English Spanish

2.7 Solving Equations by Graphing

Essential Question How can you use a system of linear equations to solve an equation that has variables on both sides?

You learned how to use algebra to solve equations with variables on both sides. Another way is by using a system of linear equations.

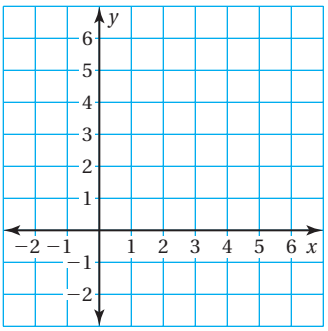
1 ACTIVITY: Solving a System of Linear Equations

Work with a partner. Find the solution of $2x - 1 = -\frac{1}{2}x + 4$.

a. Use the left side of the equation to write one linear equation. Then, use the right side to write another linear equation.

$$2x - 1 = -\frac{1}{2}x + 4$$

$y = 2x - 1$ $\qquad$ $y = -\frac{1}{2}x + 4$



b. Sketch the graphs of the two linear equations. Find the x-value of the point of intersection. The x-value is the solution of

$$2x - 1 = -\frac{1}{2}x + 4.$$

Check the solution.

c. Explain why this "graphical method" works.

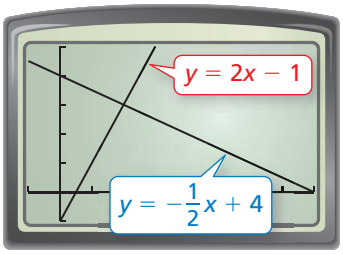
2 ACTIVITY: Using a Graphing Calculator

Use a graphing calculator to graph the two linear equations.

$$y = 2x - 1$$

$$y = -\frac{1}{2}x + 4$$

The steps used to enter the equations depend on the calculator model that you have.



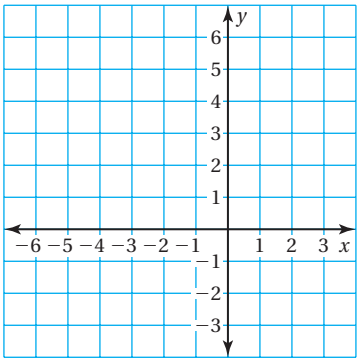
English Spanish

3 ACTIVITY: Using a System of Linear Equations

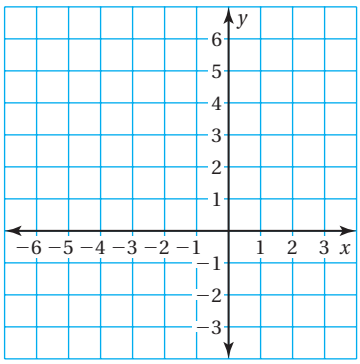
Work with a partner. Solve each equation using two methods.

- **Method 1:** Use an algebraic method.
- **Method 2:** Use a graphical method.
- Is the solution the same using both methods?

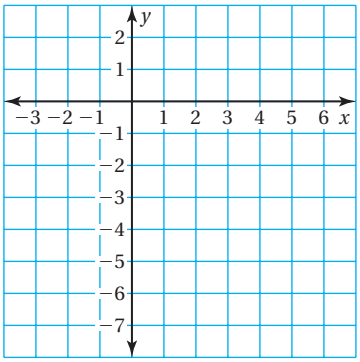
a. $\frac{1}{2}x + 4 = -\frac{1}{4}x + 1$



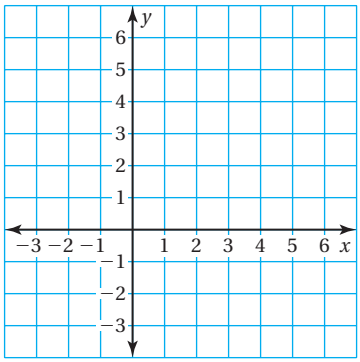
b. $\frac{2}{3}x + 4 = \frac{1}{3}x + 3$



c. $-\frac{2}{3}x - 1 = \frac{1}{3}x - 4$



d. $\frac{4}{5}x + \frac{7}{5} = 3x - 3$



What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use a system of linear equations to solve an equation that has variables on both sides? Give an example that is different from those in Activities 1 and 3.

