Grade 8 Target D

Domain, Target, Standards, DOK, Vertical Alignments, Achievement Levels, Evidence Required, Vocabulary, Response Types, Materials, Attributes, Question Types, and Question Banks (Examples)

Content Domain:Expressions and Equations

Target D [m]: 8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.

Standards included in Target D: 8.EE.C, 8.EE.C.7, 8.EE.C.8

8.EE.C Analyze and solve linear equations and pairs of simultaneous linear equations.

8.EE.C.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.C.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.

Vertical Alignment

Related Grade 7 standards

7.EE.A Use properties of operations to generate equivalent expressions.

7.EE.A.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.

7.EE.B Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

7.EE.B.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.B.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 Grade HS Standards

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.

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Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

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.

A–CED.A.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.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.

Achievement Level Descriptors

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 having graphs that are intersecting, collinear, or parallel; solve linear systems algebraically and estimate solutions using a variety of approaches; and show that a linear equation in one variable 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 one variable with rational 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.

Vocabulary

Linear equation, y–intercept, slope, standard form, intersection, system, solution, coefficient, constant, ordered pair, x-coordinate, y–coordinate

Response Types

Multiple Choice, single correct response; Multiple Choice, multiple correct response; Drag and Drop, Equation/Numeric, Graphing

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

Attributes

None

Claim 1: Concepts and Procedures (DOK 1, 2) Question Banks

Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Claim 1 8.EE.C.7a DOK Level 2

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

The student identifies and writes examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions.

Question Type 1: The student is presented with a linear equation in one variable with missing numbers.

1. Drag a number into each box to create an equation that has exactly one real solution.

$3(2x+5)-x=$ ☐ $x+$ ☐

Rubric: (1 point) Correct answer is any number other than 5 for the coefficient of x and any number as the constant.

2. Drag a number into each box to create an equation that has no real solution.

$3(2x+5)-x=$ ☐ $x+$ ☐

Rubric: (1 point) Correct answer is 5 for the coefficient of x and any number other than 15 for the constant.

3. Drag a number into each box to create an equation that has an infinite number of solutions.

$3(2x+5)-x=$ ☐ $x+$ ☐

Rubric: (1 point) Correct answer has 5 for the coefficient of x and 15 for the constant.

Response Type: Drag and Drop

Question Type 2: The student is presented with linear equations in one variable.

1. Select all equations that have no solution.

A. $6x-2-3x = 3x-2$
B. $x-(3x+8) = 16x$
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

Question Type 3: The student is presented with linear equations in one variable.

1. 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 because there is no x in the final equation.

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

Claim 1 8.EE.C.7b DOK Level 2

Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

Evidence Required

The student solves linear equations in one variable with rational coefficients, including equations with solutions that require expanding expressions using the distributive property and collecting like terms

Question Type 1: The student is presented with a linear equation in one variable.

1. Enter the value for x that makes the equation $–4(x + 13)+3x= 80$ true.

Rubric: (1 point) Correct answer is the value of xx that solves the equation, expressed in any of its equivalent forms (e.g., –132).

Response Type: Equation/Numeric

Claim 1 8.EE.C.8b DOK Level 1

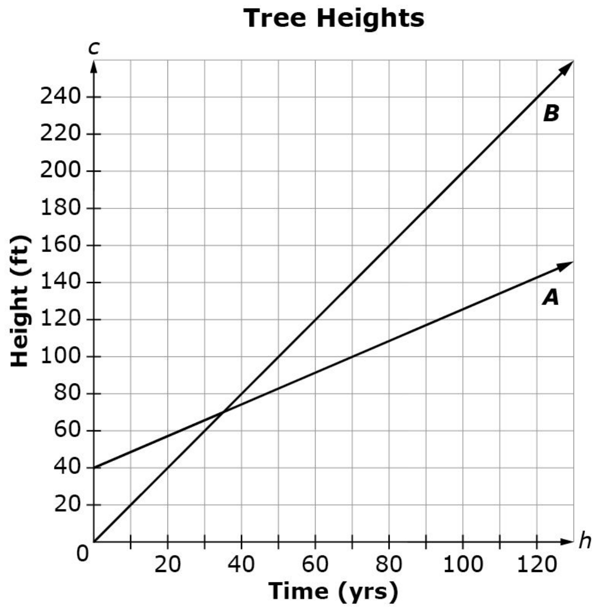
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.

Evidence Required

The student estimates solutions by graphing systems of two linear equations in two variables.

Question Type 1: The student is presented with a graph of a system of two linear equations having one solution.

