Chapter 4 Writing Linear Equations

Prerequisite Skills for the chapter "Writing Linear Equations"

1. In the equation $y = mx + b$, the value of m is the *slope* of the graph of the equation.
2. In the equation $y = mx + b$, the value of b is the *y-intercept* of the graph of the equation.
3. Two lines are *parallel* if their slopes are equal.
4. $y = x + 1$

   $m = 1, b = 1$

5. $y = \frac{3}{4}x - 6$

   $m = \frac{3}{4}, b = -6$

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

   $m = -\frac{2}{5}, b = -2$

7. The graph of $y = 3x + 5$ has slope 3 and y-intercept 5; the graph of $y = 3x - 2$ has slope 3 and y-intercept -2. The graphs have the same slope and different y-intercepts, so they are parallel lines.
8. The graph of $y = \frac{1}{4}x - 1$ has slope $\frac{1}{4}$ and y-intercept -1; the graph of $y = 4x + 3$ has slope 4 and y-intercept 3. The graphs have different slopes, so they are not parallel lines.
9. The graph of $y = \frac{1}{2}x + 4$ has slope $\frac{1}{2}$ and y-intercept 4; the graph of $y = \frac{1}{2}x - 4$ has slope $\frac{1}{2}$ and y-intercept -4. The graphs have the same slope and different y-intercepts, so they are parallel lines.
10. $f(x) = x - 10$

    $f(-2) = -2 - 10 = -12$

    $f(0) = 0 - 10 = -10$

    $f(4) = 4 - 10 = -6$

11. $f(x) = 2x + 4$

    $f(-2) = 2(-2) + 4 = 0$

    $f(0) = 2(0) + 4 = 4$

    $f(4) = 2(4) + 4 = 12$

12. $f(x) = -5x - 7$

    $f(-2) = -5(-2) - 7 = 3$

    $f(0) = -5(0) - 7 = -7$

    $f(4) = -5(4) - 7 = -27$

Investigating Algebra Activity for the lesson "Write Linear Equations in Slope-Intercept Form"

Width of Fold (inches)	Perimeter of Rectangle (inches)
0	39
1	37
2	35
3	33
4	31

1. The length was 11 inches, and the width was 8.5 inches. With each fold, the length became 1 inch shorter and the width remained the same.
2. The perimeter was 39 inches. With each fold, it became 2 inches less.
3. Since the perimeter becomes 2 inches less with each fold, after 5 folds it would be 2 inches less than after 4 folds. If it is 31 inches after 4 folds, it would be 29 inches after 5 folds.
4. Perimeter $= 39 - 2n$

   After 1 fold: $P = 39 - 2(1) = 37$

   After 2 folds: $P = 39 - 2(2) = 35$

   After 3 folds: $P = 39 - 2(3) = 33$

   After 4 folds: $P = 39 - 2(4) = 31$

Lesson 4.1 Write Linear Equations in Slope-Intercept Form

Guided Practice for the lesson "Write Linear Equations in Slope-Intercept Form"

1. $y = 8x - 7$
2. $y = \frac{3}{4}x - 3$
3. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 1}{4 - 0} = \frac{-2}{4} = -\frac{1}{2}$

   $y = mx + b$

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

4. $(0, -2), (8, 4)$

   $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-2)}{8 - 0} = \frac{6}{8} = \frac{3}{4}$

   $y = mx + b$

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

5. $(-3, 6), (0, 5)$

   $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 6}{0 - (-3)} = \frac{-1}{3} = -\frac{1}{3}$

   $y = mx + b$

   $y = -\frac{1}{3}x + 5$

6. **a.** $C = 40t + 75$

   b. $C = 40(10) + 75 = 475$

   The total cost for 10 hours of studio time is \$475.

Exercises for the lesson "Write Linear Equations in Slope-Intercept Form"

Skill Practice

1. The ratio of the rise to the run between any two points on a non-vertical line is called the *slope*.
2. The slope-intercept form is $y = mx + b$. Substitute the value of the slope for m and the value of the y-intercept for b.
3. $y = 2x + 9$
4. $y = x + 5$
5. $y = -3x$
6. $y = -7x + 1$
7. $y = \frac{2}{3}x - 9$
8. $y = \frac{3}{4}x - 6$

9. A; $y = -x + 2$

10. $m = \frac{3}{3} = 1, b = -4$

$y = x - 4$

11. $m = -\frac{1}{2}, b = 0$

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

12. $m = -\frac{3}{1} = -3, b = 4$

$y = -3x + 4$

13. $m = \frac{4}{6} = \frac{2}{3}, b = -8$

$y = \frac{2}{3}x - 8$

14. $m = -\frac{1}{1} = -1, b = -3$

$y = -x - 3$

15. $m = -\frac{2}{1} = -2, b = -2$

$y = -2x - 2$

16. The slope-intercept form is $y = mx + b$. The value of the slope should be substituted for m and the value of the y-intercept for b. The error is that the values were reversed. The equation should be $y = 2x + 7$.

17. The error is that the difference in x-values and the difference in y-values must be calculated in the same order.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 4}{5 - 0} = -\frac{4}{5}$

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

18. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 2}{3 - 0} = \frac{1}{3}$

$y = mx + b$

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

19. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 0}{0 - (-1)} = \frac{4}{1} = 4$

$y = mx + b$

$y = 4x + 4$

20. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 3}{4 + 0} = -\frac{1}{4}$

$y = mx + b$

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

21. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 4}{0 - (-3)} = -\frac{4}{3}$

$y = mx + b$

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

22. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (-4)}{4 - 0} = \frac{4}{4} = 1$

$y = mx + b$

$y = x - 4$

23. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-2)}{2 - 0} = \frac{4}{2} = 2$

$y = mx + b$

$y = 2x - 2$

24. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-8 - 1}{0 - (-3)} = -\frac{9}{3} = -3$

$y = mx + b$

$y = -3x - 8$

25. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - (-7)}{-2} = \frac{2}{-2} = -1$

$y = mx + b$

$y = -x - 5$

26. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - (-4)}{0 - 2} = \frac{0}{-2} = 0$

$y = -4$

27. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3.5 - 4}{8 - 0} = -\frac{1}{16}$

$y = mx + b$

$y = -\frac{1}{16}x + 4$

28. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 5}{1.5 - 0} = -\frac{8}{3}$

$y = mx + b$

$y = -\frac{8}{3}x + 5$

29. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-24 - 0}{0 - (-6)} = \frac{-24}{6} = -4$

$y = mx + b$

$y = -4x - 24$

30. (0, 2), (2, 4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 2}{2 - 0} = \frac{2}{2} = 1$

$y = mx + b$

$y = x + 2$

31. (0, 7), (3, 1)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 7}{3 - 0} = \frac{-6}{3} = -2$

$y = mx + b$

$y = -2x + 7$

32. (0, −2), (4, −3)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - (-2)}{4 - 0} = -\frac{1}{4}$

$y = mx + b$

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

33. (0, −1), (5, −5)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - (-1)}{5 - 0} = -\frac{4}{5}$

$y = mx + b$

$y = -\frac{4}{5}x - 1$

34. (−2, 6), (0, −4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 6}{0 - (-2)} = \frac{-10}{2} = -5$

$y = mx + b$

$y = -5x - 4$

35. (−6, −1), (0, 3)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - (-1)}{0 - (-6)} = \frac{4}{6} = \frac{2}{3}$

$y = mx + b$

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

36. (4, 13), (0, 21)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{21 - 13}{0 - 4} = \frac{8}{-4} = -2$

$y = mx + b$

$y = -2x + 21$

37. (0, 9), (3, 0)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 9}{3 - 0} = \frac{-9}{3} = -3$

$y = mx + b$

$y = -3x + 9$

38. (0.2, 1), (0, 0.6)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0.6 - 1}{0 - 0.2} = 2$

$y = mx + b$

$y = 2x + 0.6$

39. The equation in slope-intercept form of k is $y = 2x - 1$, so the parameter m is 2 and the parameter b is -1. The equation in slope-intercept form of ℓ is $y = -\frac{1}{3}x + 1$, so the parameter m is $-\frac{1}{3}$ and the parameter b is 1. The parameter m changed from 2 to $-\frac{1}{3}$, and the parameter b changed from -1 to 1.

40. *Sample answer:* A health club offers an aerobics membership that charges \$9 plus \$4 per class.

41. (1, −1), (0, 1)

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

$y = mx + b$

$y = -2x + 1$

42. (−4, −2), (0, 0)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (-2)}{0 - (-4)} = \frac{2}{4} = \frac{1}{2}$

$y = mx + b$

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

43. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7 - 5}{3 - 3} = \frac{-12}{0}$

It is not possible to write the equation of this line in slope-intercept form because slope is undefined, which means it is a vertical line.

44. $(0, b), (1, b + m)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{(b + m) - b}{1 - 0} = \frac{m}{1} = m$

y-intercept $= b$

$y = mx + b$

You can be sure $(-1, b - m)$ is on the line by substituting the x and y values into the equation $y = mx + b$.

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

$b - m = -m + b$

$b - m = b - m$

Problem Solving

45. a. Cost (dollars) = Cost per month (dollars per month) • time, t (months) + Initial fee (dollars)

$C = 44t + 48$

b. $C = 44(6) + 48 = 312$

The total cost for 6 months is \$312.

46. Cost (dollars) = Cost to enlarge 1 photo (dollars) • Number of photos to enlarge (n) + Delivery charge (dollars)

$C = 3.99n + 1.49 = 3.99(8) + 1.49 = 33.41$

The cost to enlarge and deliver 8 photographs is \$33.41.

47. Total cost (dollars) = Cost for tickets (dollars) + Parking fee (dollars per hour) • hours (h)

$C = 30 + 3h = 30 + 3(4) = 42$

The total cost of 4 hours at the aquarium is \$42.

48. a. Number of ant species = Rate of increase (species per meter) • Elevation (meters) + Number of ant species at sea level

$N = 0.0037m + 3$

b. Dependent variable: N

Independent variable: m

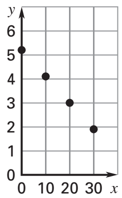
c. Substitute 2 for m (the elevation in meters), and solve the equation for N to find the number of ant species.

$N = 0.0037(2) + 3 = 3.0074$

At an elevation of 2 meters, there are about 3 species of ants.

49. a.

Years since 1970, *x*	Area of glaciers (km^2)
0	5.2
10	4.1
20	3.0
30	1.9

b. 

The area of the glaciers changed -1.1 square kilometers between every 10 year interval.

c. Area of glaciers (km^2) = Rate of change $(\text{km}^2/\text{year})$ • Years since 1970 + Area of glaciers in 1970 (km^2)

$A = -0.11t + 5.2$

The area of glaciers are decreasing at a rate of 0.11 km^2 per year.

50. a. 8.1 million gallons/hour • 10 hours = 81 million gallons

81 million gallons of water are released by 10:00 A.M.

b. Amount of water released (millions of gallons) = Release rate (millions of gallons per hour) • Hours since 10:00 A.M. (h)

$W = 130h$

c. The domain represents the number of hours since 10:00 A.M., from 10:00 A.M. to 1:00 P.M. So the domain is 0, 1, 2, 3.

51. a. Total time (minutes) = Time to scoop water (minutes) + Rate flying (minutes per mile) • Distance flow (miles) + Time to drop water (minutes)

$T = 0.2 + 0.7d + 1.8 = 0.7d + 2$

b. $T = 0.7\,(20) + 2 = 16$

It takes 16 minutes to scoop, fly, and drop if the aircraft travels 20 miles from the lake to the fire.

52. a. Distance (feet) = Increase in elevation (feet)

$\bullet \dfrac{\text{Distance farther (feet)}}{\text{1000 ft elevation}}$ + Distance at sea level (feet)

$D = E \bullet \dfrac{7}{1000} + 400$

b. $\text{feet} = \text{feet} \bullet \dfrac{\text{feet}}{\text{feet}} + \text{feet}$

$\text{feet} = \text{feet} \bullet 1 + \text{feet}$

$\text{feet} = \text{feet}$

c. $D = 3500 \bullet \dfrac{7}{1000} + 400 = 24.5 + 400 = 424.5$

The ball would travel 424.5 feet.

Graphing Calculator Activity for the lesson "Write Linear Equations in Slope-Intercept Form"

1. Slopes: $-3, -2, 2, 3$;

y-intercept: 5; point: $(-3, 11)$

$y = -2x + 5$

2. Slopes: $-4, -2.5, 2.5, 4$;

y-intercept: -1; point: $(4, -11)$

$y = -2.5x - 1$

3. Slopes: $-2, -1, 1, 2$;

y-intercept: 1.5; point: $(1, 3.5)$

$y = 2x + 1.5$

4. Slope: -3;

y-intercept: $-2, -1, 0, 1, 2$; point: $(4, -13)$

$y = -3x - 1$

5. Slope: 1.5;

y-intercept: $-2, -1, 0, 1, 2$; point: $(-2, -1)$

$y = 1.5x + 2$

6. Slope: -0.5;

y-intercept: $-3, -1.5, 0, 1.5, 3$; point: $(-4, 3.5)$

$y = -0.5x + 1.5$

7. Slope: 4;

y-intercept: $-3, -1, 0, 1, 3$; point: $(2, 5)$

$y = 4x - 3$

8. Slope: 2;

y-intercept: $-6, -3, 0, 3, 6$; point: $-2, -7$

$y = 2x - 3$

9. $y = 0.5x + b$

$2 = 0.5(2) + b$

$1 = b$

$y = 0.5x + 1$

By substituting the x and y values from the point (2, 2) into the equation $y = 0.5x + b$ and solving for b, you find the y-intercept of the equation.

10. *Sample answer:* Graph several lines with a slope of -0.25 and different y-intercepts on a graphing calculator. Use the TRACE button to see if any contain the point (8, 22). If none do, choose the y-intercepts to try until you find the correct one.

To solve algebraically, substitute -0.25 for m in the formula $y = mx + b$, and substitute the x and y values from the point $(8, -2)$ for x and y, respectively. Solve the equation for b and write the equation of the line in slope-intercept form.

Lesson 4.2 Use Linear Equations in Slope-Intercept Form

Guided Practice for the lesson "Use Linear Equations in Slope-Intercept Form"

1. $m = 2$; (6, 3)

$y = mx + b$

$3 = 2(6) + b$

$-9 = b$

$y = 2x - 9$

2. (1, 2), (−5.4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-2)}{-5 - 1} = \frac{6}{-6} = -1$

$y = mx + b$

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

$-1 = b$

$y = -x - 1$

3. $f(-2) = 10,\ f(4) = -2$

$(-2, 10), (4, -2)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - 10}{4 - (-2)} = \frac{-12}{6} = -2$

$y = mx + b$

$10 = -2(-2) + b$

$6 = b$

$y = -2x + 6$

4. Total cost = Rate per month • Number of months + Membership fee

$C = m \cdot n + b$

$250 = 35 \cdot 6 + b$

$40 = b$

$C = 35 \cdot 10 + 40$

$C = 390$

The total cost after 10 months is $390.