5. Describe three ways in which René Descartes's invention of the coordinate plane allows you to solve algebraic problems graphically.

Practice Use what you learned about solving equations by graphing to complete Exercises 3–5 on page 92.

English Spanish

2.7 Lesson

Key Idea

Solving Equations Using Graphs

Step 1: To solve the equation $ax + b = cx + d$, write two linear equations.

$ax + b = cx + d$

$y = ax + b$ and $y = cx + d$

Step 2: Graph the system of linear equations. The x-value of the solution of the system of linear equations is the solution of the equation $ax + b = cx + d$.

EXAMPLE 1 Solving an Equation Using a Graph

Solve $x - 2 = -\frac{1}{2}x + 1$ using a graph. Check your solution.

Step 1: Write a system of linear equations using each side of the equation.

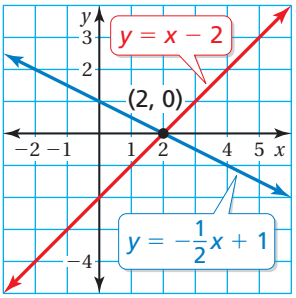
$x - 2 = -\frac{1}{2}x + 1$

$y = x - 2$ $\qquad$ $y = -\frac{1}{2}x + 1$

Step 2: Graph the system.

$y = x - 2$

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



Check

$x - 2 = -\frac{1}{2}x + 1$

$2 - 2 \stackrel{?}{=} -\frac{1}{2}(2) + 1$

$0 = 0$ ✓

∴ The graphs intersect at (2, 0). So, the solution is $x = 2$.

On Your Own

Use a graph to solve the equation. Check your solution.

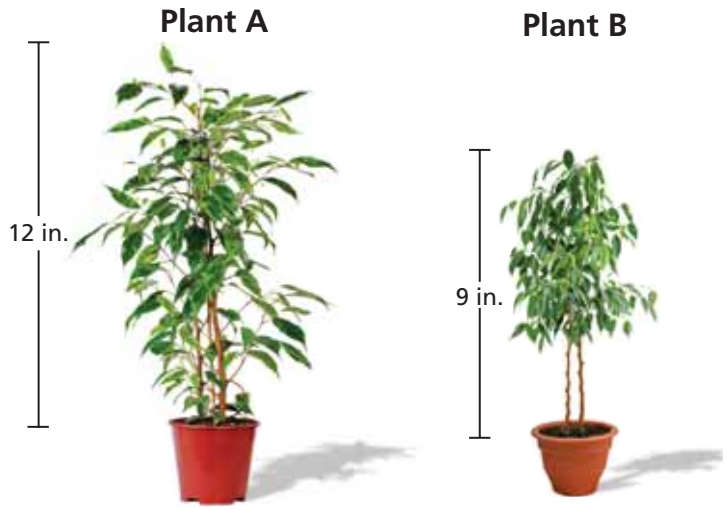
1. $\frac{1}{3}x = x + 8$

2. $1.5x + 2 = 11 - 3x$

Now You're Ready
Exercises 6 and 7

English Spanish

EXAMPLE 2 Real-Life Application



Plant A grows 0.6 inch per month. Plant B grows twice as fast.

a. Use the model to write an equation.

b. After how many months x are the plants the same height?

