

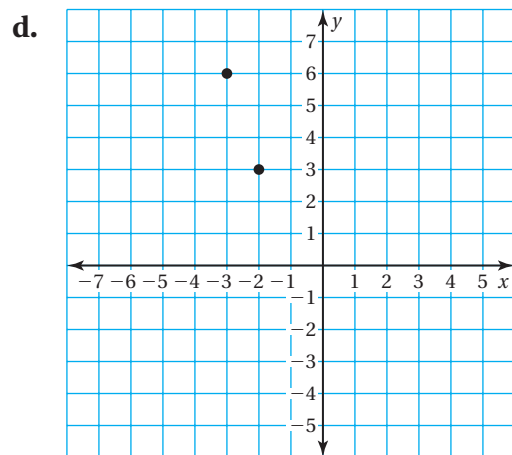
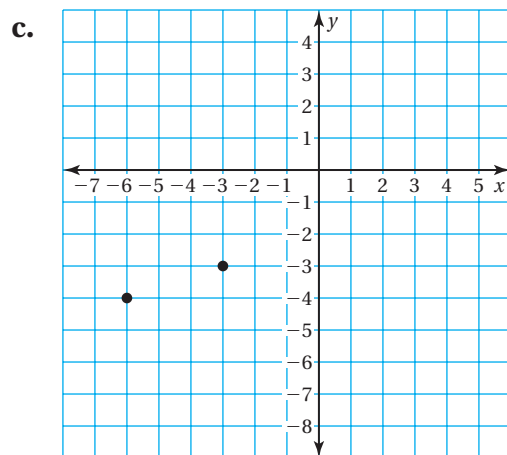
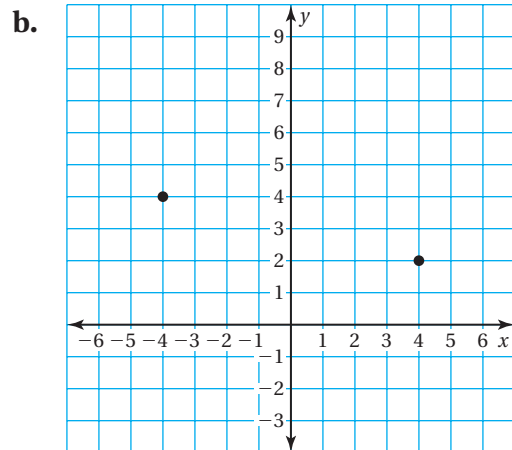
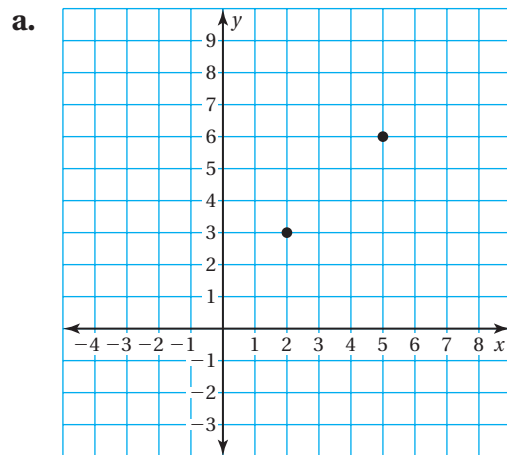
## 3.3 Writing Equations Using Two Points

**Essential Question** How can you write an equation of a line when you are given two points on the line?

### 1 ACTIVITY: Writing Equations of Lines

Work with a partner.

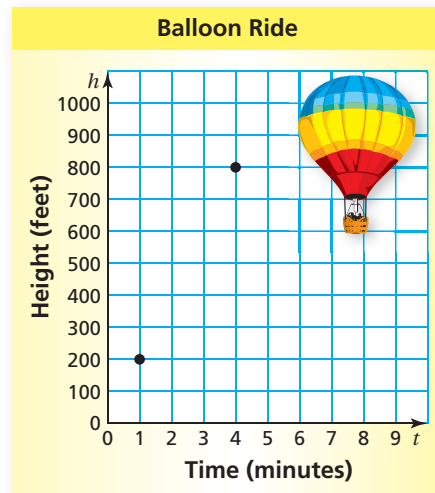
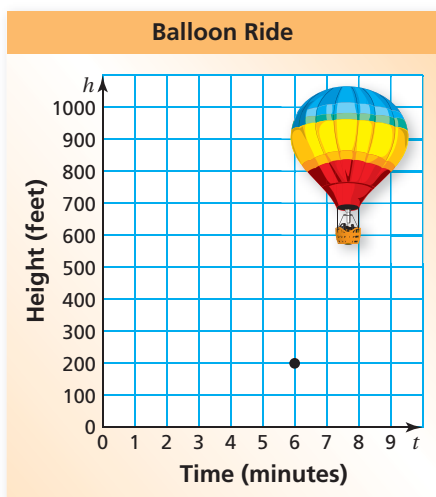
- Sketch the line that passes through the given points.
- Find the slope and  $y$ -intercept of the line.
- Write an equation of the line.



