

Simultaneous Linear Equations

8.EE.C.8a, 8.EE.C.8c Conceptual Understanding and Application Mini-Assessment by Student Achievement Partners

OVERVIEW

This mini-assessment is designed to illustrate the standard 8.EE.C.8, particularly 8.EE.C.8a and 8.EE.C.8c, which sets an expectation for understanding and applying pairs of simultaneous linear equations (systems of equations). This mini-assessment is designed for teachers to use either in the classroom, for self-learning, or in professional development settings to:

- Gain knowledge about assessing conceptual understanding and application of pairs of simultaneous linear equations;
- Use in professional development as an illustration of CCSS-aligned assessment problems; and
- Evaluate students' understanding of 8.EE.C.8a and 8.EE.C.8c in order to prepare to teach this material or to assess skills and understanding.

MAKING THE SHIFTS

This mini-assessment attends to focus as it addresses linear equations, which are at the heart of the Grade 8 standards and a key component of the major work of the grade.¹ Standard 8.EE.C.8 shows coherence across grades as it builds on foundational work from 6.EE.B.5 (see questions 1–5) to extend understanding of solving an equation to understanding of solving a system of equations. Too often, assessments separate topics so that students are not confronted with choosing the correct solution path. This mini-assessment challenges students to choose whether a linear equation or a system of linear equations correctly models the mathematical situation. In addition, this standard builds on work from grade 7, particularly understanding and using ratios and proportional relationships (7.RP) as well as using equations for problem solving (7.EE.A). Standard 8.EE.C.8a targets *conceptual understanding* and 8.EE.C.8c targets *application*, so this mini-assessment addresses two of the three elements of rigor.

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

8.EE.C.8a. 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.

A CLOSER LOOK

Standard 8.EE.C.8a addresses key concepts important for future student success working with Algebra, Functions, and Modeling. Students should know that a solution to a single equation in two variables is a pair of numbers that makes the equation true. Students should also know that a single equation in two variables generally has infinitely many solutions, in the form of infinitely many pairs of numbers that make the equation true. Solutions to an equation in two variables can be plotted on the coordinate plane. When the equation is linear, these solution pairs will graph in the coordinate plane as a straight line (see cluster 8.EE.B).

Students should know that a solution to a system of simultaneous equations in two variables is a pair of numbers that makes all of the equations true simultaneously. Solutions, if there are any, correspond to points of intersection of the equations' graphs. A system of two simultaneous linear equations in two variables will have 0, 1, or infinitely many solutions. This is easy to understand graphically, since two lines in the plane can have 0, 1, or infinitely many points of intersection.

Standard 8.EE.C.8c requires application of the conceptual understanding described in 8.EE.C.8a. Here the phrase "solve real-world and mathematical problems" shows that we are talking about a mix of application problems set in real-world contexts along with application problems that are purely mathematical. Students should have familiarity with both types of applications so that they are prepared for future work with Algebra, Functions and Modeling.

8.EE.C.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 through the first pair of points intersects the line through the second pair.

¹ For more on the Major Work of the grade, see <http://achievethecore.org/page/639/focus-in-grade-eight>.

8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations

Name: _____

1. Circle the letter next to each option that represents a solution to $2x + 2y = 0$. (1 point)

A. $x = 0$

D. $x = -2$

B. $y = -1$

E. $x = -2, y = -2$

C. $x = 1, y = -1$

F. $x = 0, y = 0$

2. The table below contains single equations in a single variable, single equations in two variables, and pairs of simultaneous equations in two variables. Check the appropriate box to show whether there is no solution, exactly 1 solution, or if there are an infinite number of solutions. (1 point)

| | No Solution | Exactly 1 Solution | Infinite Number of Solutions |
|--------------------------------------|-------------|--------------------|------------------------------|
| $9 = 4x + 7$ | | | |
| $y = 3y + 5$ | | | |
| $y = \frac{x}{2}$ | | | |
| $3x + 6y - 9 = 0$ | | | |
| $x = y$ $1.25x = 1.25y$ | | | |
| $9.9 = 6x + 8y$ $9x = 2.5y - 8.8$ | | | |
| $11x - 2y = 1.5$ $11x - 2y = 2.5$ | | | |

3. A pair of simultaneous equations is shown.

$$y = 7x - 15$$

$$y = -\frac{1}{7}x - 15$$

How many solutions are there? Describe your reasoning. (2 points)

