GLENCOE MATHEMATICS

Algebra 1

Chapter 5
Resource Masters

Glencoe McGraw-Hill

New York, New York
Columbus, Ohio
Chicago, Illinois
Peoria, Illinois
Woodland Hills, California

NAME ______________________ DATE __________ PERIOD _____

5-1 Study Guide and Intervention

Slope

Find Slope

Slope of a Line	$m = \frac{\text{rise}}{\text{run}}$ or $m = \frac{y_2 - y_1}{x_2 - x_1}$, where (x_1, y_1) and (x_2, y_2) are the coordinates of any two points on a nonvertical line

Example 1 **Find the slope of the line that passes through (−3, 5) and (4, −2).**

Let $(-3, 5) = (x_1, y_1)$ and $(4, -2) = (x_2, y_2)$.

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

$= \frac{-2 - 5}{4 - (-3)}$ $y_2 = -2, y_1 = 5, x_2 = 4, x_1 = -3$

$= \frac{-7}{7}$ Simplify.

$= -1$

Example 2 **Find the value of r so that the line through (10, r) and (3, 4) has a slope of $-\frac{2}{7}$.**

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

$-\frac{2}{7} = \frac{4 - r}{3 - 10}$ $m = -\frac{2}{7}, y_2 = 4, y_1 = r, x_2 = 3, x_1 = 10$

$-\frac{2}{7} = \frac{4 - r}{-7}$ Simplify.

$-2(-7) = 7(4 - r)$ Cross multiply.

$14 = 28 - 7r$ Distributive Property

$-14 = -7r$ Subtract 28 from each side.

$2 = r$ Divide each side by −7.

Exercises

Find the slope of the line that passes through each pair of points.

1. (4, 9), (1, 6) **1**
2. (−4, −1), (−2, −5) **−2**
3. (−4, −1), (−4, −5) **undefined**
4. (2, 1), (8, 9) $\frac{4}{3}$
5. (14, −8), (7, −6) $-\frac{2}{7}$
6. (4, −3), (8, −3) **0**
7. (1, −2), (6, 2) $\frac{4}{5}$
8. (2, 5), (6, 2) $-\frac{3}{4}$
9. (4, 3.5), (−4, 3.5) **0**

Determine the value of r so the line that passes through each pair of points has the given slope.

10. (6, 8), (r, −2), $m = 1$ **−4**
11. (−1, −3), (7, r), $m = \frac{3}{4}$ **3**
12. (2, 8), (r, −4) $m = -3$ **6**
13. (7, −5), (6, r), $m = 0$ **−5**
14. (r, 4), (7, 1), $m = \frac{3}{4}$ **11**
15. (7, 5), (r, 9), $m = 6$ $\frac{23}{3}$
16. (10, r), (3, 4), $m = -\frac{2}{7}$ **2**
17. (10, 4), (−2, r), $m = -0.5$ **10**
18. (r, 3), (7, r), $m = -\frac{1}{5}$ **2**

Lesson 5-1

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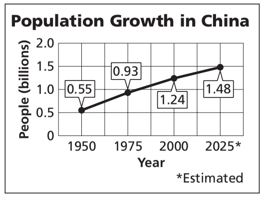
5-1 Study Guide and Intervention *(continued)*

Slope

Rate of Change

The **rate of change** tells, on average, how a quantity is changing over time. Slope describes a rate of change.

Example **POPULATION The graph shows the population growth in China.**



Source: United Nations Population Division

a. Find the rates of change for 1950–1975 and for 1975–2000.

1950–1975: $\frac{\text{change in population}}{\text{change in time}} = \frac{0.93 - 0.55}{1975 - 1950}$

$= \frac{0.38}{25}$ or 0.0152

1975–2000: $\frac{\text{change in population}}{\text{change in time}} = \frac{1.24 - 0.93}{2000 - 1975}$

$= \frac{0.31}{25}$ or 0.0124

b. Explain the meaning of the slope in each case.

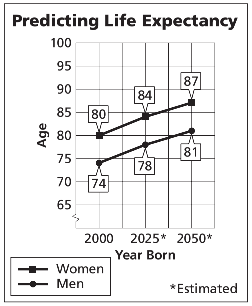
From 1950–1975, the growth was 0.0152 billion per year, or 15.2 million per year.
From 1975–2000, the growth was 0.0124 billion per year, or 12.4 million per year.

c. How are the different rates of change shown on the graph?

There is a greater vertical change for 1950–1975 than for 1975–2000. Therefore, the section of the graph for 1950–1975 has a steeper slope.

Exercises

LONGEVITY The graph shows the predicted life expectancy for men and women born in a given year.



Source: *USA TODAY*

1. Find the rates of change for women from 2000–2025 and 2025–2050. **0.16/yr, 0.12/yr**
2. Find the rates of change for men from 2000–2025 and 2025–2050. **0.16/yr, 0.12/yr**
3. Explain the meaning of your results in Exercises 1 and 2. **Both men and women increased their life expectancy at the same rates.**
4. What pattern do you see in the increase with each 25-year period? **While life expectancy increases, it does not increase at a constant rate.**
5. Make a prediction for the life expectancy for 2050–2075. Explain how you arrived at your prediction. **Sample answer: 89 for women and 83 for men; the decrease in rate from 2000–2025 to 2025–2050 is 0.04/yr. If the decrease in the rate remains the same, the change of rate for 2050–2075 might be 0.08/yr and 25(0.08) = 2 years of increase over the 25-year span.**

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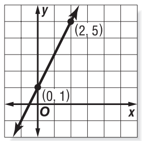
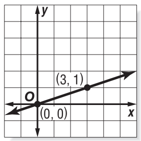
5-1 Skills Practice

Slope

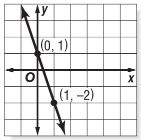
Find the slope of the line that passes through each pair of points.

1.


2

2.


$\frac{1}{3}$

3.


–3

4. (2, 5), (3, 6) **1**

5. (6, 1), (–6, 1) **0**

6. (4, 6), (4, 8) **undefined**

7. (5, 2), (5, –2) **undefined**

8. (2, 5), (–3, –5) **2**

9. (9, 8), (7, –8) **8**

10. (–5, –8), (–8, 1) **–3**

11. (–3, 10), (–3, 7) **undefined**

12. (17, 18), (18, 17) **–1**

13. (–6, –4), (4, 1) $\frac{1}{2}$

14. (10, 0), (–2, 4) $-\frac{1}{3}$

15. (2, –1), (–8, –2) $\frac{1}{10}$

16. (5, –9), (3, –2) $-\frac{7}{2}$

17. (12, 6), (3, –5) $\frac{11}{9}$

18. (–4, 5), (–8, –5) $\frac{5}{2}$

19. (–5, 6), (7, –8) $-\frac{7}{6}$

Find the value of *r* so the line that passes through each pair of points has the given slope.

20. $(r, 3), (5, 9), m = 2$ **2**

21. $(5, 9), (r, -3), m = -4$ **8**

22. $(r, 2), (6, 3), m = \frac{1}{2}$ **4**

23. $(r, 4), (7, 1), m = \frac{3}{4}$ **11**

24. $(5, 3), (r, -5), m = 4$ **3**

25. $(7, r), (4, 6), m = 0$ **6**

Lesson 5-1

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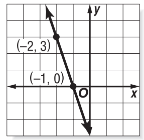
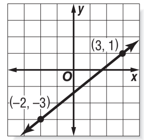
5-1 Practice (Average)

Slope

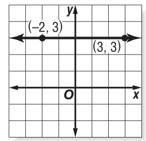
Find the slope of the line that passes through each pair of points.

1.


–3

2.


$\frac{4}{5}$

3.


0

4. (6, 3), (7, –4) **–7**

5. (–9, –3), (–7, –5) **–1**

6. (6, –2), (5, –4) **2**

7. (7, –4), (4, 8) **–4**

8. (–7, 8), (–7, 5) **undefined**

9. (5, 9), (3, 9) **0**

10. (15, 2), (–6, 5) $-\frac{1}{7}$

11. (3, 9), (–2, 8) $\frac{1}{5}$

12. (–2, –5), (7, 8) $\frac{13}{9}$

13. (12, 10), (12, 5) **undefined**

14. (0.2, –0.9), (0.5, –0.9) **0**

15. $\left(\frac{7}{3}, \frac{4}{3}\right), \left(-\frac{1}{3}, \frac{2}{3}\right)$ $\frac{1}{4}$

Find the value of *r* so the line that passes through each pair of points has the given slope.

16. $(-2, r), (6, 7), m = \frac{1}{2}$ **3**

17. $(-4, 3), (r, 5), m = \frac{1}{4}$ **4**

18. $(-3, -4), (-5, r), m = -\frac{9}{2}$ **5**

19. $(-5, r), (1, 3), m = \frac{7}{6}$ **–4**

20. $(1, 4), (r, 5)$, m undefined **1**

21. $(-7, 2), (-8, r), m = -5$ **7**

22. $(r, 7), (11, 8), m = -\frac{1}{5}$ **16**

23. $(r, 2), (5, r), m = 0$ **2**

24. ROOFING The *pitch* of a roof is the number of feet the roof rises for each 12 feet horizontally. If a roof has a pitch of 8, what is its slope expressed as a positive number? $\frac{2}{3}$

25. SALES A daily newspaper had 12,125 subscribers when it began publication. Five years later it had 10,100 subscribers. What is the average yearly rate of change in the number of subscribers for the five-year period? **–405 subscribers per year**

Answers

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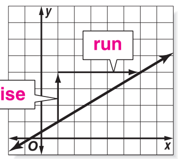
5-1 Reading to Learn Mathematics

Slope

Pre-Activity **Why is slope important in architecture?**

Read the introduction to Lesson 5-1 at the top of page 256 in your textbook. Then complete the definition of slope and fill in the boxes on the graph with the words ***rise*** and ***run***.



