

NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

## 4 Anticipation Guide

### Analyzing Linear Equations

#### Step 1 Before you begin Chapter 4

- Read each statement.
- Decide whether you Agree (A) or Disagree (D) with the statement.
- Write A or D in the first column OR if you are not sure whether you agree or disagree, write NS (Not Sure).

STEP 1 A, D, or NS	Statement	STEP 2 A or D
	1. The slope of a line given by an equation in the form $y = mx + b$ can be determined by looking at the equation.	A
	2. The y-intercept of $y = 12x - 8$ is 8.	D
	3. If two points on a line are known, then an equation can be written for that line.	A
	4. An equation in the form $y = mx + b$ is in point-slope form.	D
	5. If a pair of lines are parallel, then they have the same slope.	A
	6. Lines that intersect at right angles are called perpendicular lines.	A
	7. A scatter plot is said to have a negative correlation when the points are random and show no relation between $x$ and $y$ .	D
	8. The closer the correlation coefficient is to zero, the more closely a best-fit line models a set of data.	D
	9. The equations of a regression line and a median-fit line are very similar.	A
	10. Step functions and absolute value functions are types of piecewise-linear functions.	A

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#### Step 2 After you complete Chapter 4

- Reread each statement and complete the last column by entering an A or a D.
- Did any of your opinions about the statements change from the first column?
- For those statements that you mark with a D, use a piece of paper to write an example of why you disagree.

Chapter 4

Glencoe Algebra 1

3

# Answers (Anticipation Guide and Lesson 4-1)

NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

## 4-1 Study Guide and Intervention

### Graphing Equations in Slope-Intercept Form

#### Slope-Intercept Form

Slope-Intercept Form  $y = mx + b$ , where  $m$  is the given slope and  $b$  is the  $y$ -intercept

**Example 1** Write an equation in slope-intercept form for the line with a slope of  $-4$  and a  $y$ -intercept of  $3$ .

$y = mx + b$   
 $y = -4x + 3$   
 Slope-intercept form  
 Replace  $m$  with  $-4$  and  $b$  with  $3$ .

**Example 2** Graph  $3x - 4y = 8$ .

$3x - 4y = 8$   
 Original equation  
 $-4y = -3x + 8$  Subtract  $3x$  from each side.  
 $-4y = -3x + 8$  Divide each side by  $-4$ .  
 $y = \frac{3}{4}x - 2$  Simplify.

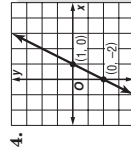
The  $y$ -intercept of  $y = \frac{3}{4}x - 2$  is  $-2$  and the slope is  $\frac{3}{4}$ . So graph the point  $(0, -2)$ . From this point, move up 3 units and right 4 units. Draw a line passing through both points.

#### Exercises

Write an equation of a line in slope-intercept form with the given slope and  $y$ -intercept.

1. slope:  $8$ ,  $y$ -intercept  $-3$   $y = 8x - 3$
2. slope:  $-2$ ,  $y$ -intercept  $-1$   $y = -2x - 1$
3. slope:  $-1$ ,  $y$ -intercept  $-7$   $y = -x - 7$

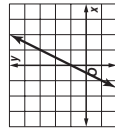
Write an equation in slope-intercept form for each graph shown.



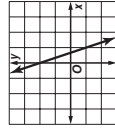
$y = 2x - 2$

Graph each equation.

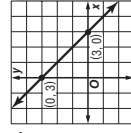
7.  $y = 2x + 1$



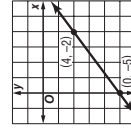
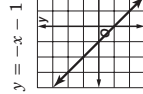
8.  $y = -3x + 2$



$y = -x + 3$



$y = \frac{3}{4}x - 5$



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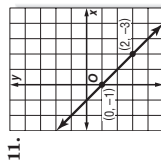
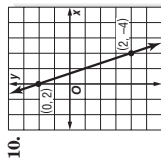
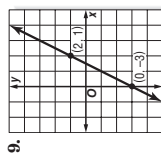
## 4-1 Skills Practice

### Graphing Equations in Slope-Intercept Form

Write an equation of a line in slope-intercept form with the given slope and  $y$ -intercept.

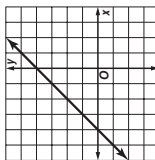
1. slope: 5,  $y$ -intercept:  $-3$     $y = 5x - 3$    2. slope:  $-2$ ,  $y$ -intercept:  $7$     $y = -2x + 7$
3. slope:  $-6$ ,  $y$ -intercept:  $-2$     $y = -6x - 2$    4. slope:  $7$ ,  $y$ -intercept:  $1$     $y = 7x + 1$
5. slope:  $3$ ,  $y$ -intercept:  $2$     $y = 3x + 2$    6. slope:  $-4$ ,  $y$ -intercept:  $-9$     $y = -4x - 9$
7. slope:  $1$ ,  $y$ -intercept:  $-12$     $y = x - 12$    8. slope:  $0$ ,  $y$ -intercept:  $8$     $y = 8$

Write an equation in slope-intercept form for each graph shown.

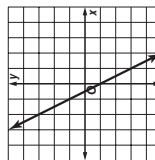


Graph each equation.

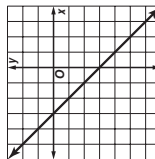
12.  $y = x + 4$



13.  $y = -2x - 1$



14.  $x + y = -3$



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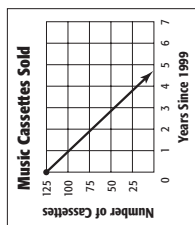
## 4-1 Study Guide and Intervention

### Graphing Equations in Slope-Intercept Form

#### Modeling Real-World Data

**Example** **MEDIA** Since 1999, the number of music cassettes sold has decreased by an average rate of 27 million per year. There were 124 million music cassettes sold in 1999.

- a. Write a linear equation to find the average number of music cassettes sold in any year after 1999.  
The rate of change is  $-27$  million per year. In the first year, the number of music cassettes sold was 124 million. Let  $N$  = the number of millions of music cassettes sold. Let  $x$  = the number of years after 1999. An equation is  $N = -27x + 124$ .



- c. **Find the approximate number of music cassettes sold in 2003.**  
 $N = -27x + 124$    Original equation  
 $N = -27(4) + 124$    Replace  $x$  with 3.  
 $N = 16$    Simplify.

There were about 16 million music cassettes sold in 2003.

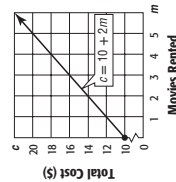
#### Exercises

1. **MUSIC** In 2001, full-length cassettes represented 3.4% of total music sales. Between 2001 and 2006, the percent decreased by about 0.5% per year.
  - a. Write an equation to find the percent  $P$  of recorded music sold as full-length cassettes for any year  $x$  between 2001 and 2006.  $P = -0.5x + 3.4$
  - b. Graph the equation on the grid at the right.
  - c. Find the percent of recorded music sold as full-length cassettes in 2004. **1.9%**
2. **POPULATION** The population of the United States is projected to be 300 million by the year 2010. Between 2010 and 2050, the population is expected to increase by about 2.5 million per year.
  - a. Write an equation to find the population  $P$  in any year  $x$  between 2010 and 2050.  $P = 2,500,000x + 300,000,000$
  - b. Graph the equation on the grid at the right.
  - c. Find the population in 2050. **about 400,000,000**

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## Lesson 4-1

### Video Store Rental Costs



15. **VIDEO RENTALS** A video store charges \$10 for a rental card plus \$2 per rental.

- a. Write an equation in slope-intercept form for the total cost  $c$  of buying a rental card and renting  $m$  movies.  $c = 10 + 2m$
- b. Graph the equation.
- c. Find the cost of buying a rental card and 6 movies.  
**\$22**

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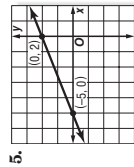
### 4-1 Practice

#### Graphing Equations in Slope-Intercept Form

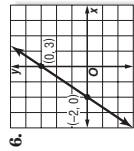
Write an equation of a line in slope-intercept form with the given slope and  $y$ -intercept.

- slope:  $\frac{1}{4}$ ,  $y$ -intercept: 3  $y = \frac{1}{4}x + 3$
- slope:  $\frac{3}{2}$ ,  $y$ -intercept:  $-4$   $y = \frac{3}{2}x - 4$
- slope: 1.5,  $y$ -intercept:  $-1$   
 $y = 1.5x - 1$
- slope:  $-2.5$ ,  $y$ -intercept: 3.5  
 $y = -2.5x + 3.5$

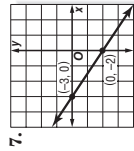
Write an equation in slope-intercept form for each graph shown.



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

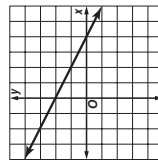


$y = \frac{3}{2}x + 3$

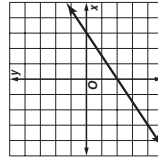


$y = -\frac{2}{3}x - 2$

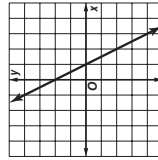
8.  $y = -\frac{1}{2}x + 2$



9.  $3y = 2x - 6$

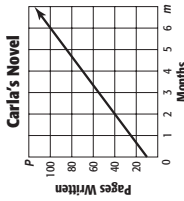


10.  $6x + 3y = 6$



11. **WRITING** Carla has already written 10 pages of a novel. She plans to write 15 additional pages per month until she is finished.