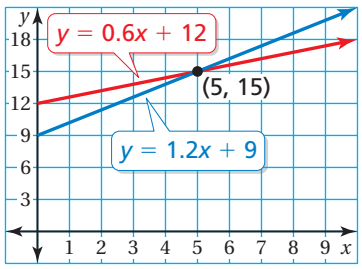
Growth rate	•	Months, x	+	Original height	=	Growth rate	•	Months, x	+	Original height

a. The equation is $0.6x + 12 = 1.2x + 9$.

b. Write a system of linear equations using each side of the equation. Then graph the system.

$$0.6x + 12 = 1.2x + 9$$

$y = 0.6x + 12$ $\qquad$ $y = 1.2x + 9$



∴ The solution of the system is $(x, y) = (5, 15)$. So, the plants are both 15 inches tall after 5 months.

On Your Own

3. Using the graph in Example 2, is the statement below true? Explain.

The system of linear equations $y = 0.6x + 12$ and $y = 1.2x + 9$ has one solution.

4. WHAT IF? In Example 2, the growth rate of Plant A is 0.5 inch per month. After how many months x are the plants the same height?

English Spanish

2.7 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **CRITICAL THINKING** Would you rather solve the equation $x - \frac{4}{5} = -x + \frac{6}{5}$ using an algebraic method or a graphical method? Explain.

2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

What is the solution of the equation $x - 3 = -\frac{1}{3}x + 5$?

What is the x-value of the solution of the linear system $y + 3 = x$ and $y + \frac{1}{3}x = 5$?

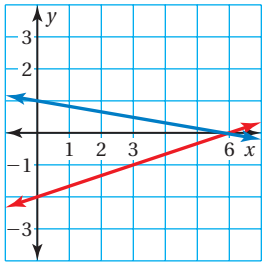
What is the y-coordinate of the intersection of $y = x - 3$ and $y = -\frac{1}{3}x + 5$?

What is the x-coordinate of the intersection of $y = x - 3$ and $y = -\frac{1}{3}x + 5$?

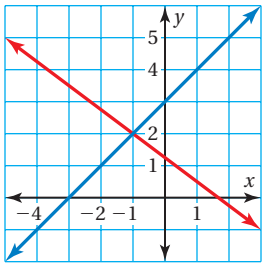
Practice and Problem Solving

Solve the equation algebraically and graphically.

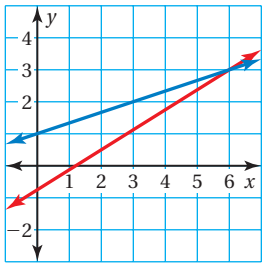
3. $\frac{1}{3}x - 2 = -\frac{1}{6}x + 1$



4. $-\frac{3}{4}x + \frac{5}{4} = x + 3$



5. $\frac{5}{8}x - \frac{3}{4} = \frac{1}{3}x + 1$



Use a graph to solve the equation. Check your solution.

1 6. $\frac{2}{5}x - 2 = -x + 12$

7. $-\frac{5}{6}x + \frac{1}{2} = -x + 1$

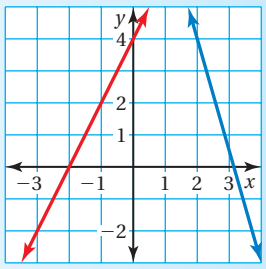
8. **ERROR ANALYSIS** Describe and correct the error in solving the equation $2x + 4 = -\frac{7}{2}x + 11$.

✗

$y = 2x + 4$

$y = -\frac{7}{2}x + 11$

There is no solution.



9. **KARAOKE** One night at karaoke, you sang $3x + 2$ songs. The next night, you sang $4x$ songs. Is it possible that you sang the same number of songs each night? Explain.