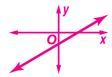
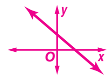
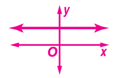
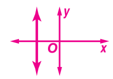
slope = $\frac{\text{rise}}{\text{run}}$

In this graph, the rise is __3__ units, and the run is __5__ units.

Thus, the slope of this line is $\frac{3 \text{ units}}{5 \text{ units}}$ or $\frac{3}{5}$.

Reading the Lesson

1. Describe each type of slope and include a sketch.

Type of Slope	Description of Graph	Sketch
positive	The graph rises as you go from left to right.	
negative	The graph falls as you go from left to right.	
zero	The graph is a horizontal line.	
undefined	The graph is a vertical line.	

2. Describe how each expression is related to *slope*.

a. $\frac{y_2 - y_1}{x_2 - x_1}$ difference of *y*-coordinates divided by difference of corresponding *x*-coordinates

b. $\frac{\text{rise}}{\text{run}}$ how far up or down as compared to how far left or right

c. $\frac{\$52{,}000 \text{ increase in spending}}{26 \text{ months}}$ slope used as rate of change

Helping You Remember

3. The word *rise* is usually associated with going up. Sometimes going from one point on the graph does not involve a rise and a run but a fall and a run. Describe how you could select points so that it is always a rise from the first point to the second point.
Sample answer: If the slope is negative, choose the second point so that its *x*-coordinate is less than that of the first point.

Lesson 5-1

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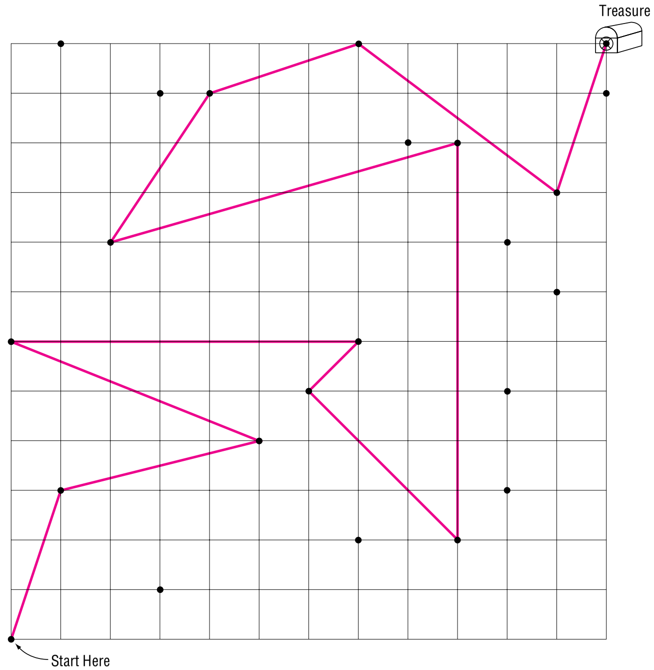
5-1 Enrichment

Treasure Hunt with Slopes

Using the definition of slope, draw lines with the slopes listed below. A correct solution will trace the route to the treasure.



1. 3	**2.** $\frac{1}{4}$	**3.** $-\frac{2}{5}$	**4.** 0
5. 1	**6.** -1	**7.** no slope	**8.** $\frac{2}{7}$
9. $\frac{3}{2}$	**10.** $\frac{1}{3}$	**11.** $-\frac{3}{4}$	**12.** 3

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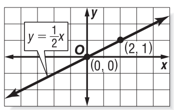
5-2 Study Guide and Intervention

Slope and Direct Variation

Direct Variation A **direct variation** is described by an equation of the form $y = kx$, where $k \neq 0$. We say that y *varies directly as* x. In the equation $y = kx$, k is the **constant of variation**.

Example 1 **Name the constant of variation for the equation. Then find the slope of the line that passes through the pair of points.**



For $y = \frac{1}{2}x$, the constant of variation is $\frac{1}{2}$.

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

$= \frac{1 - 0}{2 - 0}$ $(x_1, y_1) = (0, 0), (x_2, y_2) = (2, 1)$

$= \frac{1}{2}$ Simplify.

The slope is $\frac{1}{2}$.

Example 2 **Suppose y varies directly as x, and $y = 30$ when $x = 5$.**

a. Write a direct variation equation that relates x and y.

Find the value of k.

$y = kx$ Direct variation equation
$30 = k(5)$ Replace y with 30 and x with 5.
$6 = k$ Divide each side by 5.

Therefore, the equation is $y = 6x$.

b. Use the direct variation equation to find x when $y = 18$.

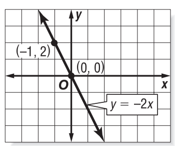
$y = 6x$ Direct variation equation
$18 = 6x$ Replace y with 18.
$3 = x$ Divide each side by 6.

Therefore, $x = 3$ when $y = 18$.

Exercises

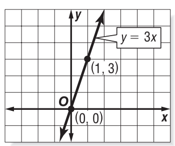
Name the constant of variation for each equation. Then determine the slope of the line that passes through each pair of points.

1.



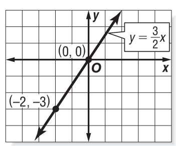
−2; −2

2.



3; 3

3.



$\frac{3}{2}$; $\frac{3}{2}$

Write a direct variation equation that relates x to y. Assume that y varies directly as x. Then solve.

4. If $y = 4$ when $x = 2$, find y when $x = 16$. **$y = 2x$; 32**

5. If $y = 9$ when $x = -3$, find x when $y = 6$. **$y = -3x$; −2**

6. If $y = -4.8$ when $x = -1.6$, find x when $y = -24$. **$y = 3x$; −8**

7. If $y = \frac{1}{4}$ when $x = \frac{1}{8}$, find x when $y = \frac{3}{16}$. **$y = 2x$; $\frac{3}{32}$**

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5-2 Study Guide and Intervention *(continued)*

Slope and Direct Variation

Solve Problems The **distance formula** $d = rt$ is a direct variation equation. In the formula, distance d varies directly as time t, and the rate r is the constant of variation.

Example **TRAVEL A family drove their car 225 miles in 5 hours.**

a. Write a direct variation equation to find the distance traveled for any number of hours.

Use given values for d and t to find r.

$d = rt$ Original equation
$225 = r(5)$ $d = 225$ and $t = 5$
$45 = r$ Divide each side by 5.

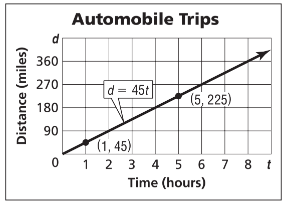
Therefore, the direct variation equation is $d = 45t$.

b. Graph the equation.

The graph of $d = 45t$ passes through the origin with slope 45.

$m = \frac{45}{1}$ $\frac{\text{rise}}{\text{run}}$

✓**CHECK** (5, 225) lies on the graph.



c. Estimate how many hours it would take the family to drive 360 miles.

$d = 45t$ Original equation
$360 = 45t$ Replace d with 360.
$t = 8$ Divide each side by 45.

Therefore, it will take 8 hours to drive 360 miles.

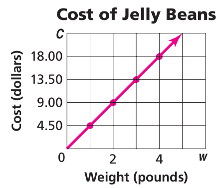
Exercises

RETAIL The total cost C of bulk jelly beans is \$4.49 times the number of pounds p.

1. Write a direct variation equation that relates the variables. **$C = 4.49p$**

2. Graph the equation on the grid at the right.

3. Find the cost of $\frac{3}{4}$ pound of jelly beans. **\$3.37**

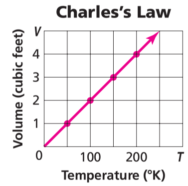


CHEMISTRY Charles's Law states that, at a constant pressure, volume of a gas V varies directly as its temperature T. A volume of 4 cubic feet of a certain gas has a temperature of 200° (absolute temperature).

4. Write a direct variation equation that relates the variables. **$V = 0.02T$**

5. Graph the equation on the grid at the right.

6. Find the volume of the same gas at 250° (absolute temperature). **5 ft^3**



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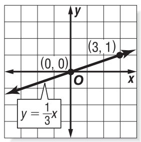
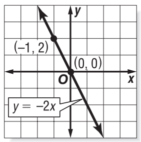
5-2 Skills Practice

Slope and Direct Variation

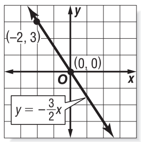
Name the constant of variation for each equation. Then determine the slope of the line that passes through each pair of points.

1. 

$\frac{1}{3}$; $\frac{1}{3}$

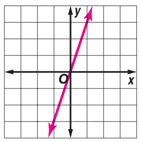
2. 

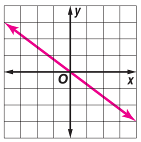
−2; −2

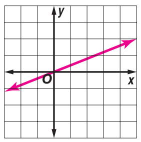
3. 

$-\frac{3}{2}$; $-\frac{3}{2}$

Graph each equation.

4. $y = 3x$ 

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

6. $y = \frac{2}{5}x$ 

Write a direct variation equation that relates x and y. Assume that y varies directly as x. Then solve.