8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations

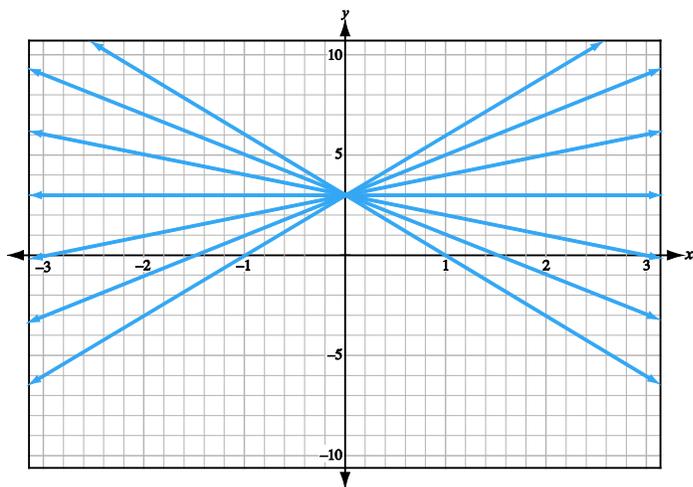
4. Consider the equation $-\frac{4}{3}y - \frac{15}{6}x = \frac{-5}{7}$.

How many solutions are there to this equation? _____

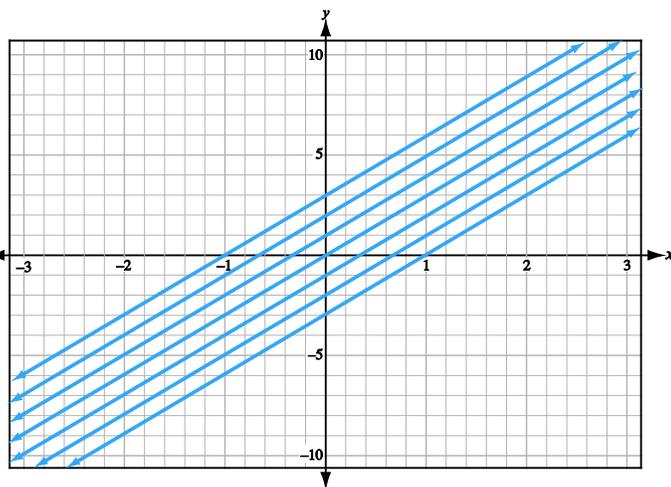
Explain what the graph of the solution(s) will look like on a coordinate plane. (2 points)

5. Which graph below shows graphs of $y = mx + 3$ for several values of m ? (1 point)

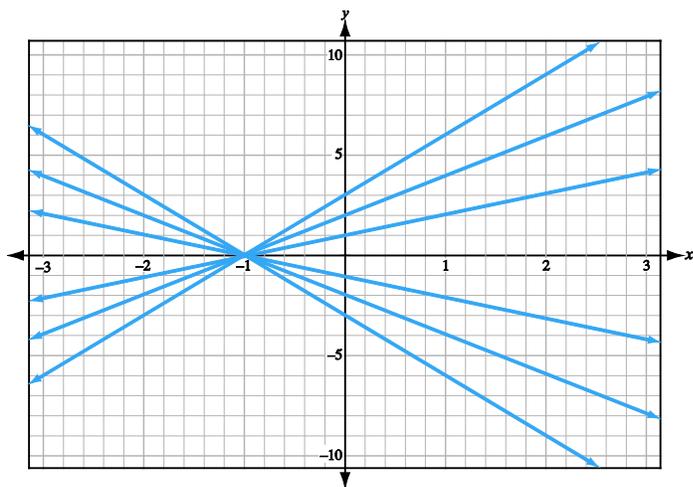
a.



