

# 5.2

## Writing Linear Equations Given the Slope and a Point

### What you should learn

**GOAL 1** Use slope and any point on a line to write an equation of the line.

**GOAL 2** Use a linear model to make predictions about a **real-life** situation, such as the number of vacation trips in **Example 3**.

### Why you should learn it

▼ To model a **real-life** situation, such as finding the total cost of a taxi ride in **Ex. 48**.



### GOAL 1 USING SLOPE AND A POINT ON A LINE

In Lesson 5.1 you learned how to write an equation of a line when given the slope and the  $y$ -intercept of the line. You used the slope-intercept form of the equation of a line,  $y = mx + b$ .

In this lesson you will learn to write an equation of a line when given its slope and *any* point on the line.

### EXAMPLE 1 Writing an Equation of a Line

Write an equation of the line that passes through the point  $(6, -3)$  and has a slope of  $-2$ .

#### SOLUTION

**Find** the  $y$ -intercept. Because the line has a slope of  $m = -2$  and passes through the point  $(x, y) = (6, -3)$ , you can substitute the values  $m = -2$ ,  $x = 6$ , and  $y = -3$  into the slope-intercept form and solve for  $b$ .

$$y = mx + b$$

Write slope-intercept form.

$$-3 = (-2)(6) + b$$

Substitute  $-2$  for  $m$ ,  $6$  for  $x$ , and  $-3$  for  $y$ .

$$-3 = -12 + b$$

Simplify.

$$9 = b$$

Solve for  $b$ .

The  $y$ -intercept is  $b = 9$ .

**Write** an equation of the line. Because you now know both the slope and the  $y$ -intercept, you can use the slope-intercept form.

$$y = mx + b$$

Write slope-intercept form.

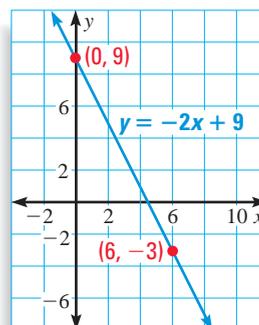
$$y = -2x + 9$$

Substitute  $-2$  for  $m$  and  $9$  for  $b$ .

✓ **CHECK** You can check your result by graphing  $y = -2x + 9$ .

Note that the line crosses the  $y$ -axis at the point  $(0, 9)$  and passes through the given point  $(6, -3)$ .

You can count the number of units in the rise and the run to check that the slope is  $-2$ .



## WRITING AN EQUATION OF A LINE GIVEN ITS SLOPE AND A POINT

- STEP 1** First find the **y-intercept**. Substitute the slope  $m$  and the coordinates of the given point  $(x, y)$  into the slope-intercept form,  $y = mx + b$ . Then solve for the  $y$ -intercept  $b$ .
- STEP 2** Then write an equation of the line. Substitute the slope  $m$  and the  $y$ -intercept  $b$  into the slope-intercept form,  $y = mx + b$ .

### EXAMPLE 2

**Writing Equations of Parallel Lines**

#### STUDENT HELP

#### Look Back

For help with parallel lines, see p. 242.

Two nonvertical lines are parallel if and only if they have the same slope. Write an equation of the line that is parallel to the line  $y = \frac{2}{3}x - 2$  and passes through the point  $(-2, 1)$ .

#### SOLUTION

- 1** The given line has a slope of  $m = \frac{2}{3}$ . Because parallel lines have the same slope, a parallel line through  $(-2, 1)$  must also have a slope of  $m = \frac{2}{3}$ .

Use this information to find the  $y$ -intercept.

$$y = mx + b \quad \text{Write slope-intercept form.}$$

$$1 = \frac{2}{3}(-2) + b \quad \text{Substitute } \frac{2}{3} \text{ for } m, -2 \text{ for } x, \text{ and } 1 \text{ for } y.$$

$$1 = -\frac{4}{3} + b \quad \text{Simplify.}$$

$$\frac{7}{3} = b \quad \text{Solve for } b.$$

The  $y$ -intercept is  $b = \frac{7}{3}$ .