7. If $y = -8$ when $x = -2$, find x when $y = 32$. $y = 4x$; 8

8. If $y = 45$ when $x = 15$, find x when $y = 15$. $y = 3x$; 5

9. If $y = -4$ when $x = 2$, find y when $x = -6$. $y = -2x$; 12

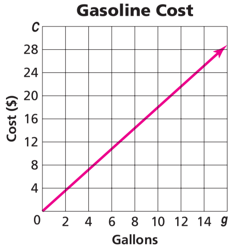
10. If $y = -9$ when $x = 3$, find y when $x = -5$. $y = -3x$; 15

11. If $y = 4$ when $x = 16$, find y when $x = 6$. $y = \frac{1}{4}x$; $\frac{3}{2}$

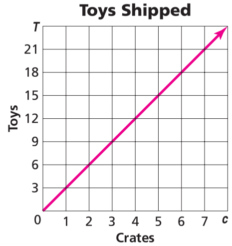
12. If $y = 12$ when $x = 18$, find x when $y = -16$. $y = \frac{2}{3}x$; −24

Write a direct variation equation that relates the variables. Then graph the equation.

13. **TRAVEL** The total cost C of gasoline is \$1.80 times the number of gallons g.
$C = 1.80g$



14. **SHIPPING** The number of delivered toys T is 3 times the total number of crates c.
$T = 3c$



Lesson 5-2

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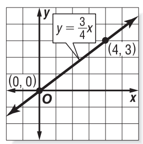
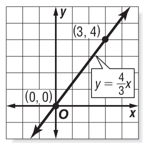
5-2 Practice (Average)

Slope and Direct Variation

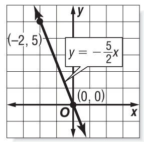
Name the constant of variation for each equation. Then determine the slope of the line that passes through each pair of points.

1. 

$\frac{3}{4}$; $\frac{3}{4}$

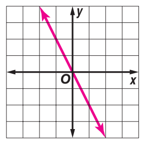
2. 

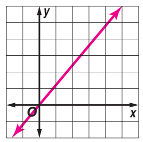
$\frac{4}{3}$; $\frac{4}{3}$

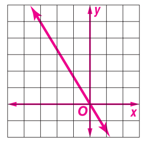
3. 

$-\frac{5}{2}$; $-\frac{5}{2}$

Graph each equation.

4. $y = -2x$ 

5. $y = \frac{6}{5}x$ 

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

Write a direct variation equation that relates x and y. Assume that y varies directly as x. Then solve.

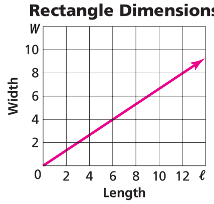
7. If $y = 7.5$ when $x = 0.5$, find y when $x = -0.3$. $y = 15x$; −4.5

8. If $y = 80$ when $x = 32$, find x when $y = 100$. $y = 2.5x$; 40

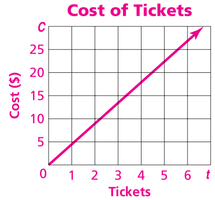
9. If $y = \frac{3}{4}$ when $x = 24$, find y when $x = 12$. $y = \frac{1}{32}x$; $\frac{3}{8}$

Write a direct variation equation that relates the variables. Then graph the equation.

10. **MEASURE** The width W of a rectangle is two thirds of the length ℓ.
$W = \frac{2}{3}\ell$



11. **TICKETS** The total cost C of tickets is \$4.50 times the number of tickets t.
$C = 4.50t$



12. **PRODUCE** The cost of bananas varies directly with their weight. Miguel bought $3\frac{1}{2}$ pounds of bananas for \$1.12. Write an equation that relates the cost of the bananas to their weight. Then find the cost of $4\frac{1}{4}$ pounds of bananas. $C = 0.32p$; \$1.36

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5-2 Reading to Learn Mathematics

Slope and Direct Variation

Pre-Activity **How is slope related to your shower?**

Read the introduction to Lesson 5-2 at the top of page 264 in your textbook.

- How do the numbers in the table relate to the graph shown?
  They are the coordinates of the points on the graph.
- Think about the first sentence. What does it mean to say that a standard showerhead uses about 6 gallons of water per minute?
  Sample answer: For each minute the shower runs, 6 gallons of water come out. So, if the shower ran 10 minutes, that would be 60 gallons.

Reading the Lesson

1. What is the form of a direct variation equation? $y = kx$

2. How is the constant of variation related to slope? **The constant of variation has the same value as the slope of the graph of the equation.**

3. The expression "y varies directly as x" can be written as the equation $y = kx$. How would you write an equation for "w varies directly as the square of t"? $w = kt^2$

4. For each situation, write an equation with the proper constant of variation.

a. The distance d varies directly as time t, and a cheetah can travel 88 feet in 1 second.
$d = 88t$

b. The perimeter p of a pentagon with all sides of equal length varies directly as the length s of a side of the pentagon. A pentagon has 5 sides. $p = 5s$

c. The wages W earned by an employee vary directly with the number of hours h that are worked. Enrique earned $172.50 for 23 hours of work. $W = \$7.50h$

Helping You Remember

5. Look up the word *constant* in a dictionary. How does this definition relate to the term constant of variation? **Sample answer: Something unchanging; the constant of variation relates *x* and *y* in the same value every time, and that relationship never changes.**

Lesson 5-2

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5-2 Enrichment

nth Power Variation

An equation of the form $y = kx^n$, where $k \neq 0$, describes an nth power variation. The variable n can be replaced by 2 to indicate the second power of x (the square of x) or by 3 to indicate the third power of x (the cube of x).

Assume that the weight of a person of average build varies directly as the cube of that person's height. The equation of variation has the form $w = kh^3$.

The weight that a person's legs will support is proportional to the cross-sectional area of the leg bones. This area varies directly as the square of the person's height. The equation of variation has the form $s = kh^2$.

Answer each question.

1. For a person 6 feet tall who weighs 200 pounds, find a value for k in the equation $w = kh^3$.
$k = 0.93$

2. Use your answer from Exercise 1 to predict the weight of a person who is 5 feet tall. **about 116 pounds**

3. Find the value for k in the equation $w = kh^3$ for a baby who is 20 inches long and weighs 6 pounds.
$k = 1.296$ **for** $h = \frac{5}{3}$ **ft**

4. How does your answer to Exercise 3 demonstrate that a baby is significantly fatter in proportion to its height than an adult?
***k* has a greater value.**

5. For a person 6 feet tall who weighs 200 pounds, find a value for k in the equation $s = kh^2$.
$k = 5.56$

6. For a baby who is 20 inches long and weighs 6 pounds, find an "infant value" for k in the equation $s = kh^2$.
$k = 2.16$ **for** $h = \frac{5}{3}$ **ft**

7. According to the adult equation you found (Exercise 1), how much would an imaginary giant 20 feet tall weigh?
7440 pounds

8. According to the adult equation for weight supported (Exercise 5), how much weight could a 20-foot tall giant's legs actually support?
only 2224 pounds

9. What can you conclude from Exercises 7 and 8?
Answers will vary. For example, bone strength limits the size humans can attain.

Answers

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5-3 Study Guide and Intervention

Slope-Intercept Form

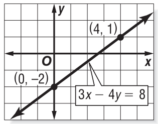
Slope-Intercept Form

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

Example 1 **Write an equation of the line whose slope is −4 and whose y-intercept is 3.**

$y = mx + b$ Slope-intercept form
$y = -4x + 3$ 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.
$\frac{-4y}{-4} = \frac{-3x + 8}{-4}$ Divide each side by −4.
$y = \frac{3}{4}x - 2$ Simplify.

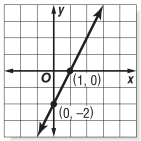
The y-intercept of $y = \frac{3}{4}x - 2$ is −2 and the slope is $\frac{3}{4}$. So graph the point (0, −2). From this point, move up 3 units and right 4 units. Draw a line passing through both points.

Exercises

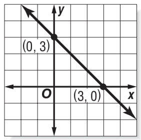
Write an equation of the line with the given slope and y-intercept.

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

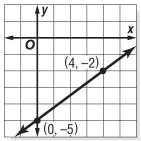
Write an equation of the line shown in each graph.

4. 

$y = 2x - 2$

5. 

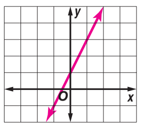
$y = -x + 3$

6. 

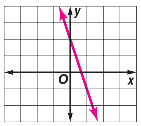
$y = \frac{3}{4}x - 5$

Graph each equation.

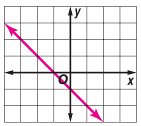
7. $y = 2x + 1$



8. $y = -3x + 2$



9. $y = -x - 1$



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5-3 Study Guide and Intervention *(continued)*

Slope-Intercept Form

Model Real-World Data

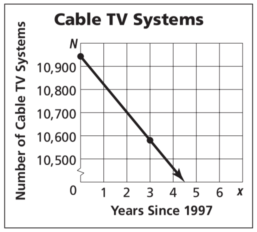
Example **MEDIA Since 1997, the number of cable TV systems has decreased by an average rate of 121 systems per year. There were 10,943 systems in 1997.**

a. Write a linear equation to find the average number of cable systems in any year after 1997.

The rate of change is −121 systems per year. In the first year, the number of systems was 10,943. Let N = the number of cable TV systems. Let x = the number of years after 1997. An equation is $N = -121x + 10{,}943$.

b. Graph the equation.

The graph of $N = -121x + 10{,}943$ is a line that passes through the point at (0, 10,943) and has a slope of −121.



Source: *The World Almanac*

c. Find the approximate number of cable TV systems in 2000.

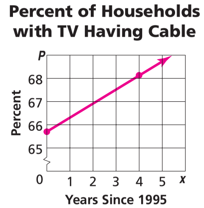
$N = -121x + 10{,}943$ Original equation
$N = -121(3) + 10{,}943$ Replace x with 3.
$N = 10{,}580$ Simplify.

There were about 10,580 cable TV systems in 2000.

Exercises

ENTERTAINMENT In 1995, 65.7% of all households with TV's in the U.S. subscribed to cable TV. Between 1995 and 1999, the percent increased by about 0.6% each year.