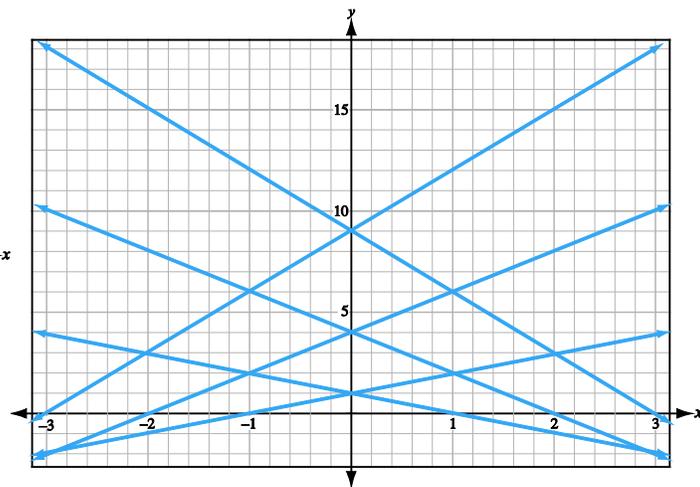
b.



c.

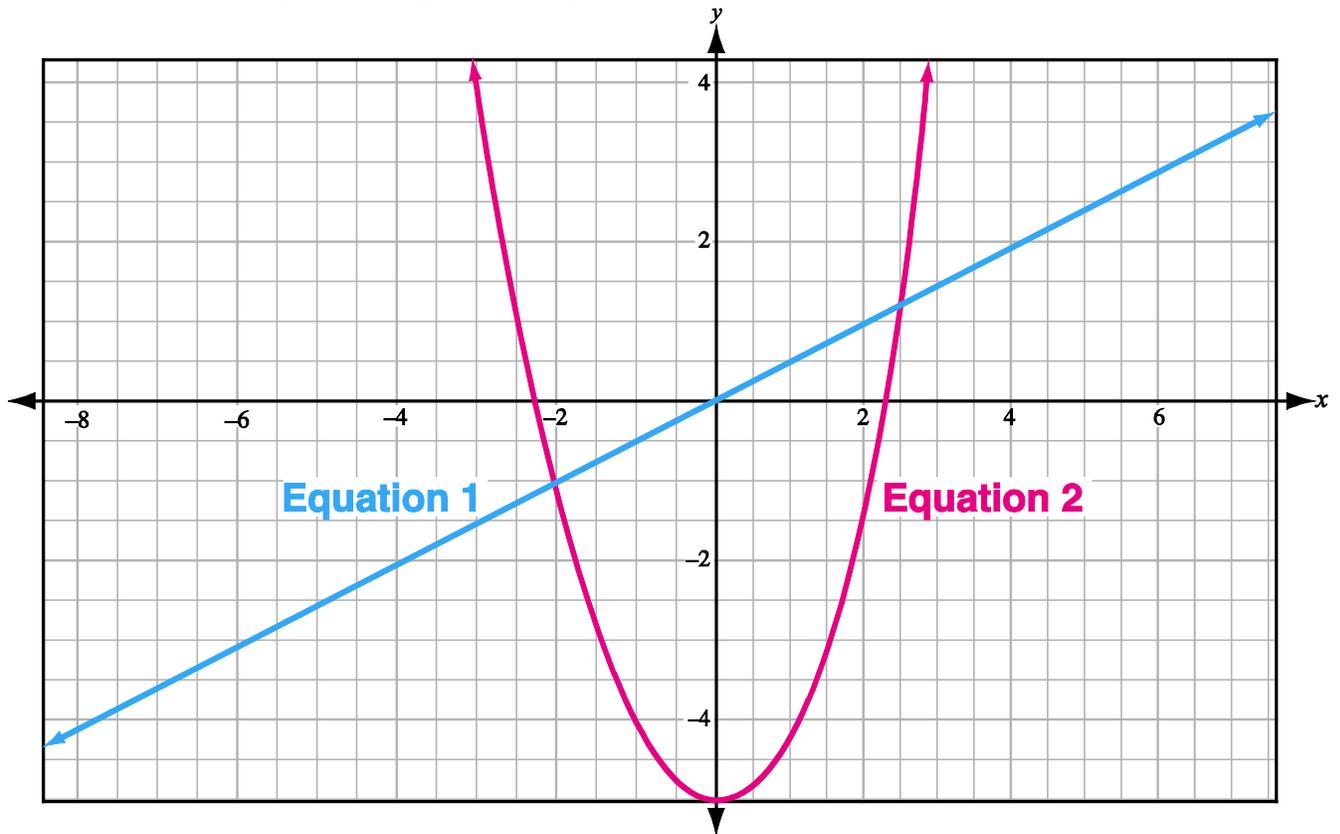


d.