- Write an equation to find the total number of pages  $P$  written after any number of months  $m$ .  $P = 10 + 15m$
- Graph the equation on the grid at the right.
- Find the total number of pages written after 5 months. **85**



## Answers (Lesson 4-1)

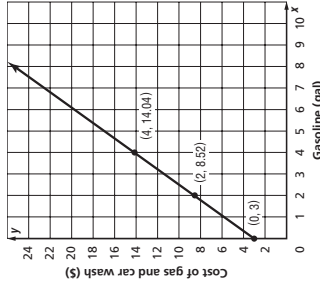
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### 4-1 Word Problem Practice

#### Graphing Equations in Slope-Intercept Form

1. **SAVINGS** Wade's grandmother gave him \$100 for his birthday. Wade wants to save his money to buy a new MP3 player that costs \$275. Each month, he adds \$25 to his MP3 savings. Write an equation in slope-intercept form for  $m$ , the number of months that it will take Wade to save \$275.  
 $275 = 25x + 100$

2. **CAR CARE** Suppose regular gasoline costs \$2.76 per gallon. You can purchase a car wash at the gas station for \$3. The graph of the equation for the cost of gasoline and a car wash is shown below. Write the equation in slope-intercept form for the line shown on the graph.

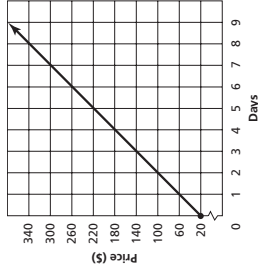


$y = 2.76x + 3$

3. **ADULT EDUCATION** Angie's mother wants to take some adult education classes at the local high school. She has to pay a one-time enrollment fee of \$25 to join the adult education community, and then \$45 for each class she wants to take. The equation  $y = 45x + 25$  expresses the cost of taking classes. What are the slope and  $y$ -intercept of the equation?  
 $m = 45$ ;  $y$ -intercept = 25

### Lesson 4-1

4. **BUSINESS** A construction crew needs to rent a trench digger for up to a week. An equipment rental company charges \$40 per day plus a \$20 non-refundable insurance cost to rent a trench digger. Write and graph an equation to find the total cost to rent the trench digger for  $d$  days.  $y = 40d + 20$



5. **ENERGY** From 2002 to 2005, U.S. consumption of renewable energy increased an average of 0.17 quadrillion BTUs per year. About 6.07 quadrillion BTUs of renewable power were produced in the year 2002.

a. Write an equation in slope-intercept form to find the amount of renewable power  $P$  (quadrillion BTUs) produced in year  $y$  between 2002 and 2005.  
 $P = 0.17y + 6.07$

b. Approximately how much renewable power was produced in 2005?  
**6.58 quadrillion BTUs**

c. If the same trend continues from 2006 to 2010, how much renewable power will be produced in the year 2010?  
**7.43 quadrillion BTUs**

### 4-1 Enrichment

#### Using Equations: Ideal Weight

You can find your ideal weight as follows.  
 A woman should weigh 100 pounds for the first 5 feet of height and 5 additional pounds for each inch over 5 feet (5 feet = 60 inches).  
 A man should weigh 106 pounds for the first 5 feet of height and 6 additional pounds for each inch over 5 feet. These formulas apply to people with normal bone structures.  
 To determine your bone structure, wrap your thumb and index finger around the wrist of your other hand. If the thumb and finger just touch, you have normal bone structure. If they overlap, you are small-boned. If they don't overlap, you are large-boned. Small-boned people should decrease their calculated ideal weight by 10%. Large-boned people should increase the value by 10%.

- Calculate the ideal weights of these people.**
- woman, 5 ft 4 in., normal-boned  
**120 lb**
  - man, 5 ft 11 in., large-boned  
**189.2 lb**
  - man, 6 ft 5 in., small-boned  
**187.2 lb**
  - you, if you are at least 5 ft tall  
**Answers will vary.**

**For Exercises 5-9, use the following information.**

Suppose a normal-boned man is  $x$  inches tall. If he is at least 5 feet tall, then  $x - 60$  represents the number of inches this man is over 5 feet tall. For each of these inches, his ideal weight is increased by 6 pounds. Thus, his proper weight ( $y$ ) is given by the formula  $y = 6(x - 60) + 106$  or  $y = 6x - 254$ . If the man is large-boned, the formula becomes  $y = 6x - 254 + 0.10(6x - 254)$ .

- Write the formula for the weight of a large-boned man in slope-intercept form.  **$y = 6.6x - 279.4$**
- Derive the formula for the ideal weight ( $y$ ) of a normal-boned female with height  $x$  inches. Write the formula in slope-intercept form.  **$y = 5x - 200$**
- Derive the formula in slope-intercept form for the ideal weight ( $y$ ) of a large-boned female with height  $x$  inches.  **$y = 5.5x - 220$**
- Derive the formula in slope-intercept form for the ideal weight ( $y$ ) of a small-boned male with height  $x$  inches.  **$y = 5.4x - 228.6$**
- Find the heights at which normal-boned males and large-boned females would weigh the same. **68 in., or 5 ft 8 in.**

### 4-2 Study Guide and Intervention

#### Writing Equations in Slope-Intercept Form

##### Write an Equation Given the Slope and a Point

**Example 1** Write an equation of the line that passes through  $(-4, 2)$  with a slope of  $\frac{1}{4}$ .

The line has slope  $\frac{1}{4}$ . To find the  $y$ -intercept, replace  $m$  with  $\frac{1}{4}$  and  $(x, y)$  with  $(-4, 2)$  in the slope-intercept form. Then solve for  $b$ .

$$y = mx + b$$

$$2 = \frac{1}{4}(-4) + b$$

$$2 = -1 + b$$

$$14 = b$$

Slope-intercept form  
 $m = 3, y = 2$ , and  $x = -4$   
 Multiply.  
 Add 12 to each side.  
 Therefore, the equation is  $y = 3x + 14$ .

**Example 2** Write an equation of the line that passes through  $(-2, -1)$  with a slope of  $\frac{1}{4}$ .

The line has slope  $\frac{1}{4}$ . Replace  $m$  with  $\frac{1}{4}$  and  $(x, y)$  with  $(-2, -1)$  in the slope-intercept form.

$$y = mx + b$$

$$-1 = \frac{1}{4}(-2) + b$$

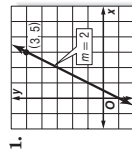
$$-1 = -\frac{1}{2} + b$$

$$-\frac{1}{2} = b$$

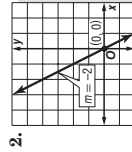
Slope-intercept form  
 $m = \frac{1}{4}, y = -1$ , and  $x = -2$   
 Multiply.  
 Add  $\frac{1}{2}$  to each side.  
 Therefore, the equation is  $y = \frac{1}{4}x - \frac{1}{2}$ .

#### Exercises

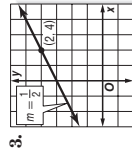
Write an equation of the line that passes through the given point and has the given slope.



- $y = 2x - 1$
- $(8, 2)$ ; slope  $-\frac{3}{4}$   
 **$y = -\frac{3}{4}x + 8$**
- $(-5, 4)$ ; slope 0  
 **$y = 4$**
- $(-3, 0)$ ,  $m = 2$   
 **$y = 2x + 6$**



- $y = -2x$
- $(-1, -3)$ ; slope 5  
 **$y = 5x + 2$**
- $(2, 2)$ ; slope  $\frac{1}{2}$   
 **$y = \frac{1}{2}x + 1$**
- $(0, 4)$ ,  $m = -3$   
 **$y = -3x + 4$**



- $y = \frac{1}{2}x + 3$
- $(4, -5)$ ; slope  $-\frac{1}{2}$   
 **$y = -\frac{1}{2}x - 3$**
- $(1, -4)$ ; slope  $-6$   
 **$y = -6x + 2$**
- $(0, 350)$ ,  $m = \frac{1}{5}$   
 **$y = \frac{1}{5}x + 350$**

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### 4-2 Study Guide and Intervention (continued) Writing Equations in Slope-Intercept Form

Write an Equation Given Two Points

**Example** Write an equation of the line that passes through (1, 2) and (3, -2). Find the slope  $m$ . To find the  $y$ -intercept, replace  $m$  with its computed value and  $(x, y)$  with (1, 2) in the slope-intercept form. Then solve for  $b$ .

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{-2 - 2}{3 - 1}$$

$$m = -2$$

$$y = mx + b$$

$$2 = -2(1) + b$$

$$2 = -2 + b$$

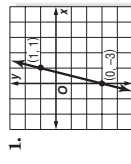
$$4 = b$$

Therefore, the equation is  $y = -2x + 4$ .

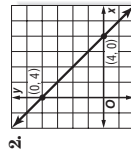
Slope formula  
Simplify.  
Slope-intercept form  
Replace  $m$  with  $-2$ ,  $y$  with  $2$ , and  $x$  with  $1$ .  
Multiply.  
Add 2 to each side.

