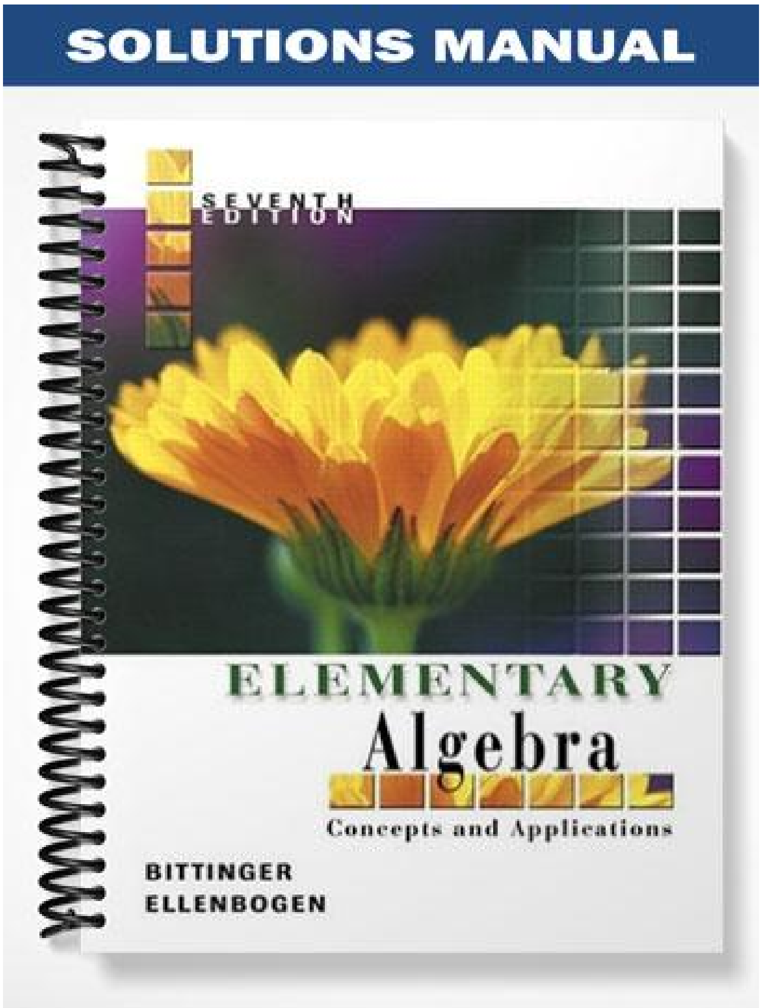

SOLUTIONS MANUAL
SEVENTH EDITION
ELEMENTARY
Algebra
Concepts and Applications
BITTINGER
ELLENBOGEN

Chapter 2

Equations, Inequalities, and Problem Solving

Exercise Set 2.1

1. A solution is a replacement that makes an equation true.

2. The equations $x + 3 = 7$ and $6x = 24$ are equivalent equations.

3. The 9 in $9ab$ is a coefficient.

4. The expressions $3(x - 2)$ and $3x - 6$ are equivalent expressions.

5. The multiplication principle is used to solve $\frac{2}{3} \cdot x = -4$.

6. The addition principle is used to solve $\frac{2}{3} + x = -4$.

7.
$$\begin{aligned} x + 6 &= 23 \\ x + 6 - 6 &= 23 - 6 \quad \text{Subtracting 6 from both sides} \\ x &= 17 \quad \text{Simplifying} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{x + 6 = 23} \\ \hline 17 + 6 & 23 \\ \end{array}$$
$$23 \stackrel{?}{=} 23 \quad \text{TRUE}$$

The solution is 17.

8. 3

9.
$$\begin{aligned} y + 7 &= -4 \\ y + 7 - 7 &= -4 - 7 \quad \text{Subtracting 7 from both sides} \\ t &= -11 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{y + 7 = -4} \\ \hline -11 + 7 & -4 \\ \end{array}$$
$$-4 \stackrel{?}{=} -4 \quad \text{TRUE}$$

The solution is -11.