1. 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

Claim 1 8.EE.C.8b DOK Level 2

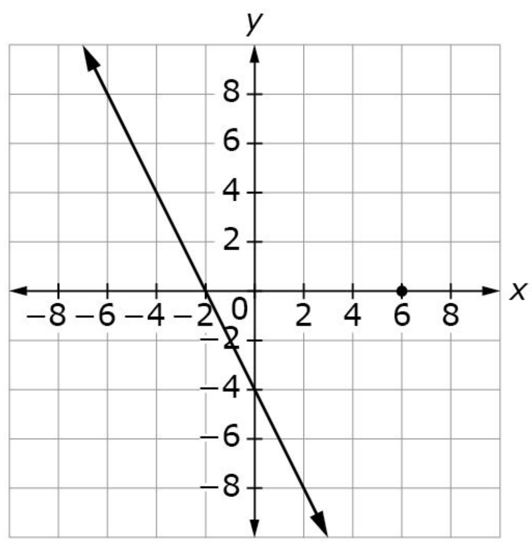
Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6

Evidence Required

The student estimates solutions by graphing systems of two linear equations in two variables.

Question Type 1: The student is presented with a system of two linear equations. One of the equations is graphed.

1. 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 the system consisting of the two 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

Claim 1 8.EE.C.8b DOK Level 2

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

The student recognizes when a system of two linear equations in two variables has one solution, no solution, or infinitely many solutions.

These pages were adapted from open source documents available on the Smarter Balanced Website: http://www.smarterbalanced.org/assessments/development/ August 2016

Question Type 1: The student is presented with two linear equations in two variables.

1. A system of two linear equations has no solution. The first equation is $3x + y = –2$. Select the second 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

2. Select the statement that correctly describes the solution to this system of equations. $3x + y = –2$ $x – 2yy= 4$

    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

Claim 1 8.EE.C.8b DOK Level 2

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

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.

Question Type 1: Two linear equations in two variables with exactly one solution, where the student enters either the x-coordinate or the y-coordinate.

1. 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

Question Type 1: The student is presented with a real-world context that can be represented as a system of two linear equations in two variables.

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 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

Claim 2 Problem Solving Question Banks

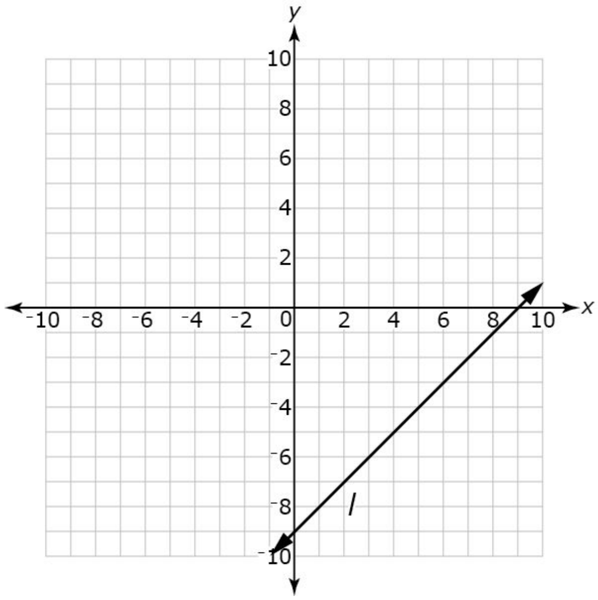
Claim Descriptors and Targets

Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

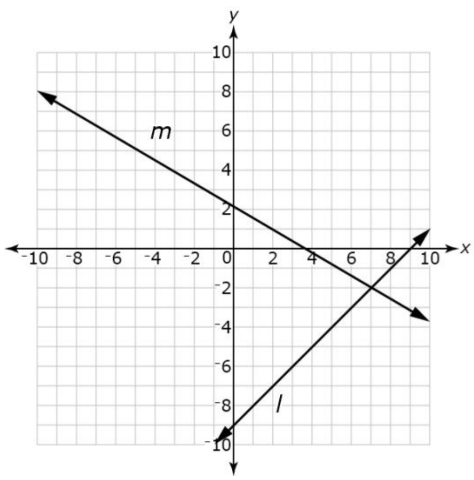
Example 1

Line L is shown on the coordinate plane. Use the Add Arrow tool to draw line M so that:

- Lines L and line M are graphs of a system of linear equations with a solution of (7, −2).
- The slope of line M is greater than −1 and less than 0.
- The y-intercept of line M is positive.



Interaction: The double arrow Add Arrow tool is available, as well as the Add Point tool.
Rubric: (1 point) The student draws a line that meets the requirements (e.g., see below).
Response Type: Graphing



<u>Claim 3 Communicating Reasoning Question Banks</u>
[Claim Descriptors and Targets]

Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

<u>Example 1</u>

Part A

Is it possible for three linear equations in x and y to have a solution common to all three? [drop-down choices: yes, no]

Part B
[If "yes" is selected] Use the Arrow tool to draw the graphs of three equations that have a common solution. Add a point that represents the common solution.
[If "no" is selected] Explain why this is not possible in the response box.

