3.3 Writing Equations Using Two Points

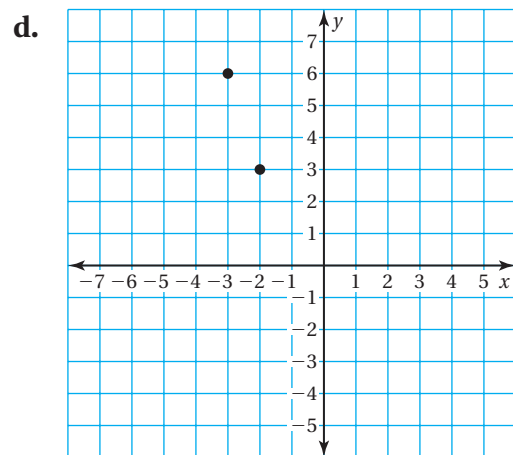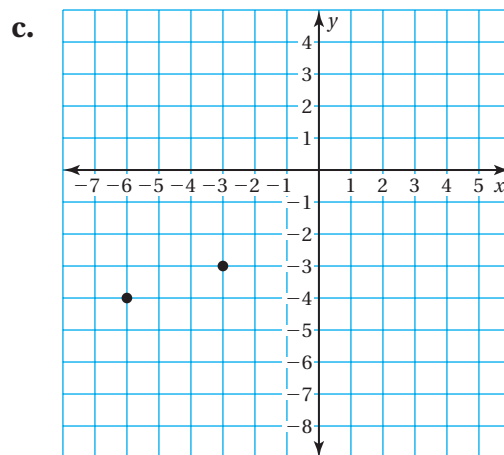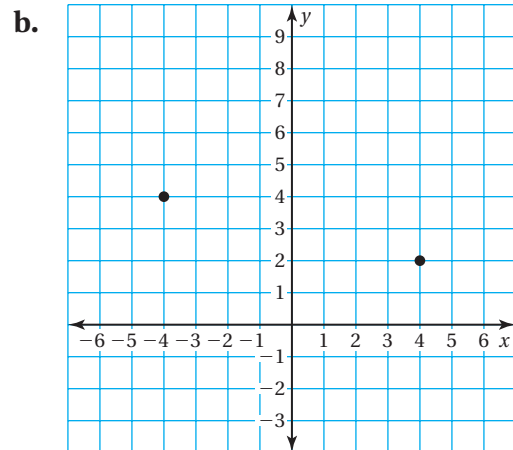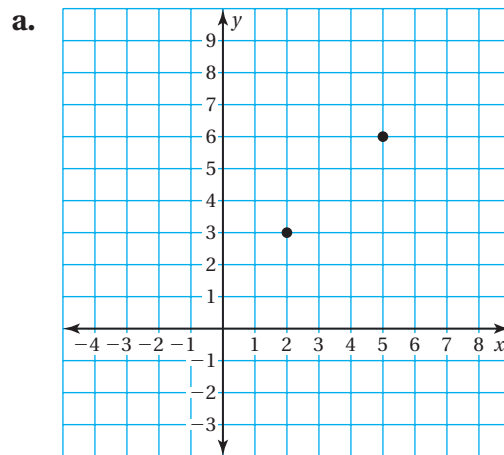**Essential Question** How can you write an equation of a line when you are given two points on the line?

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.
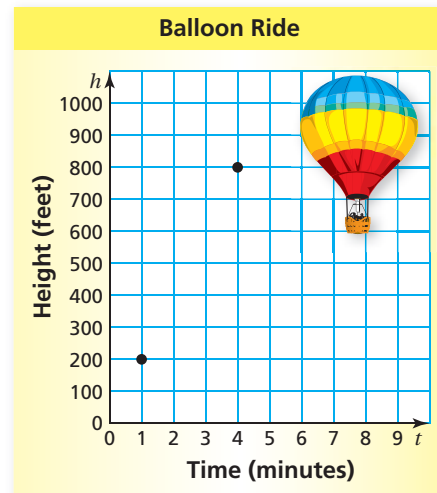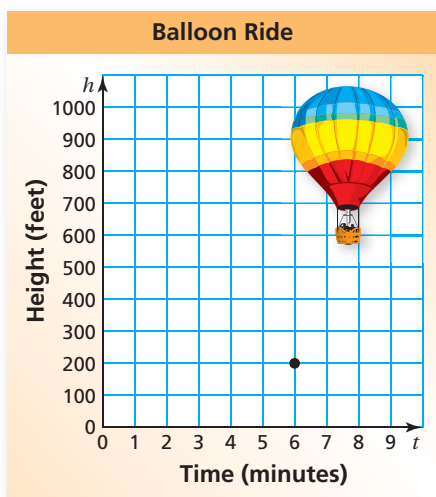- Write an equation of the line.

a.

b.

c.

d.