10. 37

11.
$$\begin{aligned} t + 9 &= -12 \\ t + 9 - 9 &= -12 - 9 \\ t &= -21 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{t + 9 = -12} \\ \hline -21 + 9 & -12 \\ \end{array}$$
$$-12 \stackrel{?}{=} -12 \quad \text{TRUE}$$

The solution is -21.

12. -10

13.
$$\begin{aligned} -6 &= y + 25 \\ -6 - 25 &= y + 25 - 25 \\ -31 &= y \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-6 = y + 25} \\ \hline -6 & -31 + 25 \\ \end{array}$$
$$-6 \stackrel{?}{=} -6 \quad \text{TRUE}$$

The solution is -31.

14. -13

15.
$$\begin{aligned} x - 8 &= 5 \\ x - 8 + 8 &= 5 + 8 \\ x &= 13 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{x - 8 = 5} \\ \hline 13 - 8 & 5 \\ \end{array}$$
$$5 \stackrel{?}{=} 5 \quad \text{TRUE}$$

The solution is 13.

16. 15

17.
$$\begin{aligned} 12 &= -7 + y \\ 7 + 12 &= 7 + (-7) + y \\ 19 &= y \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{12 = -7 + y} \\ \hline 12 & -7 + 19 \\ \end{array}$$
$$12 \stackrel{?}{=} 12 \quad \text{TRUE}$$

The solution is 19.

18. 23

19.
$$\begin{aligned} -5 + t &= -9 \\ 5 + (-5) + t &= 5 + (-9) \\ t &= -4 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-5 + t = -9} \\ \hline -5 + (-4) & -9 \\ \end{array}$$
$$-9 \stackrel{?}{=} -9 \quad \text{TRUE}$$

The solution is -4.

20. -15

21.
$$\begin{aligned} r + \frac{1}{3} &= \frac{8}{3} \\ r + \frac{1}{3} - \frac{1}{3} &= \frac{8}{3} - \frac{1}{3} \\ r &= \frac{7}{3} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{r+\frac{1}{3}=\frac{8}{3}} \\ \hline \frac{7}{3}+\frac{1}{3} & \frac{8}{3} \\ \frac{8}{3} \stackrel{?}{=} & \frac{8}{3} \end{array} \qquad \text{TRUE}$$

The solution is $\frac{7}{3}$.

22. $\frac{1}{4}$

23.
$$\begin{aligned} x+\frac{3}{5} &= -\frac{7}{10} \\ x+\frac{3}{5}-\frac{3}{5} &= -\frac{7}{10}-\frac{3}{5} \\ x &= -\frac{7}{10}-\frac{3}{5}\cdot\frac{2}{2} \\ x &= -\frac{7}{10}-\frac{6}{10} \\ x &= -\frac{13}{10} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{x+\frac{3}{5}=-\frac{7}{10}} \\ \hline -\frac{13}{10}+\frac{3}{5} & -\frac{7}{10} \\ -\frac{13}{10}+\frac{6}{10} & \\ -\frac{7}{10} \stackrel{?}{=} & -\frac{7}{10} \end{array} \qquad \text{TRUE}$$

The solution is $-\frac{13}{10}$.

24.
$$\begin{aligned} x+\frac{2}{3} &= -\frac{5}{6} \\ x &= -\frac{5}{6}-\frac{4}{6}=-\frac{9}{6} \\ x &= -\frac{3}{2} \end{aligned}$$

25.
$$\begin{aligned} x-\frac{5}{6} &= \frac{7}{8} \\ x-\frac{5}{6}+\frac{5}{6} &= \frac{7}{8}+\frac{5}{6} \\ x &= \frac{7}{8}\cdot\frac{3}{3}+\frac{5}{6}\cdot\frac{4}{4} \\ x &= \frac{21}{24}+\frac{20}{24} \\ x &= \frac{41}{24} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{x-\frac{5}{6}=\frac{7}{8}} \\ \hline \frac{41}{24}-\frac{5}{6} & \frac{7}{8} \\ \frac{41}{24}-\frac{20}{24} & \frac{21}{24} \\ \frac{21}{24} \stackrel{?}{=} & \frac{21}{24} \end{array} \qquad \text{TRUE}$$

The solution is $\frac{41}{24}$.

