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14 Understanding Systems of Equations

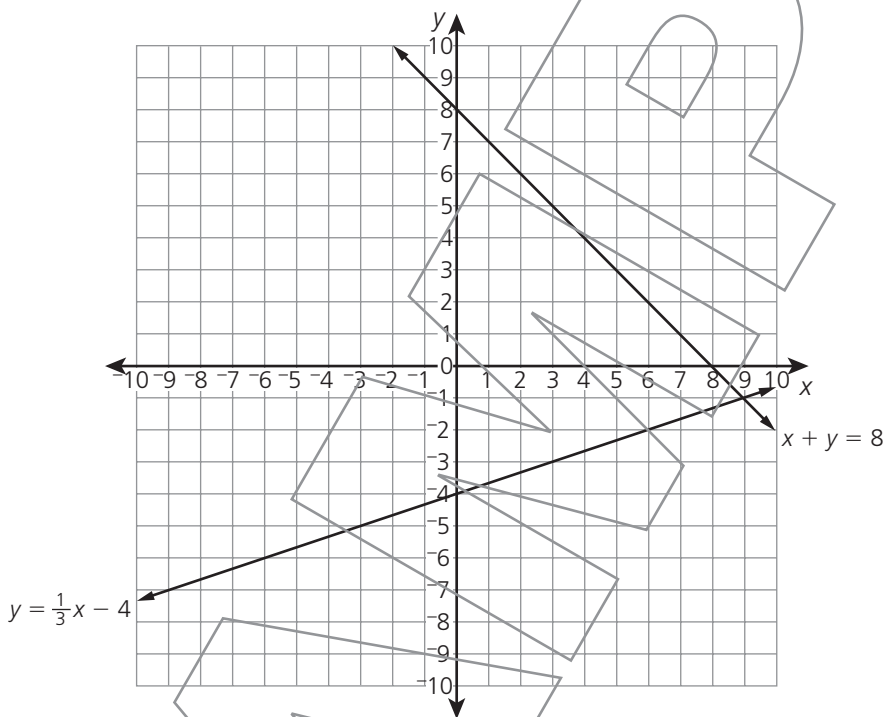
PART 1

Introduction

A **system of equations** is a set of two or more linear equations. A solution to a system of equations is the values of x and y that satisfy both of the equations. On a graph of the two equations, the solution is the point where the two lines intersect.

Find the solution to this system of equations:
$$\begin{cases} x + y = 8 \\ y = \frac{1}{3}x - 4 \end{cases}$$

Plot each line on a graph. Look for the point where the lines intersect.



It is easier to graph an equation when it is in slope-intercept form.

$y = mx + b$, where
 m = slope and
 b = y-intercept

The lines intersect at the point $(9, -1)$. This is the solution to the system of equations. It shows that both equations are true when $x = 9$ and $y = -1$.

Check the solution by substituting both values into the equations to see if the equations are true.

Not all systems of equations have a unique solution. If the lines are parallel, they never intersect, so they have no solution. Lines that are parallel have the same **slope**, or steepness, but cross the y -axis at different points.

Equations that have the same slope and cross the y -axis at the same point form the same line. Because every point overlaps and the lines continue forever, this system of equations has infinite solutions.

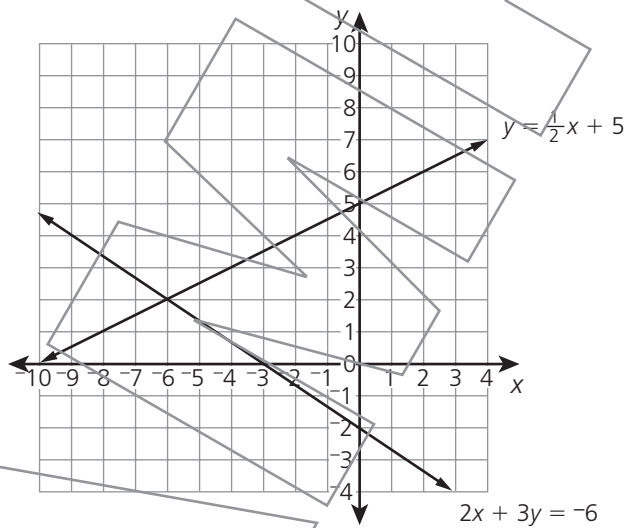
Think About It

Why do you think it is helpful to write each equation in a system in the form $y = mx + b$ in order to decide if they have a solution?