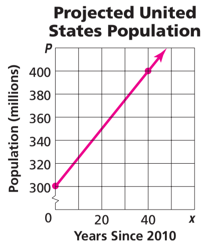
1. Write an equation to find the percent P of households that subscribed to cable TV for any year x between 1995 and 1999. **$P = 0.6x + 65.7$**
2. Graph the equation on the grid at the right.
3. Find the percent that subscribed to cable TV in 1999. **68.1%**



Source: *The World Almanac*

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.

4. Write an equation to find the population P in any year x between 2010 and 2050. **$P = 2{,}500{,}000x + 300{,}000{,}000$**
5. Graph the equation on the grid at the right.
6. Find the population in 2050. **about 400,000,000**



Source: *The World Almanac*

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5-3 Skills Practice

Slope-Intercept Form

Write an equation of the line 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 **$y = 3x + 2$**

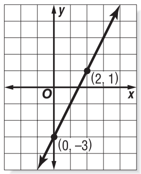
6. slope: -4, y-intercept: -9 **$y = -4x - 9$**

7. slope: 1, y-intercept: -12 **$y = x - 12$**

8. slope: 0, y-intercept: 8 **$y = 8$**

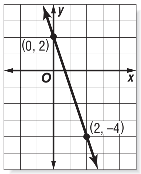
Write an equation of the line shown in each graph.

9.



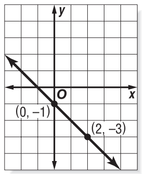
$y = 2x - 3$

10.



$y = -3x + 2$

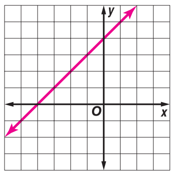
11.



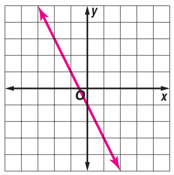
$y = -x - 1$

Graph each equation.

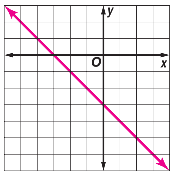
12. $y = x + 4$



13. $y = -2x - 1$



14. $x + y = -3$



Write a linear equation in slope-intercept form to model each situation.

15. A video store charges \$10 for a rental card plus \$2 per rental.
$C = 2r + 10$

16. A Norfolk pine is 18 inches tall and grows at a rate of 1.5 feet per year.
$H = 1.5t + 1.5$

17. A Cairn terrier weighs 30 pounds and is on a special diet to lose 2 pounds per month.
$W = -2m + 30$

18. An airplane at an altitude of 3000 feet descends at a rate of 500 feet per mile.
$A = -500m + 3000$

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5-3 Practice (Average)

Slope-Intercept Form

Write an equation of the line with the given slope and *y*-intercept.

1. slope: $\frac{1}{4}$, y-intercept: 3 **$y = \frac{1}{4}x + 3$**

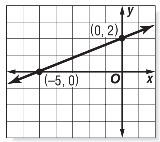
2. slope: $\frac{3}{2}$, y-intercept: -4 **$y = \frac{3}{2}x - 4$**

3. slope: 1.5, y-intercept: -1
$y = 1.5x - 1$

4. slope: -2.5, y-intercept: 3.5
$y = -2.5x + 3.5$

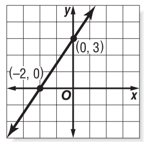
Write an equation of the line shown in each graph.

5.



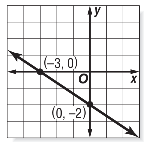
$y = \frac{2}{5}x + 2$

6.



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

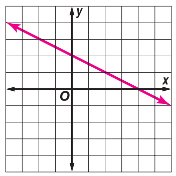
7.



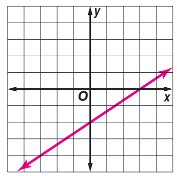
$y = -\frac{2}{3}x - 2$

Graph each equation.

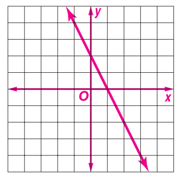
8. $y = -\frac{1}{2}x + 2$



9. $3y = 2x - 6$



10. $6x + 3y = 6$



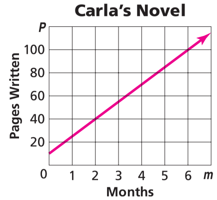
Write a linear equation in slope-intercept form to model each situation.

11. A computer technician charges \$75 for a consultation plus \$35 per hour. **$C = 35h + 75$**

12. The population of Pine Bluff is 6791 and is decreasing at the rate of 7 per year.
$P = -7t + 6791$

WRITING For Exercises 13–15, use the following information.
Carla has already written 10 pages of a novel. She plans to write 15 additional pages per month until she is finished.

Carla's Novel



13. Write an equation to find the total number of pages P written after any number of months m. **$P = 10 + 15m$**

14. Graph the equation on the grid at the right.

15. Find the total number of pages written after 5 months. **85**

Lesson 5-3

Answers

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5-3 Reading to Learn Mathematics

Slope-Intercept Form

Pre-Activity **How is a y-intercept related to a flat fee?**

Read the introduction to Lesson 5-3 at the top of page 272 in your textbook.

- What point on the graph shows that the flat fee is $5.00? **(0, 5)**
- How does the rate of $0.10 per minute relate to the graph? **It is the slope.**

Reading the Lesson

1. Fill in the boxes with the correct words to describe what m and b represent.

$y = mx + b$

m: **slope**; b: ***y*-intercept**

2. What are the slope and y-intercept of a vertical line?
The slope is undefined, and there is no *y*-intercept.

3. What are the slope and y-intercept of a horizontal line?
The slope is 0, and the *y*-intercept is where it crosses the *y*-axis.

4. Read the problem. Then answer each part of the exercise.

A ruby-throated hummingbird weighs about 0.6 gram at birth and gains weight at a rate of about 0.2 gram per day until fully grown.

a. Write a verbal equation to show how the words are related to finding the average weight of a ruby-throated hummingbird at any given week. Use the words *weight at birth*, *rate of growth*, *weight*, and *weeks after birth*. Below the equation, fill in any values you know and put a question mark under the items that you do not know.

weight	=	rate of growth	×	weeks after birth	+	weight at birth
?		0.2		?		0.6

b. Define what variables to use for the unknown quantities. **Sample answer: Let *W* be the weight at any time and *t* be the number of weeks after birth.**

c. Use the variables you defined and what you know from the problem to write an equation. $W = 0.2t + 0.6$

Helping You Remember

5. One way to remember something is to explain it to another person. Write how you would explain to someone the process for using the y-intercept and slope to graph a linear equation. **On the *y*-axis, plot the point for the *y*-intercept. Then use the rise-over-run definition of slope to determine how far up or down and right or left the next point is from the first.**

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5-3 Enrichment

Relating Slope-Intercept Form and Standard Forms

You have learned that slope can be defined in terms of $\frac{\text{rise}}{\text{run}}$ or $\frac{y_2 - y_1}{x_2 - x_1}$.

Another definition can be found from the standard from of a linear equation. Standard form is $Ax + By = C$, where A, B, and C are integers, $A \geq 0$, and A and B are not both zero.

1. Solve $Ax + By = C$ for y. Your answer should be written in slope-intercept form.
$y = -\frac{A}{B}x + \frac{C}{B}$

2. Use the slope-intercept equation you wrote in Exercise 1 to write expressions for the slope and the y-intercept in terms of A, B, and C.
$m = -\frac{A}{B}$, $b = \frac{C}{B}$

Use the expressions in Exercise 2 above to find the slope and y-intercept of each equation.

3. $2x + y = -4$
$m = -2$, $b = -4$

4. $4x + 3y = 24$
$m = -\frac{4}{3}$, $b = 8$

5. $4x + 6y = -36$
$m = -\frac{2}{3}$, $b = -6$

6. $x - 3y = -27$
$m = \frac{1}{3}$, $b = 9$

7. $x - 2y = 6$
$m = \frac{1}{2}$, $b = -3$

8. $4y = 20$
$m = 0$, $b = 5$

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5-4 Study Guide and Intervention

Writing Equations in Slope-Intercept Form

Write an Equation Given the Slope and One Point

Example 1 **Write an equation of a line that passes through (−4, 2) with slope 3.**

The line has slope 3. To find the y-intercept, replace m with 3 and (x, y) with (−4, 2) in the slope-intercept form. Then solve for b.

$y = mx + b$	Slope-intercept form
$2 = 3(-4) + b$	$m = 3$, $y = 2$, and $x = -4$
$2 = -12 + b$	Multiply.
$14 = b$	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 slope $\frac{1}{4}$.**

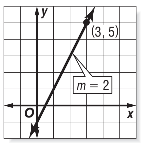
The line has slope $\frac{1}{4}$. Replace m with $\frac{1}{4}$ and (x, y) with (−2, −1) in the slope-intercept form.

$y = mx + b$	Slope-intercept form
$-1 = \frac{1}{4}(-2) + b$	$m = \frac{1}{4}$, $y = -1$, and $x = -2$
$-1 = -\frac{1}{2} + b$	Multiply.
$-\frac{1}{2} = b$	Add $\frac{1}{2}$ to each side.

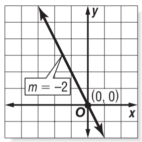
Therefore, the equation is $y = \frac{1}{4}x - \frac{1}{2}$.

Exercises

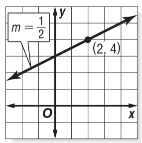
Write an equation of the line that passes through each point with the given slope.

1. 

$y = 2x - 1$

2. 

$y = -2x$

3. 