#### Exercises

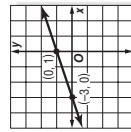
Write an equation of the line that passes through each pair of points.



1.  $y = 4x - 3$



2.  $y = -x + 4$



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

4.  $(-1, 6), (7, -10)$

$y = -2x + 4$

5.  $(0, 2), (1, 7)$

$y = 5x + 2$

7.  $(-2, -1), (2, 11)$

$y = 3x + 5$

8.  $(10, -1), (4, 2)$

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

10.  $(4, 0), (0, 2)$

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

11.  $(-3, 0), (0, 5)$

$y = \frac{5}{3}x + 5$

12.  $(0, 16), (-10, 0)$

$y = \frac{8}{5}x + 16$

## Answers (Lesson 4-2)

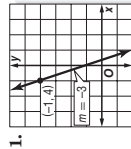
### Lesson 4-2

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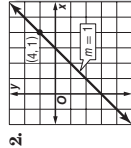
### 4-2 Skills Practice

#### Writing Equations in Slope-Intercept Form

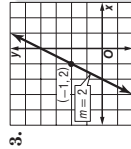
Write an equation of the line that passes through the given point with the given slope.



1.  $y = -3x + 1$



2.  $y = x - 3$



3.  $y = 2x + 4$

4.  $(1, 9)$ ; slope 4

$y = 4x + 5$

5.  $(4, 2)$ ; slope  $-2$

$y = -2x + 10$

6.  $(2, -2)$ ; slope 3

$y = 3x - 8$

7.  $(3, 0)$ ; slope 5

$y = 5x - 15$

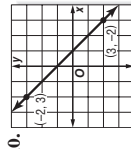
8.  $(-3, -2)$ ; slope 2

$y = 2x + 4$

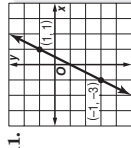
9.  $(-5, 4)$ ; slope  $-4$

$y = -4x - 16$

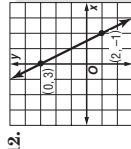
Write an equation of the line that passes through each pair of points.



10.  $y = -x + 1$



11.  $y = 2x - 1$



12.  $y = -2x + 3$

13.  $(1, 3), (-3, -5)$

$y = 2x + 1$

14.  $(1, 4), (6, -1)$

$y = -x + 5$

15.  $(1, -1), (3, 5)$

$y = 3x - 4$

16.  $(-2, 4), (0, 6)$

$y = x + 6$

17.  $(3, 3), (1, -3)$

$y = 3x - 6$

18.  $(-1, 6), (3, -2)$

$y = -2x + 4$

19. **INVESTING** The price of a share of stock in XYZ Corporation was \$74 two weeks ago. Seven weeks ago, the price was \$59 a share.

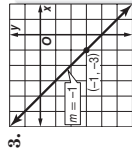
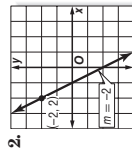
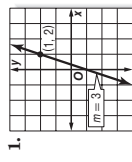
- a. Write a linear equation to find the price  $p$  of a share of XYZ Corporation stock  $w$  weeks from now.  
 $p = 3w + 80$
- b. Estimate the price of a share of stock five weeks ago.  
**\$65**

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### 4-2 Practice

#### Writing Equations in Slope-Intercept Form

Write an equation of the line that passes through the given point and has the given slope.



4.  $(-5, 4)$ ; slope  $-3$   
 $y = -3x - 11$

5.  $(4, 3)$ ; slope  $\frac{1}{2}$   
 $y = \frac{1}{2}x + 1$

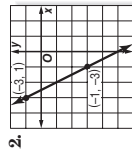
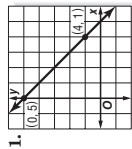
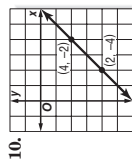
6.  $(1, -5)$ ; slope  $-\frac{3}{2}$   
 $y = -\frac{3}{2}x - \frac{7}{2}$

7.  $(3, 7)$ ; slope  $\frac{2}{7}$   
 $y = \frac{2}{7}x + 6\frac{1}{7}$

8.  $(-2, \frac{5}{2})$ ; slope  $-\frac{1}{2}$   
 $y = -\frac{1}{2}x + \frac{3}{2}$

9.  $(5, 0)$ ; slope  $0$   
 $y = 0$

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



13.  $(0, -4)$ ,  $(5, -4)$   
 $y = -4$

14.  $(-4, -2)$ ,  $(4, 0)$   
 $y = \frac{1}{4}x - 1$

15.  $(-2, -3)$ ,  $(4, 5)$   
 $y = \frac{4}{3}x - 3$

16.  $(0, 1)$ ,  $(5, 3)$   
 $y = \frac{2}{5}x + 1$

17.  $(-3, 0)$ ,  $(1, -6)$   
 $y = -\frac{3}{2}x - \frac{9}{2}$

18.  $(1, 0)$ ,  $(5, -1)$   
 $y = -\frac{1}{4}x + \frac{1}{4}$

19. **DANCE LESSONS** The cost for 7 dance lessons is \$82. The cost for 11 lessons is \$122. Write a linear equation to find the total cost  $C$  for  $l$  lessons. Then use the equation to find the cost of 4 lessons.  **$C = 10l + 12$ ; \$52**

20. **WEATHER** It is  $76^\circ\text{F}$  at the 6000-foot level of a mountain, and  $49^\circ\text{F}$  at the 12,000-foot level of the mountain. Write a linear equation to find the temperature  $T$  at an elevation  $x$  on the mountain, where  $x$  is in thousands of feet.  **$T = -4.5x + 103$**

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### 4-2 Word Problem Practice

#### Writing Equations in Slope-Intercept Form

1. **FUNDRAISING** Yvonne and her friends held a bake sale to benefit a shelter for homeless people. The friends sold 22 cakes on the first day and 15 cakes on the second day of the bake sale. They collected \$88 on the first day and \$60 on the second day. Let  $x$  represent the number of cakes sold and  $y$  represent the amount of money made. Find the slope of the line that would pass through the points given. **4**

4. **WATER** Mr. Williams pays \$40 a month for city water, no matter how many gallons of water he uses in a given month. Let  $x$  represent the number of gallons of water used per month. Let  $y$  represent the monthly cost of the city water in dollars. What is the equation of the line that represents this information? What is the slope of the line?  
 **$y = 40$ ; slope is 0. The line is horizontal.**

5. **SHOE SIZES** The table shows how women's shoe sizes in the United Kingdom compare to women's shoe sizes in the United States.

	Women's Shoe Sizes							
U.K.	3	3.5	4	4.5	5	5.5	6	
U.S.	5.5	6	6.5	7	7.5	8	8.5	

Source: DanceSport UK

2. **JOBS** Mr. Kimball receives a \$3000 annual salary increase on the anniversary of his hiring if he receives a satisfactory performance review. His starting salary was \$41,250. Write an equation to show  $k$ , Mr. Kimball's salary after  $y$  years at this company if his performance reviews are always satisfactory.  
 **$k = 3000y + 41,250$**

**$y = x + 2.5$**

a. Write a linear equation to determine any U.S. size if you are given the U.K. size.

b. What is the slope and  $y$ -intercept of the line?  
**Slope = 1;  $y$ -intercept = 2.5**

3. **CENSUS** The population of Laredo, Texas, was about 215,500 in 2007. It was about 123,000 in 1990. If we assume that the population growth is constant and  $y$  represents the number of years after 1990, write a linear equation to find  $P$ , Laredo's population for any year after 1990.  
 **$P = 5441y + 123,000$**

c. Is the  $y$ -intercept a valid data point for the given information?  
**No. It is not likely a valid data point because the U.K. sizing probably does not include zero. However, the point is the  $y$ -intercept of the line represented by the data if the data were to continue indefinitely in both directions.**

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Lesson 4-2

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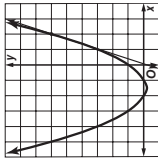
### 4-2 Enrichment

#### Tangent to a Curve

A tangent line is a line that intersects a curve at a point with the same rate of change, or slope, as the rate of change of the curve at that point.

For quadratic functions (functions of the form  $ax^2 + bx + c$ ), the equation of the tangent line can be found. This is based on the fact that the slope through any two points on the curve is equal to the slope of the line tangent to the curve at the point whose  $x$ -value is halfway between the  $x$ -values of the other two points.

**Example** To find the equation of a tangent line to the curve  $y = x^2 + 3x + 2$  through the point (2, 12), first find two points on the curve whose  $x$ -values are equidistant from the  $x$ -value of the point the tangent needs to go through.



**Step 1:** Find two more points. Use  $x = 1$  and  $x = 3$ .

When  $x = 1$ ,  $y = 1^2 + 3(1) + 2$  or 6.

When  $x = 3$ ,  $y = 3^2 + 3(3) + 2$  or 20.

So, the two ordered pairs are (1, 6) and (3, 20).

**Step 2:** Find the slope of the line that goes through these two points.  
 $m = \frac{20 - 6}{3 - 1}$  or 7

**Step 3:** Now use this slope and the point (2, 12) to find the equation of the tangent line.

$y = mx + b$   
 Slope = intercept form.