8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations

6. Two equations are graphed below. Circle the point or points on this graph that represent the solution(s) to the system of equations. (1 point)



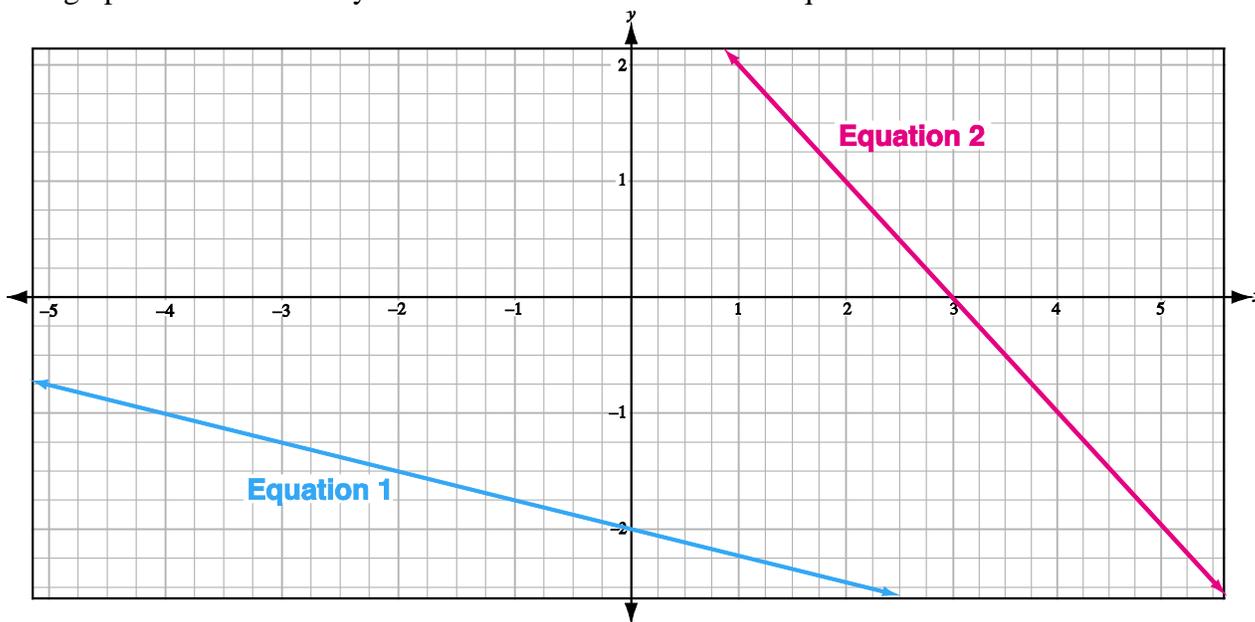
Describe how many solutions there are and how you know that those solutions are correct. (1 point)

7. A music festival charges \$54.95 per ticket sold on the day of the event. A ticket purchased before the festival costs only \$39.95. There were 20,000 tickets sold for a total of \$925,000.

How many tickets did they sell at the music festival? How many tickets did they sell before the music festival? (1 point)