26.
$$\begin{aligned} y-\frac{3}{4} &= \frac{5}{6} \\ y &= \frac{10}{12}+\frac{9}{12} \\ y &= \frac{19}{12} \end{aligned}$$

27.
$$\begin{aligned} -\frac{1}{5}+z &= -\frac{1}{4} \\ \frac{1}{5}-\frac{1}{5}+z &= \frac{1}{5}-\frac{1}{4} \\ z &= \frac{1}{5}\cdot\frac{4}{4}-\frac{1}{4}\cdot\frac{5}{5} \\ z &= \frac{4}{20}-\frac{5}{20} \\ z &= -\frac{1}{20} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-\frac{1}{5}+z=-\frac{1}{4}} \\ \hline -\frac{1}{5}+\left(-\frac{1}{20}\right) & -\frac{1}{4} \\ -\frac{4}{20}+\left(-\frac{1}{20}\right) & -\frac{5}{20} \\ -\frac{5}{20} \stackrel{?}{=} & -\frac{5}{20} \end{array} \qquad \text{TRUE}$$

The solution is $-\frac{1}{20}$.

28.
$$\begin{aligned} -\frac{1}{8}+y &= -\frac{3}{4} \\ y &= -\frac{6}{8}+\frac{1}{8} \\ y &= -\frac{5}{8} \end{aligned}$$

29.
$$\begin{aligned} m+3.9 &= 5.4 \\ m+3.9-3.9 &= 5.4-3.9 \\ m &= 1.5 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{m+3.9=5.4} \\ \hline 1.5+3.9 & 5.4 \\ 5.4 \stackrel{?}{=} & 5.4 \end{array} \qquad \text{TRUE}$$

The solution is 1.5.

30. 3.4

31.
$$\begin{aligned} -9.7 &= -4.7+y \\ 4.7+(-9.7) &= 4.7+(-4.7)+y \\ -5 &= y \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-9.7=-4.7+y} \\ \hline -9.7 & -4.7+(-5) \\ -9.7 \stackrel{?}{=} & -9.7 \end{array} \qquad \text{TRUE}$$

The solution is -5.

32. -10.6

33.
$$\begin{aligned} 5x &= 70 \\ \frac{5x}{5} &= \frac{70}{5} && \text{Dividing both sides by 5} \\ 1 \cdot x &= 14 && \text{Simplifying} \\ x &= 14 && \text{Identity property of 1} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{5x = 70} \\ \hline 5 \cdot 14 & 70 \\ 70 & \overset{?}{=} \; 70 \quad \text{TRUE} \end{array}$$

The solution is 14.

34. 13

35.
$$\begin{aligned} 9t &= 36 \\ \frac{9t}{9} &= \frac{36}{9} && \text{Dividing both sides by 9} \\ 1 \cdot t &= 4 && \text{Simplifying} \\ t &= 4 && \text{Identity property of 1} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{9t = 36} \\ \hline 9 \cdot 4 & 36 \\ 36 & \overset{?}{=} \; 36 \quad \text{TRUE} \end{array}$$

The solution is 4.

36. 12

37.
$$\begin{aligned} 84 &= 7x \\ \frac{84}{7} &= \frac{7x}{7} && \text{Dividing both sides by 7} \\ 12 &= 1 \cdot x \\ 12 &= x \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{84 = 7x} \\ \hline 84 & 7 \cdot 12 \\ 84 & \overset{?}{=} \; 84 \quad \text{TRUE} \end{array}$$

The solution is 12.