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

4. (8, 2), $m = -\frac{3}{4}$ **$y = -\frac{3}{4}x + 8$**

5. (−1, −3), $m = 5$ **$y = 5x + 2$**

6. (4, −5), $m = -\frac{1}{2}$ **$y = -\frac{1}{2}x - 3$**

7. (−5, 4), $m = 0$ **$y = 4$**

8. (2, 2), $m = \frac{1}{2}$ **$y = \frac{1}{2}x + 1$**

9. (1, −4), $m = -6$ **$y = -6x + 2$**

10. Write an equation of a line that passes through the y-intercept −3 with slope 2.
$y = 2x - 3$

11. Write an equation of a line that passes through the x-intercept 4 with slope −3.
$y = -3x + 12$

12. Write an equation of a line that passes through the point (0, 350) with slope $\frac{1}{5}$.
$y = \frac{1}{5}x + 350$

Lesson 5-4

NAME ______________________ DATE ____________ PERIOD _____

5-4 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).**

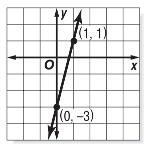
Find the slope m. To find the y-intercept, replace m with its computed value and (x, y) with (1, 2) in the slope-intercept form. Then solve for b.

$m = \frac{y_2 - y_1}{x_2 - x_1}$	Slope formula
$m = \frac{-2 - 2}{3 - 1}$	$y_2 = -2$, $y_1 = 2$, $x_2 = 3$, $x_1 = 1$
$m = -2$	Simplify.
$y = mx + b$	Slope-intercept form
$2 = -2(1) + b$	Replace m with −2, y with 2, and x with 1.
$2 = -2 + b$	Multiply.
$4 = b$	Add 2 to each side.

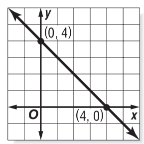
Therefore, the equation is $y = -2x + 4$.

Exercises

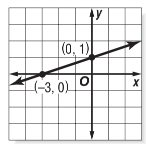
Write an equation of the line that passes through each pair of points.

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) **$y = 5x + 2$**

6. (6, −25), (−1, 3) **$y = -4x - 1$**

7. (−2, −1), (2, 11) **$y = 3x + 5$**

8. (10, −1), (4, 2) **$y = -\frac{1}{2}x + 4$**

9. (−14, −2), (7, 7) **$y = \frac{3}{7}x + 4$**

10. Write an equation of a line that passes through the x-intercept 4 and y-intercept −2.
$y = \frac{1}{2}x - 2$

11. Write an equation of a line that passes through the x-intercept −3 and y-intercept 5.
$y = \frac{5}{3}x + 5$

12. Write an equation of a line that passes through (0, 16) and (−10, 0).
$y = \frac{8}{5}x + 16$

Answers

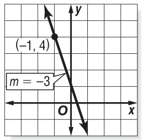
NAME ______________________ DATE __________ PERIOD _____

5-4 Skills Practice

Writing Equations in Slope-Intercept Form

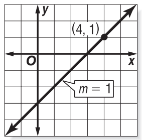
Write an equation of the line that passes through each point with the given slope.

1.



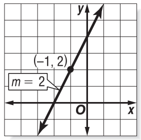
$y = -3x + 1$

2.



$y = x - 3$

3.



$y = 2x + 4$

4. (1, 9), $m = 4$ $y = 4x + 5$

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

6. (2, −2), $m = 3$ $y = 3x - 8$

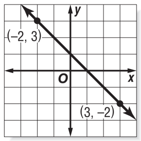
7. (3, 0), $m = 5$ $y = 5x - 15$

8. (−3, −2), $m = 2$ $y = 2x + 4$

9. (−5, 4), $m = -4$ $y = -4x - 16$

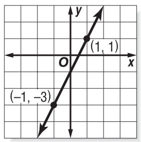
Write an equation of the line that passes through each pair of points.

10.



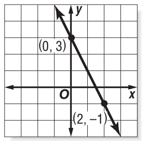
$y = -x + 1$

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) $y = -2x + 4$

Write an equation of the line that has each pair of intercepts.

19. x-intercept: −3, y-intercept: 6 $y = 2x + 6$

20. x-intercept: 3, y-intercept: 3 $y = -x + 3$

21. x-intercept: 1, y-intercept: 2 $y = -2x + 2$

22. x-intercept: 2, y-intercept: −4 $y = 2x - 4$

23. x-intercept: −4, y-intercept: −8 $y = -2x - 8$

24. x-intercept: −1, y-intercept: 4 $y = 4x + 4$

Lesson 5-4

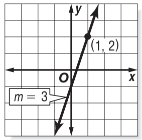
NAME ______________________ DATE __________ PERIOD _____

5-4 Practice (Average)

Writing Equations in Slope-Intercept Form

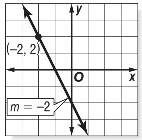
Write an equation of the line that passes through each point with the given slope.

1.



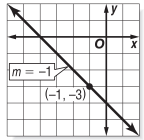
$y = 3x - 1$

2.



$y = -2x - 2$

3.



$y = -x - 4$

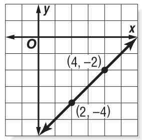
4. (−5, 4), $m = -3$ $y = -3x - 11$

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

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

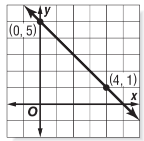
Write an equation of the line that passes through each pair of points.

7.



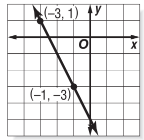
$y = x - 6$

8.



$y = -x + 5$

9.



$y = -2x - 5$

10. (0, −4), (5, −4) $y = -4$

11. (−4, −2), (4, 0) $y = \frac{1}{4}x - 1$

12. (−2, −3), (4, 5) $y = \frac{4}{3}x - \frac{1}{3}$

13. (0, 1), (5, 3) $y = \frac{2}{5}x + 1$

14. (−3, 0), (1, −6) $y = -\frac{3}{2}x - \frac{9}{2}$

15. (1, 0), (5, −1) $y = -\frac{1}{4}x + \frac{1}{4}$

Write an equation of the line that has each pair of intercepts.

16. x-intercept: 2, y-intercept: −5 $y = \frac{5}{2}x - 5$

17. x-intercept: 2, y-intercept: 10 $y = -5x + 10$

18. x-intercept: −2, y-intercept: 1 $y = \frac{1}{2}x + 1$

19. x-intercept: −4, y-intercept: −3 $y = -\frac{3}{4}x - 3$

20. 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. $C = 10\ell + 12$; \$52

21. WEATHER It is 76°F at the 6000-foot level of a mountain, and 49°F at the 12,000-foot level of the mountain. Write a linear equation to find the temperature T at an elevation e on the mountain, where e is in thousands of feet. $T = -4.5e + 103$

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5-4 Reading to Learn Mathematics

Writing Equations in Slope-Intercept Form

Pre-Activity **How can slope-intercept form be used to make predictions?**

Read the introduction to Lesson 5-4 at the top of page 280 in your textbook.

- What is the rate of change per year? **about 2000 per year**
- Study the pattern on the graph. How would you find the population in 1997? **Add 2000 to the 1996 population, which gives 179,000.**

Reading the Lesson

1. Suppose you are given that a line goes through (2, 5) and has a slope of −2. Use this information to complete the following equation.

$y = mx + b$

$\boxed{5} = \boxed{-2} \cdot \boxed{2} + \boxed{b}$

2. What must you first do if you are not given the slope in the problem?
Use the information given (two points) to find the slope.

3. What is the first step in answering any standardized test practice question?
Read the problem.

4. What are four steps you can use in solving a word problem?
Explore, Plan, Solve, Examine

5. Define the term *linear extrapolation*.
Linear extrapolation means using a linear equation to predict values that are outside the two given data points.

Helping You Remember

6. In your own words, explain how you would answer a question that asks you to write the slope-intercept form of an equation. **Sample answer: Determine what information you are given. If you have a point and the slope, you can substitute the *x*- and *y*-values and the slope into $y = mx + b$ to find the value of *b*. Then use the values of *m* and *b* to write the equation. If you have two points, use them to find the slope, and then use the method for a point and the slope.**

Lesson 5-4

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5-4 Enrichment

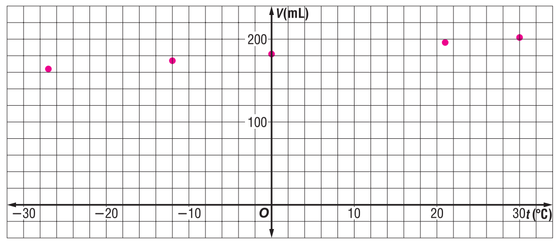
Celsius and Kelvin Temperatures

If you blow up a balloon and put it in the refrigerator, the balloon will shrink as the temperature of the air in the balloon decreases.

The volume of a certain gas is measured at 30° Celsius. The temperature is decreased and the volume is measured again.

Temperature (*t*)	Volume (*V*)
30°C	202 mL
21°C	196 mL
0°C	182 mL
–12°C	174 mL
–27°C	164 mL

1. Graph this table on the coordinate plane provided below.



2. Find the equation of the line that passes through the points you graphed in Exercise 1.
$v = \frac{2}{3}t + 182$

3. Use the equation you found in Exercise 2 to find the temperature that would give a volume of zero. This temperature is the lowest one possible and is called *absolute zero*.
−273°C

4. In 1848, Lord Kelvin proposed a new temperature scale with 0 being assigned to absolute zero. The size of the degree chosen was the same size as the Celsius degree. Change each of the Celsius temperatures in the table above to degrees Kelvin.
303°, 294°, 273°, 261°, 246°

Answers

NAME ______________________ DATE ________ PERIOD _____

5-5 Study Guide and Intervention
Writing Equations in 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 the point-slope form of an equation for a line that passes through (6, 1) and has 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 the point-slope form of an equation for a horizontal line that passes through (4, −1).**

$y - y_1 = m(x - x_1)$ Point-slope form

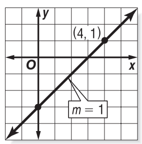
$y - (-1) = 0(x - 4)$ $m = 0$; $(x_1, y_1) = (4, -1)$

$y + 1 = 0$ Simplify.