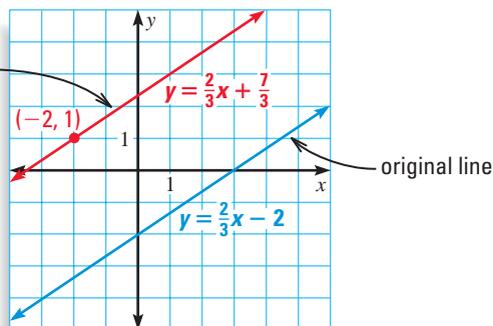
- 2** Write an equation using the slope-intercept form.

$$y = mx + b \quad \text{Write slope-intercept form.}$$

$$y = \frac{2}{3}x + \frac{7}{3} \quad \text{Substitute } \frac{2}{3} \text{ for } m \text{ and } \frac{7}{3} \text{ for } b.$$

- ✓CHECK** You can check your result graphically. The original line  $y = \frac{2}{3}x - 2$  is parallel to  $y = \frac{2}{3}x + \frac{7}{3}$ .

This line is parallel to the original line, and passes through  $(-2, 1)$ .



#### STUDENT HELP

**INTERNET** **HOMEWORK HELP**  
Visit our Web site  
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for extra examples.



**REAL LIFE** **VACATIONS** One favorite vacation destination is Washington, DC, with 22 million visitors in 1997. ▶ Source: Washington DC Convention and Visitors Association

## GOAL 2 WRITING AND USING REAL-LIFE MODELS

### EXAMPLE 3 Writing and Using a Linear Model

**VACATION TRIPS** Between 1985 and 1995, the number of vacation trips in the United States taken by United States residents increased by about 26 million per year. In 1993, United States residents went on 740 million vacation trips within the United States.  **DATA UPDATE** of Travel Industry of America at [www.mcdougallittell.com](http://www.mcdougallittell.com)

- Write a linear equation that models the number of vacation trips  $y$  (in millions) in terms of the year  $t$ . Let  $t$  be the number of years since 1985.
- Estimate the number of vacation trips in the year 2005.

#### SOLUTION

- The number of trips increased by about 26 million per year, so you know the slope is  $m = 26$ . You also know that  $(t, y) = (8, 740)$  is a point on the line, because 740 million trips were taken in 1993, 8 years after 1985.

$$y = mt + b \quad \text{Write slope-intercept form.}$$

$$740 = (26)(8) + b \quad \text{Substitute 26 for } m, 8 \text{ for } t, \text{ and } 740 \text{ for } y.$$

$$740 = 208 + b \quad \text{Simplify.}$$

$$532 = b \quad \text{The } y\text{-intercept is } b = 532.$$

Write an equation of the line using  $m = 26$  and  $b = 532$ .

$$y = mt + b \quad \text{Write slope-intercept form.}$$

$$y = 26t + 532 \quad \text{Substitute 26 for } m \text{ and } 532 \text{ for } b.$$

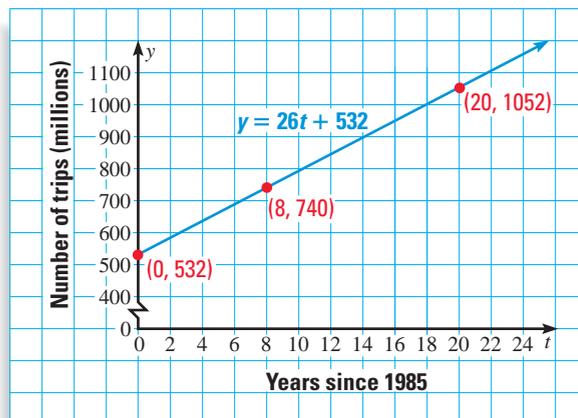
- You can estimate the number of vacation trips in the year 2005 by substituting  $t = 20$  into the linear model.

$$y = 26t + 532 \quad \text{Write linear model.}$$

$$= 26(20) + 532 \quad \text{Substitute 20 for } t.$$

$$= 1052 \quad \text{Simplify.}$$

- ▶ You can estimate that United States residents will take about 1052 million vacation trips in the year 2005. A graph can help check this result. The line goes through  $(20, 1052)$ .



# GUIDED PRACTICE

## Vocabulary Check ✓

1. Two nonvertical lines that have the same slope must be ?.

## Concept Check ✓

2. Explain how to find the equation of a line given its slope and a point on the line.

## Skill Check ✓

Write an equation of the line that passes through the point and has the given slope. Write the equation in slope-intercept form.

3.  $(3, 4)$ ,  $m = \frac{1}{2}$

4.  $(2, -4)$ ,  $m = -5$

5.  $(10, -10)$ ,  $m = \frac{2}{3}$

6.  $(-12, 2)$ ,  $m = -2$

7.  $(4, 8)$ ,  $m = 5$

8.  $(0, -5)$ ,  $m = 0$

Write an equation of the line that is parallel to the given line and passes through the point.