38. 8

39.
$$\begin{aligned} -x &= 23 \\ -1 \cdot x &= 23 \\ -1 \cdot (-1 \cdot x) &= -1 \cdot 23 \\ 1 \cdot x &= -23 \\ x &= -23 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-x = 23} \\ \hline -(-23) & 23 \\ 23 & \overset{?}{=} \; 23 \quad \text{TRUE} \end{array}$$

The solution is -23.

40. -100

41. $-t = -8$

The equation states that the opposite of t is the opposite of 8. Thus, $t = 8$. We could also do this exercise as follows.

$$\begin{aligned} -t &= -8 \\ -1(-t) &= -1(-8) && \text{Multiplying both sides by } -1 \\ t &= 8 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-t = -8} \\ \hline -(8) & -8 \\ -8 & \overset{?}{=} \; -8 \quad \text{TRUE} \end{array}$$

The solution is 8.

42. $-68 = -r$

Using the reasoning in Exercise 39, we see that $r = 68$. We can also multiply both sides of the equation by -1 to get this result. The solution is 68.

43.
$$\begin{aligned} 7x &= -49 \\ \frac{7x}{7} &= \frac{-49}{7} \\ 1 \cdot x &= -7 \\ x &= -7 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{7x = -49} \\ \hline 7(-7) & -49 \\ -49 & \overset{?}{=} \; -49 \quad \text{TRUE} \end{array}$$

The solution is -7.

44. -4

45.
$$\begin{aligned} -1.3a &= -10.4 \\ \frac{-1.3a}{-1.3} &= \frac{-10.4}{-1.3} \\ a &= 8 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-1.3a = -10.4} \\ \hline -1.3(8) & -10.4 \\ -10.4 & \overset{?}{=} \; -10.4 \quad \text{TRUE} \end{array}$$

The solution is 8.

46. 6

47.
$$\begin{aligned} \frac{y}{-8} &= 11 \\ -\frac{1}{8} \cdot y &= 11 \\ -8\left(-\frac{1}{8}\right) \cdot y &= -8 \cdot 11 \\ y &= -88 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{y}{-8} = 11} \\ \hline -\frac{88}{-8} & 11 \\ 11 & \overset{?}{=} \; 11 \quad \text{TRUE} \end{array}$$

The solution is -88.

48. 52

49.
$$\begin{aligned} \frac{4}{4} &= 16 \\ \frac{5}{4} \cdot \frac{4}{5}x &= \frac{5}{4} \cdot 16 \\ x &= \frac{5 \cdot \cancel{4} \cdot 4}{\cancel{4} \cdot 1} \\ y &= 20 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{4}{5}x = 16} \\ \hline \frac{4}{5}\cdot 20 & 16 \\ 16 & \stackrel{?}{=} 16 \end{array} \quad \text{TRUE}$$

The solution is 20.

50.
$$\begin{aligned} \frac{3}{4}x &= 27 \\ \frac{4}{3}\cdot\frac{3}{4}x &= \frac{4}{3}\cdot 27 \\ 1\cdot x &= \frac{4\cdot\cancel{3}\cdot 3\cdot 3}{\cancel{3}\cdot 1} \\ x &= 36 \end{aligned}$$

51.
$$\begin{aligned} \frac{-x}{6} &= 9 \\ -\frac{1}{6}\cdot x &= 9 \\ -6\left(-\frac{1}{6}\right)\cdot x &= -6\cdot 9 \\ x &= -54 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{-x}{6} = 9} \\ \hline \frac{-(-54)}{6} & 9 \\ \frac{54}{6} & \\ 9 & \stackrel{?}{=} 9 \end{array} \quad \text{TRUE}$$

The solution is -54.