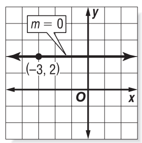
Therefore, the equation is $y + 1 = 0$.

Exercises

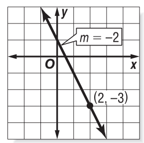
Write the point-slope form of an equation for a line that passes through each point with the given slope.

1. 

$y - 1 = x - 4$

2. 

$y - 2 = 0$

3. 

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

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

5. (−7, 2), $m = 6$ $y - 2 = 6(x + 7)$

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

7. (−6, 7), $m = 0$ $y - 7 = 0$

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

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

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

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

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

Lesson 5-5

NAME ______________________ DATE ________ PERIOD _____

5-5 Study Guide and Intervention *(continued)*
Writing Equations in Point-Slope Form

Forms of Linear Equations

Slope-Intercept Form	$y = mx + b$	m = slope; b = y-intercept
Point-Slope Form	$y - y_1 = m(x - x_1)$	m = 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

$3(y + 5) = 3\left(\frac{2}{3}\right)(x - 6)$ 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.

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

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

3. $y + 2 = \frac{2}{3}(x - 9)$ $2x - 3y = 24$

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

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

6. $y + 4 = -\frac{2}{5}(x - 1)$ $2x + 5y = -18$

Write each equation in slope-intercept form.

7. $y + 4 = 4(x - 2)$ $y = 4x - 12$

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

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

10. $y - 6 = 3\left(x - \frac{1}{3}\right)$ $y = 3x + 5$

11. $y + 4 = -2(x + 5)$ $y = -2x - 14$

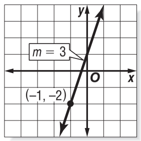
12. $y + \frac{5}{3} = \frac{1}{2}(x - 2)$ $y = \frac{1}{2}x - \frac{8}{3}$

NAME ______________________ DATE __________ PERIOD _____

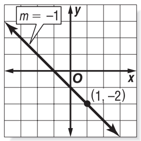
5-5 Skills Practice

Writing Equations in Point-Slope Form

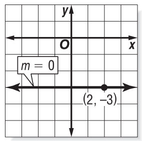
Write the point-slope form of an equation for a line that passes through each point with the given slope.

1. 

$y + 2 = 3(x + 1)$

2. 

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

3. 

$y + 3 = 0$

4. $(3, 1)$, $m = 0$
$y - 1 = 0$

5. $(-4, 6)$, $m = 8$
$y - 6 = 8(x + 4)$

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

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

8. $(3, 3)$, $m = \frac{4}{3}$
$y - 3 = \frac{4}{3}(x - 3)$

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

Write each equation in standard form.

10. $y + 1 = x + 2$
$x - y = -1$

11. $y + 9 = -3(x - 2)$
$3x + y = -3$

12. $y - 7 = 4(x + 4)$
$4x - y = -23$

13. $y - 4 = -(x - 1)$
$x + y = 5$

14. $y - 6 = 4(x + 3)$
$4x - y = -18$

15. $y + 5 = -5(x - 3)$
$5x + y = 10$

16. $y - 10 = -2(x - 3)$
$2x + y = 16$

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

18. $y + 11 = \frac{1}{3}(x + 3)$
$x - 3y = 30$

Write each equation in slope-intercept form.

19. $y - 4 = 3(x - 2)$
$y = 3x - 2$

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

21. $y - 6 = -2(x + 2)$
$y = -2x + 2$

22. $y + 1 = -5(x - 3)$
$y = -5x + 14$

23. $y - 3 = 6(x - 1)$
$y = 6x - 3$

24. $y - 8 = 3(x + 5)$
$y = 3x + 23$

25. $y - 2 = \frac{1}{2}(x + 6)$
$y = \frac{1}{2}x + 5$

26. $y + 1 = -\frac{1}{3}(x + 9)$
$y = -\frac{1}{3}x - 4$

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

NAME ______________________ DATE __________ PERIOD _____

5-5 Practice (Average)

Writing Equations in Point-Slope Form

Write the point-slope form of an equation for a line that passes through each point with the given slope.

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

2. $(1, -6)$, $m = -1$
$y + 6 = -(x - 1)$

3. $(-3, -4)$, $m = 0$
$y + 4 = 0$

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

5. $(-8, 5)$, $m = -\frac{2}{5}$
$y - 5 = -\frac{2}{5}(x + 8)$

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

Write each equation in standard form.

7. $y - 11 = 3(x - 2)$
$3x - y = -5$

8. $y - 10 = -(x - 2)$
$x + y = 12$

9. $y + 7 = 2(x + 5)$
$2x - y = -3$

10. $y - 5 = \frac{3}{2}(x + 4)$
$3x - 2y = -22$

11. $y + 2 = -\frac{3}{4}(x + 1)$
$3x + 4y = -11$

12. $y - 6 = \frac{4}{3}(x - 3)$
$4x - 3y = -6$

13. $y + 4 = 1.5(x + 2)$
$3x - 2y = 2$

14. $y - 3 = -2.4(x - 5)$
$12x + 5y = 75$

15. $y - 4 = 2.5(x + 3)$
$5x - 2y = -23$

Write each equation in slope-intercept form.

16. $y + 2 = 4(x + 2)$
$y = 4x + 6$

17. $y + 1 = -7(x + 1)$
$y = -7x - 8$

18. $y - 3 = -5(x + 12)$
$y = -5x - 57$

19. $y - 5 = \frac{3}{2}(x + 4)$
$y = \frac{3}{2}x + 11$

20. $y - \frac{1}{4} = -3\left(x + \frac{1}{4}\right)$
$y = -3x - \frac{1}{2}$

21. $y - \frac{2}{3} = -2\left(x - \frac{1}{4}\right)$
$y = -2x + \frac{7}{6}$

CONSTRUCTION For Exercises 22–24, use the following information.

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.

22. Write the point-slope form of an equation to find the total fee y for any number of hours x. $y - 195 = 15(x - 9)$

23. Write the equation in slope-intercept form. $y = 15x + 60$

24. What is the fee for the use of a trash dumpster? $60

MOVING For Exercises 25–27, use the following information.

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.

25. 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. $y - 64 = 0.5(x - 48)$

26. Write the equation in slope-intercept form. $y = 0.5x + 40$

27. What is the daily fee? $40

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5-5 Reading to Learn Mathematics

Writing Equations in Point-Slope Form

Pre-Activity **How can you use the slope formula to write an equation of a line?**

Read the introduction to Lesson 5-5 at the top of page 286 in your textbook.

Note that in the final equation there is a value subtracted from x and from y. What are these values?

The value subtracted from x is the x-coordinate of the given point. The value subtracted from y is the y-coordinate of the given point.

Reading the Lesson

1. In the formula $y - y_1 = m(x - x_1)$, what do x_1 and y_1 represent?

x_1 and y_1 represent the coordinates of any given point on the graph of the line.

2. Complete the chart below by listing three forms of equations. Then write the formula for each form. Finally, write three examples of equations in those forms.
Sample examples are given.

Form of Equation	Formula	Example
slope-intercept	$y = mx + b$	$y = 3x + 2$
point-slope	$y - y_1 = m(x - x_1)$	$y - 2 = 4(x + 3)$
standard	$Ax + By = C$	$3x - 5y = 15$

3. Refer to Example 5 on page 288 of your textbook. What do you think the *hypotenuse* of a right triangle is? **Sample answers: The hypotenuse is the longest side of the right triangle. The hypotenuse is the side opposite the right angle in a right triangle.**

Helping You Remember

4. Suppose you could not remember all three formulas listed in the table above. Which of the forms would you concentrate on for writing linear equations? Explain why you chose that form. **Sample answer: Point-slope form; the slope-intercept form can be written from the point-slope form. This is so because the y-intercept lets you write the coordinates of the point where the line crosses the y-axis. You can use that point as the given point in the point-slope formula.**

Lesson 5-5

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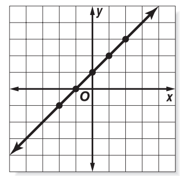
5-5 Enrichment

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.
$y = 1x + 1$

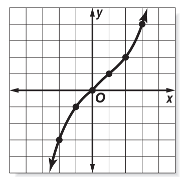


2. How are the equations related?
They are the same.

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.
$y = 1x + 0$; $y = 2x - 2$; $y = 2x + 1$



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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5-6 Study Guide and Intervention

Geometry: Parallel and Perpendicular Lines

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

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

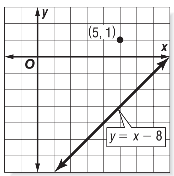
A line parallel to $y = 2x + 12$ has the same slope, 2. Replace m with 2 and (x_1, y_1) with $(-1, 6)$ in the point-slope form.

$y - y_1 = m(x - x_1)$	Point-slope form
$y - 6 = 2(x - (-1))$	$m = 2$; $(x_1, y_1) = (-1, 6)$
$y - 6 = 2(x + 1)$	Simplify.
$y - 6 = 2x + 2$	Distributive Property
$y = 2x + 8$	Slope-intercept form

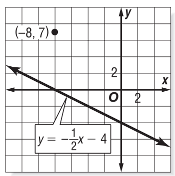
Therefore, the equation is $y = 2x + 8$.

Exercises

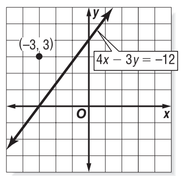
Write the slope-intercept form for an equation of the line that passes through the given point and is parallel to the graph of each equation.