5. a. (3, 76), (7, 124)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{124 - 76}{7 - 3} = \frac{48}{4} = 12$

$y = mx + b$

$76 = 12(3) + b$

$40 = b$

A track membership costs $40.

b. The slope represents the entry fee per race, which is $12.

c. Cost = Entry fee per race • Races entered + Membership cost

$C = m \cdot r + b$

$C = mr + b$

$C = 12r + 40$

Exercises for the lesson "Use Linear Equations in Slope-Intercept Form"

Skill Practice

1. The y-coordinate of a point where a graph crosses the y-axis is called the y-intercept.

2. In the equation $y = mx + b$, b is considered to be the starting value because it is the value of y when $x = 0$.

3. (1, 1); $m = 3$

$y = mx + b$

$1 = 3(1) + b$

$-2 = b$

$y = 3x - 2$

4. (5, 1); $m = 2$

$y = mx + b$

$1 = 2(5) + b$

$-9 = b$

$y = 2x - 9$

5. $(-4, 7);\ m = -5$

$y = mx + b$

$7 = -5(-4) + b$

$-13 = b$

$y = -5x - 13$

6. $(5, -5);\ m = -2$

$y = mx + b$

$-5 = -2(5) + b$

$5 = b$

$y = -2x + 5$

7. $(8, -4);\ m = -\frac{3}{4}$

$y = mx + b$

$-4 = -\frac{3}{4}(8) + b$

$2 = b$

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

8. $(-3, -11);\ m = \frac{1}{2}$

$y = mx + b$

$-11 = \frac{1}{2}(-3) + b$

$-9\frac{1}{2} = b$

$y = \frac{1}{2}x - 9\frac{1}{2}$

9. The error is that the y-value of the point $(6, -3)$ was substituted for x in the equation $y = mx + b$ instead of y, and vice versa.

$y = mx + b$

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

$9 = b$

10. The value of $18 per month should have been substituted for m, not for b.

$C = mt + b$

$81 = 18(2) + b$

$\$45 = b$

11. (1, 4), (2, 7)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 4}{2 - 1} = \frac{3}{1} = 3$

$y = mx + b$

$4 = 3(1) + b$

$1 = b$

$y = 3x + 1$

12. (3, 2), (4, 9)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 2}{4 - 3} = \frac{7}{1} = 7$

$y = mx + b$

$2 = 7(3) + b$

$-19 = b$

$y = 7x - 19$

13. $(10, -5), (-5, 1)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-5)}{-5 - 10} = \frac{6}{-15} = -\frac{2}{5}$

$y = mx + b$

$-5 = -\frac{2}{5}(10) + b$

$-1 = b$

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

14. $(-2, 8), (-6, 0)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 8}{-6 - (-2)} = \frac{-8}{-4} = 2$$

$y = mx + b$

$8 = 2(-2) + b$

$12 = b$

$y = 2x + 12$

15. $\left(\frac{9}{2}, 1\right), \left(-\frac{7}{2}, 7\right)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 1}{-\frac{7}{2} - \frac{9}{2}} = \frac{6}{-8} = -\frac{3}{4}$$

$y = mx + b$

$1 = -\frac{3}{4}\left(\frac{9}{2}\right) + b$

$4\frac{3}{8} = b$

$y = -\frac{3}{4}x + 4\frac{3}{8}$

16. $\left(-5, \frac{3}{4},\right)\left(-2, -\frac{3}{4}\right)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-\frac{3}{4} - \frac{3}{4}}{-2 - (-5)} = \frac{-\frac{3}{2}}{3} = -\frac{1}{2}$$

$y = mx + b$

$\frac{3}{4} = -\frac{1}{2}(-5) + b$

$-1\frac{3}{4} = b$

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

17. $(3, -3), (4, 1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-3)}{4 - 3} = \frac{4}{1} = 4$$

$y = mx + b$

$-3 = 4(3) + b$

$-15 = b$

$y = 4x - 15$

18. $(-2, 0), (3, 2)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 0}{3 - (-2)} = \frac{2}{5}$$

$y = mx + b$

$0 = \frac{2}{5}(-2) + b$

$\frac{4}{5} = b$

$y = \frac{2}{5}x + \frac{4}{5}$

19. $(-3, 2), (1, 0)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 2}{1 - (-3)} = -\frac{2}{4} = -\frac{1}{2}$$

$y = mx + b$

$2 = -\frac{1}{2}(-3) + b$

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

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

20. $(-1, 3), (2, -0.5)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-0.5 - 3}{2 - (-1)} = \frac{-3.5}{3} = -\frac{7}{6}$$

$y = mx + b$

$3 = -\frac{7}{6}(-1) + b$

$\frac{11}{6} = b$

$y = -\frac{7}{6}x + \frac{11}{6}$

21. $(-2, -2), (1, -1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - (-2)}{1 - (-2)} = \frac{1}{3}$$

$y = mx + b$

$-2 = \frac{1}{3}(-2) + b$

$-\frac{4}{3} = b$

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

22. $(-3, 2), (-2, -1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 2}{-2 - (-3)} = \frac{-3}{1} = -3$$

$y = mx + b$

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

$-7 = b$

$y = -3x - 7$

23. $f(-2) = 15,\ f(1) = 9$

$(-2, 15), (1, 9)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 15}{1 - (-2)} = \frac{-6}{3} = -2$$

$y = mx + b$

$15 = -2(-2) + b$

$11 = b$

$f(x) = -2x + 11$

24. $f(-2) = -2,\ f(4) = -8$

$(-2, -2), (4, -8)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-8 - (-2)}{4 - (-2)} = \frac{-6}{6} = -1$$

$y = mx + b$

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

$-4 = b$

$f(x) = -x - 4$

25. $f(2) = 7,\ f(4) = 6$

$(2, 7), (4, 6)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6 - 7}{4 - 2} = -\frac{1}{2}$$

$y = mx + b$

$7 = -\frac{1}{2}(2) + b$

$8 = b$

$f(x) = -\frac{1}{2}x + 8$

26. $f(-4) = -8, f(-8) = -11$

$(-4, -8), (-8, -11)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-11 - (-8)}{-8 - (-4)} = \frac{-3}{-4} = \frac{3}{4}$

$y = mx + b$

$-8 = \frac{3}{4}(-4) + b$

$-5 = b$

$f(x) = \frac{3}{4}x - 5$

27. $f(3) = 1, f(6) = 4$

$(3, 1), (6, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{6 - 3} = \frac{3}{3} = 1$

$y = mx + b$

$1 = 3(1) + b$

$-2 = b$

$f(x) = x - 2$

28. $f(-5) = 9, f(11) = -39$

$(-5, 9), (11, -39)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-39 - 9}{11 - (-5)} = \frac{-48}{16} = -3$

$y = mx + b$

$9 = -3(-5) + b$

$-6 = b$

$f(x) = -3x - 6$

29. D; $f(x) = 24x - 111$

$f(4) = -15, f(7) = 57$

$(4, -15), (7, 57)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{57 - (-15)}{7 - 4} = \frac{72}{3} = 24$

$y = mx + b$

$-15 = 24(4) + b$

$-111 = b$

30. $f(-4) = 6, f(4) = 4$

$(-4, 6), (4, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 6}{4 - (-4)} = \frac{-2}{8} = -\frac{1}{4}$

$y = mx + b$

$6 = -\frac{1}{4}(-4) + b$

$5 = b$

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

31. $f(-3) = 8, f(3) = 4$

$(-3, 8), (3, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 8}{3 - (-3)} = \frac{-4}{6} = -\frac{2}{3}$

$y = mx + b$

$8 = -\frac{2}{3}(-3) + b$

$6 = b$

$f(x) = -\frac{2}{3}x + 6$

32. $f(-6) = 6, f(-2) = 4$

$(-6, 6), (-2, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 6}{-2 - (-6)} = \frac{-2}{4} = -\frac{1}{2}$

$y = mx + b$

$6 = -\frac{1}{2}(-6) + b$

$3 = b$

$f(x) = -\frac{1}{2}x + 3$

33. $f(-2) = -16, f(-1) = -10$

$(-2, -16), (-1, -10)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-10 - (-16)}{-1 - (-2)} = \frac{6}{1} = 6$

$y = mx + b$

$-16 = 6(-2) + b$

$-4 = b$

$f(x) = 6x - 4$

34. Yes.

Example: $(1, 5), (-2, -3)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - 5}{-2 - 1} = \frac{-8}{-3} = \frac{8}{3}$

$y = mx + b$

$5 = \frac{8}{3}(1) + b$

$\frac{7}{3} = b$

$y = \frac{8}{3}x + \frac{7}{3}$

Examples will vary.

35. Yes.

Examples: Slope: 2

Point: (4, 6)

$y = mx + b$

$6 = 2(4) + b$

$-2 = b$

$y = 2x - 2$

Examples will vary.

36. No, slope alone is not enough information to write the equation of a line because many lines can have the same slope.

37. Yes.

Example: x-intercept $= -3$

y-intercept $= 5$

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

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 0}{0 - (-3)} = \frac{5}{3}$

$y = mx + b$

$0 = \frac{5}{3}(-3) + b$

$5 = b$

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

Examples will vary.

38. $(-1, -2), (3, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-2)}{3 - (-1)} = \frac{6}{4} = \frac{3}{2}$

$y = mx + b$

$-2 = \frac{3}{2}(-1) + b$

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

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

39. $y = \left(\frac{3}{2} \cdot 3x\right) - \frac{1}{2}$

$y = \frac{9}{2}x - \frac{1}{2}$

40. $y = \frac{3}{2}x - \frac{1}{2} + 6$

$y = \frac{3}{2}x + \frac{11}{2}$

41. The lines from Exercises 38 and 39 intersect, and the lines from Exercises 39 and 40 intersect because they have different slopes. The lines from Exercises 38 and 40 do not intersect because they have the same slope and, therefore, are parallel.

42. $(-4, -2), (2, 2.5), (8, 7)$

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2.5 - (-2)}{2 - (-4)} = \frac{4.5}{6} = 0.75$

$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - 2.5}{8 - 2} = \frac{4.5}{6} = 0.75$

The points do lie on the same line because the slopes between the points are the same.

$y = mx + b$

$-2 = 0.75(-4) + b$

$1 = b$

$y = 0.75x + 1$

43. $(2, 2), (-4, 5), (6, 1)$

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 2}{-4 - 2} = \frac{3}{-6} = -\frac{1}{2}$

$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 5}{6 - (-4)} = \frac{-4}{10} = -\frac{2}{5}$

The points do not lie on the same line because the slope between (2, 2) and (−4, 5) is not the same as the slope between (−4, 5) and (6, 1).

44. $(-10, 4), (-3, 2.8), (-17, 6.8)$

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2.8 - 4}{-3 - (-10)} = \frac{-1.2}{7} = -0.17$

$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{6.8 - 2.8}{-17 - (-3)} = \frac{4}{-14} = -0.29$

The points do not lie on the same line because the slope between (−10, 4) and (−3, 2.8) is not the same as the slope between (−3, 2.8) and (−17, 6.8).

45. $(-5.5, 3), (-7.5, 4), (-4, 5)$

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 3}{-7.5 - (-5.5)} = \frac{1}{-2} = -0.5$

$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 4}{-4 - (-7.5)} = \frac{1}{3.5} = 0.29$

The points do not lie on the same line because the slope between (−5.5, 3) and (−7.5, 4) is not the same as the slope between (−7.5, 4) and (−4, 5).

46. $(-2, 3), (2, 5), (6, k)$

Find the slope between the two known points.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 3}{2 - (-2)} = \frac{2}{4} = \frac{1}{2}$

If all the points line on the same line, the slope between each point is the same. Use the slope formula to solve for k.

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

$\frac{1}{2} = \frac{k - 5}{6 - 2}$

$1(6 - 2) = 2(k - 5)$

$4 = 2k - 10$

$14 = 2k$

$7 = k$

Problem Solving

47. $(4, 9), (8, 12)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - 9}{8 - 4} = \frac{3}{4} = 0.75$

The growth rate of the hedge maple is 0.75 feet per year.

$y = mx + b$

$9 = 0.75(4) + b$

$6 = b$

When the tree was planted, its height was 6 feet.

48. **a.** (28, 34.80), (30, 40.70)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{40.70 - 34.80}{30 - 28} = 2.95$$

After the first 25 articles, the cost per article is $2.95.

b.

Total cost	=	Cost per article	•	Number of articles after 25	+	Subscription fee

$C = m \cdot a + b$

$34.80 = 2.95(3) + b$

$25.95 = b$

The cost of the subscription is $25.95.

49.

Cooking time	=	Time rate per pound	•	Number of pounds	+	Extra time

$C = m \cdot p + b$

Write an equation to express total cooking time in terms of the weight of meat cooked (in pounds). Substitute the time it takes to cook a 2 pound roast and solve for *b* (the extra time needed).

$85 = 30 \cdot 2 + b$

$25 = b$

You need 25 minutes of extra cooking time. Substitute 25 for *b* and 30 for *m* in the equation $C = mp + b$. Substitute 3 for *p* (the number of pounds of roast), and solve for *C*, the total cooking time.

$C = 30 \cdot 3 + 25$

$C = 115$

The total cooking time for a 3 pound roast is 115 minutes or 1 hour and 55 minutes.

50. **a.** $914 = 27.80(20) + b$

$358 = b$

The cost in 1981 was $358.

b.

Annual cost	=	Rate per year	•	Number of years since 1981	+	Cost in 1981

$C = m \cdot t + b$

$C = 27.80t + 358$

c. $C = 27.80(19) + 358$

$C = 886.2$

The annual cost in 2000 was $886.20.

51. **a.** $903 = 11.8(27) + b$

$584.4 = b$

About 584 newspapers were in circulation in 1970.

b.

Number in circulation	=	Rate of change	•	Years since 1970	+	Number in circulation in 1970

$N = m \cdot t + b$

$N = 11.8t + 584$

c. $N = 11.8(30) + 584$

$N = 938$

There were about 938 newspapers in circulation in 2000.

52. **a.** $19{,}306 = 175(11) + b$

$17{,}381 = b$

b.

Number of airports	=	Rate of change	•	Years since 1990	+	Number of airports in 1990

$N = m \cdot t + b$

$N = mt + b$

$N = 175t + 17{,}381$

c. $19{,}200 = 175t + 17{,}381$

$1819 = 175t$

$10.4 \approx t$

$1990 + 10.4 = 2000.4$

The number of U.S. airports reached 19,200 in 2000.

53. **a.** (1, 216), (5, 144)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{144 - 216}{5 - 1} = \frac{-72}{4} = -18$$

$y = mx + b$

$216 = -18(1) + b$

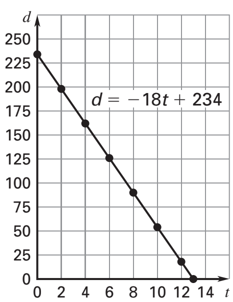
$234 = b$

Distance from town	=	Rate of travel	•	Hours since 12:00 P.M.	+	Distance from town at 12:00 P.M.

$D = mt + b$

$D = -18t + 234$

b.



The slope indicates the rate at which the hurricane is traveling. The *y*-intercept indicates the distance (in miles) the hurricane is from the town at 12:00 P.M.

c. Use the equation $D = -18t + 234$. Substitute 0 for D (the distance the hurricane is from the town) because it will be 0 miles from town when it reaches the town. Solve the equation for t (the time, in hours, since 12:00 P.M.).

$$0 = -18t + 234$$
$$-234 = -18t$$
$$13 = t$$

The hurricane will reach the town 13 hours after 12:00 P.M. which is 1:00 A.M.