52.
$$\begin{aligned} \frac{-t}{5} &= 9 \\ -\frac{1}{5}\cdot t &= 9 \\ -5\left(-\frac{1}{5}\right)\cdot t &= -5\cdot 9 \\ t &= -45 \end{aligned}$$

53.
$$\begin{aligned} \frac{1}{9} &= \frac{z}{5} \\ \frac{1}{9} &= \frac{1}{5}\cdot z \\ 5\cdot\frac{1}{9} &= 5\cdot\frac{1}{5}\cdot z \\ \frac{5}{9} &= z \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{1}{9} = \frac{z}{5}} \\ \hline \frac{1}{9} & \frac{5/9}{5} \\ & \frac{5}{9}\cdot\frac{1}{5} \\ \frac{1}{9} & \stackrel{?}{=} \frac{1}{9} \end{array} \quad \text{TRUE}$$

The solution is $\frac{5}{9}$.

54. $\frac{6}{7}$

55. $-\frac{3}{5}r = -\frac{3}{5}$

The solution of the equation is the number that is multiplied by $-\frac{3}{5}$ to get $-\frac{3}{5}$. That number is 1. We could also do this exercise as follows:
$$\begin{aligned} -\frac{3}{5}r &= -\frac{3}{5} \\ -\frac{5}{3}\cdot\left(-\frac{3}{5}r\right) &= -\frac{5}{3}\left(-\frac{3}{5}\right) \\ r &= 1 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-\frac{3}{5}r = -\frac{3}{5}} \\ \hline -\frac{3}{5}\cdot 1 & -\frac{3}{5} \\ -\frac{3}{5} & \stackrel{?}{=} -\frac{3}{5} \end{array} \quad \text{TRUE}$$

The solution is 1.

56.
$$\begin{aligned} -\frac{2}{5}y &= -\frac{4}{15} \\ -\frac{5}{2}\left(-\frac{2}{5}y\right) &= -\frac{5}{2}\cdot\left(-\frac{4}{15}\right) \\ y &= -\frac{\cancel{5}\cdot\cancel{2}\cdot 2}{\cancel{2}\cdot 3\cdot\cancel{5}} \\ y &= \frac{2}{3} \end{aligned}$$

57.
$$\begin{aligned} \frac{-3r}{2} &= -\frac{27}{4} \\ -\frac{3}{2}r &= -\frac{27}{4} \\ -\frac{2}{3}\cdot\left(-\frac{3}{2}r\right) &= -\frac{2}{3}\cdot\left(-\frac{27}{4}\right) \\ r &= \frac{\cancel{2}\cdot\cancel{3}\cdot 3\cdot 3}{\cancel{3}\cdot\cancel{2}\cdot 2} \\ r &= \frac{9}{2} \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{-3r}{2} = -\frac{27}{4}} \\ \hline -\frac{3}{2}\cdot\frac{9}{2} & -\frac{27}{4} \\ -\frac{27}{4} & \stackrel{?}{=} -\frac{27}{4} \end{array} \quad \text{TRUE}$$

The solution is $\frac{9}{2}$.

58.
$$\begin{aligned} \frac{5x}{7} &= -\frac{10}{14} \\ \frac{5}{7}x &= -\frac{10}{14} \\ \frac{7}{5}\cdot\frac{5}{7}x &= \frac{7}{5}\cdot\left(-\frac{10}{14}\right) \\ x &= -\frac{7\cdot 5\cdot 2}{5\cdot 2\cdot 7} \\ x &= -1 \end{aligned}$$

59.
$$\begin{aligned} 4.5+t &= -3.1 \\ 4.5+t-4.5 &= -3.1-4.5 \\ t &= -7.6 \end{aligned}$$
The solution is -7.6.

60.
$$\begin{aligned} \frac{3}{4}x &= 18 \\ x &= \frac{4}{3}\cdot 18 \\ x &= 24 \end{aligned}$$

61.
$$\begin{aligned} -8.2x &= 20.5 \\ \frac{-8.2x}{-8.2} &= \frac{20.5}{-8.2} \\ x &= -2.5 \end{aligned}$$
The solution is -2.5.

62. -5.5

63.
$$\begin{aligned} x-4 &= -19 \\ x-4+4 &= -19+4 \\ x &= -15 \end{aligned}$$
The solution is -15.