## 2 ACTIVITY: Writing and Using Linear Equations

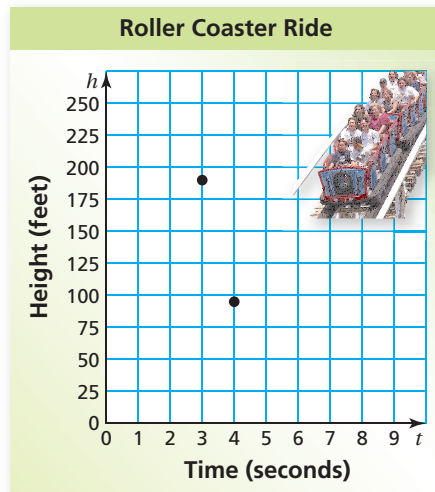
Work with a partner.

- a. You are rising in a hot air balloon. After 1 minute, you are 200 feet above the ground. After 4 minutes, you are 800 feet above the ground.
- Write an equation for the height  $h$  in terms of the time  $t$ .
  - Use your equation to find the height of the balloon after 5 minutes.



- b. After 5 minutes, the hot air balloon starts to descend. After 6 minutes, you are 200 feet above the ground.
- Write an equation for the height  $h$  in terms of the time  $t$ .
  - Use your equation to estimate when the balloon lands on the ground.

- c. You are on a roller coaster. After 3 seconds, you are 190 feet above the ground and have reached maximum speed. One second later, you are 95 feet above the ground.
- Write an equation for the height  $h$  in terms of the time  $t$ .
  - When will you reach ground level?



### What Is Your Answer?

3. **IN YOUR OWN WORDS** How can you write an equation of a line when you are given two points on the line? Give an example that is different from those in Activities 1 and 2.

#### Practice

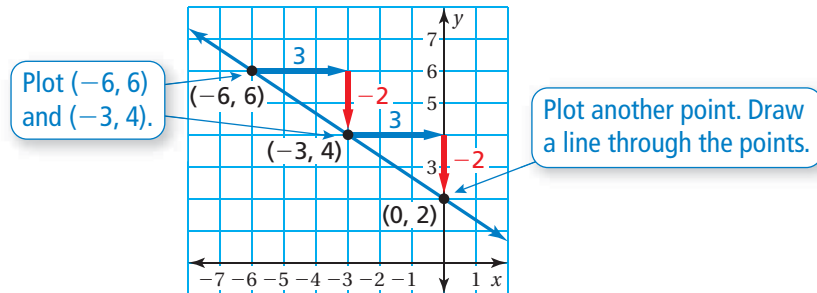
Use what you learned about writing equations using two points to complete Exercises 3–5 on page 122.

**EXAMPLE 1** Writing Equations Using Two Points

Write an equation of the line that passes through the points.

- a.  $(-6, 6)$ ,  $(-3, 4)$

Use a graph to find the slope and  $y$ -intercept.


**Study Tip**

After writing an equation, check that the given points are solutions of the equation.

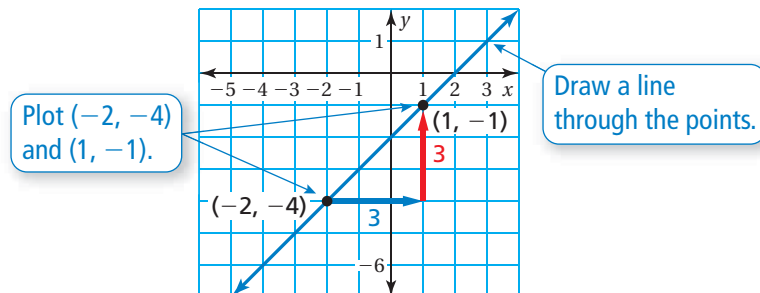
$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{-2}{3} = -\frac{2}{3}$$

Because the line crosses the  $y$ -axis at  $(0, 2)$ , the  $y$ -intercept is 2.

∴ So, the equation is  $y = -\frac{2}{3}x + 2$ .

- b.  $(-2, -4)$ ,  $(1, -1)$

Use a graph to find the slope and  $y$ -intercept.



$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{3}{3} = 1$$

Because the line crosses the  $y$ -axis at  $(0, -2)$ , the  $y$ -intercept is  $-2$ .

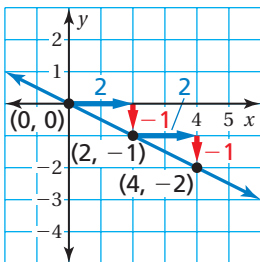
∴ So, the equation is  $y = 1x + (-2)$ , or  $y = x - 2$ .