2 Focused Instruction

You can find the solution to a system of equations visually by looking at a graph of the lines.

- ▶ Johnny graphed a system of equations. What is the solution? How can you check?



When coordinates are given, the x-value always comes first: (x, y) .

Do the lines intersect each other? _____

Does the system of equations have a solution? If so, how many? _____

What is the solution? _____

How can you check that your solution is correct?

You can use the slope-intercept form of equations to understand what the graph of the lines will look like. You may not need to graph the lines to find the solution.

► Brenda is looking for the solution to the system $\begin{cases} y = \frac{2}{3}x + 7 \\ 3y - 2x = 21 \end{cases}$.

Is the first equation in slope-intercept form? If not, rewrite it.

Is the second equation in the form $y = mx + b$? If not, rewrite it.

What do you notice about the two equations?

What would the graph of the equations look?

How many solutions does the system of equations have?

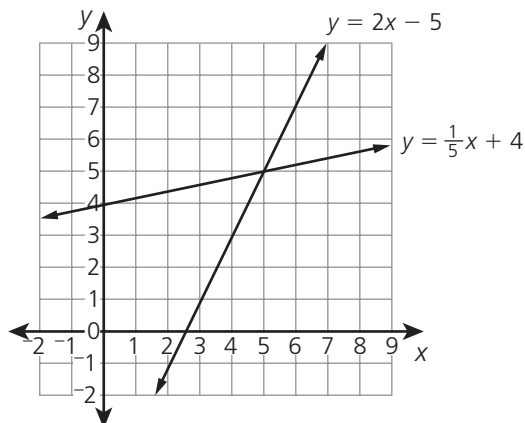
To write an equation in slope-intercept form, solve for y .

Use what you know about systems of equations to answer these questions.

1 Does the system of equations have a solution? If so, what is it?

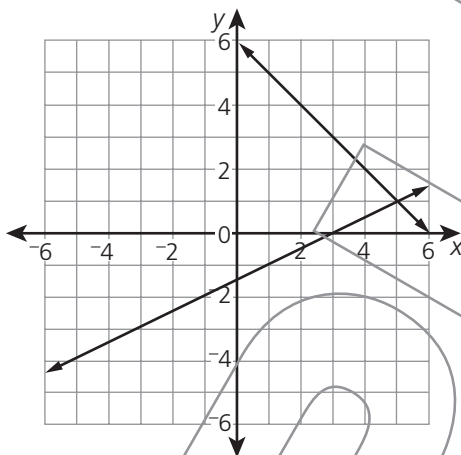
$$\begin{cases} y = 3x + 4 \\ y = 3x - 8 \end{cases}$$

2 What is the solution to the system of equations shown at the right?



Solve the following problems.

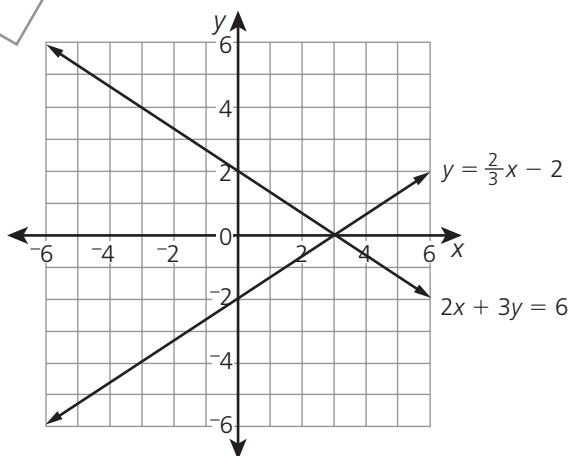
- 1** Consider the graph of the following system of equations. What is the solution to this system of equations?



