CHAPTER 5
Solving Systems of Linear Equations
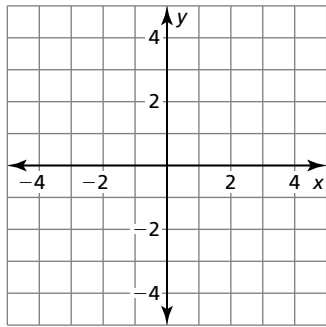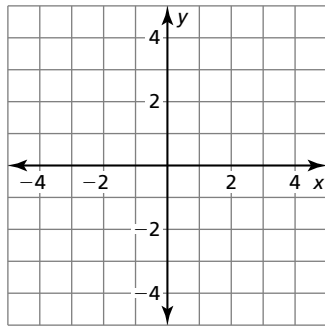
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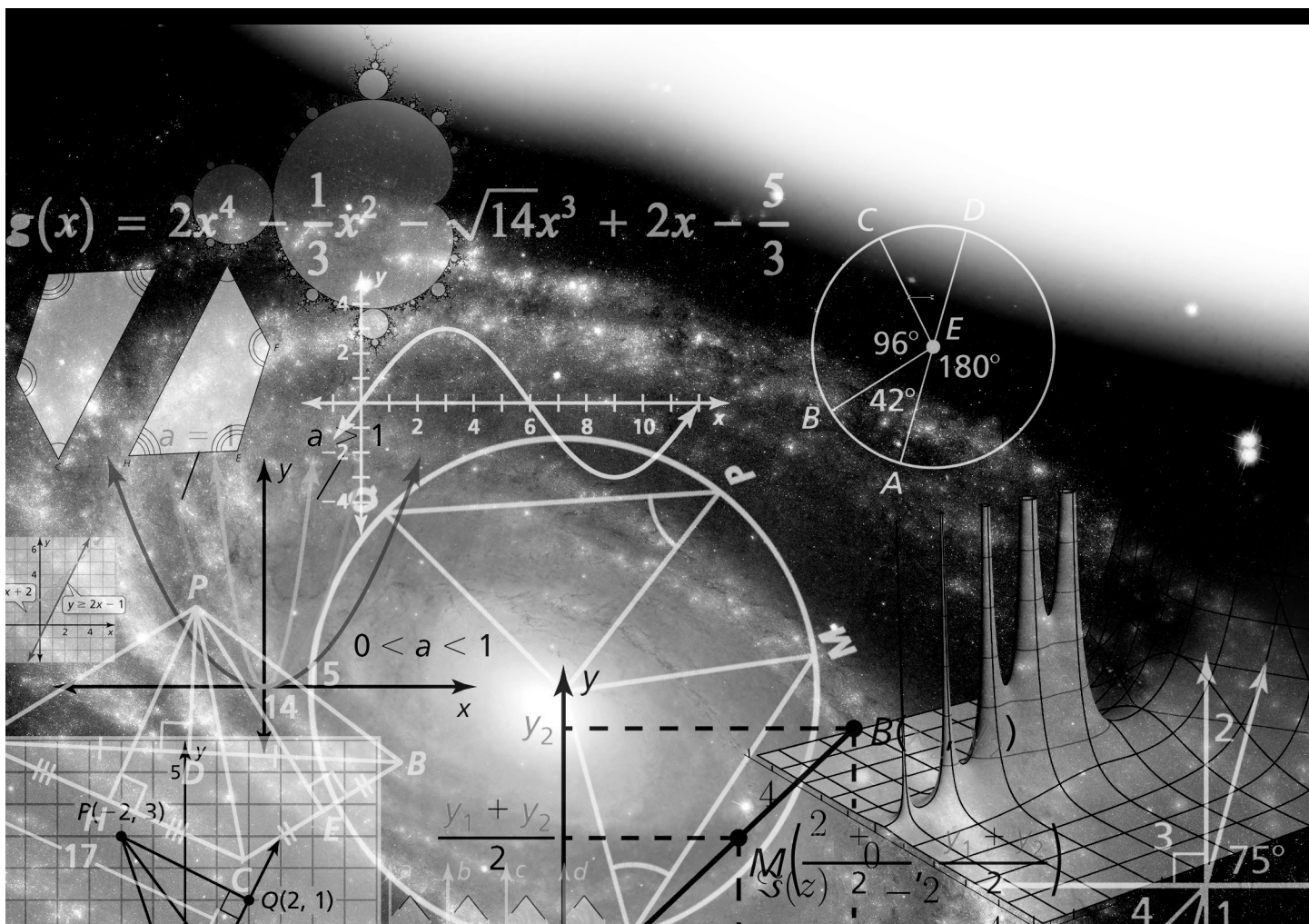
Maintaining Mathematical Proficiency