54. a. (24, 300), (29, 350)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{350 - 300}{29 - 24} = \frac{50}{5} = 10$$

$$y = mx + b$$
$$300 = 10(24) + b$$
$$60 = b$$

$$\text{Total distance} = \text{Rate of change} \cdot \text{Time at top speed} + \text{Distance to top speed}$$

$$D = 10 \cdot t + 60$$

b. The rate of change is the slope and it represents the distance traveled (in meters) per second. The initial value represents the distance (in meters) that it takes to get to top speed.

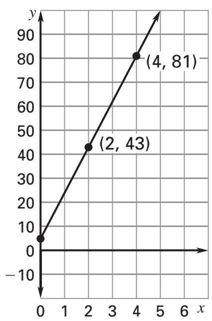
$$m = \frac{m}{s} \cdot s + m$$
$$m = m + m$$
$$m = m$$

c.
$$D = 10t + 60$$
$$200(3) = 10t + 60$$
$$540 = 10t$$
$$54 = t$$

The skater spends 54 seconds traveling at top speed. (Substitute the value of D into the equation from part (a) and solve for t, the time in seconds.)

Problem Solving Workshop for the lesson "Use Linear Equations in Slope-Intercept Form"

1. (2, 43), (4, 81)



The y-intercept is 5, so the delivery fee is \$5. The slope of the line represents the cost per calendar. The slope is $\frac{38}{2} = 19$, so the cost per calendar is \$19.

Number of Calendars Purchased	Cost (dollars)
0	5
1	24
2	43
3	62
4	81

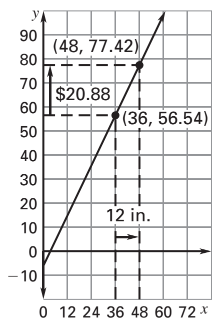
Cost per calendar $= \frac{38}{2} = \$19$

The delivery fee is the cost when no calendars are sold, so the delivery fee is \$5.

2.

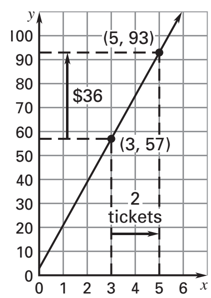
Height (inches)	Price (dollars)
36	56.54
48	77.42
60	98.30
72	119.18

For each 12 inches added to the height, the bookshelf costs \$20.88 more, so the cost of a 72 inch bookshelf is \$119.18.



3. You could not solve the problem if the price of one bookshelf changed because there would not be a constant slope between each height and price. The difference between prices of each bookshelf would not be the same. It would not be possible to determine the price of the next highest bookshelf.

4. (5, 93), (3, 57)



The cost of 4 tickets is \$75.

Number of Tickets	Total Cost (dollars)
3	57
4	75
5	93

The difference between the cost of 3 tickets and 5 tickets is \$36.

$\frac{97 - 53}{5 - 3} = \frac{36}{2} = 18$

The cost for 4 tickets is \$57 + \$18 = \$75.

5. This method is incorrect because the price paid for 3 tickets includes the fixed fee added to every order. This method would work if the price paid only included the price of the tickets.

(5, 93), (3, 57)

$m = \frac{57 - 93}{3 - 5} = \frac{-36}{-2} = 18$

$y = mx + b$

$93 = 18(5) + b$

$3 = b$

$y = 18(4) + 3 = 75$

Lesson 4.3 Write Linear Equations in Point-Slope Form

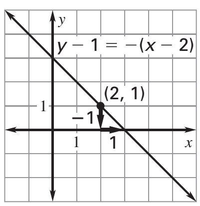
Guided Practice for the lesson "Write Linear Equations in Point-Slope Form"

1. $y - y_1 = m(x - x_1)$

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

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

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



3. (2, 3), (4, 4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 3}{4 - 2} = \frac{1}{2}$

$y - y_1 = m(x - x_1)$

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

4. Rate of Change: \$60 per 1000 stickers

Data Pair: (s_1, C_1)

(1000 stickers, \$250)

a. $C - C_1 = m(s - s_1)$

$C - 250 = 60(s - 1)$

$C - 250 = 60s - 60$

$C = 60s + 190$

b. $C = 60(9) + 190 = 730$

The second company would charge less for 9000 stickers.

5. This situation can be modeled by a linear equation because the rate of change between each of the data pairs is the same.

$m = \frac{y_2 - y_1}{x_2 - x_1} = 0.23$

$y - y_1 = m(x - x_1)$

$y - 0.37 = 0.23(x - 1)$

$y - 0.37 = 0.23x - 0.23$

$y = 0.23x + 0.14$

Exercises for the lesson "Write Linear Equations in Point-Slope Form"

Skill Practice

1. Slope: −2; Point: (−5, 5)

2. You would use the slope formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ to find the slope. Substitute the slope value for m and the coordinates of one of the points into the formula $y - y_1 = m(x - x_1)$.

3. (2, 1), $m = 2$

$y - y_1 = m(x - x_1)$

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

4. (3, 5), $m = -1$

$y - y_1 = m(x - x_1)$

$y - 5 = -(x - 3)$

5. (7, −1), $m = -6$

$y - y_1 = m(x - x_1)$

$y + 1 = -6(x - 7)$

6. (5, −1), $m = -2$

$y - y_1 = m(x - x_1)$

$y + 1 = -2(x - 5)$

7. (−8, 2), $m = 5$

$y - y_1 = m(x - x_1)$

$y - 2 = 5(x + 8)$

8. (−6, 6), $m = \frac{3}{2}$

$y - y_1 = m(x - x_1)$

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

9. (−11, −3), $m = -9$

$y - y_1 = m(x - x_1)$

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

10. (−3, −9), $m = \frac{7}{3}$

$y - y_1 = m(x - x_1)$

$y + 9 = \frac{7}{3}(x + 3)$

11. (5, −12), $m = -\frac{2}{5}$

$y - y_1 = m(x - x_1)$

$y + 12 = -\frac{2}{5}(x - 5)$

12. C; (−6, 2), $m = -1$

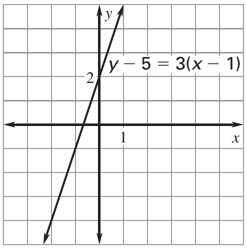
$y - y_1 = m(x - x_1)$

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

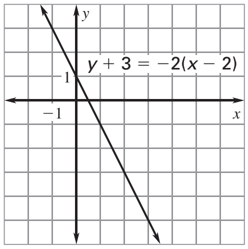
13. The point-slope formula is $y - y_1 = m(x - x_1)$. Because the y-coordinate in the given point is negative, it becomes positive when substituted into the equation.

$y + 5 = -2(x - 1)$

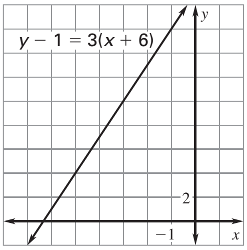
14. $y - 5 = 3(x - 1)$



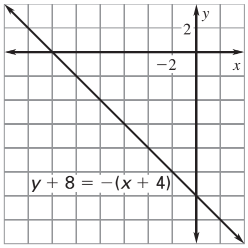
15. $y + 3 = -2(x - 2)$



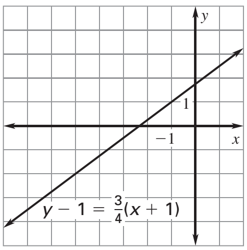
16. $y - 1 = 3(x + 6)$



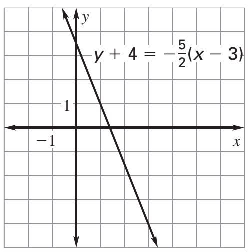
17. $y + 8 = -(x + 4)$



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



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



20. $(1, -3), (3, 1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-3)}{3 - 1} = \frac{4}{2} = 2$$

$$y - y_1 = m(x - x_1)$$

$$y + 3 = 2(x - 1) \text{ or } y - 1 = 2(x - 3)$$

21. $(-2, 1), (1, 4)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{1 - (-2)} = \frac{3}{3} = 1$$

$$y - y_1 = m(x - x_1)$$

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

22. $(-5, 4), (-1, 2)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 4}{-1 - (-5)} = -\frac{2}{4} = -\frac{1}{2}$$

$$y - y_1 = m(x - x_1)$$

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

23. $(7, 2), (2, 12)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - 2}{2 - 7} = \frac{10}{-5} = -2$$

$$y - y_1 = m(x - x_1)$$

$$y - 2 = -2(x - 7) \text{ or } y - 12 = -2(x - 2)$$

24. $(6, -2), (12, 1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - (-2)}{12 - 6} = \frac{3}{6} = \frac{1}{2}$$

$$y - y_1 = m(x - x_1)$$

$$y + 2 = \frac{1}{2}(x - 6) \text{ or } y - 1 = \frac{1}{2}(x - 12)$$

25. $(-4, -1), (6, -7)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7 - (-1)}{6 - (-4)} = \frac{-6}{10} = -\frac{3}{5}$$

$$y - y_1 = m(x - x_1)$$

$$y + 1 = -\frac{3}{5}(x + 4) \text{ or } y + 7 = -\frac{3}{5}(x - 6)$$

26. $(4, 5), (-4, -5)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - 5}{-4 - 4} = \frac{-10}{-8} = \frac{5}{4}$$

$$y - y_1 = m(x - x_1)$$

$$y - 5 = \frac{5}{4}(x - 4) \text{ or } y + 5 = \frac{5}{4}(x + 4)$$

27. $(-3, -20), (4, 36)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{36 - (-20)}{4 - (-3)} = \frac{56}{7} = 8$$

$$y - y_1 = m(x - x_1)$$

$$y + 20 = 8(x + 3) \text{ or } y - 36 = 8(x - 4)$$

28. $(-5, -19), (5, 13)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{13 - (-19)}{5 - (-5)} = \frac{32}{10} = \frac{16}{5}$$

$$y - y_1 = m(x - x_1)$$

$$y + 19 = \frac{16}{5}(x + 5) \text{ or } y - 13 = \frac{16}{5}(x - 5)$$

29. The y-value and the x-value put into the point-slope equation must come from the same point, not from two different points.

$$y - 2 = \frac{2}{3}(x - 1) \text{ or } y - 4 = \frac{2}{3}(x - 4)$$

30. B; $m = \frac{-3}{1} = -3$, $(2, 4)$

$$y - y_1 = m(x - x_1)$$

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

31. $m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - (-1)}{4 - 2} = \frac{6}{2} = 3$

$$m_2 = \frac{15 - 5}{6 - 4} = \frac{10}{2} = 5$$

The data cannot be modeled by a linear equation because the slope between each of the points is not the same.

32. $m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1.4 - 1.2}{2 - 1} = 0.2$

$m_2 = \frac{1.6 - 1.4}{3 - 2} = 0.2$

$m_3 = \frac{2 - 1.6}{5 - 3} = \frac{0.4}{2} = 0.2$

$m_2 = \frac{2.4 - 2}{7 - 5} = \frac{0.4}{2} = 0.2$

The data can be modeled by a linear equation because the slope between each of the points is the same.

$y - y_1 = m(x - x_1)$

$y - 1.2 = 0.2(x - 1)$

33. $m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - 2}{2 - 1} = \frac{-5}{1} = -5$

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-3)}{3 - 2} = \frac{7}{1} = 7$

The data cannot be modeled by a linear equation because the slope between each of the points is not the same.

34. $m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{10 - 16}{-1 - (-3)} = \frac{-6}{2} = -3$

$m_2 = \frac{4 - 10}{1 - (-1)} = \frac{-6}{2} = -3$

$m_3 = \frac{-2 - 4}{3 - 1} = \frac{-6}{2} = -3$

$m_4 = \frac{-8 - (-2)}{5 - 3} = \frac{-6}{2} = -3$

The data can be modeled by a linear equation because the slope between each of the points is the same.

$y - y_1 = m(x - x_1)$

$y - 16 = -3(x + 3)$

35. $(k, 4k), (k + 2, 3k)$

$m = -1$

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

$-1 = \frac{3k - 4k}{(k + 2) - k}$

$-1(k + 2 - k) = 3k - 4k$

$-k - 2 + k = -k$

$-2 = -k$

$2 = k$

$(k, 4k) = (2, 8)$

$y - y_1 = m(x - x_1)$

$y - 8 = -(x - 2)$

36. $(-k + 1, 3), (3, k + 3), m = 3$

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

$3 = \frac{(k + 3) - 3}{3 - (-k + 1)}$

$3(3 + k - 1) = k + 3 - 3$

$9 + 3k - 3 = k$

$6 = -2k$

$-3 = k$

$(-k + 1, 3) = (4, 3)$

$y - y_1 = m(x - x_1)$

$y - 3 = 3(x - 4)$

Problem Solving

37. a.

Total Cost	=	Cost per minute	•	Time after 2 minutes	+	Cost for first 2 minutes

$C = m(t - 2) + b$

$C = mt - 2m + b$

$C = 130t - 2(130) + 790$

$C = 130t + 530$

b. $C = 130(8) + 530$

$C = 1570$

The total cost is \$1570.

38. This can be modeled by a linear equation because the rate of change in cost is the same each month.

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12{,}806 - 9378}{4 - 2} = 1714$

The monthly service fee is \$1714.

$y - y_1 = m(x - x_1)$

$y - 9378 = 1714(x - 2)$

$y - 9378 = 1714x - 3428$

$y = 1714x + 5950$

The installation fee is \$5950.

39. $m = \$10{,}000, (3, \$97{,}000)$

$y - y_1 = m(x - x_1)$

$y - 97{,}000 = 10{,}000(x - 3)$

$y - 97{,}000 = 10{,}000x - 30{,}000$

$y = 10{,}000x + 67{,}000$

y = Annual sales (dollars)

x = years since 1994

$y = 10{,}000(6) + 67{,}000$

$y = 127{,}000$

The sales in 2000 were \$127,000.

40. a. $m = 1.4$ gallons of fuel (5 years since 1990, 37 gallons of fuel)

$y - y_1 = m(x - x_1)$

$y - 37 = 1.4(x - 5)$

$y - 37 = 1.4x - 7$

$y = 1.4x + 30$

Annual excess fuel (gal/person)	=	Rate of fuel increase (gal/person)	•	Years since 1990	+	Excess fuel in 1990 (gal/person)

$F = 1.4t + 30$

b. $F = 1.4(11) + 30 = 45.4$

In 2001, 45.4 gallons of excess fuel per person was consumed.

41. a. The situation can be modeled by a linear equation because the rate of change in cost is the same between each print.

b. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2.47 - 1.98}{2 - 1} = 0.49$

$y - y_1 = m(x - x_1)$

$y - 1.98 = 0.49(x - 1)$

$y - 1.98 = 0.49x - 0.49$

$y = 0.49x + 1.49$

y = total cost ($)

x = number of prints

$1.49 = shipping charge

c. The shipping charge for up to 10 prints is $1.49.

d. (15 prints, $9.14)

$y - y_1 = m(x - x_1)$

$y - 9.14 = 0.49(x - 15)$

$y - 9.14 = 0.49x - 7.35$

$y = 0.49x + 1.79$

The shipping charge for 15 prints is $1.79.