$12 = 7(2) + b$   
 Replace  $x$  with 2,  $y$  with 12, and  $m$  with 7.

$-2 = b$   
 Solve for  $b$ .

So, the equation of the tangent line to  $y = x^2 + 3x + 2$  through the point (2, 12) is  $y = 7x - 2$ .

#### Exercises

For 1-3, find the equations of the lines tangent to each curve through the given point.

1.  $y = x^2 - 3x + 7$ , (2, 5)      2.  $y = 3x^2 + 4x - 5$ , (-4, 27)      3.  $y = 5 - x^2$ , (1, 4)  
 $y = x + 3$        $y = -20x - 53$        $y = -2x + 6$

4. Find the slope of the line tangent to the curve at  $x = 0$  for the general equation  $y = ax^2 + bx + c$ .       $m = b$

5. Find the slope of the line tangent to the curve  $y = ax^2 + bx + c$  at  $x$  by finding the slope of the line through the points (0,  $c$ ) and (2 $x$ ,  $4ax^2 + 2bx + c$ ). Does this answer work for  $x = 0$  in the answer you found to problem 4?       $m = 2ax + b$ , yes

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### 4-3 Study Guide and Intervention

#### Point-Slope Form

#### Point-Slope Form

**Point-Slope Form**  $y - y_1 = m(x - x_1)$ , where  $(x_1, y_1)$  is a given point on a nonvertical line and  $m$  is the slope of the line

**Example 1** Write an equation in point-slope form for the line that passes through (6, 1) with a slope of  $-\frac{5}{2}$ .

$y - y_1 = m(x - x_1)$       Point-slope form  
 $y - 1 = -\frac{5}{2}(x - 6)$        $m = -\frac{5}{2}$ ,  $(x_1, y_1) = (6, 1)$

Therefore, the equation is  $y - 1 = -\frac{5}{2}(x - 6)$ .

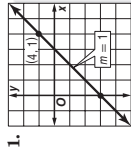
**Example 2** Write an equation in point-slope form for a horizontal line that passes through (4, -1).

$y - y_1 = m(x - x_1)$       Point-slope form  
 $y - (-1) = 0(x - 4)$        $m = 0$ ;  $(x_1, y_1) = (4, -1)$   
 $y + 1 = 0$       Simplify.

Therefore, the equation is  $y + 1 = 0$ .

#### Exercises

Write an equation in point-slope form for the line that passes through the given point with the slope provided.



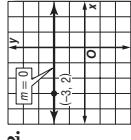
$y - 1 = x - 4$

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

$y - 1 = 4(x - 2)$

7. (-6, 7),  $m = 0$

$y - 7 = 0$



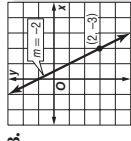
$y - 2 = 0$

5. (-7, 2),  $m = 6$

$y - 2 = 6(x + 7)$

8. (4, 9),  $m = \frac{3}{4}$

$y - 9 = \frac{3}{4}(x - 4)$



$y + 3 = -2(x - 2)$

6. (8, 3),  $m = 1$

$y - 3 = x - 8$

9. (-4, -5),  $m = -\frac{1}{2}$

$y + 5 = -\frac{1}{2}(x + 4)$

10. Write an equation in point-slope form for a horizontal line that passes through (4, -2).       $y + 2 = 0$

11. Write an equation in point-slope form for a horizontal line that passes through (-5, 6).       $y - 6 = 0$

12. Write an equation in point-slope form for a horizontal line that passes through (5, 0).       $y = 0$

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### 4-3 Study Guide and Intervention (continued)

#### Point-Slope Form

##### Forms of Linear Equations

Slope-Intercept Form	$y = mx + b$	$m = \text{slope}, b = y\text{-intercept}$
Point-Slope Form	$y - y_1 = m(x - x_1)$	$m = \text{slope}; (x_1, y_1)$ is a given point.
Standard Form	$Ax + By = C$	$A$ and $B$ are not both zero. Usually $A$ is nonnegative and $A, B,$ and $C$ are integers whose greatest common factor is 1.

**Example 1** Write  $y + 5 = \frac{2}{3}(x - 6)$  in standard form.

$y + 5 = \frac{2}{3}(x - 6)$  Original equation  
 $3(y + 5) = 3 \cdot \frac{2}{3}(x - 6)$  Multiply each side by 3.  
 $3y + 15 = 2(x - 6)$  Distributive Property  
 $3y + 15 = 2x - 12$  Distributive Property  
 $3y = 2x - 27$  Subtract 15 from each side.  
 $-2x + 3y = -27$  Add  $-2x$  to each side.  
 $2x - 3y = 27$  Multiply each side by  $-1$ .  
 Therefore, the standard form of the equation is  $2x - 3y = 27$ .

**Example 2** Write  $y - 2 = -\frac{1}{4}(x - 8)$  in slope-intercept form.

$y - 2 = -\frac{1}{4}(x - 8)$  Original equation  
 $y - 2 = -\frac{1}{4}x + 2$  Distributive Property  
 $y = -\frac{1}{4}x + 4$  Add 2 to each side.  
 Therefore, the slope-intercept form of the equation is  $y = -\frac{1}{4}x + 4$ .

#### Exercises

Write each equation in standard form.

- $y + 2 = -3(x - 1)$        $2. y - 1 = -\frac{1}{3}(x - 6)$   
 $3x + y = 1$                $x + 3y = 9$
- $y + 3 = -(x - 5)$        $5. y - 4 = \frac{5}{3}(x + 3)$   
 $x + y = 2$                  $5x - 3y = -27$

Write each equation in slope-intercept form.

- $y + 4 = 4(x - 2)$        $8. y - 5 = \frac{1}{3}(x - 6)$   
 $y = 4x - 12$              $y = \frac{1}{3}x + 3$
- $y - 6 = 3(x - 3)$        $11. y + 4 = -2(x + 5)$   
 $y = 3x + 5$                $y = -2x - 14$
- $y - 8 = -\frac{1}{4}(x + 8)$   
 $y = -\frac{1}{4}x + 6$
- $y + \frac{5}{3} = \frac{1}{2}(x - 2)$   
 $y = \frac{1}{2}x - \frac{8}{3}$

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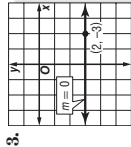
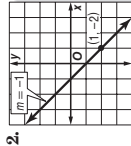
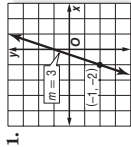
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### 4-3 Skills Practice

#### Point-Slope Form

Write an equation in point-slope form for the line that passes through the given point with the slope provided.



- $y + 2 = 3(x + 1)$
- $y + 2 = -(x - 1)$
- $(3, 1), m = 0$
- $(-4, 6), m = 8$
- $(-4, -3), m = -4$
- $(1, -3), m = -4$
- $(4, -6), m = 1$
- $(3, 3), m = \frac{4}{3}$
- $(-5, -1), m = -\frac{5}{4}$
- $y + 1 = -\frac{5}{4}(x + 5)$

Write each equation in standard form.

- $y + 1 = x + 2$        $11. y + 9 = -3(x - 2)$   
 $x - y = -1$              $3x + y = -3$
- $y - 4 = -(x - 1)$        $14. y - 6 = 4(x + 3)$   
 $x + y = 5$               $4x - y = -18$
- $y - 10 = -2(x - 3)$        $17. y - 2 = -\frac{1}{2}(x - 4)$   
 $2x + y = 16$           $x + 2y = 8$

Write each equation in slope-intercept form.

- $y - 4 = 3(x - 2)$        $20. y + 2 = -(x + 4)$   
 $y = 3x - 2$              $y = -x - 6$
- $y + 1 = -5(x - 3)$        $23. y - 3 = 6(x - 1)$   
 $y = -5x + 14$          $y = 6x - 3$
- $y - 2 = \frac{1}{2}(x + 6)$        $26. y + 1 = -\frac{1}{3}(x + 9)$   
 $y = \frac{1}{2}x + 5$              $y = -\frac{1}{3}x - 4$

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### 4-3 Practice

#### Point-Slope Form

Write an equation in point-slope form for the line that passes through the given point with the slope provided.

- $(2, 2), m = -3$        $y - 2 = -3(x - 2)$
- $(1, -6), m = -1$        $y + 6 = -(x - 1)$
- $(-3, -4), m = 0$        $y + 4 = 0$
- $(1, 3), m = -\frac{3}{4}$        $y - 3 = -\frac{3}{4}(x - 1)$
- $(-8, 5), m = -\frac{2}{5}$        $y - 5 = -\frac{2}{5}(x + 8)$
- $(3, -3), m = \frac{1}{3}$        $y + 3 = \frac{1}{3}(x - 3)$

Write each equation in standard form.