Graph the equation.

1. $y + 2 = x$

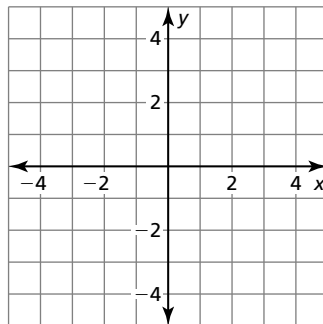**2.** $2x - y = 3$

3. $5x + 2y = 10$
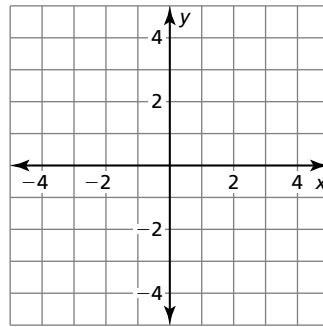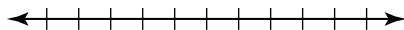
4. $y - 3 = x$
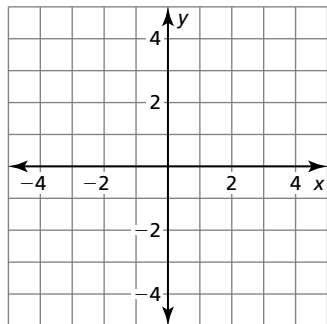
5. $3x - y = -2$
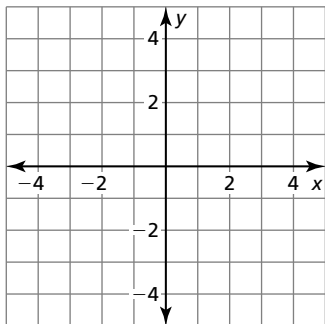
6. $3x + 4y = 12$

Solve the inequality. Graph the solution.
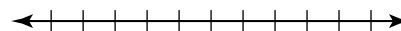
7. $a - 3 > -2$

8. $-4 \geq -2c$

9. $2d - 5 < -3$

10. $8 - 3r \leq 5 - 2r$

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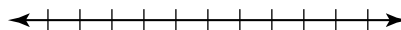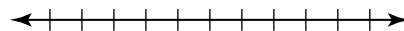
5.1 Solving Systems of Linear Equations by Graphing
For use with Exploration 5.1

Essential Question How can you solve a system of linear equations?

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1 EXPLORATION: Writing a System of Linear Equations

Work with a partner. Your family opens a bed-and-breakfast. They spend $600 preparing a bedroom to rent. The cost to your family for food and utilities is $15 per night. They charge $75 per night to rent the bedroom.

    a. Write an equation that represents the costs.

$$\begin{array}{l} \text{Cost, } C \\ \text{(in dollars)} \end{array} = \begin{array}{l} \$15 \text{ per} \\ \text{night} \end{array} \bullet \begin{array}{l} \text{Number of} \\ \text{nights, } x \end{array} + \$600$$

    b. Write an equation that represents the revenue (income).

$$\begin{array}{l} \text{Revenue, } R \\ \text{(in dollars)} \end{array} = \begin{array}{l} \$75 \text{ per} \\ \text{night} \end{array} \bullet \begin{array}{l} \text{Number of} \\ \text{nights, } x \end{array}$$

    c. A set of two (or more) linear equations is called a **system of linear equations.** Write the system of linear equations for this problem.