42. a. (3 years since 1991, 20.8 million metric tons), (9 years since 1991, 35.5 million metric tons)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{35.5 - 20.8}{9 - 3} = 2.45$

$y - y_1 = m(x - x_1)$

$y - 20.8 = 2.45(x - 3)$

$y - 20.8 = 2.45x - 7.35$

$y = 2.45x + 13.45$

y = World aquaculture

2.45 = Rate of change

x = Years since 1991

13.45 = World aquaculture in 1991

b. $y = 2.45(10) + 13.45 = 37.95$

$37.95(0.702) = 26.64$

China's aquaculture in 2001 was about 26.64 million metric tons.

43. a. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{17 - 16.7}{70 - 75} = -0.06$

$y - y_1 = m(x - x_1)$

$y - 16.7 = -0.06(x - 75)$

$y - 16.7 = -0.06x + 4.5$

$y = -0.06x + 21.2$

y = Running speed (ft/sec)

-0.06 = Rate of change

x = Temperature

b. $y = -0.06(80) + 21.2 = 16.4$

The runner's pace when the temperature is 80°F is 16.4 feet per second.

44. a. (5 years since 1972, 23.5 cans per pound of aluminum), (28 years since 1972, 33.1 cans per pound of aluminum)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{33.1 - 23.5}{28 - 5} = 0.42$

$y - y_1 = m(x - x_1)$

$y - 23.5 = 0.42(x - 5)$

$y - 23.5 = 0.42x - 2.1$

$y = 0.42x + 21.4$

y = Cans per pound of aluminum

0.42 = Rate of change

x = Years since 1972

21.4 = Cans per aluminum in 1972

b. $y = 0.42(30) + 21.4$

= 34 cans per pound of aluminum

$\frac{53.8 \text{ billion cans}}{34 \text{ cans per pound}} = 1.58$ billion pounds

About 1.58 billion pounds of aluminum were collected 2002. By substituting 30 years since 1972 for x in the equation from part (a) and solving for y, you find the number of cans per pound of aluminum. Divide the total number of cans by the number of cans per pound to find the total number of pounds of aluminum collected.

Extension for the lesson "Write Linear Equations in Point-Slope Form"

1. $a_2 - a_1 = 14 - 17 = -3$

$a_3 - a_2 = 11 - 14 = -3$

$a_4 - a_3 = 8 - 11 = -3$

$a_5 - a_4 = 5 - 8 = -3$

The sequence is arithmetic, the difference is -3. The next 2 terms are $a_6 = 2$ and $a_7 = -1$.

2. $a_2 - a_1 = 4 - 1 = 3$

$a_3 - a_2 = 16 - 4 = 12$

The sequence is not arithmetic because there isn't a common difference.

3. $a_2 - a_1 = -15 - (-8) = -7$

$a_3 - a_2 = -22 - (-15) = -7$

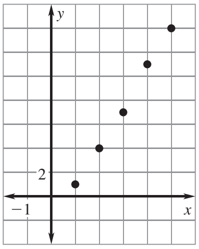
$a_4 - a_3 = -29 - (-22) = -7$

$a_5 - a_4 = -36 - (-29) = -7$

Because the terms have a common difference ($d = -7$), the sequence is arithmetic. The next 2 terms are $a_6 = -43$ and $a_7 = -50$.

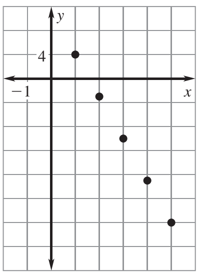
4.

Position, *x*	1	2	3	4	5
Term, *y*	1	4	7	11	14



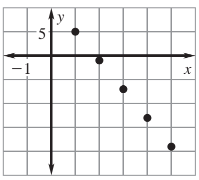
5.

Position, *x*	1	2	3	4	5
Term, *y*	4	−3	−10	−17	−24



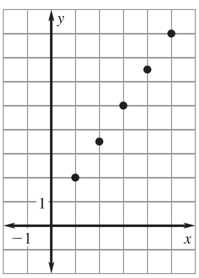
6.

Position, *x*	1	2	3	4	5
Term, *y*	5	−1	−7	−13	−19



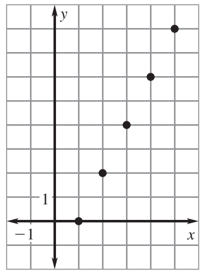
7.

Position, *x*	1	2	3	4	5
Term, *y*	2	$3\frac{1}{2}$	5	$6\frac{1}{2}$	8



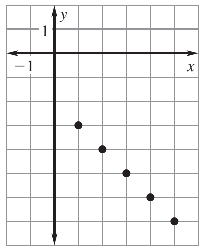
8.

Position, *x*	1	2	3	4	5
Term, *y*	0	2	4	6	8



9.

Position, *x*	1	2	3	4	5
Term, *y*	−3	−4	−5	−6	−7



10. $a_1 = -12, d = 7$

$a_n = a_1 + (n - 1)d$

$a_n = -12 + (n - 1)7$

$a_{100} = -12 + (100 - 1)7$

$a_{100} = 681$

11. $a_1 = 51, d = 21$

$a_n = a_1 + (n - 1)d$

$a_n = 51 + (n - 1)21$

$a_{100} = 51 + (100 - 1)21$

$a_{100} = 2130$

12. $a_1 = 0.25, d = -1$

$a_n = a_1 + (n - 1)d$

$a_n = 0.25 + (n - 1)(-1)$

$a_{100} = 0.25 + (100 - 1)(-1)$

$a_{100} = -98.75$

13. $a_1 = \frac{1}{4}, d = \frac{1}{8}$

$a_n = a_1 + (n - 1)d$

$a_n = \frac{1}{4} + (n - 1)\frac{1}{8}$

$a_{100} = \frac{1}{4} + (100 - 1)\frac{1}{8}$

$a_{100} = 12\frac{5}{8}$

14. $a_1 = 0, d = -5$

$a_n = a_1 + (n - 1)d$

$a_n = 0 + (n - 1)(-5)$

$a_{100} = 0 + (100 - 1)(-5)$

$a_{100} = -495$

15. $a_1 = 1, d = \frac{1}{3}$

$a_n = a_1 + (n - 1)d$

$a_n = 1 + (n - 1)\frac{1}{3}$

$a_{100} = 1 + (100 - 1)\frac{1}{3}$

$a_{100} = 34$

16. $a_{n+1} - a_n = d$

d is the difference between a term of the sequence and the preceding term. If a_{n+1} is a term of the sequence, then a_n is the preceding term. So, $a_{n+1} - a_n$ is equal to the difference, d.

Example: Sequence 0, 2, 4, 6, 8 …, $d = 2$

Let a_n be $a_4 = 6$

$a_{4+1} - a_4 = d$

$8 - 6 = 2$

$2 = 2$

Lesson 4.4 Write Linear Equations in Standard Form

Guided Practice for the lesson "Write Linear Equations in Standard Form"

1. *Sample answer:*

$x - y = 3$

$2x - 2y = 6$ (Multiply each side by 2.)

$3x - 3y = 9$ (Multiply each side by 3.)

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

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - (-1)}{2 - 3} = \frac{-2}{-1} = 2$

$y - y_1 = m(x - x_1)$

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

$y + 1 = 2x - 6$

$-2x + y = -7$

3. $(-8, -9)$

Horizontal line: $y = -9$

Vertical line: $x = -8$

4. $(13, -5)$

Horizontal line: $y = -5$

Vertical line: $x = 13$

5. $-4x + By = 7, (-1, 1)$

$-4(-1) + B(1) = 7$

$B = 3$

$-4x + 3y = 7$

6. $Ax + y = -3, (2, 11)$

$A(2) + 11 = -3$

$A(2) = -14$

$A = -7$

$-7x + y = -3$

7. Total number of people $= 144 - 8 = 136$

$8s + 12\ell = 136$

$8s + 12(0) = 136$

$s = 17$

Some possible combinations are 0 large and 17 small, 8 large and 5 small, 2 small and 10 large. (Examples will vary.)

Exercises for the lesson "Write Linear Equations in Standard Form"

Skill Practice

1. $2x + 8y = -3$

Standard form

2. $y = -5x + 8$

Slope-intercept form

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

Point-slope form

4. Find the slope of the equation. Use one of the points to write the equation in point-slope form, $y - y_1 = m(x - x_2)$. Rewrite the equation in standard form $Ax + By = C$.

5. $x + y = -10$

$2x + 2y = -20$ (Multiply by 2.)

$0.5x + 0.5y = -5$ (Multiply by 0.5.)

6. $5x + 10y = 15$

$10x + 20y = 30$ (Multiply by 2.)

$x + 2y = 3$ $\left(\text{Multiply by } \frac{1}{5}.\right)$

7. $-x + 2y = 9$

$-2x + 4y = 18$ (Multiply by 2.)

$-3x + 6y = 27$ (Multiply by 3.)

8. $-9x - 12y = -16$

$-18x - 24y = 12$ (Multiply by 2.)

$-3x - 4y = 2$ $\left(\text{Multiply by } \frac{1}{3}.\right)$

9. $9x - 3y = -12$

$18x - 6y = -24$ (Multiply by 2.)

$3x - y = -4$ $\left(\text{Multiply by } \frac{1}{3}.\right)$

10. $-2x + 4y = -5$

$-4x + 8y = -10$ (Multiply by 2.)

$-6x + 12y = -15$ (Multiply by 3.)

11. $(-3, 2), m = 1$

$y - y_1 = m(x - x_1)$

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

$-x + y = 5$

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

$y - y_1 = m(x - x_1)$

$y + 1 = 3(x - 4)$

$y + 1 = 3x - 12$

$-3x + y = -13$

13. $(0, 5), m = -2$

$y - y_1 = m(x - x_1)$

$y - 5 = -2(x - 0)$

$2x + y = 5$

14. $(-8, 0), m = -4$

$y - y_1 = m(x - x_1)$

$y - 0 = -4(x + 8)$

$y = -4x - 32$

$4x + y = -32$

15. $(-4, -4), m = -\frac{3}{2}$

$y - y_1 = m(x - x_1)$

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

$y + 4 = -\frac{3}{2}x - 6$

$\frac{3}{2}x + y = -10$

16. $(-6, -10), m = \frac{1}{6}$

$y - y_1 = m(x - x_1)$

$y + 10 = \frac{1}{6}(x + 6)$

$y + 10 = \frac{1}{6}x + 1$

$-\frac{1}{6}x + y = -9$

17. $(-8, 4), (4, -4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 4}{4 - (-8)} = \frac{-8}{12} = -\frac{2}{3}$

$y - y_1 = m(x - x_1)$

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

$y - 4 = -\frac{2}{3}x - \frac{16}{3}$

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

18. $(-5, 2), (-4, 3)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 2}{-4 - (-5)} = \frac{1}{1} = 1$

$y - y_1 = m(x - x_1)$

$y - 2 = 1(x + 5)$

$-x + y = 7$

19. $(0, -1), (-6, -9)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-9 - (-1)}{-6 - 0} = \frac{-8}{-6} = \frac{4}{3}$

$y - y_1 = m(x - x_1)$

$y + 1 = \frac{4}{3}(x - 0)$

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

20. $(3, 9), (1, 1)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 9}{1 - 3} = \frac{-8}{-2} = 4$

$y - y_1 = m(x - x_1)$

$y - 9 = 4(x - 3)$

$y - 9 = 4x - 12$

$-4x + y = -3$

21. $(10, 6), (-12, -5)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - 6}{-12 - 10} = \frac{-11}{-22} = \frac{1}{2}$

$y - y_1 = m(x - x_1)$

$y - 6 = \frac{1}{2}(x - 10)$

$y - 6 = \frac{1}{2}x - 5$

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

22. $(-6, -2), (-1, -2)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-2)}{-1 - (-6)} = \frac{0}{5} = 0$

$y - y_1 = m(x - x_1)$

$y + 2 = 0(x + 6)$

$y = -2$

23. $(3, 2)$

Horizontal: $y = 2$

Vertical: $x = 3$

24. $(-5, -3)$

Horizontal: $y = -3$

Vertical: $x = -5$

25. $(-1, 3)$

Horizontal: $y = 3$

Vertical: $x = -1$

26. $(5, 3)$

Horizontal: $y = 3$

Vertical: $x = 5$

27. $(-1, 4)$

Horizontal: $y = 4$

Vertical: $x = -1$

28. $(-6, -2)$

Horizontal: $y = -2$

Vertical: $x = -6$

29. The x and y values were switched when substituted into the equation. The x-value is the first number in the ordered pair and must be substituted for x in the equation.

$A(1) - 3(-4) = 5$

$A + 12 = 5$

$A = -7$

30. $\frac{x}{6} + \frac{y}{4} = 1$; *Sample answer:* Because $2x + 3(0) = 12$, the x-intercept a of the line is 6. Because $2(0) + 3y = 12$, the y-intercept b of the line is 4. Substituting $a = 6$ and $b = 4$ into the general equation $\frac{x}{a} + \frac{y}{b} = 1$ produces the intercept form of the equation, $\frac{x}{6} + \frac{y}{4} = 1$.

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

$A(2) + 3(-1) = 5$

$2A - 3 = 5$

$A = 4$

$4x + 3y = 5$

32. $Ax - 4y = -1, (6, 1)$

$A(6) - 4(1) = -1$

$6A - 4 = -1$

$6A = 3$

$A = \frac{1}{2}$

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

33. $-x + By = 10, (-2, -2)$

$-(-2) + B(-2) = 10$

$-2B = 8$

$B = -4$

$-x - 4y = 10$

34. $8x + By = 4, (-5, 4)$

$8(-5) + B(4) = 4$

$-40 + 4B = 4$

$4B = 44$

$B = 11$

$8x + 11y = 4$

35. $Ax - 3y = -5, (1, 0)$

$A(1) - 3(0) = -5$

$A = -5$

$-5x - 3y = -5$

36. $2x + By = -4, (-3, 7)$

$$2(-3) + B(7) = -4$$
$$-6 + 7B = -4$$
$$7B = 2$$
$$B = \frac{2}{7}$$
$$2x + \frac{2}{7}y = -4$$

37. $(0, a), (b, 0)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - a}{b - 0} = -\frac{a}{b}$$
$$y - y_1 = m(x - x_1)$$
$$y - a = -\frac{a}{b}(x - 0)$$
$$y - a = -\frac{a}{b}x$$
$$\frac{a}{b}x + y = a \text{ or } ax + by = ab$$

Problem Solving

38.

Cost of vinca • Number of vincas + Cost of phlox • Number of phlox plants = Total cost

$$1.20 \cdot v + 2.50 \cdot p = c$$
$$1.20v + 2.50p = 300$$

Possible combinations include 0 vinca plants and 120 phlox plants, 250 vinca plants and 0 phlox plants, 100 vinca plants and 72 phlox plants. Examples will vary.

39. a. Let x = ounces in a box of wheat cereal

$$12(5) + 4x = 120$$
$$4x = 60$$
$$x = 15$$

There are 15 ounces in a box of wheat cereal.

b.