## 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.

Balloon Ride

Balloon Ride

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?

Roller Coaster Ride
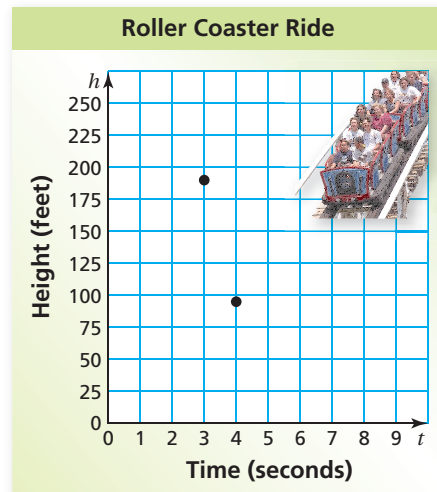
What Is Your Answer?

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.
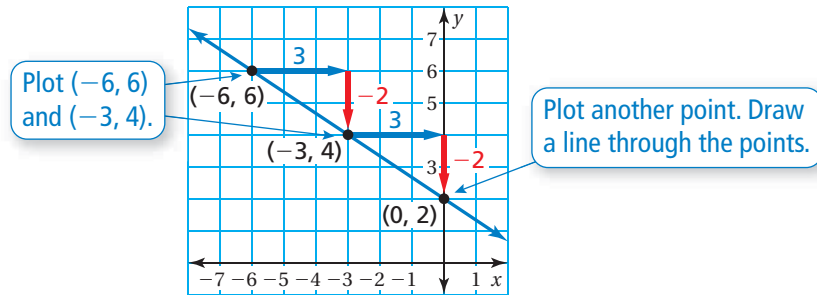
Practice

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

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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.

Plot $(-6, 6)$ and $(-3, 4)$.

$(-6, 6)$

3
-2
3

$(-3, 4)$

-2

Plot another point. Draw a line through the points.

$(0, 2)$

Study Tip

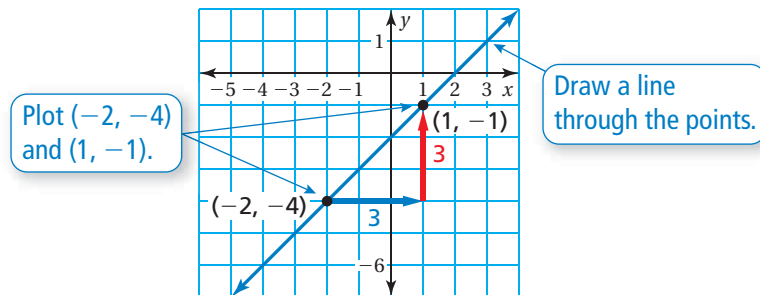After writing an equation, check that the given points are solutions of the equation.

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

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

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

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

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

Plot $(-2, -4)$ and $(1, -1)$.

$(1, -1)$

3

$(-2, -4)$

3

Draw a line through the points.

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

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

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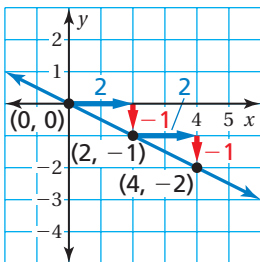
On Your Own

Now You're Ready
Exercises 6–14

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 $(4, -2)$?

Ⓐ $y = -\dfrac{1}{2}x$

Ⓑ $y = \dfrac{1}{2}x$

Ⓒ $y = -2x$

Ⓓ $y = 2x$

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 $y = -\dfrac{1}{2}x + 0$, or $y = -\dfrac{1}{2}x$.

The correct answer is Ⓐ.

**EXAMPLE** **3**　**Real-Life Application**

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?

22.5 oz

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 $y = 3x + 3$.
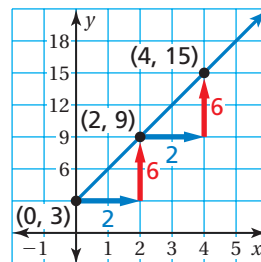
b. Find the value of x when $y = 22.5$.

$y = 3x + 3$	Write the equation.
$22.5 = 3x + 3$	Substitute 22.5 for y.
$19.5 = 3x$	Subtract 3 from each side.
$6.5 = x$	Solve for x.

⋮ The kitten in the photo is 6.5 weeks old.

🔴 **On Your Own**

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

4. 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?

Vocabulary and Concept Check

1. **WRITING** Describe how to write an equation of a line using two points on the line.