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2 EXPLORATION: Using a Table or Graph to Solve a System

Go to *BigIdeasMath.com* for an interactive tool to investigate this exploration.

Work with a partner. Use the cost and revenue equations from Exploration 1 to determine how many nights your family needs to rent the bedroom before recovering the cost of preparing the bedroom. This is the *break-even point*.

    a. Complete the table.

x (nights)	0	1	2	3	4	5	6	7	8	9	10	11
C (dollars)												
R (dollars)												

5.1 **Solving Systems of Linear Equations by Graphing** (continued)

2 **EXPLORATION:** Using a Table or Graph to Solve a System (continued)

b. How many nights does your family need to rent the bedroom before breaking even?

c. In the same coordinate plane, graph the cost equation and the revenue equation from Exploration 1.
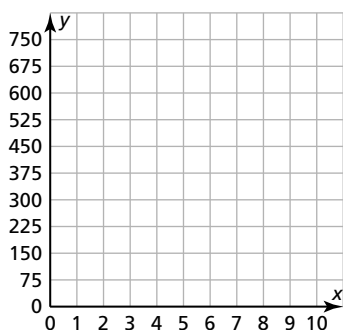
d. Find the point of intersection of the two graphs. What does this point represent? How does this compare to the break-even point in part (b)? Explain.

Communicate Your Answer

3. How can you solve a system of linear equations? How can you check your solution?

4. Solve each system by using a table or sketching a graph. Explain why you chose each method. Use a graphing calculator to check each solution.

a. $y = -4.3x - 1.3$
$y = 1.7x + 4.7$

b. $y = x$
$y = -3x + 8$

c. $y = -x - 1$
$y = 3x + 5$

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Practice
For use after Lesson 5.1

Core Concepts

Solving a System of Linear Equations by Graphing

Step 1 Graph each equation in the same coordinate plane.

Step 2 Estimate the point of intersection.

Step 3 Check the point from Step 2 by substituting for x and y in each equation of the original system.

Notes:

Worked-Out Examples

Example #1

Tell whether the ordered pair is a solution of the system of linear equations.

$(-1, 3);$ $\begin{aligned} y &= -7x - 4 \\ y &= 8x + 5 \end{aligned}$

Equation 1   *Equation 2*

$y = -7x - 4$ $y = 8x + 5$

$3 \overset{?}{=} -7(-1) - 4$ $3 \overset{?}{=} 8(-1) + 5$

$3 \overset{?}{=} 7 - 4$ $3 \overset{?}{=} -8 + 5$

$3 = 3 ✓$ $3 \neq -3 ✗$

The ordered pair $(-1, 3)$ is a solution of the first equation, but it is not a solution of the second equation. So, $(-1, 3)$ is *not* a solution of the linear system.

Example #2

Solve the system of linear equations by graphing.

$\begin{aligned} 9x + 3y &= -3 \\ 2x - y &= -4 \end{aligned}$

$9x + 3y = -3$ $2x - y = -4$

$9x - 9x + 3y = -3 - 9x$ $2x - 2x - y = -4 - 2x$

$3y = -9x - 3$ $-y = -2x - 4$

$\dfrac{3y}{3} = \dfrac{-9x - 3}{3}$ $\dfrac{-y}{-1} = \dfrac{-2x - 4}{-1}$

$y = -3x - 1$ $y = 2x + 4$

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Check *Equation 1*   *Equation 2*

$$9x + 3y = -3 \qquad\qquad 2x - y = -4$$

$$9(-1) + 3(2) \overset{?}{=} -3 \qquad 2(-1) - 2 \overset{?}{=} -4$$

$$-9 + 6 \overset{?}{=} -3 \qquad\qquad -2 - 2 \overset{?}{=} -4$$
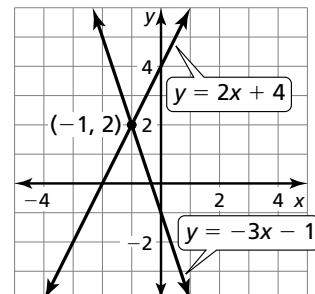
$$-3 = -3 \checkmark \qquad\qquad -4 = -4 \checkmark$$