Ounces in a box of corn cereal • Number of boxes of corn cereal + Ounces in a box of wheat cereal • Number of boxes of wheat cereal = Total ounces

$$12 \cdot c + 15 \cdot w = T$$

c. $12c + 15w = 120$

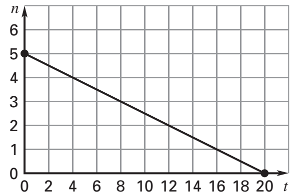
Possibilities include 5 boxes of corn and 4 boxes of wheat, 0 boxes of corn and 8 boxes of wheat, 10 boxes of corn and 0 boxes of wheat. Examples will vary.

40.

Charge per night • Number of nights + Charge per treat • Number of treats = Total charge

$$20 \cdot n + 5 \cdot t = C$$
$$20n + 5t = 100$$

(5,0), (0, 20)



The n-intercept indicates the number of nights it would take for the entire charge to be from boarding charges and none from treats. The t-intercept indicates the amount of treats it would take for the entire charge to be from treats and none from boarding charges.

41. a.

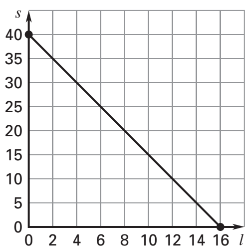
Cost of large raft • Number of large rafts + Cost of small raft • Number of small rafts = Total cost

$$100 \cdot \ell + 40 \cdot s = C$$
$$100\ell + 40s = 1600$$

ℓ-intercept: 16

s-intercept: 40

b.



c.

Large rafts	0	2	4	6	8	10	12	14	16
Small rafts	40	35	30	25	20	15	10	5	0

42. a.

Cost of bus ride • Number of bus rides + Cost of subway ride • Number of subway rides = Total cost

$$0.75 \cdot b + 1.00 \cdot s = C$$
$$C = 36(0.75) + 36(1) = 63$$
$$0.75b + s = 63$$

b. $0.75(60) + s = 63$

$$s = 18$$

You must ride the subway 18 times. By substituting 60 for b (the number of bus rides) and solving the equation for s, you find the number of subway rides necessary for the cost to equal the value of the pass.

43. $P = 2(10) + 2(20) = 60$

2 • Length + 2 • Width = Perimeter

$2\ell + 2w = 60$

Length	5	8	10	12	14
Width	25	22	20	18	16

44. a. Let x = amount of pure acid (mL)

Let y = amount of water (mL)

x(100% acid) + y(0% acid) = Total amount (40% acid)

$x(1) + y(0) = (x + y)(0.4)$

x(100% acid) + y(0% acid) = Total amount (60% acid)

$x(1) + y(0) = (x + y)(0.6)$

b. $x(1) + y(0) = 700(0.4)$

$x = 280$ mL of acid

1000 mL − 280mL = 720 mL

$720(1) + y(0) = (720 + y)(0.6)$

$720 = 432 + 0.6y$

480 mL water $= y$

$480 + 720 = 1200$

You can prepare 1200 mL of the 60% dilution.

c. 700 mL total − 280mL acid = 420 mL water

You need 420 mL of water.

Quiz for the lessons "Write Linear Equations in Slope-Intercept Form", "Use Linear Equations in Slope-Intercept Form", "Write Linear Equations in Point-Slope Form", and "Write Linear Equations in Standard Form"

1. $(2, 5), m = 3$

$y = mx + b$

$5 = 3(2) + b$

$-1 = b$

$y = 3x - 1$

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

$y = mx + b$

$4 = -2(-1) + b$

$2 = b$

$y = -2x + 2$

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

$y = mx + b$

$-7 = 5(0) + b$

$-7 = b$

$y = 5x - 7$

4. $(0, 2), (9, 5)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 2}{9 - 0} = \frac{3}{9} = \frac{1}{3}$

$y = mx + b$

$2 = \frac{1}{3}(0) + b$

$2 = b$

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

5. $(5, 7), (19, 14)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{14 - 7}{19 - 5} = \frac{7}{14} = \frac{1}{2}$

$y = mx + b$

$7 = \frac{1}{2}(5) + b$

$\frac{9}{2} = b$

$y = \frac{1}{2}x + \frac{9}{2}$

6. $(4, 24), (-11, 19)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{19 - 24}{-11 - 4} = \frac{-5}{-15} = \frac{1}{3}$

$y = mx + b$

$24 = \frac{1}{3}(4) + b$

$\frac{68}{3} = b$

$y = \frac{1}{3}x + \frac{68}{3}$

7. $(-5, 2), (-4, 3)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 2}{-4 - (-5)} = \frac{1}{1} = 1$

$y - y_1 = m(x - x_1)$

$y - 2 = 1(x + 5)$ or $y - 3 = 1(x + 4)$

Point-slope → $y - 2 = x + 5$ or $y - 3 = x + 4$

Standard form → $-x + y = 7$

8. $(0, -1), (-6, -9)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-9 - (-1)}{-6 - 0} = \frac{-8}{-6} = \frac{4}{3}$

$y - y_1 = m(x - x_1)$

$y + 1 = \frac{4}{3}(x - 0)$ or $y + 9 = \frac{4}{3}(x + 6)$

Point-slope → $y + 1 = \frac{4}{3}x$ or $y + 9 = \frac{4}{3}(x + 6)$

Standard form → $-\frac{4}{3}x + y = -1$

9. $(3, 9), (1, 1)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 9}{1 - 3} = \frac{-8}{-2} = 4$

$y - y_1 = m(x - x_1)$

Point-slope → $y - 9 = 4(x - 3)$ or $y - 1 = 4(x - 1)$

Standard form → $-4x + y = -3$

10. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{18 - 20}{2 - 1} = \frac{-2}{1} = -2$

$y - y_1 = m(x - x_1)$

$y - 20 = -2(x - 1)$

$y - 20 = -2x + 2$

$y = -2x + 22$

y = Price per DVD

x = Number of DVD's purchased

Mixed Review of Problem Solving for the lessons "Write Linear Equations in Slope-Intercept Form", "Use Linear Equations in Slope-Intercept Form", "Write Linear Equations in Point-Slope Form" and "Write Linear Equations in Standard Form"

1. a. Rate of change: \$13 per month

Starting Value: \$100

b.

$$\text{Total cost} = \text{Rate of change} \cdot \text{Number of months} + \text{Cost for equipment}$$

$C = 13t + 100$

c. $C = 13(12) + 100 = 256$

The total cost after 1 year of service is \$256.

2. a.

$$\text{Total distance} = \text{Speed (mi/h)} \cdot \text{Time since break} + \text{Distance before break}$$

$D = 3.5t + 5$

b. $D = 3.5t + 5 = 3.5(4) + 5 = 19$

The total distance was 19 miles.

3. a. The situation can be modeled by a linear equation because the rate of change in cost per person is constant.

b. $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{288 - 192}{18 - 12} = 16$

$y - y_1 = m(x - x_1)$

$y - 192 = 16(x - 12)$

$y - 192 = 16x - 192$

$y = 16x$

$y =$ Total cost

$16 =$ Cost per Person

$x =$ Number of people attending

c. $y = 16(120) = 1920$

The cost for 120 people is \$1920.

4. (5 minutes, 15 gallons of water)

(30 minutes, 90 gallons of water)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{90 - 15}{30 - 5} = \frac{75}{25} = 3$

$$\text{Volume of water} = \text{Rate of change} \cdot \text{Time (minutes)}$$

$V = mt$

$V = 3t$

The volume of water in the pool is equal to the rate that water is going into the pool (slope) times the amount of time the pool is being filled. Substitute 150 gallons for V and solve for t to find the time it takes to put 150 gallons of water in the pool.

$150 = 3t$

$50 = t$

It take 50 minutes to put 150 gallons of water in the pool.

5. a. (4 days, 8 miles remaining)

(10 days, 5 miles remaining)

This can be modeled by a linear equation because it can be written as an equation in slope-intercept form.

b.

$$\text{Distance left to be paved} = \text{Rate of paving} \cdot \text{Time (days)} + \text{Distance to be paved}$$

$D = m \cdot t + d$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 8}{10 - 4} = \frac{-3}{6} = -\frac{1}{2}$

$-y_1 = m(x - x_1)$

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

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

$y = -\frac{1}{2}x + 10$

c. $0 = -\frac{1}{2}x + 10$

$20 = x$

The entire path will be paved in 20 days.

$20 - 10 = 10$

So it will take 10 more days to finish paving.

6.

$$\text{Worth of nickel} \cdot \text{Number of nickels} + \text{Worth of dime} \cdot \text{Number of dimes} = \text{Total amount}$$

$0.05n + 0.10d = T$

(Amount of money and possible combinations will vary.)

7.

$$\text{Total saved} = \text{Rate of savings} \cdot \text{Time (weeks)} + \text{Amount already saved}$$

$T = m \cdot t + b$

$T = 20(7) + 50 = 190$

You expect to save \$190.

8. (26 miles, \$62.50)

(38 miles, \$65.50)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{65.50 - 62.50}{38 - 26} = \frac{3}{12} = \frac{1}{4}$

$y - y_1 = m(x - x_1)$

$y - 62.50 = \frac{1}{4}(x - 26)$

$y - 62.50 = \frac{1}{4}x - 6.5$

$y = \frac{1}{4}x + 56$

$y = \frac{1}{4}(54) + 56$

$y = 69.5$

A 54 mile trip costs \$69.50.

Lesson 4.5 Write Equations of Parallel and Perpendicular Lines

Guided Practice for the lesson "Write Equations of Parallel and Perpendicular Lines"

1. $m = -1, (-2, 11)$

$y = mx + b$

$11 = -1(-2) + b$

$9 = b$

$y = -x + 9$

2. Line a: $2x + 6y = -3$

$6y = -2x - 3$

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

Line b: $y = 3x - 8$

Line c: $-1.5y + 4.5x = 6$

$-1.5y = -4.5x + 6$

$y = 3x - 4$

Lines b and c have slopes of 3, so they are parallel. Line a has a slope of $-\frac{1}{3}$, the negative reciprocal of 3, so it is perpendicular to lines b and c.

3. Line a: $2y + x = -12$

$2y = -x - 12$

$y = -\frac{1}{2}x - 6$

Line b: $2y = 3x - 8$

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

The slopes are not negative reciprocals, so lines a and b are not perpendicular.

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

$y = mx + b$

$3 = -\frac{1}{4}(4) + b$

$4 = b$

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

Exercises for the lesson "Write Equations of Parallel and Perpendicular Lines"

Skill Practice

1. Two lines in a plane are *perpendicular* if they intersect to form a right angle.

2. If the slopes of the lines are negative reciprocals, the lines are perpendicular.

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

$y = mx + b$

$3 = 2(-1) + b$

$5 = b$

$y = 2x + 5$

4. $m = -\frac{5}{2}, (6, 8)$

$y = mx + b$

$8 = -\frac{5}{2}(6) + b$

$23 = b$

$y = -\frac{5}{2}x + 23$

5. $m = -\frac{3}{5}, (5, -1)$

$y = mx + b$

$-1 = -\frac{3}{5}(5) + b$

$2 = b$

$y = -\frac{3}{5}x + 2$

6. $m = 5, (-1, 2)$

$y = mx + b$

$2 = 5(-1) + b$

$7 = b$

$y = 5x + 7$

7. $-6x + y = -1$

$y = 6x - 1$

$m = 6, (1, 7)$

$y = mx + b$

$7 = 6(1) + b$

$1 = b$

$y = 6x + 1$

8. $3y = x - 12$

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

$m = \frac{1}{3}, (18, 2)$

$y = mx + b$

$2 = \frac{1}{3}(18) + b$

$-4 = b$

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

9. $2y = 4x - 6$

$y = 2x - 3$

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

$y = mx + b$

$5 = 2(-2) + b$

$9 = b$

$y = 2x + 9$

10. $y - x = 3$

$y = x + 3$

$m = 1, (9, 4)$

$y = mx + b$

$4 = 1(9) + b$

$-5 = b$

$y = x - 5$

11. $-y + 3x = 16$

$-y = -3x + 16$

$y = 3x - 16$

$m = 3, (-10, 0)$

$y = mx + b$

$0 = 3(-10) + b$

$30 = b$

$y = 3x + 30$

12. Line a: $y = 4x - 2$

Line b: $y = -\frac{1}{4}x$

Line c: $y = -4x + 1$

Lines a and b are perpendicular because they have slopes that are negative reciprocals.

13. Line a: $y = \frac{3}{5}x + 1$

Line b: $5y = 3x - 2$

$y = \frac{3}{5}x - \frac{2}{5}$

Line c: $10x - 6y = -4$

$-6y = -10x - 4$

$y = \frac{5}{3}x + \frac{2}{3}$

Lines a and b are parallel because they both have slopes of $\frac{3}{5}$.

14. Line a: $y = 3x + 6$

Line b: $3x + y = 6$

$y = -3x + 6$

Line c: $3y = 2x + 18$

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

All of the lines have different slopes, and none are negative reciprocals. So none of these lines are parallel or perpendicular.

15. Line a: $4x - 3y = 2$

$-3y = -4 + 2$

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

Line b: $3x + 4y = -1$

$4y = -3x - 1$

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

Line c: $4y - 3x = 20$

$4y = 3x + 20$

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

Lines a and b are perpendicular because their slopes are negative reciprocals, $\frac{4}{3}$ and $-\frac{3}{4}$.

16. D; Lines a and c are perpendicular.

Line a: $-2x + y = 4$

$y = 2x + 4$

Line b: $2x + 5y = 2$

$5y = -2x + 2$

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

Line c: $x + 2y = 4$

$2y = -x + 4$

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

17. Line a: $(-2, 1), (0, 3)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - 1}{0 - (-2)} = \frac{2}{2} = 1$

Line b: $(1, 3), (4, 1)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 3}{4 - 1} = -\frac{2}{3}$

Line c: $(4, 1), (6, 4)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 1}{6 - 4} = \frac{3}{2}$

Lines b and c are perpendicular because their slopes, $-\frac{2}{3}$ and $\frac{3}{2}$, are negative reciprocals.

18. $m = -1, (3, -3)$

$y = mx + b$

$-3 = -1(3) + b$

$0 = b$

$y = -x$

19. $m = -\frac{1}{3}, (-9, 2)$

$y = mx + b$

$2 = -\frac{1}{3}(-9) + b$

$-1 = b$

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

20. $m = -\frac{1}{5}, (5, 1)$

$y = mx + b$

$1 = -\frac{1}{5}(5) + b$

$2 = b$

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

21. $m = -2, (7, 10)$

$y = mx + b$

$10 = -2(7) + b$

$24 = b$

$y = -2x + 24$

22. $m = \frac{7}{2}, (-2, -4)$

$y = mx + b$

$-4 = \frac{7}{2}(-2) + b$

$3 = b$

$y = \frac{7}{2}x + 3$

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

$y = mx + b$

$-1 = -\frac{3}{4}(-4) + b$

$-4 = b$

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

24. $2y = 3x - 6$

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

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

$y = mx + b$

$3 = -\frac{2}{3}(3) + b$

$5 = b$

$y = -\frac{2}{3}x + 5$

25. $y + 3 = 2x$

$y = 2x - 3$

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

$y = mx + b$

$2 = -\frac{1}{2}(-5) + b$

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

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

26. $4y + 2x = 12$

$4y = -2x + 12$

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

$m = 2, (8, -1)$

$y = mx + b$

$-1 = 2(8) + b$

$-17 = b$

$y = 2x - 17$

27. The error is that 1 should have been substituted into the equation for y and 2 should have been substituted for x, not vice versa.