- $y - 11 = 3(x - 2)$        $3x - y = -5$
- $y - 10 = -(x - 2)$        $x + y = 12$
- $y - 5 = \frac{3}{2}(x + 4)$        $3x + 4y = -11$
- $y - 3 = -\frac{3}{4}(x - 1)$        $3x - 2y = -22$
- $(-8, 5), m = -\frac{2}{5}$        $13y + 4 = 1.5(x + 2)$
- $(3, -3), m = \frac{1}{3}$        $3x - 2y = 2$
- $y + 7 = 2(x + 5)$        $2x - y = -3$
- $y - 6 = \frac{4}{3}(x - 3)$        $4x - 3y = -6$
- $y - 4 = 2.5(x + 3)$        $5x - 2y = -23$
- $y + 1 = -7(x + 1)$        $7x + y = -8$
- $y - \frac{1}{4} = -3(x + \frac{1}{4})$        $3x + y = -\frac{13}{4}$
- $y - 2 = 2(x + 1)$        $2x - y = -3$
- $y - 6 = \frac{4}{3}(x - 3)$        $4x - 3y = -6$
- $y - 4 = 2.5(x + 3)$        $5x - 2y = -23$

Write each equation in slope-intercept form.

- $y + 2 = 4(x + 2)$        $y = 4x + 6$
- $y + 1 = -7(x + 1)$        $y = -7x - 8$
- $y - 5 = \frac{3}{2}(x + 4)$        $y = \frac{3}{2}x + 11$
- $y - 2 = 2(x + 1)$        $2x - y = -3$
- $y - 3 = -5(x + 12)$        $y = -5x - 57$
- $y - \frac{2}{3} = -2(x - \frac{1}{4})$        $y = -2x + \frac{7}{6}$

**22. CONSTRUCTION** A construction company charges \$15 per hour for debris removal, plus a one-time fee for the use of a trash dumpster. The total fee for 9 hours of service is \$195.

- Write the point-slope form of an equation to find the total fee  $y$  for any number of hours  $x$ .  $y - 195 = 15(x - 9)$
- Write the equation in slope-intercept form.  $y = 15x + 60$
- What is the fee for the use of a trash dumpster? \$60

**23. MOVING** There is a set daily fee for renting a moving truck, plus a charge of \$0.50 per mile driven. It costs \$64 to rent the truck on a day when it is driven 48 miles.

- Write the point-slope form of an equation to find the total charge  $y$  for any number of miles  $x$  for a one-day rental.  $y - 64 = 0.5(x - 48)$
- Write the equation in slope-intercept form.  $y = 0.5x + 40$
- What is the daily fee? \$40

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## Answers (Lesson 4-3)

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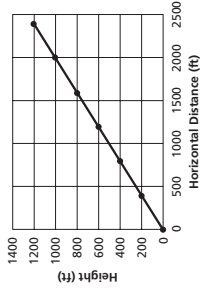
### 4-3 Word Problem Practice

#### Point-Slope Form

**1. BICYCLING** Harvey rides his bike at an average speed of 12 miles per hour. In other words, he rides 12 miles in 1 hour, 24 miles in 2 hours, and so on. Let  $h$  be the number of hours he rides and  $d$  be the distance traveled. Write the equation for the relationship between distance and time in point-slope form.  
 $d - 12 = 12(h - 1)$

**4. CANOEING** Geoff paddles his canoe at an average speed of 3.5 miles per hour. After 5 hours of canoeing, Geoff has traveled 18 miles. Write an equation in the point-slope form to find the total distance  $y$  for any number of hours  $x$ .  
 $y - 18 = 3.5(x - 5)$

**5. AVIATION** A jet plane takes off and climbs consistently 20 feet for every 40 feet it moves horizontally. The graph shows the trajectory of the jet.



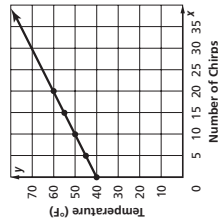
**a.** Write an equation in point-slope form for the line representing the jet's horizontal trajectory.  
 $y - 0 = 0.5(x - 0)$

**b.** Write the equation from part a in slope-intercept form.  $y = 0.5x$

**c.** Write the equation in standard form.  
 $x - 2y = 0$

**2. GEOMETRY** The perimeter of a square varies directly with the side length. The point-slope form of the equation for this function is  $y - 4 = 4(x - 1)$ . Write the equation in standard form.  
 $4x - y = 0$

**3. NATURE** In a near perfect linear relationship, the frequency of a male cricket's chirp matches the outdoor temperature. The relationship is expressed by the equation  $T = n + 40$ , where  $T$  is the temperature in degrees Fahrenheit and  $n$  is the number of chirps the cricket makes in 14 seconds. Use the information on the graph below to write a point-slope form of the equation for the line.



**Sample answer:**  
 $T - 60 = 1(n - 20)$

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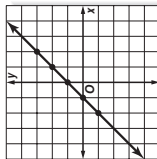
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## 4-3 Enrichment

### Collinearity

You have learned how to find the slope between two points on a line. Does it matter which two points you use? How does your choice of points affect the slope-intercept form of the equation of the line?

1. Choose three different pairs of points from the graph at the right. Write the slope-intercept form of the line using each pair.  
 $y = x + 1$

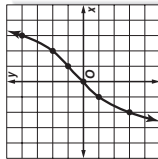


2. How are the equations related?  
**They are the same.**

3. What conclusion can you draw from your answers to Exercises 1 and 2?  
**The equation of a line is the same no matter which two points you choose.**

When points are contained in the same line, they are said to be **collinear**. Even though points may *look* like they form a straight line when connected, it does not mean that they actually do. By checking pairs of points on a line you can determine whether the line represents a linear relationship.

4. Choose several pairs of points from the graph at the right and write the slope-intercept form of the line using each pair.  
 $y = x; y = 2x - 2; y = 2x + 1$



5. What conclusion can you draw from your equations in Exercise 4? Is this a straight line?

**The points are not collinear. This is not a straight line.**

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## 4-3 Graphing Calculator Activity

### Writing Linear Equations

Lists can be used with the linear regression function to write and verify linear equations given two points on a line, or the slope of a line and a point through which it passes. The linear regression function, **LinReg** ( $ax + b$ ), is found under the **STAT CALC** menu.

**Example 1** Write the slope-intercept form of an equation of the line that passes through  $(3, -2)$  and  $(6, 4)$ .

Enter the  $x$ -coordinates of the points into L1 and the  $y$ -coordinates into L2. Use the linear regression function to write the equation of the line.

Keystrokes: **STAT** **ENTER** **3** **ENTER** **6** **ENTER** **2** **ENTER** **4**  
**ENTER** **STAT** **4** **2nd** **L1** **2nd** **L2** **ENTER**

The equation is  $y = 2x - 8$ . If you have already written the equation of a line, you can use the given information to verify your equation.



**Example 2** Verify the equation of a line passing through  $(2, -3)$  with slope  $-\frac{3}{4}$  can be written as  $3x + 4y = -6$ .

Use the given point and slope to determine a second point through which the line passes. Enter the  $x$ -coordinates of the points into L1 and the  $y$ -coordinates into L2. Use **LinReg** ( $ax + b$ ) to determine the slope-intercept form of an equation.

The slope-intercept form of the equation is  $y = -0.75x - 1.5$  or  $y = -\frac{3}{4}x - \frac{3}{2}$ . This can be rewritten in standard form as  $3x + 4y = -6$ .



### Exercises

Write the slope-intercept form and the standard form of an equation of the line that satisfies each condition.

- passes through  $(0, 7)$  and  $(\frac{1}{7}, -5)$   
 $y = -84x + 7; 84x + y = 7$
- passes through  $(-5, 1)$ ,  $(10, 10)$ , and  $(-10, -2)$   
 $y = \frac{3}{5}x + 4; 3x - 5y = -20$
- passes through  $(6, -4)$ ,  $m = \frac{2}{3}$   
 $y = \frac{2}{3}x - 8; 2x - 3y = 24$
- passes through  $(3, 5)$ ,  $m = -4$   
 $y = -4x + 17; 4x + y = 17$
- $x$ -intercept:  $1$ ,  $y$ -intercept:  $-\frac{1}{2}$   
 $y = \frac{1}{2}x - \frac{1}{2}; x - 2y = 1$
- passes through  $(-18, 11)$ ,  $y$ -intercept:  $3$   
 $y = -\frac{4}{9}x + 3; 4x + 9y = 27$

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### 4-4 Study Guide and Intervention

#### Parallel and Perpendicular Lines

**Parallel Lines** Two nonvertical lines are **parallel** if they have the same slope. All vertical lines are parallel.

**Example** Write an equation in slope-intercept form for the line that passes through  $(-1, 6)$  and is parallel to the graph of  $y = 2x + 12$ .

A line parallel to  $y = 2x + 12$  has the same slope, 2. Replace  $m$  with 2 and  $(x_1, y_1)$  with  $(-1, 6)$  in the point-slope form.

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - 6 = 2(x - (-1)) \quad m = 2; (x_1, y_1) = (-1, 6)$$

$$y - 6 = 2(x + 1) \quad \text{Simplify.}$$

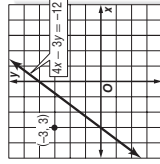
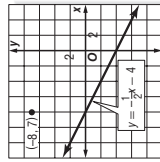
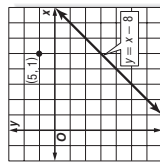
$$y - 6 = 2x + 2 \quad \text{Distributive Property}$$

$$y = 2x + 8 \quad \text{Slope-intercept form}$$

Therefore, the equation is  $y = 2x + 8$ .

#### Exercises

Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.