The solution is $(-1, 2)$.

Practice A

In Exercises 1–6, tell whether the ordered pair is a solution of the system of linear equations.

1. $(3, 1)$; $x + y = 4$
$\quad\quad\quad 2x - y = 3$

2. $(1, 3)$; $x - y = -2$
$\quad\quad\quad 2x + y = 5$

3. $(2, 0)$; $y = x - 2$
$\quad\quad\quad y = -3x + 6$

4. $(-1, -2)$; $x - 2y = 3$
$\quad\quad\quad\quad 2x - y = 0$

5. $(-2, 3)$; $3x - 2y = -12$
$\quad\quad\quad\quad 2x + 4y = 9$

6. $(4, -3)$; $2x + 2y = 2$
$\quad\quad\quad\quad 3x - 3y = 21$
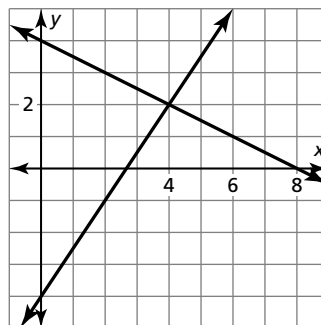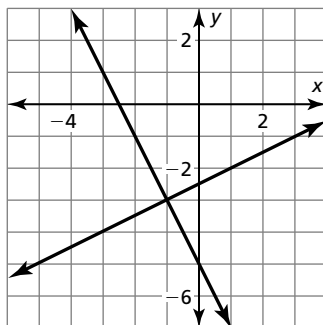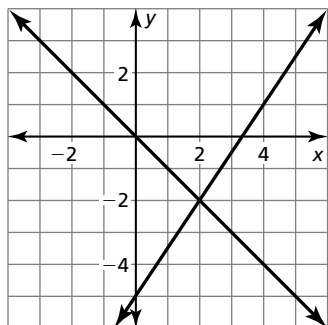
In Exercises 7–9, use the graph to solve the system of linear equations. Check your solution.

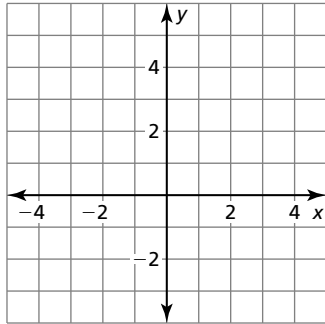**7.** $3x - 2y = 10$
$\quad\ x + y = 0$

8. $x - 2y = 5$
$\quad 2x + y = -5$
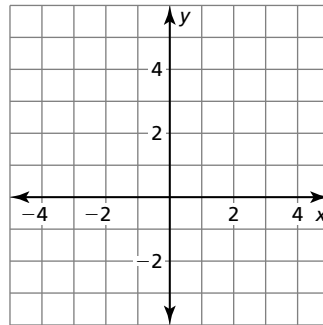
9. $x + 2y = 8$
$\quad 3x - 2y = 8$

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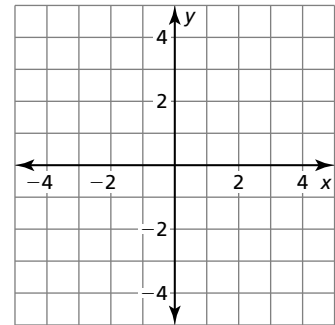**In Exercises 10–15, solve the system of linear equations by graphing.**