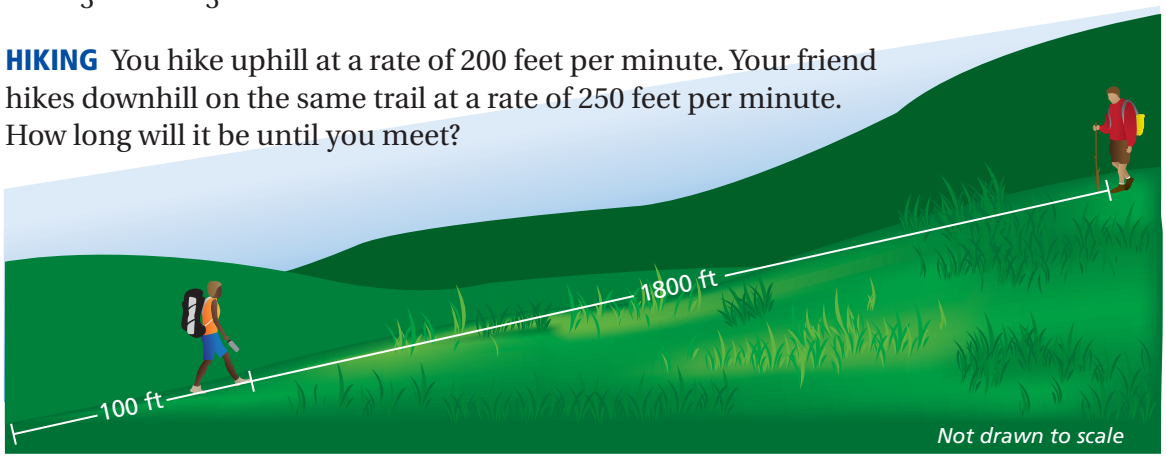
English Spanish

Use a graph to solve the equation. Check your solution.

10. $2.5x + 3 = 4x - 3$ **11.** $-1.4x + 1 = 1.6x - 5$ **12.** $0.7x - 1.2 = -1.4x - 7.5$

13. **CRITICAL THINKING** What happens when you use a graphical method to solve $\frac{1}{3}x - 5 = \frac{1}{3}x + 8$? Does an algebraic method give the same result?

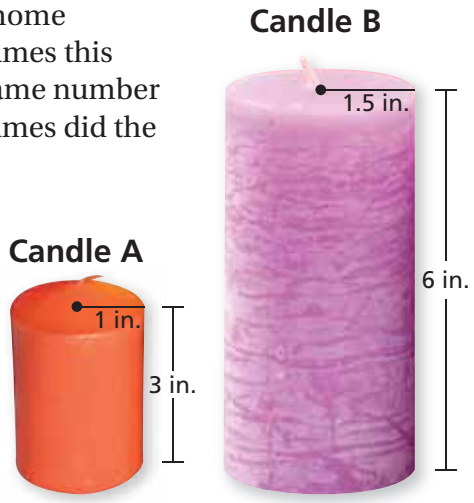
14. **HIKING** You hike uphill at a rate of 200 feet per minute. Your friend hikes downhill on the same trail at a rate of 250 feet per minute. How long will it be until you meet?



Last Year	
Home	Away
11	x

15. **SOCCER** A soccer team played four more home games and three-fourths as many away games this year than last year. The team played the same number of games each season. How many away games did the team play last year?

16. Geometry Candle A burns at an average rate of 11 cubic centimeters per hour. Candle B burns at an average rate of 18 cubic centimeters per hour. Do the candles ever have the same volume? Explain.

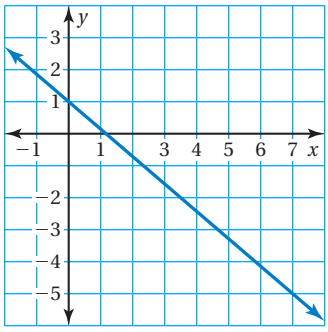


Fair Game Review What you learned in previous grades & lessons

Find the *y*-intercept of the graph of the linear equation. SECTION 2.3

17. $y = 3x + 4$ **18.** $y = -\frac{2}{3}x + 6$ **19.** $y = 2.4x - 3$ **20.** $y = 2x - \pi$

21. **MULTIPLE CHOICE** Which of the following is the slope of the line? SECTION 2.2



(A) $-\frac{6}{7}$ (B) $-\frac{7}{6}$

(C) $\frac{6}{7}$ (D) $\frac{7}{6}$