1.  $y = x - 4$

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

3.  $y = \frac{4}{3}x + 7$

4.  $(-2, 2), y = 4x - 2$

5.  $(6, 4), y = \frac{1}{3}x + 1$

6.  $(4, -2), y = -2x + 3$

7.  $(-2, 4), y = -3x + 10$

8.  $(-1, 6), 3x + y = 12$

9.  $(4, -6), x + 2y = 5$

10.  $y = -3x - 2$

11.  $y = -3x + 3$

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

10. Find an equation of the line that has a y-intercept of 2 that is parallel to the graph of the line  $4x + 2y = 8$ .  $y = -2x + 2$

11. Find an equation of the line that has a y-intercept of  $-1$  that is parallel to the graph of the line  $x - 3y = 6$ .  $y = \frac{1}{3}x - 1$

12. Find an equation of the line that has a y-intercept of  $-4$  that is parallel to the graph of the line  $y = 6$ .  $y = -4$

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### 4-4 Study Guide and Intervention

#### Parallel and Perpendicular Lines

**Perpendicular Lines** Two non-vertical lines are **perpendicular** if their slopes are negative reciprocals of each other. Vertical and horizontal lines are perpendicular.

**Example** Write an equation in slope-intercept form for the line that passes through  $(-4, 2)$  and is perpendicular to the graph of  $2x - 3y = 8$ .

Find the slope of  $2x - 3y = 8$ .

$$2x - 3y = 8 \quad \text{Original equation}$$

$$-3y = -2x + 8 \quad \text{Subtract } 2x \text{ from each side.}$$

$$y = \frac{2}{3}x - \frac{8}{3} \quad \text{Divide each side by } -3.$$

The slope of  $y = \frac{2}{3}x - \frac{8}{3}$  is  $\frac{2}{3}$ . So, the slope of the line passing through  $(-4, 2)$  that is perpendicular to this line is the negative reciprocal of  $\frac{2}{3}$ , or  $-\frac{3}{2}$ .

Use the point-slope form to find the equation.

$$y - y_1 = m(x - x_1) \quad \text{Point-slope form}$$

$$y - 2 = -\frac{3}{2}(x - (-4)) \quad m = -\frac{3}{2}; (x_1, y_1) = (-4, 2)$$

$$y - 2 = -\frac{3}{2}(x + 4) \quad \text{Simplify.}$$

$$y - 2 = -\frac{3}{2}x - 6 \quad \text{Distributive Property}$$

$$y = -\frac{3}{2}x - 4 \quad \text{Slope-intercept form}$$

#### Exercises

1. **ARCHITECTURE** On the architect's plans for a new high school, a wall represented by  $\overline{MN}$  has endpoints  $M(-3, -1)$  and  $N(2, 1)$ . A wall represented by  $\overline{PQ}$  has endpoints  $P(4, -4)$  and  $Q(-2, 11)$ . Are the walls perpendicular? Explain.

**Yes, because the slope of  $\overline{MN}$  is  $\frac{2}{5}$  and the slope of  $\overline{PQ}$  is  $-\frac{5}{2}$ .**

Determine whether the graphs of the following equations are **parallel** or **perpendicular**. Explain.

2.  $2x + y = -7, x - 2y = -4, 4x - y = 5$  **first two are parallel**

3.  $y = 3x, 6x - 2y = 7, 3y = 9x - 1$  **all are parallel**

Write an equation in slope-intercept form for the line that passes through the given point and is perpendicular to the graph of each equation.

4.  $(4, 2), y = \frac{1}{2}x + 1$  **5.  $(2, -3), y = -\frac{2}{3}x + 4$  **6.  $(6, 4), y = 7x + 1$****   
 $y = -1x + 10$  **7.  $(-8, -7), y = -x - 8$  **8.  $(6, -2), y = -3x - 6$  **9.  $(-5, -1), y = \frac{5}{2}x - 3$****   
 $y = x + 1$  **10.  $(-2, 1), y = \frac{1}{2}x - 4$  **11.  $(-3, 4), y = -\frac{1}{3}x + 7$  **12.  $(-1, 5), y = -\frac{2}{5}x - 3$********

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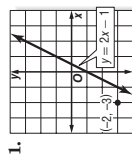
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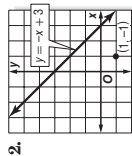
### 4-4 Skills Practice

#### Parallel and Perpendicular Lines

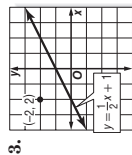
Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.



$y = 2x + 1$



$y = -x$



$y = -3x + 5$

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

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

6.  $(-1, 1), y = x - 4$

$y = 3x - 7$

$y = -3x - 5$

$y = x + 2$

7.  $(1, -3), y = -4x - 1$

8.  $(-4, 2), y = x + 3$

9.  $(-4, 3), y = \frac{1}{2}x - 6$

$y = -4x + 1$

$y = x + 6$

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

10. **RADAR** On a radar screen, a plane located at  $A(-2, 4)$  is flying toward  $B(4, 3)$ .

Another plane, located at  $C(-3, 1)$ , is flying toward  $D(3, 0)$ . Are the planes' paths perpendicular? Explain.

**No; the slopes are equal, meaning the paths are parallel.**

Determine whether the graphs of the following equations are *parallel* or *perpendicular*. Explain.

11.  $y = \frac{2}{3}x + 3, y = \frac{3}{2}x, 2x - 3y = 8$

**first and third are parallel; slopes are equal**

12.  $y = 4x, x + 4y = 12, 4x + y = 1$

**first and second are perpendicular; slopes are negative reciprocals**

Write an equation in slope-intercept form for the line that passes through the given point and is perpendicular to the graph of each equation.

13.  $(-3, -2), y = x + 2$

14.  $(4, -1), y = 2x - 4$

15.  $(-1, -6), x + 3y = 6$

$y = -x - 5$

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

$y = 3x - 3$

16.  $(-4, 5), y = -4x - 1$

17.  $(-2, 3), y = \frac{1}{4}x - 4$

18.  $(0, 0), y = \frac{1}{2}x - 1$

$\frac{1}{4}x + 6$

$y = -4x - 5$

$y = -2x$

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### 4-4 Practice

#### Parallel and Perpendicular Lines

Write an equation in slope-intercept form for the line that passes through the given point and is parallel to the graph of each equation.

1.  $(3, 2), y = x + 5$

$y = x - 1$

4.  $(5, 4), y = \frac{2}{5}x - 2$

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

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

$y = -4x - 3$

5.  $(12, 3), y = \frac{4}{3}x + 5$

$y = \frac{4}{3}x - 13$

3.  $(4, -6), y = -\frac{3}{4}x + 1$

$y = -\frac{3}{4}x - 3$

6.  $(3, 1), 2x + y = 5$

$y = -2x + 7$

9.  $(-8, 2), 5x - 4y = 1$

$y = \frac{5}{4}x + 12$

7.  $(-3, 4), 3y = 2x - 3$

$y = \frac{2}{3}x + 6$

10.  $(-1, -4), 8x + 3y = 8$

$y = -3x - 7$

11.  $(-5, 6), 4x + 3y = 1$

$y = -\frac{4}{3}x - \frac{2}{3}$

8.  $(-1, -2), 3x - y = 5$

$y = 3x + 1$

12.  $(3, 1), 2x + 5y = 7$

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

$y = 4x - 3$

16.  $(0, 1), x + 5y = 15$

$y = 5x + 1$

17.  $(2, 4), x - 6y = 2$

$y = -6x + 16$

18.  $(-1, -7), 3x + 12y = -6$

$y = 5x + 1$

19.  $(-4, 1), 4x + 7y = 6$

$y = -\frac{4}{7}x + 6$

20.  $(10, 5), 5x + 4y = 8$

$y = \frac{5}{4}x - 3$

21.  $(4, -5), 2x - 5y = -10$

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

22.  $(1, 1), 3x + 2y = -7$

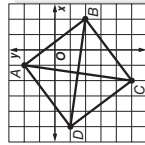
$y = \frac{2}{3}x + \frac{3}{2}$

23.  $(-6, -5), 4x + 3y = -6$

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

24.  $(-3, 5), 5x - 6y = 9$

$y = -\frac{6}{5}x + \frac{7}{5}$



25. **GEOMETRY** Quadrilateral  $ABCD$  has diagonals  $\overline{AC}$  and  $\overline{BD}$ . Determine whether  $\overline{AC}$  is perpendicular to  $\overline{BD}$ . Explain.

**Yes; they are perpendicular because their slopes are 7 and  $-\frac{1}{7}$  which are negative reciprocals.**

26. **GEOMETRY** Triangle  $ABC$  has vertices  $A(0, 4)$ ,  $B(1, 2)$ , and  $C(4, 6)$ . Determine whether triangle  $ABC$  is a right triangle. Explain.