9.  $y = \frac{1}{2}x + 8$ ,  $(-6, 4)$

10.  $y = -3x - 3$ ,  $(-4, -3)$

11.  **BANKING** Christina has her savings in a bank account. She withdraws \$8.25 per week from her account. After 10 weeks, the balance is \$534. Write an equation that models the balance  $y$  of Christina's account in terms of the number of weeks  $x$ . Do not consider any interest earned by the account.

# PRACTICE AND APPLICATIONS

### STUDENT HELP

**Extra Practice**  
to help you master  
skills is on p. 801.

**WRITING EQUATIONS** Write an equation of the line that passes through the point and has the given slope. Write the equation in slope-intercept form.

12.  $(1, 4)$ ,  $m = 3$

13.  $(2, -3)$ ,  $m = 2$

14.  $(-4, 2)$ ,  $m = -1$

15.  $(1, -3)$ ,  $m = -4$

16.  $(-3, -5)$ ,  $m = -2$

17.  $(1, 3)$ ,  $m = 4$

18.  $(2, 5)$ ,  $m = \frac{1}{2}$

19.  $(-3, 2)$ ,  $m = \frac{1}{3}$

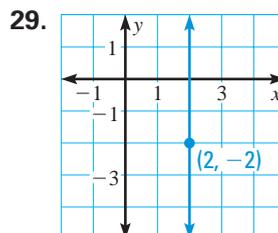
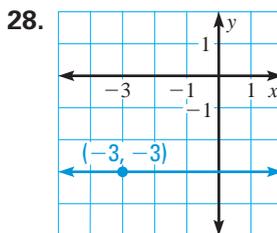
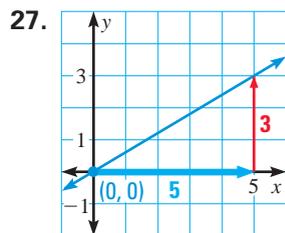
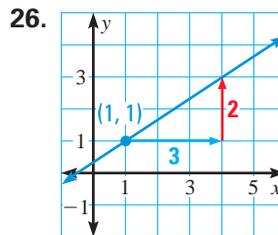
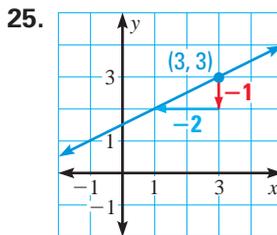
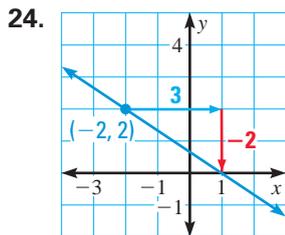
20.  $(0, 2)$ ,  $m = 3$

21.  $(0, -2)$ ,  $m = 4$

22.  $(3, 4)$ ,  $m = 0$

23.  $(-2, 4)$ ,  $m = 0$

**GRAPHICAL REASONING** Write an equation of the line shown in the graph.



### STUDENT HELP

#### HOMEWORK HELP

**Example 1:** Exs. 12–29  
**Example 2:** Exs. 32–41  
**Example 3:** Exs. 42–45

**USING x-INTERCEPTS** Write an equation of the line that has the given x-intercept and slope.

30. x-intercept = 2,  $m = -\frac{2}{3}$

31. x-intercept = 4,  $m = 3$

**PARALLEL LINES** Write an equation of the line that is parallel to the given line and passes through the given point.

32.  $y = 2x + 2$ , (3, 2)

33.  $y = x + 4$ , (-2, 0)

34.  $y = -2x + 3$ , (4, 4)

35.  $y = -3x + 1$ , (4, 2)

36.  $y = \frac{2}{3}x - 2$ , (2, 1)

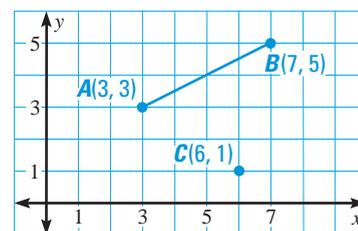
37.  $y = -\frac{1}{3}x - 1$ , (4, 1)

38.  $y = -4x - 2$ , (5, 3)

39.  $y = 6x + 9$ , (5, -3)

40.  $y = -9x - 8$ , (7, -2)

41. **GEOMETRY CONNECTION**  $\overline{AB}$  is part of a line with a slope of  $\frac{1}{2}$ . To begin to draw a parallelogram, you want to draw a line parallel to  $\overline{AB}$  through point C. Write an equation of the line.