**On Your Own**

Write an equation of the line that passes through the points.

1.  $(2, 3)$ ,  $(4, 4)$                       2.  $(-1, 2)$ ,  $(1, -4)$

## EXAMPLE 2 Standardized Test Practice



The graph of which equation passes through  $(2, -1)$  and  $(4, -2)$ ?

- (A)  $y = -\frac{1}{2}x$                       (B)  $y = \frac{1}{2}x$   
 (C)  $y = -2x$                       (D)  $y = 2x$

Graph the line through the points. Find the slope and  $y$ -intercept.

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{-1}{2} = -\frac{1}{2}$$

Because the line crosses the  $y$ -axis at  $(0, 0)$ , the  $y$ -intercept is 0.

∴ So, the equation is  $y = -\frac{1}{2}x + 0$ , or  $y = -\frac{1}{2}x$ .

The correct answer is (A).

## EXAMPLE 3 Real-Life Application



22.5 oz

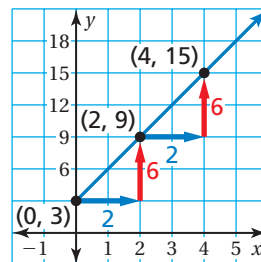
A 2-week old kitten weighs 9 ounces. Two weeks later, it weighs 15 ounces. (a) Write an equation to represent the weight  $y$  (in ounces) of the kitten  $x$  weeks after birth. (b) How old is the kitten in the photo?

- a. The kitten weighs 9 ounces after 2 weeks and 15 ounces after 4 weeks. So, graph the line that passes through  $(2, 9)$  and  $(4, 15)$ .

$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{6}{2} = 3$$

Because the line crosses the  $y$ -axis at  $(0, 3)$ , the  $y$ -intercept is 3.

∴ So, the equation is  $y = 3x + 3$ .



- b. Find the value of  $x$  when  $y = 22.5$ .

$$y = 3x + 3 \quad \text{Write the equation.}$$

$$22.5 = 3x + 3 \quad \text{Substitute 22.5 for } y.$$

$$19.5 = 3x \quad \text{Subtract 3 from each side.}$$

$$6.5 = x \quad \text{Solve for } x.$$

∴ The kitten in the photo is 6.5 weeks old.

### On Your Own

- The graph of which equation in Example 2 passes through  $(-2, 4)$  and  $(-1, 2)$ ?
- A 3-week old kitten weighs 12 ounces. Two weeks later, it weighs 18 ounces. How old is the kitten when it weighs 27 ounces?

# 3.3 Exercises

## Vocabulary and Concept Check

- WRITING** Describe how to write an equation of a line using two points on the line.
- WHICH ONE DOESN'T BELONG?** Which pair of points does *not* belong with the other three? Explain your reasoning.

(0, 1), (2, 3)

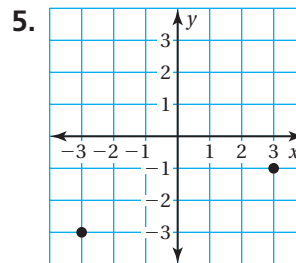
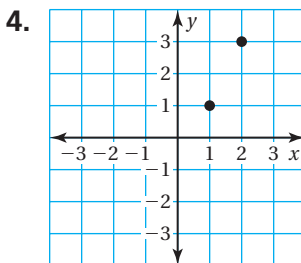
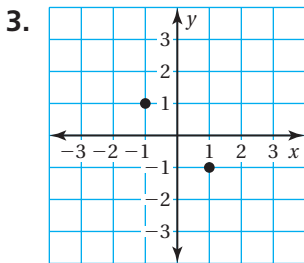
(1, 2), (4, 5)

(2, 3), (5, 6)

(1, 2), (4, 6)

## Practice and Problem Solving

Find the slope and  $y$ -intercept of the line that passes through the points. Then write an equation of the line.



Write an equation of the line that passes through the points.

6.  $(-1, -1), (1, 5)$
7.  $(2, 4), (3, 6)$
8.  $(-2, 3), (2, 7)$
9.  $(4, 1), (8, 2)$
10.  $(-9, 5), (-3, 3)$
11.  $(1, 2), (-2, -1)$
12.  $(-5, 2), (5, -2)$
13.  $(2, -7), (8, 2)$
14.  $(1, -2), (3, -8)$

15. **ERROR ANALYSIS** Describe and correct the error in finding the equation of the line that passes through  $(-1, -6)$  and  $(3, 2)$ .