1. 

$y = x - 4$

2. 

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

3. 

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

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

5. $(6, 4)$, $y = \frac{1}{3}x + 1$ — $y = \frac{1}{3}x + 2$

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

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

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

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

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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5-6 Study Guide and Intervention *(continued)*

Geometry: Parallel and Perpendicular Lines

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

Example **Write the slope-intercept form for an equation that passes through (−4, 2) and is perpendicular to the graph of $2x - 3y = 9$.**

Find the slope of $2x - 3y = 9$.

$2x - 3y = 9$	Original equation
$-3y = -2x + 9$	Subtract $2x$ from each side.
$y = \frac{2}{3}x - 3$	Divide each side by −3.

The slope of $y = \frac{2}{3}x - 3$ 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.

$y - y_1 = m(x - x_1)$	Point-slope form
$y - 2 = -\frac{3}{2}(x - (-4))$	$m = -\frac{3}{2}$; $(x_1, y_1) = (-4, 2)$
$y - 2 = -\frac{3}{2}(x + 4)$	Simplify.
$y - 2 = -\frac{3}{2}x - 6$	Distributive Property
$y = -\frac{3}{2}x - 4$	Slope-intercept form

Exercises

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

1. $(4, 2)$, $y = \frac{1}{2}x + 1$ — $y = -2x + 10$

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

3. $(6, 4)$, $y = 7x + 1$ — $y = -\frac{1}{7}x + \frac{34}{7}$

4. $(-8, -7)$, $y = -x - 8$ — $y = x + 1$

5. $(6, -2)$, $y = -3x - 6$ — $y = \frac{1}{3}x - 4$

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

7. $(-9, -5)$, $y = -3x - 1$ — $y = \frac{1}{3}x - 2$

8. $(-1, 3)$, $2x + 4y = 12$ — $y = 2x + 5$

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

10. Find an equation of the line that has a y-intercept of −2 and is perpendicular to the graph of the line $x - 2y = 5$. $y = -2x - 2$

11. Find an equation of the line that has a y-intercept of 5 and is perpendicular to the graph of the line $4x + 3y = 8$. $y = \frac{3}{4}x + 5$

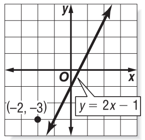
NAME ______________________ DATE __________ PERIOD _____

5-6 Skills Practice

Geometry: Parallel and Perpendicular Lines

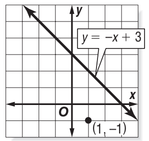
Write the slope-intercept form of an equation of the line that passes through the given point and is parallel to the graph of each equation.

1.



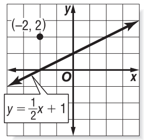
$y = 2x + 1$

2.



$y = -x$

3.



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

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

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

6. (−1, 1), $y = x - 4$ — **$y = x + 2$**

7. (1, −3), $y = -4x - 1$ — **$y = -4x + 1$**

8. (−4, 2), $y = x + 3$ — **$y = x + 6$**

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

10. (4, 1), $y = -\frac{1}{4}x + 7$ — **$y = -\frac{1}{4}x + 2$**

11. (−5, −1), $2y = 2x - 4$ — **$y = x + 4$**

12. (3, −1), $3y = x + 9$ — **$y = \frac{1}{3}x - 2$**

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

13. (−3, −2), $y = x + 2$ — **$y = -x - 5$**

14. (4, −1), $y = 2x - 4$ — **$y = -\frac{1}{2}x + 1$**

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

16. (−4, 5), $y = -4x - 1$ — **$y = \frac{1}{4}x + 6$**

17. (−2, 3), $y = \frac{1}{4}x - 4$ — **$y = -4x - 5$**

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

19. (3, −3), $y = \frac{3}{4}x + 5$ — **$y = -\frac{4}{3}x + 1$**

20. (−5, 1), $y = -\frac{5}{3}x - 7$ — **$y = \frac{3}{5}x + 4$**

21. (0, −2), $y = -7x + 3$ — **$y = \frac{1}{7}x - 2$**

22. (2, 3), $2x + 10y = 3$ — **$y = 5x - 7$**

23. (−2, 2), $6x + 3y = -9$ — **$y = \frac{1}{2}x + 3$**

24. (−4, −3), $8x - 2y = 16$ — **$y = -\frac{1}{4}x - 4$**

NAME ______________________ DATE __________ PERIOD _____

5-6 Practice (Average)

Geometry: Parallel and Perpendicular Lines

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

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

2. (−2, 5), $y = -4x + 2$ — **$y = -4x - 3$**

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

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

5. (12, 3), $y = \frac{4}{3}x + 5$ — **$y = \frac{4}{3}x - 13$**

6. (3, 1), $2x + y = 5$ — **$y = -2x + 7$**

7. (−3, 4), $3y = 2x - 3$ — **$y = \frac{2}{3}x + 6$**

8. (−1, −2), $3x - y = 5$ — **$y = 3x + 1$**

9. (−8, 2), $5x - 4y = 1$ — **$y = \frac{5}{4}x + 12$**

10. (−1, −4), $9x + 3y = 8$ — **$y = -3x - 7$**

11. (−5, 6), $4x + 3y = 1$ — **$y = -\frac{4}{3}x - \frac{2}{3}$**

12. (3, 1), $2x + 5y = 7$ — **$y = -\frac{2}{5}x + \frac{11}{5}$**

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

13. (−2, −2), $y = -\frac{1}{3}x + 9$ — **$y = 3x + 4$**

14. (−6, 5), $x - y = 5$ — **$y = -x - 1$**

15. (−4, −3), $4x + y = 7$ — **$y = \frac{1}{4}x - 2$**

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

17. (2, 4), $x - 6y = 2$ — **$y = -6x + 16$**

18. (−1, −7), $3x + 12y = -6$ — **$y = 4x - 3$**

19. (−4, 1), $4x + 7y = 6$ — **$y = \frac{7}{4}x + 8$**

20. (10, 5), $5x + 4y = 8$ — **$y = \frac{4}{5}x - 3$**

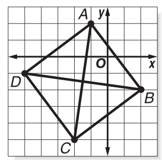
21. (4, −5), $2x - 5y = -10$ — **$y = -\frac{5}{2}x + 5$**

22. (1, 1), $3x + 2y = -7$ — **$y = \frac{2}{3}x + \frac{1}{3}$**

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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5-6 Reading to Learn Mathematics

Geometry: Parallel and Perpendicular Lines

Pre-Activity **How can you determine whether two lines are parallel?**

Read the introduction to Lesson 5-6 at the top of page 292 in your textbook.

- What is a family of graphs? **A group of graphs that have at least one characteristic in common, such as slope or *y*-intercept.**
- Do you think lines that do not appear to intersect are parallel or perpendicular? **parallel**

Reading the Lesson

1. Refer to the Key Concept box on page 292. Why does the definition use the term *nonvertical* when talking about lines with the same slope? **Vertical lines have slopes that are undefined so we cannot say they have the same slope.**

2. What is a right angle? **Sample answers: A right angle is one that measures 90°. It is an angle formed by perpendicular lines.**

3. Refer to the Key Concept box on page 293. Describe how you find the opposite reciprocal of a number. **Sample answer: The reciprocal of a given number is the number formed when you switch the numerator and denominator. Then you give it the opposite sign of the original number.**

4. Write the opposite reciprocal of each number.

   a. 2 $-\frac{1}{2}$ **b.** -3 $\frac{1}{3}$ **c.** $\frac{12}{13}$ $-\frac{13}{12}$ **d.** $-\frac{1}{5}$ 5

Helping You Remember

5. One way to remember how slopes of parallel lines are related is to say "same direction, same slope." Try to think of a phrase to help you remember that perpendicular lines have slopes that are opposite reciprocals.

   Sample answer: Nicely right angles formed, use opposite reciprocals.

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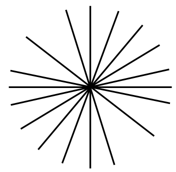
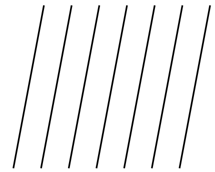
5-6 Enrichment

Pencils of Lines

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

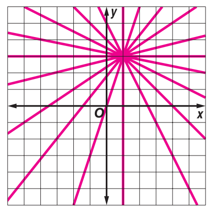
All lines with the same slope, but different intercepts, are also called a "pencil," a **pencil of parallel lines**.



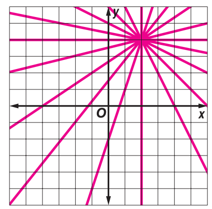


Graph some of the lines in each pencil.

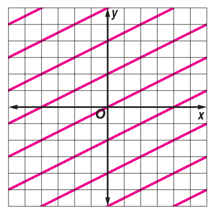
1. A pencil of lines through the point (1, 3)



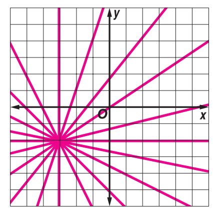
2. A pencil of lines described by $y - 4 = m(x - 2)$, where m is any real number



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



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

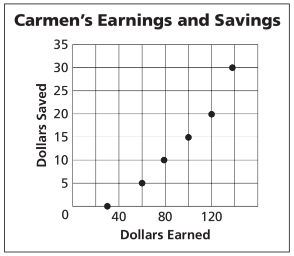


5-7 Study Guide and Intervention

Scatter Plots and Lines of Fit

Interpret Points on a Scatter Plot 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.**

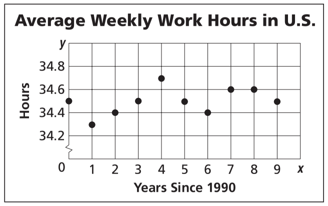


The graph shows a positive correlation. The more Carmen earns, the more she saves.