The solution is the place at which the lines intersect.

Answer _____

- 2** Nerina graphed the equations $2x + 3y = 6$ and $y = \frac{2}{3}x - 2$ on this coordinate plane. Nerina thinks the solution to this system of equations is $(3, 0)$. Is she correct? Explain how you know.

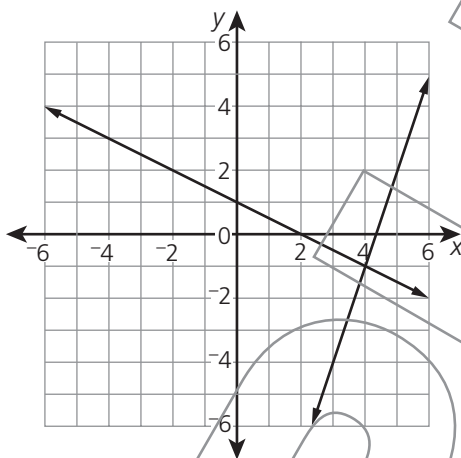


- 3** Describe the graph of the equations $12y = 6x - 24$ and $y = \frac{1}{2}x - 2$. What does this tell you about the solution?

It is helpful to rewrite both equations in the same form so you can compare the slopes and y-intercepts.

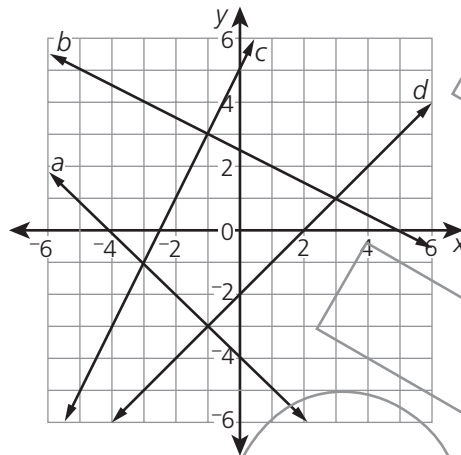
Solve the following problems.

- 1 What is the solution to the system of equations shown on this graph?

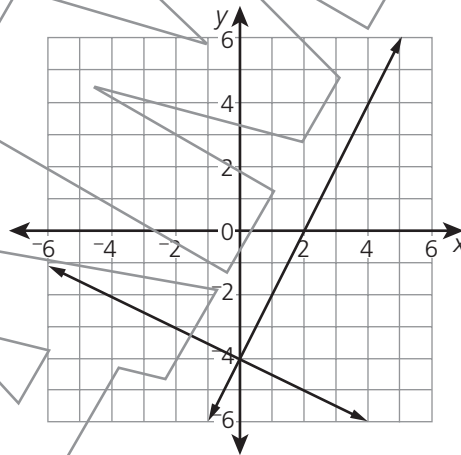


- A (1, 4)
B (-1, 4)
C (4, 1)
D (4, -1)
- 2 Given the equations $6x + 2y = 4$ and $y = -3x + 2$, how many solutions satisfy this system of equations? Explain.

- 3** Which pair of lines represents a system of equations with the solution $(-1, -3)$?



- A** a and c
 - B** b and c
 - C** b and d
 - D** d and a
- 4** What is the solution to the system of linear equations in the graph below?



Answer

- 5 Is $(6, 5)$ the solution to the system of equations below? Verify your answer.

$$\begin{cases} y = \frac{1}{2}x + 2 \\ y = x - 1 \end{cases}$$

- 6 How many solutions does this system of linear equations have?

$$\begin{cases} y = -\frac{1}{3}x + \frac{1}{3} \\ 2x + 6y = 4 \end{cases}$$

- A 0
- B exactly 1
- C exactly 2
- D infinitely many