Stem: Enter the value for x that makes the equation $-4(x + 13) + 3x = 80$ true.
	
	Rubric: (1 point) Correct answer is the numerical solution to x and all its equivalent values (e.g., −132).
	
	Response Type: Equation/Numeric

Task Model 3

Response Type: Equation/Numeric

DOK Level 1

8.EE.8b
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.*

Evidence Required:
3. The student estimates solutions by graphing systems of two linear equations in two variables.

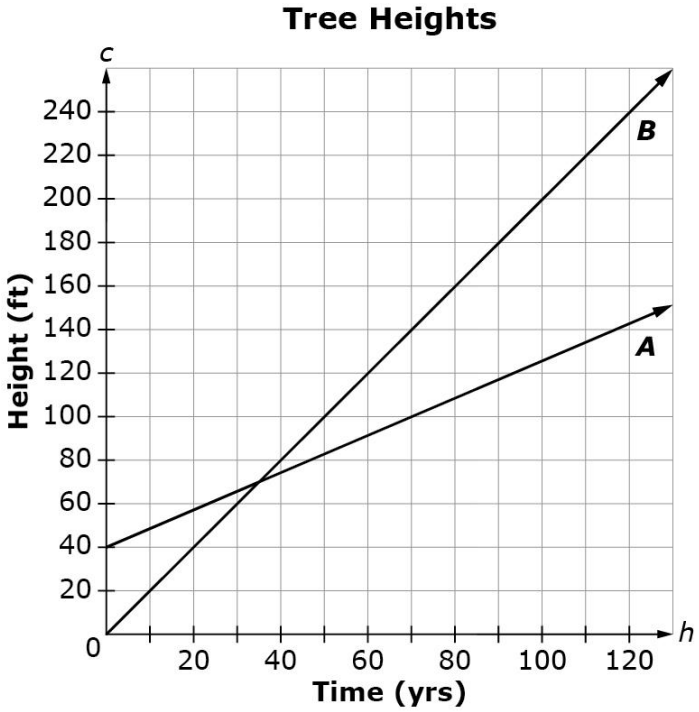
Tools: Calculator

Prompt Features: The student identifies solutions to a system of two linear equations in two variables by locating points of intersection of their graphs.

Stimulus Guidelines:
- Context should be familiar to 13–15 year olds.
- Student interprets graph for either the x value, or the y value, within the given context.
- Item difficulty can be adjusted via these example methods:
  - Point of intersection on graph is on intersecting grid lines.
  - Point of intersection on graph is not intersecting grid lines.

TM3a
Stimulus: The student is presented with a graph of two linear equations having one solution.

Example Stem: The graph shown compares the height of Tree *A* and the height Tree *B* over time (in years).



How many years after Tree *B* was planted did Tree *A* and Tree *B* have the same height?

Rubric: (1 point) Student correctly gives the appropriate value from the coordinate point (e.g., 35 years).

Response Type: Equation/Numeric

Task Model 3

Response Type: Graphing

DOK Level 2

8.EE.8b
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.*

Evidence Required:
3. The student estimates solutions by graphing systems of two linear equations in two variables.

Tools: Calculator

Prompt Features: The student is prompted to graph one of the equations in a system of two linear equations in two variables with one solution.

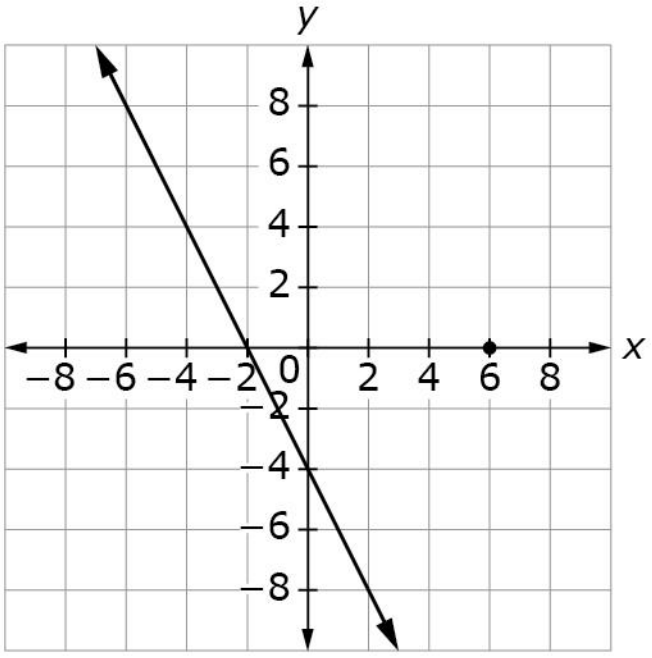
Stimulus Guidelines:

- The student uses the Add Arrow tool to draw the line on a coordinate grid with labeled x– and y–axes and a scale.
- The student uses the Add Point tool to plot the solution to the system of equations.
- y-intercept of the equation the student will graph should be integers
- Item difficulty can be adjusted via these example methods:
  - Equation graphed by the student is in slope-intercept form; coefficient, constant, and slope are positive integers
  - Equation graphed by the student is in slope-intercept form with rational number coefficients; slope is an integer
  - Equation graphed by the student is in standard form; slope is a rational number
  - Equation graphed by the student is in standard form with rational coefficients; slope is a positive or negative fraction

TM3b
Stimulus: The student is presented with a system of two linear equations. One of the equations is graphed.