64.
$$\begin{aligned} y-6 &= -14 \\ y-6+6 &= -14+6 \\ y &= -8 \end{aligned}$$

65.
$$\begin{aligned} 3+t &= 21 \\ -3+3+t &= -3+21 \\ t &= 18 \end{aligned}$$
The solution is 18.

66.
$$\begin{aligned} 9+t &= 3 \\ -9+9+t &= -9+3 \\ t &= -6 \end{aligned}$$

67.
$$\begin{aligned} -12x &= 72 \\ \frac{-12x}{-12} &= \frac{72}{-12} \\ 1\cdot x &= -6 \\ x &= -6 \end{aligned}$$
The solution is -6.

68.
$$\begin{aligned} -15x &= 105 \\ \frac{-15x}{-15} &= \frac{105}{-15} \\ x &= -7 \end{aligned}$$

69.
$$\begin{aligned} 48 &= -\frac{3}{8}y \\ -\frac{8}{3}\cdot 48 &= -\frac{8}{3}\left(-\frac{3}{8}y\right) \\ -\frac{8\cdot\cancel{3}\cdot 16}{\cancel{3}} &= y \\ -128 &= y \end{aligned}$$
The solution is -128.

70.
$$\begin{aligned} 14 &= t+27 \\ 14-27 &= t+27-27 \\ -13 &= t \end{aligned}$$

71.
$$\begin{aligned} a-\frac{1}{6} &= -\frac{2}{3} \\ a-\frac{1}{6}+\frac{1}{6} &= -\frac{2}{3}+\frac{1}{6} \\ a &= -\frac{4}{6}+\frac{1}{6} \\ a &= -\frac{3}{6} \\ a &= -\frac{1}{2} \end{aligned}$$
The solution is $-\frac{1}{2}$.

72.
$$\begin{aligned} -\frac{x}{7} &= \frac{2}{9} \\ -7\left(-\frac{x}{7}\right) &= -7\cdot\frac{2}{9} \\ x &= -\frac{14}{9} \end{aligned}$$

73.
$$\begin{aligned} -24 &= \frac{8x}{5} \\ -24 &= \frac{8}{5}x \\ \frac{5}{8}(-24) &= \frac{5}{8}\cdot\frac{8}{5}x \\ -\frac{5\cdot\cancel{8}\cdot 3}{\cancel{8}\cdot 1} &= x \\ -15 &= x \end{aligned}$$
The solution is -15.

74.
$$\begin{aligned} \frac{1}{5}+y &= -\frac{3}{10} \\ y &= -\frac{3}{10}-\frac{2}{10} = -\frac{5}{10} \\ y &= -\frac{1}{2} \end{aligned}$$

75.
$$\begin{aligned} -\frac{4}{3}t &= -16 \\ -\frac{3}{4}\left(-\frac{4}{3}t\right) &= -\frac{3}{4}(-16) \\ t &= \frac{3\cdot\cancel{4}\cdot 4}{\cancel{4}} \\ t &= 12 \end{aligned}$$
The solution is 12.

76. $\frac{17}{35} = -x$

The opposite of x is $\frac{17}{35}$, so $x = -\frac{17}{35}$. We could also multiply both sides of the equation by -1 to get this result. The solution is $-\frac{17}{35}$.

77.
$$\begin{aligned} -483.297 &= -794.053 + t \\ -483.297 + 794.053 &= -794.053 + t + 794.053 \\ 310.756 &= t \quad \text{Using a calculator} \end{aligned}$$

The solution is 310.756.

78. Using a calculator we find that the solution is -8655.

79. *Writing Exercise.* For an equation $x + a = b$, add the opposite of a (or subtract a) on both sides of the equation. For an equation $ax = b$, multiply by $1/a$ (or divide by a) on both sides of the equation.

80. *Writing Exercise.* Equivalent expressions have the same value for all possible replacements for the variables. Equivalent equations have the same solution(s).