**Yes; sides  $\overline{AB}$  and  $\overline{AC}$  are perpendicular because their slopes are  $-2$  and  $\frac{1}{2}$ , which are negative reciprocals.**

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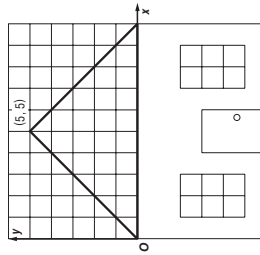
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### 4-4 Word Problem Practice

#### Parallel and Perpendicular Lines

- 1. BUSINESS** Brady's Books is a retail store that also sells books online. The store's profits  $y$  are given by the equation  $y = 2x + 3$  where  $x$  is the number of available hours for customer purchases. Brady's discontinues the online shopping option. Write a new equation in slope-intercept form to show a new profit line with the same profit rate containing the point  $(0, 0)$ .  $y = 2x$

- 2. ARCHITECTURE** The front view of a house is drawn on graph paper. The left side of the roof of the house is represented by the equation  $y = x$ . The rooflines intersect at a right angle and the peak of the roof is represented by the point  $(5, 5)$ . Write the equation in slope-intercept form for the line that creates the right side of the roof.



$y = -x + 10$

- 3. ARCHAEOLOGY** An archaeologist is comparing the location of a jeweled box she just found to the location of a brick wall. The wall can be represented by the equation  $y = -\frac{5}{3}x + 13$ . The box is located at the point  $(10, 9)$ . Write an equation representing a line that is perpendicular to the wall and that passes through the location of the box.

$y = \frac{3}{5}x + 3$

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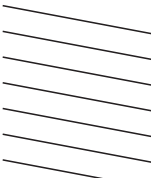
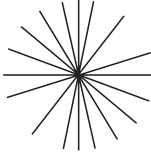
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### 4-4 Enrichment

#### Pencils of Lines

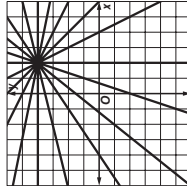
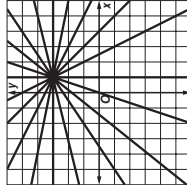
All of the lines that pass through a single point in the same plane are called a **pencil of lines**.

All lines with the same slope, but different intercepts, are also called a "pencil," a **pencil of parallel lines**.

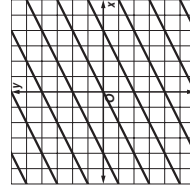


#### Graph some of the lines in each pencil.

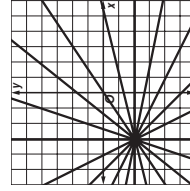
1. A pencil of lines through the point  $(1, 3)$
2. A pencil of lines described by  $y - 4 = m(x - 2)$ , where  $m$  is any real number



3. A pencil of lines parallel to the line  $x - 2y = 7$



4. A pencil of lines described by  $y = mx + 3m - 2$



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- a. How many pairs of parallel sides are there in the shape she designed? Explain.

**1 pair:  $\overline{BC}$  and  $\overline{AD}$  are parallel because their slopes are both 0.5.**

- b. How many pairs of perpendicular sides are there in the shape she designed? Explain.

**2 pairs:  $\overline{BC} \perp \overline{AB}$  and  $\overline{AB} \perp \overline{AD}$  because  $\overline{AB}$  has a slope of  $-2$ , which is the opposite reciprocal of the slopes of  $\overline{BC}$  and  $\overline{AD}$ , 0.5.**

- c. What is the shape of her new island? **a trapezoid**

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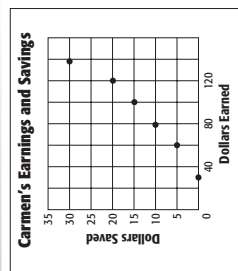
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### 4-5 Study Guide and Intervention

#### Scatter Plots and Lines of Fit

**Investigate Relationships Using Scatter Plots** A scatter plot is a graph in which two sets of data are plotted as ordered pairs in a coordinate plane. If  $y$  increases as  $x$  increases, there is a **positive correlation** between  $x$  and  $y$ . If  $y$  decreases as  $x$  increases, there is a **negative correlation** between  $x$  and  $y$ . If  $x$  and  $y$  are not related, there is **no correlation**.

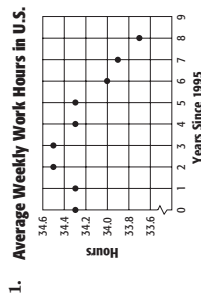


**Example EARNINGS** The graph at the right shows the amount of money Carmen earned each week and the amount she deposited in her savings account that same week. Determine whether the graph shows a **positive correlation**, a **negative correlation**, or **no correlation**. If there is a positive or negative correlation, describe its meaning in the situation.

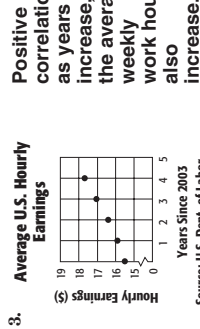
The graph shows a positive correlation. The more Carmen earns, the more she saves.

#### Exercises

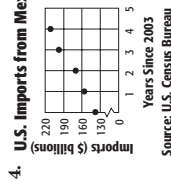
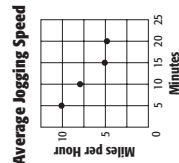
Determine whether each graph shows a **positive correlation**, a **negative correlation**, or **no correlation**. If there is a positive or negative correlation, describe its meaning in the situation.



Source: *The World Almanac*.



Source: U.S. Dept. of Labor.



Source: U.S. Census Bureau.

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### 4-5 Study Guide and Intervention

#### Scatter Plots and Lines of Fit

#### Use Lines of Fit

**Example** The table shows the number of students per computer in Easton High School for certain school years from 1996 to 2008.

Year	1996	1998	2000	2002	2004	2006	2008
Students per Computer	22	18	14	10	6.1	5.4	4.9

a. Draw a scatter plot and determine what relationship exists, if any.

Since  $y$  decreases as  $x$  increases, the correlation is negative.

b. Draw a line of fit for the scatter plot.

Draw a line that passes close to most of the points. A line of fit is shown.

c. Write the slope-intercept form of an equation for the line of fit.

The line of fit shown passes through (1999, 16) and (2005, 5.7). Find the slope.

$$m = \frac{5.7 - 16}{2005 - 1999}$$

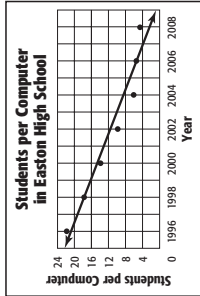
$$m = -1.7$$

$$\text{Find } b \text{ in } y = -1.7x + b.$$

$$16 = -1.7 \cdot 1999 + b$$

$$3404 = b$$

Therefore, an equation of a line of fit is  $y = -1.7x + 3404$ .



#### Exercises

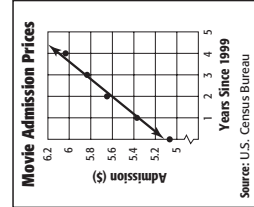
Refer to the table for Exercises 1–3.

1. Draw a scatter plot.

2. Draw a line of fit for the data.

3. Write the slope-intercept form of an equation for the line of fit.

The points (0, 5.08) and (3, 5.81) give  $y = 0.243x + 5.08$  as a line of fit.



Source: U.S. Census Bureau.

Years Since 1999	Admission (dollars)
0	\$5.08
1	\$5.39
2	\$5.66
3	\$5.81
4	\$6.03

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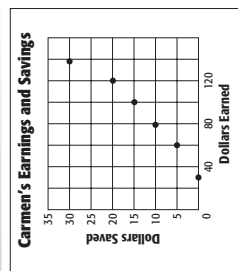
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### 4-5 Study Guide and Intervention

#### Scatter Plots and Lines of Fit

**Investigate Relationships Using Scatter Plots** A scatter plot is a graph in which two sets of data are plotted as ordered pairs in a coordinate plane. If  $y$  increases as  $x$  increases, there is a **positive correlation** between  $x$  and  $y$ . If  $y$  decreases as  $x$  increases, there is a **negative correlation** between  $x$  and  $y$ . If  $x$  and  $y$  are not related, there is **no correlation**.

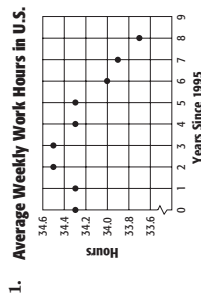


**Example EARNINGS** The graph at the right shows the amount of money Carmen earned each week and the amount she deposited in her savings account that same week. Determine whether the graph shows a **positive correlation**, a **negative correlation**, or **no correlation**. If there is a positive or negative correlation, describe its meaning in the situation.

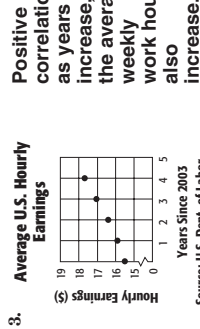
The graph shows a positive correlation. The more Carmen earns, the more she saves.

#### Exercises

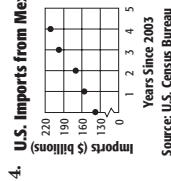
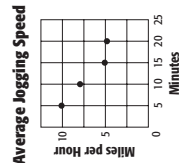
Determine whether each graph shows a **positive correlation**, a **negative correlation**, or **no correlation**. If there is a positive or negative correlation, describe its meaning in the situation.



Source: *The World Almanac*.



Source: U.S. Dept. of Labor.



Source: U.S. Census Bureau.

NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

### 4-5 Study Guide and Intervention

#### Scatter Plots and Lines of Fit

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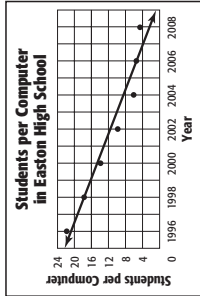
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#### Exercises

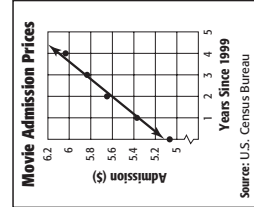
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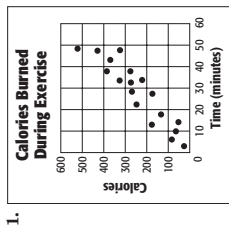


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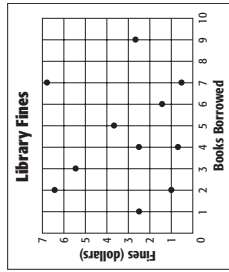
### 4-5 Skills Practice

#### Scatter Plots and Lines of Fit

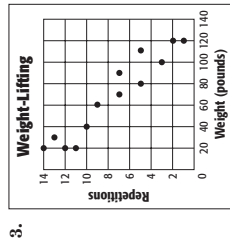
Determine whether each graph shows a *positive correlation*, a *negative correlation*, or *no correlation*. If there is a positive or negative correlation, describe its meaning in the situation.



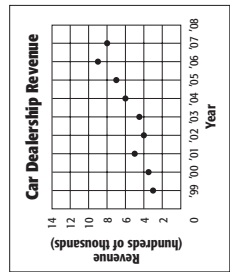
**Positive; the longer the exercise, the more Calories burned.**



**no correlation**

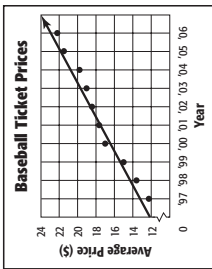


**Negative; as weight increases, the number of repetitions decreases.**



**Positive; as the year increases, the dealership's revenue increases**

5. **BASEBALL** The scatter plot shows the average price of a major-league baseball ticket from 1997 to 2006.



a. Determine what relationship, if any, exists in the data. Explain. **Positive; as the year increases, the price increases.**

b. Use the points (1998, 13.60) and (2003, 19.00) to write the slope-intercept form of an equation for the line of fit shown in the scatter plot.

$y = 1.08x - 2144.24$

c. Predict the price of a ticket in 2009. **about \$25.48**

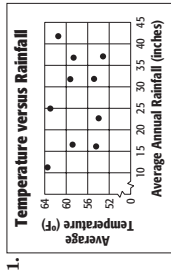
Source: Team Marketing Report, Chicago

NAME \_\_\_\_\_ DATE \_\_\_\_\_ PERIOD \_\_\_\_\_

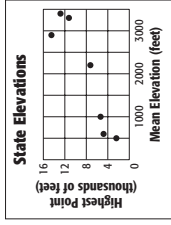
### 4-5 Practice

#### Scatter Plots and Lines of Fit

Determine whether each graph shows a *positive correlation*, a *negative correlation*, or *no correlation*. If there is a positive or negative correlation, describe its meaning in the situation.



Source: National Oceanic and Atmospheric Administration  
**no correlation**



Source: U.S. Geological Survey  
**Positive; as the mean elevation increases, the highest point increases.**

3. **DISEASE** The table shows the number of cases of Foodborne Botulism in the United States for the years 2001 to 2005.

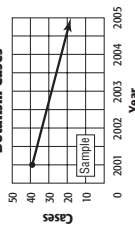
Year	2001	2002	2003	2004	2005
Cases	39	28	20	16	18

Source: Centers for Disease Control

a. Draw a scatter plot and determine what relationship, if any, exists in the data. **Negative correlation; as the year increases, the number of cases decreases.**

b. Draw a line of fit for the scatter plot.

c. Write the slope-intercept form of an equation for the line of fit. **Sample answer:  $y = -129.75x + 906$**



4. **2005** The table shows the average and maximum longevity of various animals in captivity.

Longevity (years)	20	25	30	35	40	45
Avg.	12	15	18	20	22	24
Max.	47	50	54	60	65	70

Source: Walker's Mammals of the World

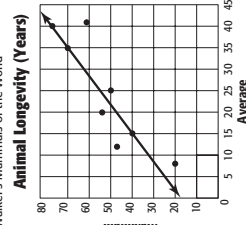
a. Draw a scatter plot and determine what relationship, if any, exists in the data. **Positive correlation; as the average increases, the maximum increases.**

b. Draw a line of fit for the scatter plot.

**Sample answer: Use (15, 40), (35, 70).**

c. Write the slope-intercept form of an equation for the line of fit. **Sample answer:  $y = 1.5x + 17.5$**

d. Predict the maximum longevity for an animal with an average longevity of 33 years. **about 67 yr**



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## 4-5 Enrichment

### Latitude and Temperature

The *latitude* of a place on Earth is the measure of its distance from the equator. What do you think is the relationship between a city's latitude and its January temperature? At the right is a table containing the latitudes and January mean temperatures for fifteen U.S. cities.

U.S. City	Latitude	January Mean Temperature
Albany, New York	42:40 N	20.7°F
Albuquerque, New Mexico	35:07 N	34.3°F
Anchorage, Alaska	61:11 N	14.9°F
Birmingham, Alabama	33:32 N	41.7°F
Charleston, South Carolina	32:47 N	47.1°F
Chicago, Illinois	41:50 N	21.0°F
Columbus, Ohio	39:59 N	26.3°F
Duluth, Minnesota	46:47 N	7.0°F
Fairbanks, Alaska	64:50 N	-10.1°F
Galveston, Texas	29:14 N	52.9°F
Honolulu, Hawaii	21:19 N	72.9°F
Las Vegas, Nevada	36:12 N	45.1°F
Miami, Florida	25:47 N	67.3°F
Richmond, Virginia	37:32 N	35.8°F
Tucson, Arizona	32:12 N	51.3°F

**Sample answers are given.**

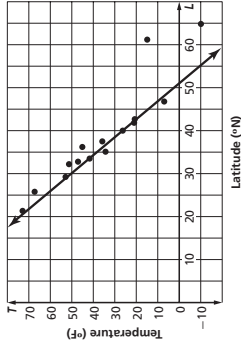
Sources: National Weather Service

- Use the information in the table to create a scatter plot and draw a line of best fit for the data.
- Write an equation for the line of fit. Make a conjecture about the relationship between a city's latitude and its mean January temperature.

**Sample answer:**  
 $y = -2.39x + 121.86$ ; The higher the latitude, the lower the temperature.

- Use your equation to predict the January mean temperature of Juneau, Alaska, which has latitude 58:23 N. **-17.7°F**
- What would you expect to be the latitude of a city with a January mean temperature of 15°F? **44:42 N**

- Was your conjecture about the relationship between latitude and temperature correct? **Yes; as the latitude increases, the temperature decreases.**
- Research the latitudes and temperatures for cities in the southern hemisphere instead. Does your conjecture hold for these cities as well? **Yes.**



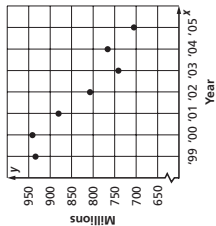
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## 4-5 Word Problem Practice

### Scatter Plots and Lines of Fit

- MUSIC** The scatter plot shows the number of CDs (in millions) that were sold from 1999 to 2005. If the trend continued, about how many CDs were sold in 2006?

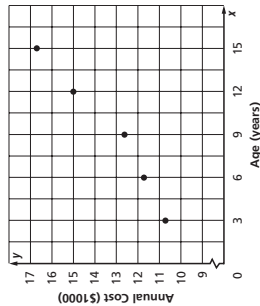


Sources: RIAA

**Sample answer: around 700 million**

- FAMILY** The table shows the predicted annual cost for a middle income family to raise a child from birth until adulthood. Draw a scatter plot and describe what relationship exists within the data.

Child's Age	Annual Cost (\$)
3	10,700
6	11,700
9	12,600
12	15,000
15	16,700



Sources: The World Almanac

**There is a positive correlation between the child's age and annual cost.**

- HOUSING** The median price of an existing home was \$160,000 in 2000 and \$240,000 in 2007. If 2000 represents year 0, use these data points to determine a possible line of best fit for the trends in the price of existing homes. Write the equation in slope-intercept form.

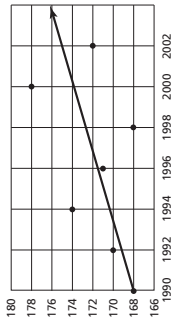
$y = 4285.7x + 110,000$

- BASEBALL** The table shows the average length (in minutes) of professional baseball games in selected years.

Average Length of Major League Baseball Games						
Year	'92	'94	'96	'98	'00	'02
Time (min)	170	174	171	168	178	167

Sources: Elias Sports Bureau

- Draw a scatter plot and determine what relationship, if any, exists in the data.



**no correlation**

- Explain what the scatter plot shows. **There is no consistent trend regarding the length of games.**
- Draw a line of fit for the scatter plot. **See line of fit on scatter plot above.**

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