$y = mx + b$

$1 = 2(2) + b$

$-3 = b$

28. B; $y = -\frac{1}{2}x$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 3}{6 - 2} = \frac{-2}{4} = -\frac{1}{2}$

29. (4, 3), (3, −1)

$m_1 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 3}{3 - 4} = \frac{-4}{-1} = 4$

(−3, 3), (1, 2)

$m_2 = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - 3}{1 - (-3)} = -\frac{1}{4}$

The lines are perpendicular because their slopes are negative reciprocals.

30. Answers will vary.

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

$m_\perp = -\left(\frac{x_2 - x_1}{y_2 - y_1}\right)$

Problem Solving

32. a. (−4, 0), (0, 8)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{8 - 0}{0 - (-4)} = \frac{8}{4} = 2$

$y = mx + b$

$0 = 2(-4) = b$

$8 = b$

$y = 2x + 8$

b. (0, 8), (−4, 16)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{16 - 8}{-4 - 0} = \frac{8}{-4} = -2$

$y = mx + b$

$8 = 0(-2) + b$

$8 = b$

$y = -2x + 8$

c. The path from the puck does not form a right angle because the slopes from the two paths are not negative reciprocals.

33. a. $y = 200x + 6000$

$y = 200x + 6250$

$y =$ weight

$x =$ number of days

b. $y = 200(30) + 6000 = 12{,}000$

$y = 200(30) + 6250 = 12{,}250$

One calf will weigh 12,000 pounds, and the other will weigh 12,250 pounds.

c. The graphs of the equations are parallel because they have the same slope of 200.

34. Park: $3y - 2x = 12$

$3y = 2x + 12$

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

Main: $y = -6x + 44$

2nd Street: $3y = 2x - 13$

$y = \frac{2}{3}x - \frac{13}{3}$

Sea: $2y = -3x + 37$

$y = -\frac{3}{2}x + \frac{37}{2}$

Park and 2nd Street are parallel because they both have slopes of $\frac{2}{3}$. Sea is perpendicular to Park and 2nd Street because its slope of $-\frac{3}{2}$ is a negative reciprocal to the slopes of the other two which is $\frac{2}{3}$.

35. They paid different registration fees. The monthly fee is represented by the slopes of the lines. If they are parallel, they have the same slope and therefore the same monthly fee.

36. a. Total Cost = Monthly fee • Time (months) + Joining fee

$C = m \cdot t + b$

$C = 38.75t + 49$

b. $C = 38.75t + 149$

c. The graphs are parallel because their slopes are the same. The monthly fee is represented by the slopes of the graphs.

d. $C = 38.75(6) + 49 = 281.5$

$C = 38.75(6) + 149 = 381.5$

$381.5 - 281.5 = 100$

The difference in total cost after 6 months is \$100.

$C = 38.75(12) + 49 = 514$

$C = 38.75(12) + 149 = 614$

$615 - 514 = 100$

The difference in total cost after 12 months is \$100.

37. a. Value $=$ Rate of decrease $\cdot$ Number of months after 6 months $+$ Initial cost

$y = m \cdot x + b$

Your card: $y = -2.50x + 50$

Your friend's card: $y = -2.50x + 30$

b. The graphs of these functions are parallel because their slopes (which represent the rate of decrease in value of the gift cards) are the same.

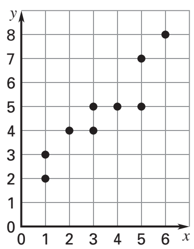
c. The x-intercepts of the function are, your card: $x = 20$, and your friend's card: $x = 12$. These represent the number of months it will take, after the first 6 months, until the card is worth nothing.

Lesson 4.6 Fit a Line to Data

Guided Practice for the lesson "Fit a Line to Data"

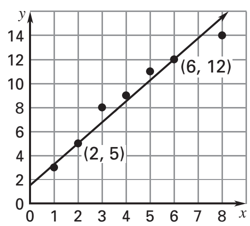
1. *Sample answer:* A reasonable test score for 4.5 hours of studying is 71. A reasonable test score for 4.5 hours of television watching is 76.

2.



There is a positive correlation. As x increases, y increases.

3.



Sample answer:

(2, 5), (6, 12)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{12 - 5}{6 - 2} = \frac{7}{4}$

$y = mx + b$

$5 = \frac{7}{4}(2) + b$

$\frac{3}{2} = b$

$y = \frac{7}{4}x + \frac{3}{2}$

4. About 1; *Sample answer:* I drew a line of fit through the scatter plot shown in Ex. 2 above. My line passed through (1, 2) and (6, 7.5). I found the slope of the line:

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7.5 - 2}{6 - 1} = \frac{5.5}{5} = 1.1$

The slope of the line I drew is 1.1, or about 1, so y changes at a rate of about 1 with respect to x.

Exercises for the lesson "Fit a Line to Data"

Skill Practice

1. When data have a positive correlation, the dependent variable tends to *increase* as the independent variable increases.

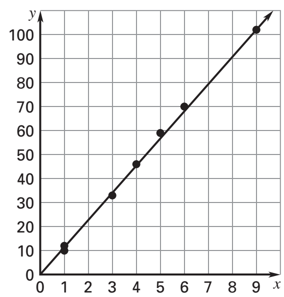
2. If data have a positive correlation, the dependent variable increases as the independent variable increases. If data have a negative correlation, the dependent variable decreases as the independent variable increases. If data have relatively no correlation, the dependent and independent variable have no apparent relationship.

3. Positive correlation

4. Relatively no correlation

5. Negative correlation

6.



Sample answer:

(3, 33), (5, 59)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{59 - 33}{5 - 3} = 13$

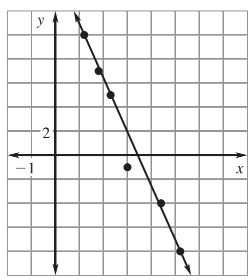
$y = mx + b$

$33 = 13(3) + b$

$-6 = b$

$y = 13x - 6$

7.



Sample answer:

(2.3, 5), (4.4, −4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - 5}{4.4 - 2.3} = \frac{-9}{2.1} = -4.3$

$y = mx + b$

$5 = -4.3(2.3) + b$

$14.9 = b$

$y = 4.3x + 14.9$

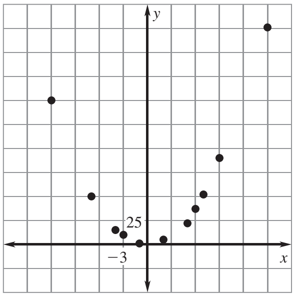
8. C; $y = -x + 8$

9. The line has many more points below it than above. This results in a line that does not accurately fit the data. To correct this error, the line should be repositioned further downward.

10. It should say that the dependent variable decreases as x increases. The dependent variable is y, and the independent variable is x.

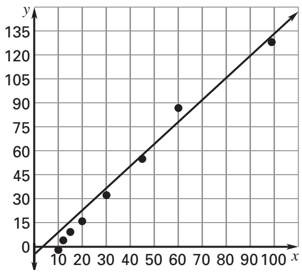
11. Answers will vary.

12.



The data have relatively no correlation. You cannot fit a line to the data because there is no apparent linear relationship between x and y.

13.



The data show a positive correlation because y increases as x increases.

Sample answer: (30, 32), (60, 87)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{87 - 32}{60 - 30} = \frac{55}{30} = 1.8$$

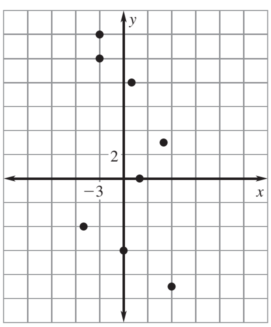
$y = mx + b$

$32 = 1.8(30) + b$

$-22 = b$

$y = 1.8x - 22$

14.

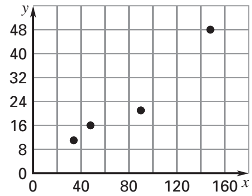


There is relatively no correlation in the data. There is no apparent relationship between x and y.

15. Line b is a better line of fit because there is closer to an equal number of points above and below this line than above and below line a.

Problem Solving

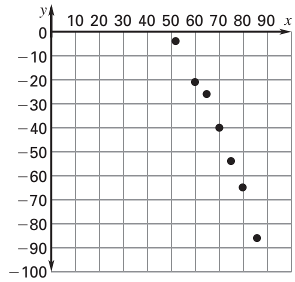
16. a.



b. The data show a positive correlation. As x increases, y increases.

c. The snow leopard does not fit into the pacing trend of the other cats because its home range size is greater than that of the leopard but its pacing time is less.

17. a.



b. *Sample answer:* (70, −40), (80, −65)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-65 - (-90)}{80 - 70} = \frac{-25}{10} = -2.5$$

$y = mx + b$

$-40 = -2.5(70) + b$

$135 = b$

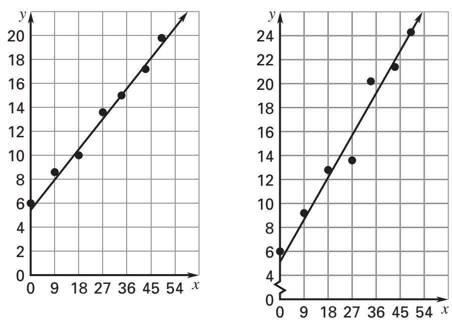
$y = -2.5x + 135$

y = temperature (°C)

x = altitude (km)

c. *Sample answer:* The temperature decreases 2.5°C with each kilometer of increase in altitude.

18.



Alligator 1: (18, 10), (34, 15)

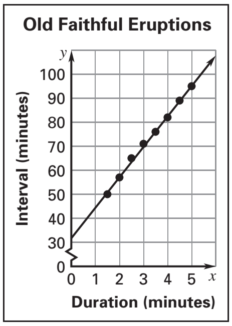
$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - 10}{34 - 18} = \frac{5}{16} = 0.31$$

Alligator 2: (18, 12.8), (49, 24.3)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{24.3 - 12.8}{49 - 18} = \frac{11.5}{31} = 0.37$$

Alligator 2 has a slightly faster growth rate than Alligator 1.

19.



Sample answer: (2, 57), (3.5, 76)

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{76 - 57}{3.5 - 2} = \dfrac{19}{1.5} = 12.67$

$y = mx + b$

$57 = 12.67(2) + b$

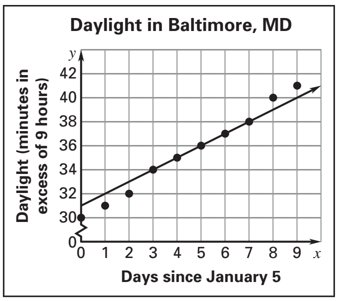
$31.67 = b$

$y = 12.67x + 31.67$

y = interval (minutes)

x = duration (minutes)

20.



a. *Sample answer:* (3, 34), (5, 36)

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{36 - 34}{5 - 3} = \dfrac{2}{2} = 1$

$y = mx + b$

$34 = 3(1) + b$

$31 = b$

$y = x + 31$

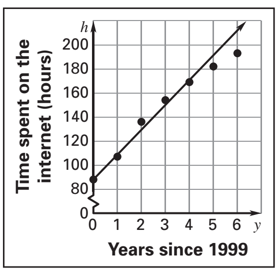
y = daylight (minutes in excess of 9 hours)

x = days since January 5

b. The hours of daylight increase by 1 minute each day.

c. *Sample answer:* This trend would not continue indefinitely because that would mean that eventually there would be constant daylight. We know that is not true.

21.



a. *Sample answer:* (0,88), (4, 169)

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{169 - 88}{4 - 0} = \dfrac{81}{4} = 20.25$

$y = mx + b$

$88 = 20.25(0) + b$

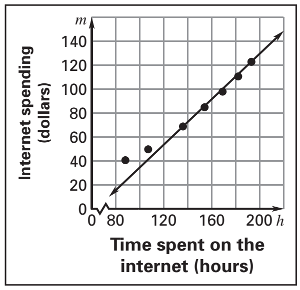
$88 = b$

$h = 20.67y + 88$

h = time (hours)

y = years since 1999

b.



Sample answer: (136, 68.70), (193, 122.67)

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{122.67 - 68.70}{193 - 136} = \dfrac{53.97}{57} = 0.95$

$y = mx + b$

$68.70 = 0.95\,(136) + b$

$-60.5 = b$

$m = 0.95h - 60.5$

m = money spent

h = time (hours)

c. *Sample answer:*

$h = 20.25y + 88$

$m = 0.95(20.25y + 88) - 60.5$

$m = 19.24y + 23.1$

This function tells the amount of money spent on the Internet as a function of the number of years since 1999.

d. (0, 40.55), (4, 97.76)

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{97.76 - 40.55}{4 - 0} = 14.3$

$y = mx + b$

$40.55 = 14.3(0) + b$

$40.55 = b$

$m = 14.3y + 40.55$

By choosing two points and figuring out the equation from the given points in the scatter plot, we find that the equation is somewhat close to the function from part (c) but not exactly the same.

Graphing Calculator Activity for the lesson "Fit a Line to Data"

1.

L_1	L_2
0	10.1
1	10.6
2	10.5
3	10.8
4	10.3
5	9.9

The data have relatively no correlation, but the sales remain somewhat the same from year to year.

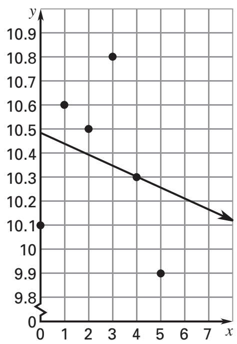
2. Lin Reg

$y = ax + b$

$a = -0.046$

$b = 10.48$

3. $y = -0.046x + 10.48$



4. The value of r for Exercise 2 tells you that the data show a weak negative correlation.

5. *Sample answer:* You could find a point with a greater x-value (a greater number of years since 1997), and find the corresponding y-value. This figure is an estimate of the sales of men's clothing in that year.

Extension for the lesson "Fit a Line to Data"

1. Use a graphing calculator to create a scatter plot and find the equation of the best-fitting line and the correlation coefficient, $r \approx 0.927$. There is a strong positive correlation. An increase in the number of minutes played may contribute to an increase in the number of points scored, but there is not causation. The number of minutes played and the number of points scored may both be a result of the ability of the player.

2. Use a graphing calculator to create a scatter plot and find the equation of the best-fitting line and the correlation coefficient, $r \approx -0.970$. There is a strong negative correlation. An increase in sales of hot drinks does not cause a decrease in sales of cold drinks. The increase in one and the decrease in the other are probably a result of changes in the weather.

3. *Sample answer:* As music downloads increase, sales of CDs decrease, so I would expect a strong negative correlation. The increase in the number of music downloads causes the decline in CD sales as users find downloading a more convenient way to obtain music.

Lesson 4.7 Predict with Linear Models

Investigating Algebra Activity for the lesson "Predict with Linear Models"

1–3. Data and answers will vary depending on lengths of sides chosen.

Guided Practice for the lesson "Predict with Linear Models"

1. a.