81.
$$\begin{aligned} & 9 - 2 \cdot 5^2 + 7 \\ = {} & 9 - 2 \cdot 25 + 7 && \text{Simplifying the exponential expression} \\ = {} & 9 - 50 + 7 && \text{Multiplying} \\ = {} & -41 + 7 && \text{Subtracting and} \\ = {} & -34 && \text{Adding from left to right} \end{aligned}$$

82. $10 \div 2 \cdot 3^2 - 4 = 10 \div 2 \cdot 9 - 4 = 5 \cdot 9 - 4 = 45 - 4 = 41$

83.
$$\begin{aligned} & 16 \div (2 - 3 \cdot 2) + 5 \\ = {} & 16 \div (2 - 6) + 5 && \text{Simplifying inside} \\ = {} & 16 \div (-4) + 5 && \text{the parentheses} \\ = {} & -4 + 5 && \text{Dividing} \\ = {} & 1 && \text{Adding} \end{aligned}$$

84. $12 - 5 \cdot 2^3 + 4 \cdot 3 = 12 - 5 \cdot 8 + 4 \cdot 3 = 12 - 40 + 12 = -28 + 12 = -16$

85. *Writing Exercise.* Yes, it will form an equivalent equation by the addition principle. It will not help to solve the equation, however. The multiplication principle should be used to solve the equation.

86. *Writing Exercise.* Since $a - c = b - c$ can be rewritten as $a + (-c) = b + (-c)$, it is not necessary to state a subtraction principle.

87.
$$\begin{aligned} 2x &= x + x \\ 2x &= 2x \quad \text{Adding on the right side} \end{aligned}$$

This is an identity.

88.
$$\begin{aligned} x + 5 + x &= 2x \\ 2x + 5 &= 2x \\ 5 &= 0 \quad \text{Subtracting } 2x \text{ from both sides.} \end{aligned}$$

This is a contradiction.

89.
$$\begin{aligned} 5x &= 0 \\ \frac{5x}{5} &= \frac{0}{5} \\ x &= 0 \end{aligned}$$

The solution is 0.

90.
$$\begin{aligned} 4x - x &= 2x + x \\ 3x &= 3x \end{aligned}$$

This is an identity.

91.
$$\begin{aligned} x + 8 &= 3 + x + 7 \\ x + 8 &= 10 + x \quad \text{Adding on the right side} \\ x + 8 - x &= 10 + x - x \\ 8 &= 10 \end{aligned}$$

This is a contradiction.

92. 0

93.
$$\begin{aligned} 2|x| &= -14 \\ \frac{2|x|}{2} &= -\frac{14}{2} \\ |x| &= -7 \end{aligned}$$

Since the absolute value of a number is always nonnegative, this is a contradiction.

94. $|3x| = 6$

This means that $3x = -6$ or $3x = 6$, or $x = -2$ or $x = 2$.

95.
$$\begin{aligned} mx &= 9.4m \\ \frac{mx}{m} &= \frac{9.4m}{m} \\ x &= 9.4 \end{aligned}$$

The solution is 9.4.

96.
$$\begin{aligned} x - 4 + a &= a \\ x - 4 &= 0 \\ x &= 4 \end{aligned}$$

97.
$$\begin{aligned} cx + 5c &= 7c \\ cx + 5c - 5c &= 7c - 5c \\ cx &= 2c \\ \frac{cx}{c} &= \frac{2c}{c} \\ x &= 2 \end{aligned}$$

The solution is 2.

98.
$$\begin{aligned} c \cdot \frac{21}{a} &= \frac{7cx}{2a} \\ \frac{2a}{7c} \cdot c \cdot \frac{21}{a} &= \frac{2a}{7c} \cdot \frac{7cx}{2a} \\ \frac{2 \cdot \cancel{a} \cdot \cancel{c} \cdot 3 \cdot \cancel{7}}{\cancel{7} \cdot \cancel{c} \cdot \cancel{a}} &= x \\ 6 &= x \end{aligned}$$

99.
$$\begin{aligned} 7 + |x| &= 20 \\ -7 + 7 + |x| &= -7 + 20 \\ |x| &= 13 \end{aligned}$$

x represents a number whose distance from 0 is 13. Thus $x = -13$ or $x = 13$.