Example Stem: The graph of $2x - y = 4$ is shown.

Use the Add Arrow tool to graph the equation $y = 3x - 2$ on the same coordinate plane. Use the Add Point tool to plot the solution to this system of linear equations.



	Interaction: The student uses the [double] Add Arrow tool to graph a line on a grid. The student uses the Add Point tool to place a point on the graph. **Rubric:** (1 point) The student plots the line correctly and places a point on the point of intersection. **Response Type:** Graphing

Task Model 4
 	
Response Type: Multiple Choice, single correct response
 	
DOK Level 2
 	
8.EE.8b
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
 	
Evidence Required:
4. The student recognizes when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions.
 	
Tools: Calculator
	Prompt Features: The student is prompted to identify if a system of linear equations has one solution, no solution, or infinitely many solutions.
	
	Stimulus Guidelines:
	• System of two linear equations in two variables with integer coefficients
	• Item difficulty can be adjusted via these example methods:
	  ○ Equations are written in the same form
	  ○ Equations are written in different forms
	  ○ The x- and y-coefficients are the same in both equations
	  ○ The coefficients in one equation are not multiples of the coefficients of the other equation
	  ○ The x- and y- coefficients in one equation are whole number or fractional multiples of the coefficients in the other equation
	  ○ The constant is the same in both equations
	  ○ The constant is different in each equation
	
	TM4
	Stimulus: The student is presented with two linear equations in two variables.
	
	Example Stem 1: A system of two linear equations has no solution. One equation is $3x + y = -2$. Select the equation that would make this system have no solution.
	
	A. $2x + y = 4$
	B. $2x + y = 5$
	C. $3x + y = 4$
	D. $4x + y = 5$
	
	Answer Choices: The correct answer is the linear equation in two variables that satisfies the given condition for the number of solutions. The distractors will be equations that yield other solution sets that do not satisfy the given condition.
	
	Rubric: (1 point) Correct answer is the linear equation in two variables that satisfies the given condition for the number of solutions (e.g., C).
	
	Response Type: Multiple Choice, single correct response
	
	Example Stem 2: Select the statement that correctly describes the solution to this system of equations.
	
	$3x + y = -2$
	$x - 2y = 4$
	
	A. There is no solution.
	B. There are infinitely many solutions.
	C. There is exactly one solution at (−2, −4).
	D. There is exactly one solution at (0, −2).

	Answer Choices: The correct answer is the statement that describes the solution to the system of equations such as "There are infinitely many solutions," "There is no solution" or "There is exactly one solution at (a, b)." The distractors will be statements that incorrectly describe the solution to the system of equation including "There is exactly one solution at (a, b)," where (a, b) is not a correct solution to the system of equations. **Rubric:** (1 point) Correct answer is the statement that describes the solution to the system of equations (e.g., D). **Response Type:** Multiple Choice, single correct response

Task Model 5 **Response Type: Equation/Numeric** **DOK Level 2** **8.EE.8b** Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. *For example,* $3x + 2y = 5$ *and* $3x + 2y = 6$ *have no solution because* $3x + 2y$ *cannot simultaneously be 5 and 6.* **Evidence Required:** 5. The student solves a system of two linear equations in two variables algebraically, or solves real-world and mathematical problems leading to two linear equations in two variables. **Tools:** Calculator	**Prompt Features:** The student is prompted to solve two linear equations in two variables. **Stimulus Guidelines:** • Sets of linear equations in two variables with one solution • Item difficulty can be adjusted via these example methods: ○ The equations are written with integer coefficients: ▪ Both equations are in slope-intercept form, $y = mx + b$, and $b = 0$ for at least one equation. ○ The equations are written with integer coefficients: ▪ Both equations are in slope-intercept form, $y = mx + b$, and $b \neq 0$. ○ Both equations are in standard form with integer coefficients. ○ Equations are in different forms with fraction or decimal coefficients. **TM5a** **Stimulus:** Two linear equations in two variables with exactly one solution, where the student enters either the *x*-coordinate or the *y*-coordinate. **Example Stem:** Enter the *y* coordinate of the solution to this system of equations. $3x + y = -2$ $x - 2y = 4$ **Rubric:** (1 point) Student enters the correct numerical solution (e.g., –2). **Response Type:** Equation/Numeric

Task Model 5 **Response Type: Equation/Numeric** **DOK Level 2** **8.EE.8c** Solve real-world and mathematical problems leading to two linear equations in two variables. *For example, given coordinates for two pairs of points, determine whether the line though the first pair of points intersects the line through and second pair.* **Evidence Required:** 5. The student solves a system of two linear equations in two variables algebraically, or solves real-world and mathematical problems leading to two linear equations in two variables. **Tools:** Calculator	**Prompt Features:** The student is prompted to solve a real-world problem with two linear equations with two variables. **Stimulus Guidelines:** Item difficulty can be adjusted via these example methods: • Using integer values • Rational numbers including fractions and decimals to the tenths place. **TM5b** **Stimulus:** The student is presented with a real-world content that can be represented by two linear equations with two variables. **Example Stem 1:** A tree that is 8 feet tall is growing at a rate of 1 foot each year. A tree that is 10 feet tall is growing at a rate of $\frac{1}{2}$ foot each year. Enter the number of years it will take the two trees to reach the same height. **Rubric:** (1 point) Student enters the correct numerical solution (e.g., 4). **Response Type:** Equation/Numeric