Years since 1995	Median Floor Area (ft^2)
L_1	L_2
0	1920
1	1950
2	1975
3	2000
4	2028

$y = 26.6x + 1921.4$

b. $y = 26.6x + 1921.4$

$y = 26.6(5) + 1921.4 = 2054.4$

In 2000, the median floor area will be about 2054.4 square feet.

$y = 26.6(6) + 1921.4 = 2081$

In 2001, the median floor area will be about 2081 square feet.

c. The prediction for 2000 will probably be more accurate because it is one year closer to the given data.

2. $y = -0.02x + 1.435$

$1.25 = -0.02x + 1.435$

$9.25 = x$

There will be 1.25 million participants about 9 years after 1997, or in 2006.

3. $y = -1.23x + 14$

$0 = -1.23x + 14$

$11.38 = x$

The zero of the function is about 11. The function has a negative slope, which means that the number of jet boats purchased is decreasing. According to the model, there will be no jet boats purchased 11 years after 1995, or in 2006.

Exercises for the lesson "Predict with Linear Models"

Skill Practice

1. Using a linear function to approximate a value within a range of known data values is called *linear interpolation*.

2. Extrapolation means approximating a value outside the range of known values, while interpolation means approximating value within the range of known values.

(Scatter plots are done on calculator)

3. $y = 2.6x + 2.3$
when $x = 5, y = 15.3$

4. $y = 8.2x - 10.1$
when $x = 5, y = 30.9$

5. $y = 10.7x + 20$
when $x = 10, y = 127$

6. $y = 0.33x + 0.22$
when $x = 10, y = 3.52$

7. $f(x) = 7.5x - 20$
$0 = 7.5x - 20$
$2.67 = x$
The zero of the function is 2.67.

8. $f(x) = -x + 7$
$0 = -x + 7$
$7 = x$
The zero of the function is 7.

9. $f(x) = \frac{1}{8}x + 2$
$0 = \frac{1}{8}x + 2$
$-16 = x$
The zero of the function is -16.

10. $f(x) = 17x - 68$
$0 = 17x - 68$
$4 = x$
The zero of the function is 4.

11. $f(x) = -0.5x + 0.75$
$0 = -0.5x + 0.75$
$1.5 = x$
The zero of the function is 1.5.

12. $f(x) = 5x - 7$
$0 = 5x - 7$
$1.4 = x$
The zero of the function is 1.4.

13. The zero of a function is the value of x when $y = 0$ and is often referred to as the x-intercept. In order to find this value, y must be set equal to zero, not x.
$y = 2.3x - 2$
$0 = 2.3x - 2$
$0.87 = x$ *HDF*

14. B; 5
$y = 12.6x + 3$
$66 = 12.6x + 3$
$5 = x$

15. The form of the best fitting line as given by the calculator is $y = ax + b$. If $a = 4.47$, then it needs to be substituted as the coefficient of x, or the slope, in the equation.
$y = 4.47x + 23.1$

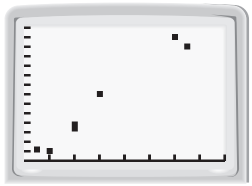
16. Answers will vary.

17. a. You cannot fit one line to the data because it is not consistently a positive or negative correlation.

b. You could use one line to model the data for the first ten years, where it represents a positive correlation. Then use another line to model the data for the next ten years, where it represents a negative correlation.

Problem Solving

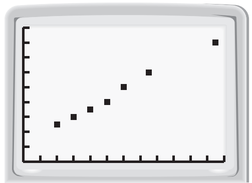
18. a. Create the scatter plot on a graphing calculator.



b. Lin Reg
$y = ax + b$
$y = 513.43x - 5257.78$

c. $y = 513.43(20) - 5257.78 = 5010.82$
The cost of a 20 foot sailboat is about \$5010.

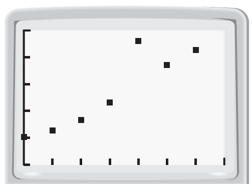
19. a. Create a scatter plot on a graphing calculator.



b. Lin Reg
$y = ax + b$
$y = 0.03x + 1.23$

c. When $x = 250$, $y = 8.73$. About 8.73 square feet of living space is recommended for a pig weighing 250 pounds.

20. a. Create a scatter plot using a graphing calculator.



Lin Reg
$y = ax + b$
$y = 31.5x + 1540.2$

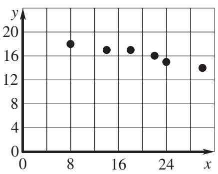
b. The number of TV stations increased at a rate of around 32 stations per year.

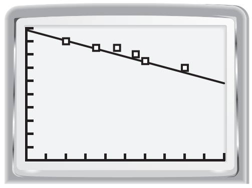
c. $x = 7.9$ when $y = 1790$, there were 1790 TV stations 7.9 years after 1996, or around 2004.

21. a. Lin Reg
$y = ax + b$
$y = -197.6x + 3542$

b. $0 = -197.6x + 3542$
$17.9 = x$
The zero of the function is about 18. The zero indicates that in 18 years from 1985 there will not be any people living in high noise areas near U.S. airports. This is not reasonable because, even though the number is declining, it is likely that some people will continue to live in these high noise areas.

22. a.

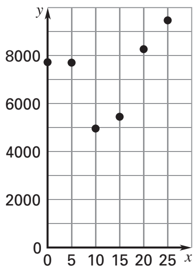


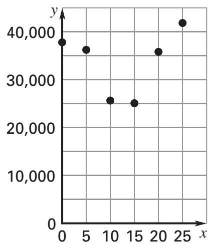


b. Lines of fit may vary. Use a graphing calculator to find the equation of the best-fitting line, $y = -0.2x + 19.7$. Comparisons may vary.

c. The slope, -0.2, of the best-fitting line is the change in the cost (in thousands of dollars per thousand miles) of a local car of the same model, make, and year. The y-intercept, 19.7, of the best-fitting line is the predicted selling price (in thousands of dollars) for a local car of the same model, make, and year with a mileage of 0.

23. a.





b. Both sets of data show relatively no correlation. However the mallard population accounts for a significant portion of the total duck population. Any changes in the mallard population drastically affect the total population. Based on this fact, predictions can be made accordingly.

Quiz for the lessons "Write Equations of Parallel and Perpendicular Lines", "Fit a Line to Data", and "Predict with Linear Models"

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

$y - y_1 = m(x - x_1)$

$y - 8 = 3(x - (-6))$

$y - 8 = 3x + 18$

$y = 3x + 26$

2. $m = 1, (5, 5)$

$y - y_1 = m(x - x_1)$

$y - 5 = 1(x - 5)$

$y - 5 = x - 5$

$y = x$

3. $m = -\frac{1}{2}, (10, -3)$

$y - y_1 = m(x - x_1)$

$y - (-3) = -\frac{1}{2}(x - 10)$

$y + 3 = -\frac{1}{2}x + 5$

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

4. $x + 2y = -7$

$2y = -x - 7$

$y = -\frac{1}{2}x - \frac{7}{2}$

$m = 2, (2, 3)$

$y - y_1 = m(x - x_1)$

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

$y - 3 = 2x - 4$

$y = 2x - 1$

5. a.

L_1	L_2
0	345
2	225
4	159
5	76
8	31

Lin Reg

$y = ax + b$

$y = -38.85x + 322.6$

b. The number of tapes shipped decreased at a rate of about 38.85 million tapes per year.

c. $125 = -38.85x + 322.6$

$5.09 = x$

125 million tapes were shipped about 5 years after 1994, or 1999.

d. $0 = -38.85x + 322.6$

$8.3 = x$

The zero of the function is about 8.3. This means that about 8.3 years after 1994, or by around 2003, no tapes were shipped.

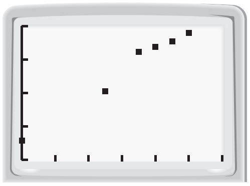
Internet Activity for the lesson "Predict with Linear Models"

Answers for Exercises 1–3 are sample answers.

1.

Year	Agricultural Imports (Millions of dollars)
1990	22,920
1995	30,263
1997	36,159
1998	36,908
1999	37,735
2000	38,991

2. Make a scatter plot on a graphing calculator.



Lin Reg

$y = ax + b$

$y = 1677.5x + 22{,}925.9$

3. Graph the equation found in Exercise 2 on a graphing calculator. Use the TRACE function to find the x-value when $y = \$45{,}000$ million.

$x = 13.2$

The total value of agricultural imports will be $45,000 million 13.2 years after 1990, or 2003.

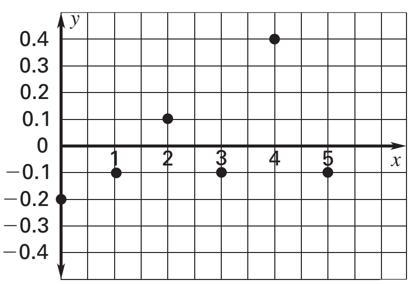
Extension for the lesson "Predict with Linear Models"

Practice

1. The residuals are consistently positive; this implies that the line is in the wrong place.
2. The residuals are growing; this implies that the data is not linear.
3. The distances between the points and the x axis appear to be relatively small and the points are more or less evenly distributed above and below the x-axis. The linear model is a good fit.
4. The residuals are wildly scattered; this implies that the data might have no correlation.
5. The residuals are the differences between each value of the dependent variable y given in the table and each corresponding value of y found using the model $y = 2x + 0.2$.

x	$y = 2x + 0.2$	Residual
0	0.2	$0 - 0.2 = -0.2$
1	2.2	$2.1 - 2.2 = -0.1$
2	4.2	$4.3 - 4.2 = 0.1$
3	6.2	$6.1 - 6.2 = -0.1$
4	8.2	$8.6 - 8.2 = 0.4$
5	10.2	$10.1 - 10.2 = -0.1$

The residuals are -0.2, -0.1, 0.1, -0.1, 0.4, and -0.1.

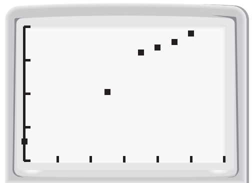


Mixed Review of Problem Solving for the lessons "Write Equations of Parallel and Perpendicular Lines", "Fit a Line to Data", and "Predict with Linear Models"

1. a.

L_1	L_2
0	1245
1	1560
2	2032
3	2174
4	2420
5	2948

Make a scatter plot on a graphing calculator.



b. Lin Reg

$y = ax + b$

$y = 321x + 1260$

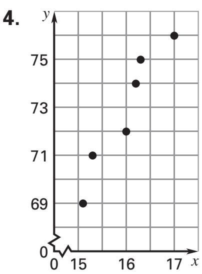
c. The value changed at a rate of about $321 million per year.

d. $x = 7.3$, when $y = 3600$. The value of the schools built in the U.S. will be $3,600,000,000 7.3 years after 1995, or in 2002.

2. The slope of Park Street is 2.

3. Answers will vary.

4.



This date shows a positive correlation because the dependent variable increases as the independent variable increases.

5. a.

L_1	L_2
0	9
1	7.9
2	7.6
3	6.1
4	4
5	4.1

Lin Reg

$y = ax + b$

$y = -1.08x + 9.14$

b. The percent of revenue decreased at a rate of about 1.08% per year.

c. $0 = -1.08x + 9.14$

$8.46 = x$

The zero of the function is 8.46. This means that 8.46 years from 1998, or in 2006, the percent of revenue will be zero.

6. Total cost (adults) = Game fee • Number of games + Adult shoe rental

$A = 4.00n + 2.25$

Total cost (children) = Game fee • Number of games + Child shoe rental

$C = 4.00n + 1.75$

The graphs of the equations have the same slope, but the y-intercept of the adult equation is higher. The lines are, therefore, parallel.

Chapter Review for the chapter "Writing Linear Equations"

1. If a best fitting line falls from left to right, then the data have a *negative* correlation.

2. Using a linear function to approximate a value beyond a range of known values is called a *linear extrapolation*.

3. The zero of a function is an x-value for which $f(x) = 0$, or $y = 0$. The zero of a function is the x-intercept of the graph.

4. $y = 3x - 10$

5. $y = \frac{4}{9}x + 5$

6. $y = -\frac{2}{11}x + 7$

7. Amount left ($) = Initial amount − Cost per bagel • Number of bagels purchased

$A = 25 - 1.25n$

$A = 25 - 1.25(2) = 22.5$

After purchasing 2 bagels, $22.50 is left on the card.

8. $(-3, -1)$; $m = 4$

$y = mx + b$

$-1 = 4(-3) + b$

$11 = b$

$y = 4x + 11$

9. $(-2, 1)$; $m = 1$

$y = mx + b$

$1 = 1(-2) + b$

$3 = b$

$y = x + 3$

10. $(8, -4)$; $m = -3$

$y = mx + b$

$-4 = -3(8) + b$

$20 = b$

$y = -3x + 20$

11. $(4, 7), (5, 1)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 7}{5 - 4} = \frac{-6}{1} = -6$

$y - y_1 = m(x - x_1)$

$y - 7 = -6(x - 4)$ or $y - 1 = -6(x - 5)$

12. $(9, -2), (-3, 2)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-2)}{-3 - 9} = \frac{4}{-12} = -\frac{1}{3}$

$y - y_1 = m(x - x_1)$

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

13. $(8, -8), (-3, -2)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2 - (-8)}{-3 - 8} = \frac{6}{-11} = -\frac{6}{11}$

$y - y_1 = m(x - x_1)$

$y + 8 = -\frac{6}{11}(x - 8)$ or $y + 2 = -\frac{6}{11}(x + 3)$

14. Distance from site (miles) = Speed (miles per minute) • Time (minutes) since 10:00 A.M.

$d = rt$

(25 minutes, −100 miles)

(75 minutes, −65 miles)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-65 - (-100)}{75 - 25} = \frac{35}{50} = 0.7$

$y - y_1 = m(x - x_1)$

$y + 100 = 0.7(x - 25)$

$y + 100 = 0.7(90 - 25)$

$y = -54.5$

At 11:30 A.M., the bus is 54.5 miles from the site.

15. $m = -4, (-2, 7)$

$y - y_1 = m(x - x_1)$

$y - 7 = -4(x - (-2))$

$y - 7 = -4x - 8$

$4x + y = -1$

16. $(-1, -5), (3, 7)$

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - (-5)}{3 - (-1)} = \frac{12}{4} = 3$

$y - y_1 = m(x - x_1)$

$y + 5 = 3(x + 1)$

$y + 5 = 3x + 3$

$-3x + y = -2$

17. Cost of organza • Yards of organza + Cost of satin • Yards of satin = Total cost

$0.07x + 0.04y = 5$

Sample answer:

$0.07(20) + 0.04y = 5$

$y = 90$

$0.07(50) + 0.04y = 5$

$y = 37.5$

$0.07(70) + 0.04y = 5$

$y = 2.5$

Some combinations include 20 yards of organza and 90 yards of satin, 50 yards of organza and 37.5 yards of satin, 70 yards of organza and 2.5 yards of satin.