Interaction: The student has to select yes or no before seeing Part B. If the student selects "yes" then he/she sees the graphing tools and is asked to graph the system. If he/she selects "no" there is a text box that asks for an explanation as to it is not possible. The student can change his/her mind.

Rubric: (1 point) The student selects "yes" and draws three lines that intersect in a single point and places a point at the intersection of the three lines (it is allowable for the lines to coincide, but they have to draw three graphs).

Response Type: Drop-Down Menu and Graphing/Short-Text
Note: Functionality for this item type does not currently exist but it could be implemented by showing Parts A and B simultaneously. When possible, the point of having a student try to explain his or her incorrect reasoning is that in the process of trying to construct an argument, he or she may self-correct.

Example 2

The students in Mr. Martin's class are learning about linear equations. Kenny made a claim and two supporting claims about the possible number of solutions to a system of linear equations. Rhonda made a different claim with two supporting claims.
Indicate whether each claim is valid or not valid.

Kenny's Claims		Valid	Not Valid
Claim 1.	A system of two linear equations can only have zero solutions or one solution.		
Claim 1a.	If the corresponding lines are distinct and parallel, then there are no solutions.		
Claim 1b.	If the corresponding lines are distinct and intersect, then there is one solution.		

Rhonda's Claims		Valid	Not Valid
Claim 2.	A system of two linear equations can have more than one solution.		
Claim 2a.	If the corresponding lines intersect in exactly two places, then there will be exactly two solutions.		
Claim 2b.	If the corresponding lines completely coincide, then there are an infinite number of solutions.		

Rubric: (1 point) The student selects the correct claims (NVV, VNV).
Response Type: Matching Table

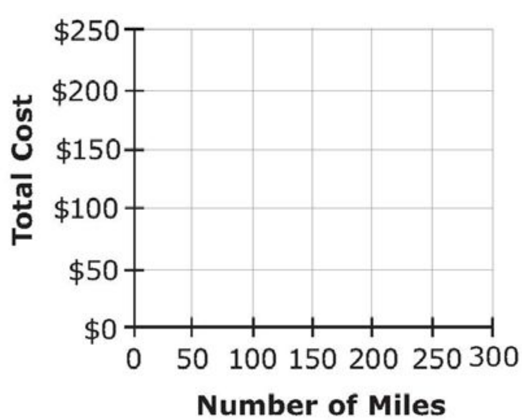
<u>Claim 4 Modeling and Data Analysis Question Banks</u>
Claim Descriptors and Targets

Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

<u>Example 1</u>

This table represents the cost of renting a truck from Moving Company X and Moving Company Y. Each company charges a one-time rental fee plus a charge for each mile driven.

Moving Company	One-time Rental Fee	Charge per Mile
X	$150	$0.25
Y	$ 50	$0.75



Part A

Use the Add Arrow tool to graph two linear equations that represent the cost of using each moving company given a number of miles driven.

Part B

Select the moving company that will be the least expensive to move between the given cities. Refer to the map shown to determine the distances.

Cities	Company A	Company B
Tucson to Phoenix		
Phoenix to Flagstaff		
Tucson to Flagstaff		

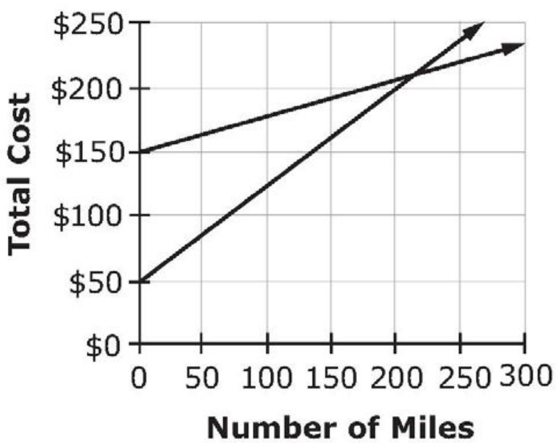
Interaction: The student can use the ruler tool to measure distances on the map.

Rubric: Each part of this item is scored independently for a total of 2 points.

Part A (1 point) The student correctly graphs both functions.

Part B (1 point) The student selects the correct cells in the table.

Exemplar:



Cities	Company A	Company B
Tucson to Phoenix		
Phoenix to Flagstaff		
Tucson to Flagstaff		

Interaction: The Add Arrow tool will be available (with one arrow) to graph the lines, as well as Hot Spot to select the correct cells in the table. Also, the ruler tool needs to be active.

Response Type: Graphing and Hot Spot