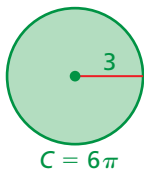
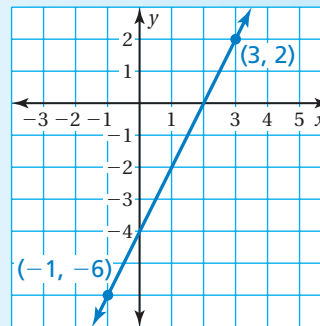
16. **JET SKI** It costs \$175 to rent a jet ski for 2 hours. It costs \$300 to rent a jet ski for 4 hours. Write an equation that represents the cost  $y$  (in dollars) of renting a jet ski for  $x$  hours.



$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{8}{4} = 2$$

The  $y$ -intercept is  $(0, -4)$ .

$$\text{The equation is } y = -4x + 2.$$

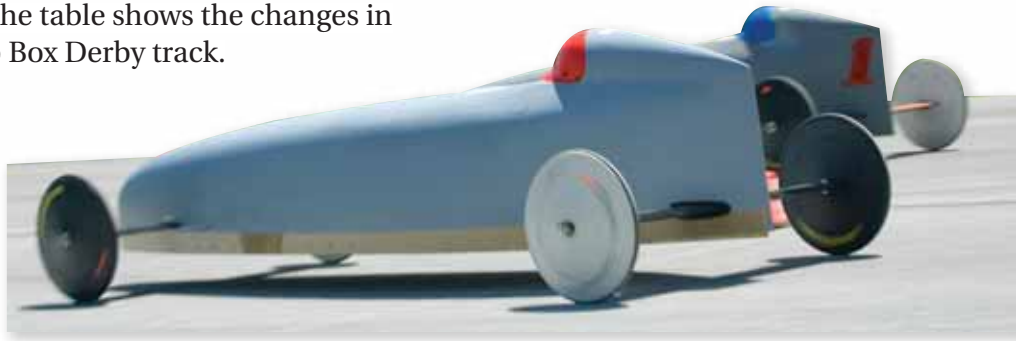


17. **CIRCUMFERENCE** Consider the circles shown.

- Plot the points  $(2, 4\pi)$  and  $(3, 6\pi)$ .
- Write an equation of the line that passes through the two points.

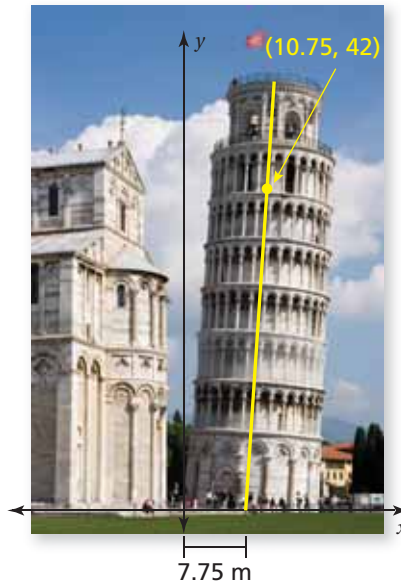
18. **SOAP BOX DERBY** The table shows the changes in elevation for a Soap Box Derby track.

Track Distance	Elevation
0 ft	48 ft
100 ft	38 ft
200 ft	28 ft
350 ft	18 ft
600 ft	8 ft
989 ft	0 ft



- Draw a Soap Box Derby track in a coordinate plane.
  - Does each section of the track have the same slope? Explain.
  - Write an equation that represents the elevation  $y$  (in feet) of the track between 100 feet and 200 feet.
19. **CAR VALUE** The value of a car decreases at a constant rate. After 3 years, the value of the car is \$15,000. After 2 more years the value of the car is \$11,000.
- Write an equation that represents the value  $y$  (in dollars) of the car after  $x$  years.
  - Graph the equation.
  - What is the  $y$ -intercept of the line? Interpret the  $y$ -intercept.

Leaning Tower of Pisa



20. **WATERING CAN** You water the plants in your classroom at a constant rate. After 5 seconds, your watering can contains 58 ounces of water. Fifteen seconds later, the can contains 28 ounces of water.
- Write an equation that represents the amount  $y$  (in ounces) of water in the can after  $x$  seconds.
  - How much water was in the can when you started watering the plants?
  - When is the watering can empty?
21. **Critical Thinking** The Leaning Tower of Pisa in Italy was built between 1173 and 1350.
- Write an equation for the yellow line.
  - The tower is 56 meters tall. How far off center is the top of the tower?



## Fair Game Review What you learned in previous grades & lessons

Find the percent of the number.

22. 15% of 300

23. 140% of 125

24. 6% of  $-75$

25. **MULTIPLE CHOICE** What is the  $x$ -intercept of the equation  $3x + 5y = 30$ ?

Ž

(A)  $-10$

(B)  $-6$

(C)  $6$

(D)  $10$