18. a. Parallel:

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

$y = mx + b$

$2 = -4(0) + b$

$2 = b$

$y = -4x + 2$

b. Perpendicular:

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

$y = mx + b$

$2 = \frac{1}{4}(0) + b$

$2 = b$

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

19. a. Parallel:

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

$y = mx + b$

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

$1 = b$

$y = -2x + 1$

b. Perpendicular:

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

$y = mx + b$

$-3 = \frac{1}{2}(2) + b$

$-4 = b$

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

20. a. Parallel:

$(6, 0), m = \frac{3}{4}$

$y = mx + b$

$0 = \frac{3}{4}(6) + b$

$-\frac{9}{2} = b$

$y = \frac{3}{4}x - \frac{9}{2}$

b. Perpendicular:

$(6, 0), m = -\frac{4}{3}$

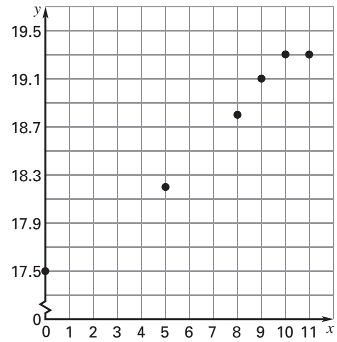
$y = mx + b$

$0 = -\frac{4}{3}(6) + b$

$8 = b$

$y = -\frac{4}{3}x + 8$

21.



The data show a positive correlation because the dependent variable increases as the independent variable increases.

22. Find 2 points on the line of best fit, and then find the equation of the line.

(8, 3), (10, 3.25)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3.25 - 3}{10 - 8} = \frac{0.25}{2} = 0.125$

$y = mx + b$

$3 = 0.125(8) + b$

$2 = b$

$y = 0.125x + 2$

Substitute 30 for x and solve for y, the time it takes to cook a 30 pound turkey.

$y = 0.125(30) + 2$

$y = 5.75$

It takes about 5.75 hours to roast a 30 pound turkey.

Chapter Test for the chapter "Writing Linear Equations"

1. $y = 5x - 7$

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

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

4. $(-2, -8), m = 3$

$y = mx + b$

$-8 = 3(-2) + b$

$-2 = b$

$y = 3x - 2$

5. $(1, 1), m = -4$

$y = mx + b$

$1 = -4(1) + b$

$5 = b$

$y = -4x + 5$

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

$y = mx + b$

$3 = -6(-1) + b$

$-3 = b$

$y = -6x - 3$

7. (4, 5), (2, 9)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9 - 5}{2 - 4} = \frac{4}{-2} = -2$

$y - y_1 = m(x - x_1)$

$y - 5 = -2(x - 4)$ or $y - 9 = -2(x - 2)$

8. (−2, 2), (8, −3)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-3 - 2}{8 - (-2)} = \frac{-5}{10} = -\frac{1}{2}$

$y - y_1 = m(x - x_1)$

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

9. $(3, 4), (1, -6)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6 - 4}{1 - 3} = \frac{-10}{-2} = 5$$

$$y - y_1 = m(x - x_1)$$

$$y - 4 = 5(x - 3) \text{ or } y - 1 = 5(x + 6)$$

10. $m = 10, (6, 2)$

$$y - y_1 = m(x - x_1)$$

$$y - 2 = 10(x - 6)$$

$$y - 2 = 10x - 60$$

$$-10x + y = -58$$

11. $(-3, 2), (6, -1)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-1 - 2}{6 - (-3)} = \frac{-3}{9} = -\frac{1}{3}$$

$$y - y_1 = m(x - x_1)$$

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

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

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

12. a. Parallel

$$m = -5, (2, 0)$$

$$y = mx + b$$

$$0 = -5(2) + b$$

$$10 = b$$

$$y = -5x + 10$$

b. Perpendicular

$$m = \frac{1}{5}, (2, 0)$$

$$y = mx + b$$

$$0 = \frac{1}{5}(2) + b$$

$$-\frac{2}{5} = b$$

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

13. a. Parallel

$$m = -1, (-1, 4)$$

$$y = mx + b$$

$$4 = -1(-1) + b$$

$$3 = b$$

$$y = -x + 3$$

b. Perpendicular

$$m = 1, (-1, 4)$$

$$y = mx + b$$

$$4 = 1(-1) + b$$

$$5 = b$$

$$y = x + 5$$

14. a. Parallel

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

$$y = mx + b$$

$$-9 = \frac{1}{4}(4) + b$$

$$-10 = b$$

$$y = \frac{1}{4}x - 10$$

b. Perpendicular

$$m = -4, (4, -9)$$

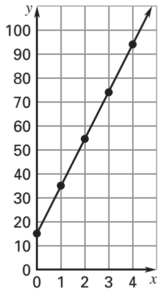
$$y = mx + b$$

$$-9 = -4(4) + b$$

$$7 = b$$

$$y = -4x + 7$$

15.



Sample answer: $(0, 15), (1, 35)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{35 - 15}{1 - 0} = 20$$

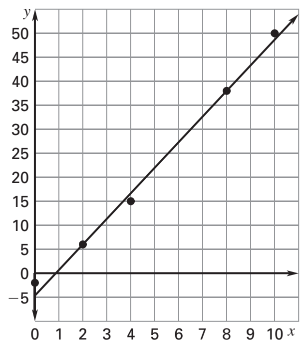
$$y = mx + b$$

$$15 = 20(0) + b$$

$$15 = b$$

$$y = 20x + 15$$

16.



Sample answer: $(2, 6), (8, 38)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{38 - 6}{8 - 2} = \frac{32}{6} = 5.3$$

$$y = mx + b$$

$$6 = 5.3(2) + b$$

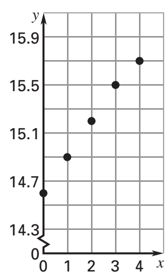
$$-4.6 = b$$

$$y = 5.3x - 4.6$$

17. Total cost = Cost per person • Number of people + Group tour cost

$$C = 3 \cdot p + 60$$

18. a.



b. *Sample answer:* (0, 14.6), (2, 15.2)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15.2 - 14.6}{2 - 0} = \frac{0.6}{2} = 0.3$$

$y = mx + b$

$14.6 = 0.3(0) + b$

$14.6 = b$

$y = 0.3x + 14.6$

c. *Sample answer:* The number of golf facilities increased at a rate of about 300 facilities per year.

d. *Sample answer:* $y = 0.3(7) + 14.6 = 16.7$

In 2004, there will be about 16,700 golf facilities.

e. *Sample answer:* Substitute 16 for y in the equation from part (b) and solve for x.

$16 = 0.3x + 14.6$

$4.67 = x$

The number of golf facilities will reach 16,000 in around 5 years after 1997, or in 2002.

Extra Practice for the chapter "Writing Linear Equations"

1. Slope: 3

y-intercept: 6

$y = 3x + 6$

2. Slope: -2

y-intercept: 4

$y = -2x + 4$

3. Slope: 5

y-intercept: -1

$y = 5x - 1$

4. Slope: -1

y-intercept: -3

$y = -x - 3$

5. Slope: $\frac{1}{2}$

y-intercept: -5

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

6. Slope: $-\frac{7}{10}$

y-intercept: 8

$y = -\frac{7}{10}x + 8$

7. Use (3, 8) and $m = 2$.

$y = mx + b$

$8 = 2(3) + b$

$2 = b$

An equation of the line is $y = 2x + 2$.

8. Use $(-1, 5)$ and $m = -4$.

$y = mx + b$

$5 = -4(-1) + b$

$1 = b$

An equation of the line is $y = -4x + 1$.

9. Use $(-6, 3)$ and $m = \frac{2}{3}$.

$y = mx + b$

$3 = \frac{2}{3}(-6) + b$

$7 = b$

An equation of the line is $y = \frac{2}{3}x + 7$.

10. (2, 4), (5, 13)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{13 - 4}{5 - 2} = \frac{9}{3} = 3$$

Use (2, 4) and $m = 3$.

$y = mx + b$

$4 = 3(2) + b$

$-2 = b$

An equation of the line is $y = 3x - 2$.

11. $(1, -2), (-2, 13)$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{13 - (-2)}{-2 - 1} = \frac{15}{-3} = -5$$

Use $(1, -2)$ and $m = -5$.

$y = mx + b$

$-2 = -5(1) + b$

$3 = b$

An equation of the line is $y = -5x + 3$.

12. $\left(2, \frac{1}{3}\right)$, (6, 3)

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - \frac{1}{3}}{6 - 2} = \frac{\frac{8}{3}}{4} = \frac{2}{3}$$

Use (6, 3) and $m = \frac{2}{3}$.

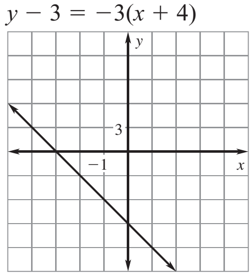
$y = mx + b$

$3 = \frac{2}{3}(6) + b$

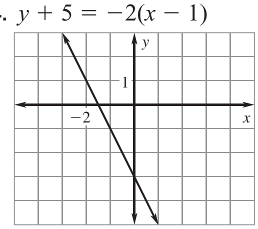
$-1 = b$

An equation of the line is $y = \frac{2}{3}x - 6$.

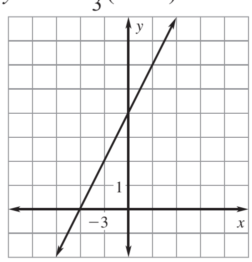
13. $y - 3 = -3(x + 4)$



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



15. $y - 6 = \frac{2}{3}(x - 3)$



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

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{16 - 2}{-2 - (-4)} = \frac{14}{2} = 7$$

Use $(-4, 2)$ and $m = 7$.

$y - y_1 = m(x - x_1)$

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

Use $(-2, 16)$ and $m = 7$.

$y - y_1 = m(x - x_1)$

$y - 16 = 7(x + 2)$

An equation in point-slope form of the line is

$y - 2 = 7(x + 4)$ or $y - 16 = 7(x + 2)$.

17. (3, 9), (−7, 4)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - 9}{-7 - 3} = \frac{-5}{-10} = \frac{1}{2}$

Use (3, 9) and $m = \frac{1}{2}$.

$y - y_1 = m(x - x_1)$

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

Use (−7, 4) and $m = \frac{1}{2}$.

$y - y_1 = m(x - x_1)$

$y - 4 = \frac{1}{2}(x + 7)$

An equation in point-slope form of the line is

$y - 9 = \frac{1}{2}(x - 3)$ or $y - 4 = \frac{1}{2}(x + 7)$.

18. (10, −2), (12, −6)

$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6 - (-2)}{12 - 10} = \frac{-4}{2} = -2$

Use (10, −2) and $m = -2$.

$y - y_1 = m(x - x_1)$

$y + 2 = -2(x - 10)$

Use (12 −6) and $m = -2$.

$y - y_1 = m(x - x_1)$

$y + 6 = -2(x - 12)$

An equation in point slope form of the line is

$y + 2 = -2(x - 10)$ or $y + 6 = -2(x - 12)$.

19. Use (2, 7) and $m = -4$.

$y - y_1 = m(x - x_1)$

$y - 7 = -4(x - 2)$

$y - 7 = -4x + 8$

$4x + y = 15$

An equation of the line in standard form is $4x + y = 15$.

20. Use (5, 11) and $m = 3$

$y - y_1 = m(x - x_1)$

$y - 11 = 3(x - 5)$

$y - 11 = 3x - 15$

$-3x + y = -4$

$3x - y = 4$

An equation of the line in standard form is $3x - y = 4$.

21. (1, −2), (−2, 4)

$m = \frac{4 - (-2)}{-2 - 1} = \frac{6}{-3} = -2$

Use (1, −2) and $m = -2$.

$y - y_1 = m(x - x_1)$

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

$y + 2 = -2x + 2$

$2x + y = 0$

An equation of the line in standard form is $2x + y = 0$.

22. (5, 4), $y = 3x + 5$

The slope of the given line is 3, so use $m = 3$.

$y = mx + b$

$4 = 3(5) + b$

$-11 = b$

$y = 3x - 11$

An equation of the parallel line is $y = 3x - 11$.

23. (−3, −7), $y = -5x - 2$

The slope of the given line is −5, so use $m = -5$.

$y = mx + b$

$-7 = -5(-3) + b$

$-22 = b$

$y = -5x - 22$

An equation of the parallel line is $y = -5x - 22$.

24. (8, −3), $y = \frac{3}{4}x + 5$

The slope of the given line is $\frac{3}{4}$, so use $m = \frac{3}{4}$.

$y = mx + b$

$-3 = \frac{3}{4}(8) + b$

$-9 = b$

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

An equation of the parallel line is $y = \frac{3}{4}x - 9$.

25. (−12, −2), $y = 3x + 2$

The slope of the given line is 3, so use $m = -\frac{1}{3}$.

$y = mx + b$

$-2 = -\frac{1}{3}(-12) + b$

$-6 = b$

$y = -\frac{1}{3}x - 6$

An equation of the perpendicular line is $y = -\frac{1}{3}x - 6$.

26. (15, −11), $y = \frac{3}{5}x - 8$

The slope of the line is $\frac{3}{5}$, so use $m = -\frac{5}{3}$.

$y = mx + b$

$-11 = -\frac{5}{3}(15) + b$

$14 = b$

$y = -\frac{5}{3}x + 14$

An equation of the perpendicular line is $y = -\frac{5}{3}x + 14$.

27. (7, −6), $4x + 6y = 7$

$4x + 6y = 7 \rightarrow y = -\frac{2}{3}x + \frac{7}{6}$

The slope of the line is $-\frac{2}{3}$, so use $m = \frac{3}{2}$.

$y = mx + b$

$-6 = \frac{3}{2}(7) + b$

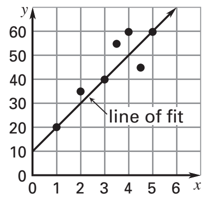
$-6 = \frac{21}{2} + b$

$-\frac{33}{2} = b$

$y = \frac{3}{2}x - \frac{33}{2}$

An equation of the perpendicular line is $y = \frac{3}{2}x - \frac{33}{2}$.

28.



Sample answer: Use (0, 15) and (6, 70).

$$m = \frac{70 - 15}{6 - 0} = \frac{55}{6}$$

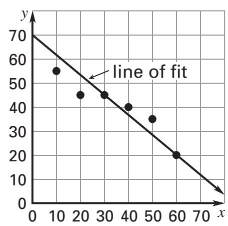
$$y - y_1 = m(x - x_1)$$

$$y - 15 = \frac{55}{6}(x - 0)$$

$$y = \frac{55}{6}x + 15$$

An equation is $y = \frac{55}{6}x + 15$.

29.



Use (10, 55) and (50, 30).

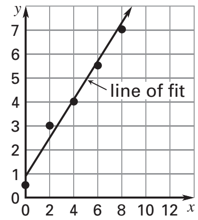
$$m = \frac{30 - 55}{50 - 10} = -\frac{25}{40} = -\frac{5}{8}$$

$$y - y_1 = m(x - x_1)$$

$$y - 55 = -\frac{5}{8}(x - 10)$$

$$y = -\frac{5}{8}x + \frac{245}{4}$$

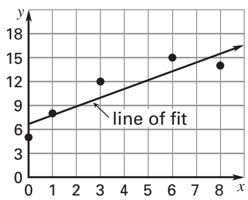
30.



The equation of the best-fitting line is $y = 0.78x + 0.9$.

When $x = 7$, y is about 6.36.

31.



The equation of the best-fitting line is $y = 1.1x + 6.7$.

When $x = 7$, y is about 14.4.