10. $y = -x + 3$
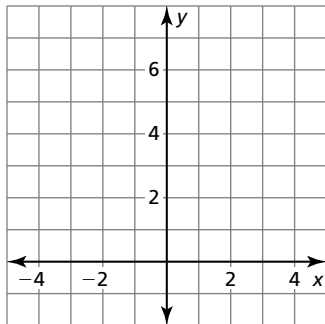$y = x + 5$

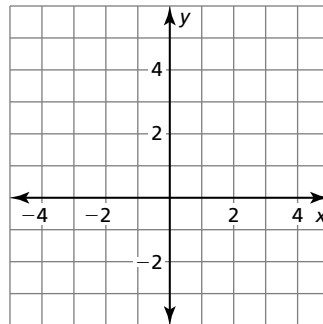**11.** $y = \frac{1}{2}x + 2$
$y = -\frac{1}{2}x + 4$

12. $3x - 2y = 6$
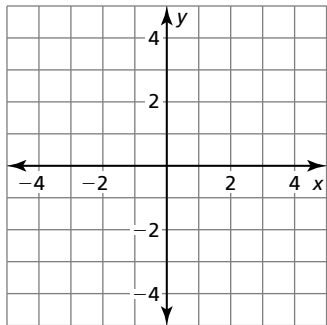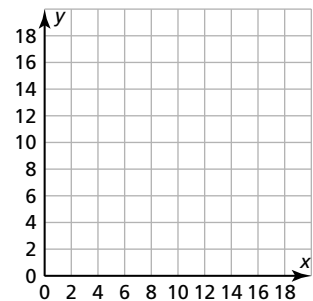$y = -3$

13. $y = 4x$
$y = -4x + 8$

14. $y = \frac{1}{4}x + 3$
$y = \frac{3}{4}x + 5$

15. $3x - 4y = 7$
$5x + 2y = 3$

16. A test has twenty questions worth 100 points. The test consists of x true-false questions worth 4 points each and y multiple choice questions worth 8 points each. How many of each type of question are on the test?
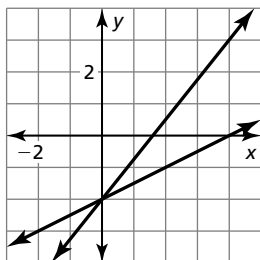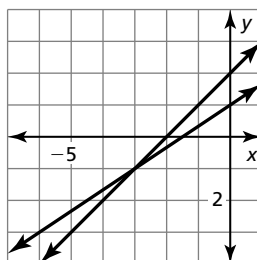
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Practice B

In Exercises 1 and 2, use the graph to solve the system of linear equations. Check your solution.

1. $5x - 4y = 8$

$-x + 2y = -4$

2. $4x - 6y = -6$

$4x - 4y = -8$

In Exercises 3–6, solve the system of linear equations by graphing.

3. $3x - 5y = 2$

$y = 2$

4. $-x + 4y = -10$

$2x - 3y = 5$

5. $y = -\frac{3}{2}x - 3$

$y = \frac{1}{2}x + 5$

6. $3x + 3y = -3$

$5x + 2y = 1$

In Exercises 7 and 8, use a graphing calculator to solve the system of linear equations.

7. $0.8x - 0.9y = 0$

$x - 0.5y = 1$

8. $4.2x - y = 3$

$2x - y = -0.3$

9. You spend $11 on school supplies. You purchase pencils for $0.25 each and pens for $2 each. You purchase a total of 30 pencils and pens. How many of each did you purchase?

10. You begin with $90 in your savings account and your friend begins with $35 in her savings account. You deposit $10 in savings each week, and your friend deposits $15 in savings each week.

a. Write and graph a system of linear equations that represent the amounts in each of your savings accounts.

b. Your friend says that in 10 weeks you will both have the same amount of money in your savings accounts. Is your friend correct? Use the graph from part (a) to explain your answer.