8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations

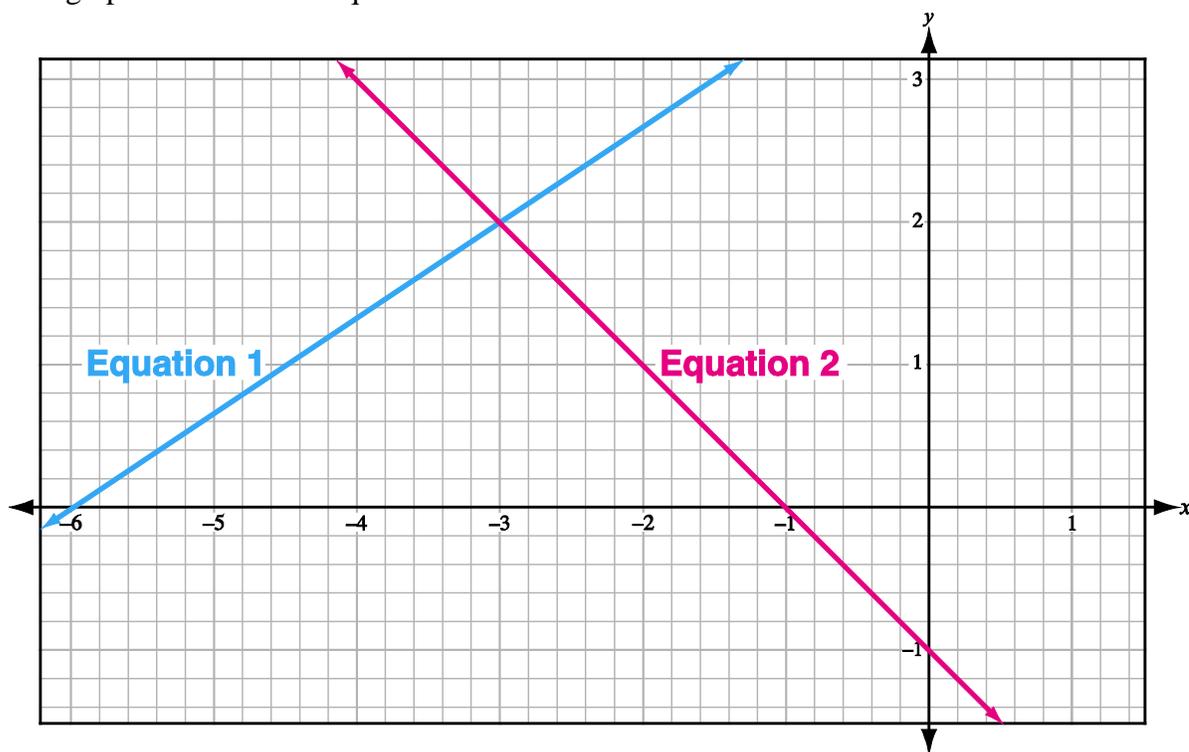
8. The graph below shows a system of two simultaneous linear equations.



How many solutions are there? Describe your reasoning. (2 points)

9. Find the solution(s) to $4x - \frac{4}{7}y - 16 = 0$ and $6x = -7 - 8y$. (1 point)

10. The graphs of two linear equations are shown below.



Check the box next to each correct statement. (1 point)

- | | |
|---|--|
| <input type="checkbox"/> $(-3, 2)$ is a solution for equation 1. | <input type="checkbox"/> $(-2, 1)$ is a solution for equation 1. |
| <input type="checkbox"/> $(-3, 2)$ is a solution for equation 2. | <input type="checkbox"/> $(0, -6)$ is a solution for equation 2. |
| <input type="checkbox"/> $(-3, 2)$ is a solution to both equations. | <input type="checkbox"/> $(-3, 2)$ is the only solution to both equations. |
| <input type="checkbox"/> $(-3, 2)$ is the value of x for the solution to the two equations. | |

11. Henry is four times older than James. Next year, Henry will be three times older than James will be.

How old are Henry and James now? (1 point)

8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations

12. Kim has a small container and a large container as shown.



It takes 16 of the small container to fill the large container. Three small containers leave 1.95 gallons of space in the large container.

What is the size of each of the two containers? (1 point)

13. These two equations form a system of equations:

- The equation $3x + 9 = -4y + 2$
- The equation of the line that passes through the points (0, 1) and (2, 5).

Does this system have a solution? If so, find the solution(s) to the system of equations. (1 point)

8.EE.C.8a & 8.EE.C.8c Conceptual Understanding & Application Mini-Assessment: Simultaneous Linear Equations Answer Key

1. Students receive full credit for only selecting these two choices: **C.** $x = 1, y = -1$ and **F.** $x = 0, y = 0$

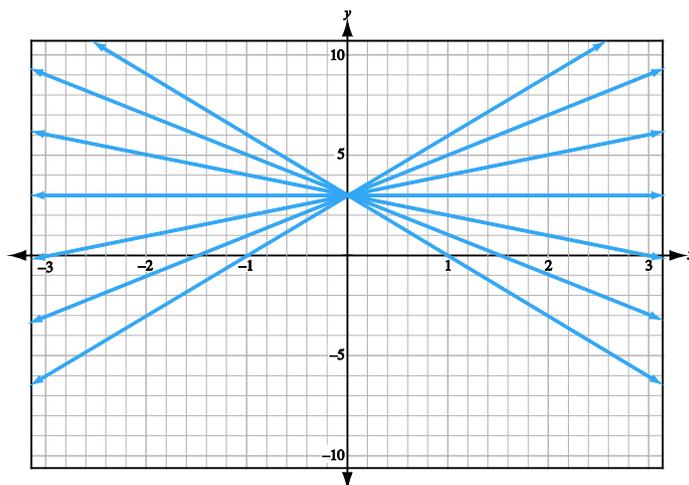
2.