**FOCUS ON APPLICATIONS**



**REAL LIFE** **KENOSHA** borders Lake Michigan and originally had an economy dominated by the shipping industry.

**POPULATION** In Exercises 42 and 43, use the following information.

In 1991, the population of Kenosha, Wisconsin, was 132,000. Between 1991 and 1996, the population of Kenosha increased by approximately 2000 people per year. **Source:** U.S. Bureau of the Census

42. Write an equation that models the population  $y$  of Kenosha in terms of  $x$ , where  $x$  represents the number of years since 1991.

43. Use the model to estimate the population of Kenosha in 2006.

**SALARY** In Exercises 44 and 45, use the following information.

At the start of your second year as a veterinary technician, you receive a raise of \$750. You expect to receive the same raise every year. Your total yearly salary after your first raise is \$18,000 per year.

44. Write an equation that models your total salary  $s$  in terms of the number of years  $n$  since you started as a technician.

45. Calculate your yearly salary after six years as a veterinary technician.

**CELLULAR RATES** In Exercises 46 and 47, use the following information.

You are moving to Houston, Texas, and are switching your cellular phone company. Your new peak air time rate in Houston is \$.23 per minute. Your bill also includes a monthly access charge. For 110 minutes of peak air time your bill is \$51.30.

46. Write an equation that models the cost  $C$  of your monthly bill in terms of the number of minutes  $m$  used. (All of your minutes are during peak air time.)

47. How much is your monthly bill for 60 minutes of peak air time?

**TAXI RIDE** In Exercises 48 and 49, the cost of a taxi ride is an initial fee plus \$1.50 for each mile. Your fare for 9 miles is \$15.50.

48. Write an equation that models the total cost  $y$  of a taxi ride in terms of the number of miles  $x$ .

49. How much is the initial fee?

## Test Preparation

50. **MULTI-STEP PROBLEM** After 6 weeks on a fitness program, Greg jogs 35 miles per week. His average mileage gain has been 2 miles per week.
- Write an equation that models Greg's weekly mileage  $m$  in terms of the number of weeks  $n$  that he stays on the program.
  - When will Greg jog over 45 miles per week?
  - Writing* According to the equation, what will be Greg's weekly mileage after 52 weeks? Do you think this is realistic? Explain.

## ★ Challenge

51. **RENTING A CAR** You are comparing the costs of car rental agencies for a one-day car rental. Car Rental Agency A charges \$30 a day plus \$.08 per mile. Car Rental Agency B charges a flat fee of \$40 a day.
- Write an equation in slope-intercept form that models the cost of renting a car from each car rental agency.
  - Use a graphing calculator to graph the two equations on the same coordinate plane.
  - Under what conditions would the cost of renting a car from either rental agency be the same?
  - Under what conditions would the cost of renting a car from Car Rental Agency A be the best deal? Under what conditions would it be cheaper for you to rent a car from Car Rental Agency B?

### EXTRA CHALLENGE

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## MIXED REVIEW

**EVALUATING EXPONENTIAL EXPRESSIONS** Use a calculator to evaluate the power. (Review 1.2)

- |           |           |              |              |
|-----------|-----------|--------------|--------------|
| 52. $5^7$ | 53. $8^5$ | 54. $9^6$    | 55. $3^{12}$ |
| 56. $2^8$ | 57. $4^3$ | 58. $8^4$    | 59. $10^4$   |
| 60. $7^8$ | 61. $6^9$ | 62. $5^{11}$ | 63. $9^{13}$ |

**RULES OF ADDITION** Find the sum. (Review 2.2)

- |                    |                                      |                       |
|--------------------|--------------------------------------|-----------------------|
| 64. $-7 + (-1)$    | 65. $4 + \left(-4\frac{1}{2}\right)$ | 66. $-9 + 11$         |
| 67. $-10 + (-1)$   | 68. $2 + (-6)$                       | 69. $-18 + (-2)$      |
| 70. $6 + (-8) - 4$ | 71. $4 - (-7) + 3$                   | 72. $5 + (-3) + (-5)$ |

**FINDING SLOPE** Find the slope of the line. (Review 4.4 for 5.3)