2. **WHICH ONE DOESN'T BELONG?** Which pair of points does *not* belong with the other three? Explain your reasoning.
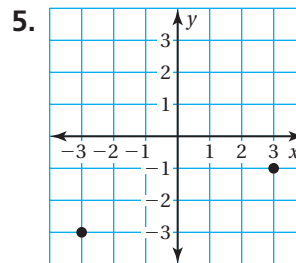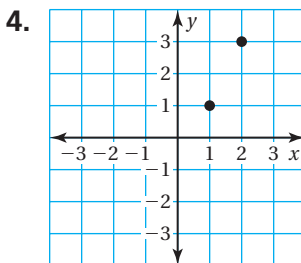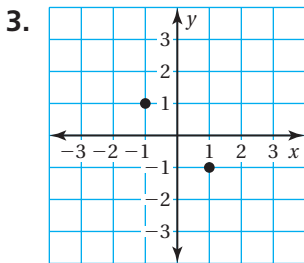
$(0, 1), (2, 3)$ $(1, 2), (4, 5)$ $(2, 3), (5, 6)$ $(1, 2), (4, 6)$

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.

3.

4.

5.

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 $(3, 2)$.
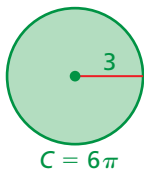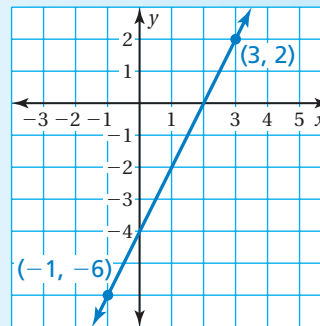
16. JET SKI It costs $175 to rent a jet ski for 2 hours. It costs $300 to rent a jet ski for 4 hours. Write an equation that represents the cost y (in dollars) of renting a jet ski for x hours.

✗

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

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

The equation is $y = -4x + 2$.

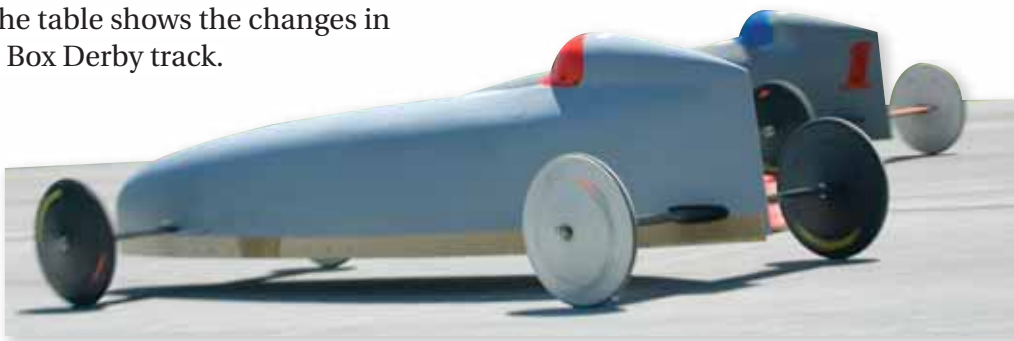**17. CIRCUMFERENCE** Consider the circles shown.

$C = 4\pi$ $C = 6\pi$

a. Plot the points $(2, 4\pi)$ and $(3, 6\pi)$.

b. 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

  a. Draw a Soap Box Derby track in a coordinate plane.

  b. Does each section of the track have the same slope? Explain.

  c. 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.

  a. Write an equation that represents the value y (in dollars) of the car after x years.

  b. Graph the equation.

  c. What is the y-intercept of the line? Interpret the y-intercept.

Leaning Tower of Pisa
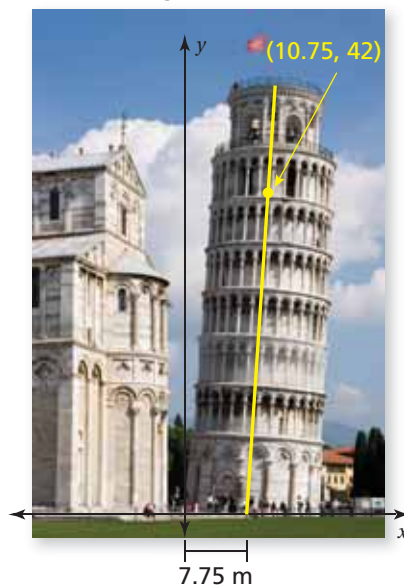
20. WATERING CAN You water the plants in your classroom at a constant rate. After 5 seconds, your watering can contains 58 ounces of water. Fifteen seconds later, the can contains 28 ounces of water.

  a. Write an equation that represents the amount y (in ounces) of water in the can after x seconds.

  b. How much water was in the can when you started watering the plants?

  c. When is the watering can empty?

21. **Critical Thinking** The Leaning Tower of Pisa in Italy was built between 1173 and 1350.

  a. Write an equation for the yellow line.

  b. 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