| | No Solution | Exactly 1 Solution | Infinite Number of Solutions |
|--------------------------------------|-------------|--------------------|------------------------------|
| $9 = 4x + 7$ | | ✓ | |
| $y = 3y + 5$ | | ✓ | |
| $y = \frac{x}{2}$ | | | ✓ |
| $3x + 6y - 9 = 0$ | | | ✓ |
| $x = y$ $1.25x = 1.25y$ | | | ✓ |
| $9.9 = 6x + 8y$ $9x = 2.5y - 8.8$ | | ✓ | |
| $11x - 2y = 1.5$ $11x - 2y = 2.5$ | ✓ | | |

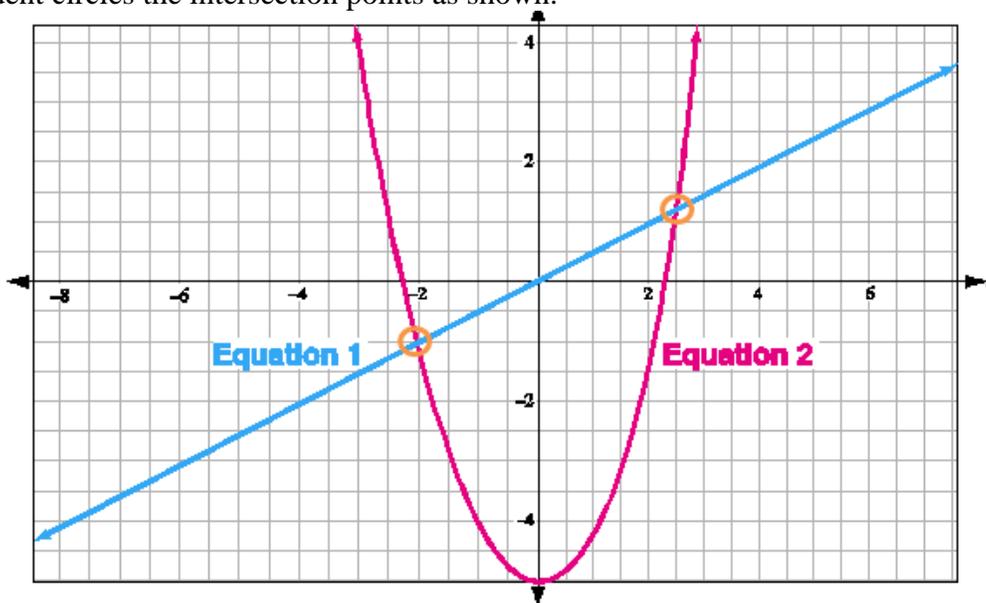
3. There is one solution. (Or any answer that expresses the same idea.)
NOTE: There is a variety of possible explanations, such as “I know when $x = 0$ then $y = -15$ for both equations,” “because the slopes are different, the lines will intersect,” “the graph of the lines are not parallel so they will cross,” etc.

4. Infinitely many solutions. (Or any answer that expresses the same idea.)
The graph will be a line.

5.



6. Student circles the intersection points as shown.



There are two solutions.

There is a variety of possible explanations, including “because the graphs intersect at two points,” “the equations share two values,” “there are two points on the graph of both equations,” etc.

7. 8,400 tickets were sold at the music festival; 11,600 tickets were sold before the music festival

8. There is one solution.

There is a variety of possible explanations, including “because the lines will eventually cross,” “the lines are not parallel,” “the lines have different slopes,” etc.

9. $(3.5, -3.5)$ or any equivalent answer

10. Student only selects these four statements:

- $(-3, 2)$ is a solution for equation 1.
- $(-3, 2)$ is a solution for equation 2.
- $(-3, 2)$ is the solution to the two equations.
- $(-3, 2)$ is the only solution to both equations.

11. James is 2 years old; Henry is 8 years old.

12. The small container holds 0.15 gallons; the large container holds 2.4 gallons.

13. Yes, there is one solution at $(-1, -1)$.