Exercises

Determine whether each graph shows a positive correlation, a negative correlation, or no correlation. If there is a positive correlation, describe it.

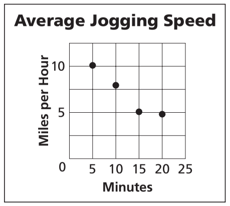
1.



Source: *The World Almanac*

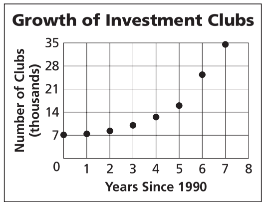
no correlation

2.



Negative correlation; as time increases, speed decreases.

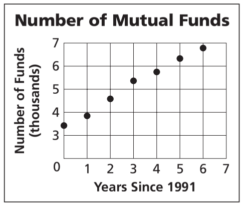
3.



Source: *The Wall Street Journal Almanac*

Positive correlation; as the number of years increases, the number of clubs increases.

4.



Source: *The Wall Street Journal Almanac*

Positive correlation; as the number of years increases, the number of funds increases.

5-7 Study Guide and Intervention *(continued)*

Scatter Plots and Lines of Fit

Lines of Fit

Example **The table below shows the number of students per computer in United States public schools for certain school years from 1990 to 2000.**

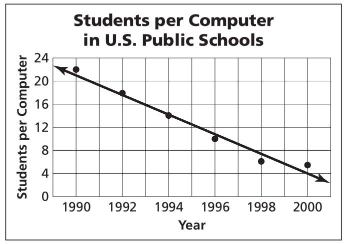
Year	1990	1992	1994	1996	1998	2000
Students per Computer	22	18	14	10	6.1	5.4

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.



Source: *The World Almanac*

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

The line of fit shown passes through (1993, 16) and (1999, 5.7). Find the slope.

$m = \frac{5.7 - 16}{1999 - 1993}$

$m = -1.7$

Find b in $y = -1.7x + b$.

$16 = -1.7 \cdot 1993 + b$

$3404 = b$

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

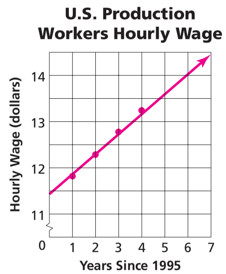
Exercises

Refer to the table for Exercises 1–3.

Years Since 1995	Hourly Wage
0	$11.43
1	$11.82
2	$12.28
3	$12.78
4	$13.24

1. Draw a scatter plot.

2. Draw a line of fit for the data.



Source: *The World Almanac*

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

The points (0, 11.43) and (2, 12.28) give $y = 0.425x + 11.43$ as a line of fit.

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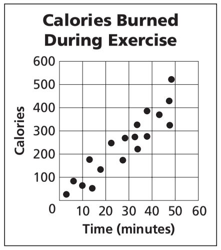
5-7 Skills Practice

Statistics: Scatter Plots and Lines of Fit

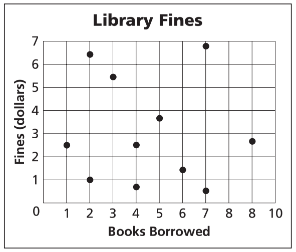
Determine whether each graph shows a *positive correlation*, a *negative correlation*, or *no correlation*. If there is a positive or negative correlation, describe its meaning in the situation.

1.



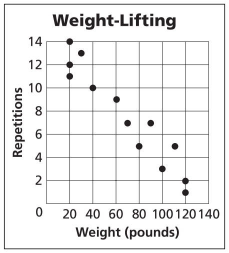
Positive; the longer the exercise, the more Calories burned.

2.



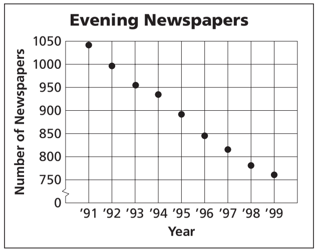
no correlation

3.



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

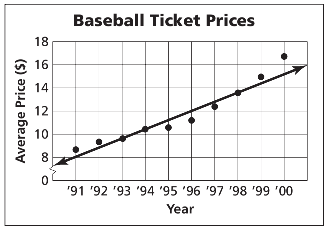
4.



Source: *Editor & Publisher*

Negative; as the year increases, the number of evening newspapers decreases.

BASEBALL For Exercises 5–7, use the scatter plot that shows the average price of a major-league baseball ticket from 1991 to 2000.



Source: Team Marketing Report, Chicago

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

6. Use the points (1993, 9.60) and (1998, 13.60) to write the slope-intercept form of an equation for the line of fit shown in the scatter plot.
$y = 0.8x - 1584.8$

7. Predict the price of a ticket in 2004.
about $18.40

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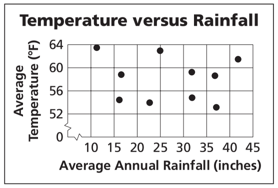
5-7 Practice (Average)

Statistics: 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.

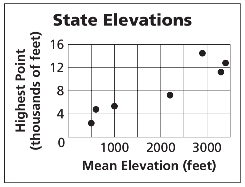
1.



Source: National Oceanic and Atmospheric Administration

no correlation

2.



Source: U.S. Geological Survey

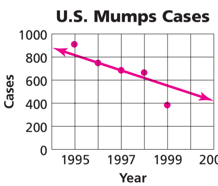
Positive; as the mean elevation increases, the highest point increases.

DISEASE For Exercises 3–6, use the table that shows the number of cases of mumps in the United States for the years 1995 to 1999.

U.S. Mumps Cases					
Year	1995	1996	1997	1998	1999
Cases	906	751	683	666	387

Source: Centers for Disease Control and Prevention

3. 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.



4. Draw a line of fit for the scatter plot.
Sample answer: Use (1996, 751), (1997, 683).

5. Write the slope-intercept form of an equation for the line of fit. **Sample answer: $y = -68x + 136{,}479$**

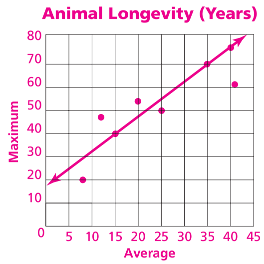
6. Predict the number of cases in 2004. **about 207**

ZOOS For Exercises 7–10, use the table that shows the average and maximum longevity of various animals in captivity.

Longevity (years)								
Avg.	12	25	15	8	35	40	41	20
Max.	47	50	40	20	70	77	61	54

Source: *Walker's Mammals of the World*

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



8. Draw a line of fit for the scatter plot.
Sample answer: Use (15, 40), (35, 70).

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

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

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5-7 Reading to Learn Mathematics

Statistics: Scatter Plots and Lines of Fit

Pre-Activity **How do scatter plots help identify trends in data?**

Read the introduction to Lesson 5-7 at the top of page 298 in your textbook.

- What does the phrase *linear relationship* mean to you? **Sample answer: It means that when you graph the data points on a coordinate grid, the points all lie on or close to a line that you could draw on the grid.**
- Write three ordered pairs that fit the description *as x increases, y decreases*. **Sample answer: {(2, 5), (3, 3), (4, 1)}**

Reading the Lesson

1. Look up the word *scatter* in a dictionary. How does this definition compare to the term *scatter plot*? **One definition states "to occur or fall irregularly or at random." The points in a scatter plots usually do not follow an exact linear pattern, but fall irregularly on the coordinate plane.**

2. What is a *line of fit*? How many data points fall on the line of fit? **A line of fit shows the trend of the data. It is impossible to say how many data points may fall on a line of fit—maybe several, maybe none.**

3. What is *linear interpolation*? How can you distinguish it from linear *extrapolation*? **Linear interpolation is the process of predicting a *y*-value for a given *x*-value that lies between the least and greatest *x*-values in the data set. "Inter-" means between and "extra-" means beyond. If the *x*-value is between the extremes of the *x*-values in the data set, you say interpolation; if the *x*-value is less than or greater than the extremes, you say extrapolation.**

Helping You Remember

4. How can you remember whether a set of data points shows a positive correlation or a negative correlation? **If it looks like a line of fit for the points would have a positive slope, there is a positive correlation. If it looks like a line of fit would have a negative slope, there is a negative correlation.**

Lesson 5-7

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5-7 Enrichment

Latitude and Temperature

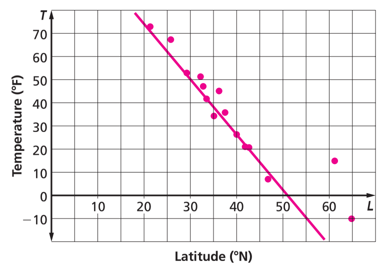
The *latitude* of a place on Earth is the measure of its distance from the equator. What do you think is the relationship between a city's latitude and its January temperature? At the right is a table containing the latitudes and January mean temperatures for fifteen U.S. cities.

Sample answers are given.

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

Sources: www.indo.com and www.nws.noaa.gov/climatex.html

1. Use the information in the table to create a scatter plot and draw a line of best fit for the data.



2. Write an equation for the line of fit. Make a conjecture about the relationship between a city's latitude and its mean January temperature. **$y = -2.39x + 121.86$; The higher the latitude, the lower the temperature.**

3. Use your equation to predict the January mean temperature of Juneau, Alaska, which has latitude 58:23 N. **−17.7°F**

4. What would you expect to be the latitude of a city with a January mean temperature of 15°F? **44:42 N**

5. Was your conjecture about the relationship between latitude and temperature correct? **Yes; as the latitude increases, the temperature decreases.**

6. Research the latitudes and temperatures for cities in the southern hemisphere instead. Does your conjecture hold for these cities as well? **Yes.**