100.
$$\begin{aligned} ax - 3a &= 5a \\ ax &= 8a \\ x &= 8 \end{aligned}$$

101.
$$\begin{aligned} t - 3590 &= 1820 \\ t - 3590 + 3590 &= 1820 + 3590 \\ t &= 5410 \\ t + 3590 &= 5410 + 3590 \\ t + 3590 &= 9000 \end{aligned}$$

102.
$$\begin{aligned} n + 268 &= 124 \\ n + 268 - 268 &= 124 - 268 \\ n &= -144 \\ n - 268 &= -144 - 268 \\ n - 268 &= -412 \end{aligned}$$

103. To "undo" the last step, divide 22.5 by 0.3.

$22.5 \div 0.3 = 75$

Now divide 75 by 0.3.

$75 \div 0.3 = 250$

The answer should be 250 not 22.5.

104. *Writing Exercise.* No; -5 is a solution of $x^2 = 25$ but not of $x = 5$.

Exercise Set 2.2

1.
$$\begin{aligned} 3x - 1 &= 7 \\ 3x - 1 + 1 &= 7 + 1 \quad \text{Adding 1 to both sides} \\ 3x &= 7 + 1 \end{aligned}$$

Choice (c) is correct.

2.
$$\begin{aligned} 4x + 5x &= 12 \\ 9x &= 12 \quad \text{Combining like terms} \end{aligned}$$

Choice (e) is correct.

3.
$$\begin{aligned} 6(x - 1) &= 2 \\ 6x - 6 &= 2 \quad \text{Using the distributive law} \end{aligned}$$

Choice (a) is correct.

4.
$$\begin{aligned} 7x &= 9 \\ \frac{7x}{7} &= \frac{9}{7} \quad \text{Dividing both sides by 7} \\ x &= \frac{9}{7} \end{aligned}$$

Choice (f) is correct.

5.
$$\begin{aligned} 4x &= 3 - 2x \\ 4x + 2x &= 3 - 2x + 2x \quad \text{Adding } 2x \text{ to both sides} \\ 4x + 2x &= 3 \end{aligned}$$

Choice (b) is correct.

6.
$$\begin{aligned} 8x - 5 &= 6 - 2x \\ 8x - 5 + 5 &= 6 - 2x + 5 \quad \text{Adding 5 to both sides} \\ 8x &= 6 - 2x + 5 \\ 8x + 2x &= 6 - 2x + 5 + 2x \quad \text{Adding 2 to both sides} \\ 8x + 2x &= 6 + 5 \end{aligned}$$

Choice (d) is correct.

7.
$$\begin{aligned} 2x + 9 &= 25 \\ 2x + 9 - 9 &= 25 - 9 \quad \text{Subtracting 9 from both sides} \\ 2x &= 16 \quad \text{Simplifying} \\ \frac{2x}{2} &= \frac{16}{2} \quad \text{Dividing both sides by 2} \\ x &= 8 \quad \text{Simplifying} \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{2x + 9 = 25} \\ \hline 2 \cdot 8 + 9 & 25 \\ 16 + 9 & \\ 25 & \stackrel{?}{=} 25 \quad \text{TRUE} \end{array}$$

The solution is 8.

8.
$$\begin{aligned} 3x + 6 &= 30 \\ 3x &= 24 \\ x &= 8 \end{aligned}$$

9.
$$\begin{aligned} 6z + 4 &= 46 \\ 6z + 4 - 4 &= 46 - 4 \quad \text{Subtracting 4 from both sides} \\ 6z &= 42 \quad \text{Simplifying} \\ \frac{6z}{6} &= \frac{42}{6} \quad \text{Dividing both sides by 6} \\ z &= 7 \quad \text{Simplifying} \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{6z + 4 = 46} \\ \hline 6 \cdot 7 + 4 & 46 \\ 42 + 4 & \\ 46 & \stackrel{?}{=} 46 \quad \text{TRUE} \end{array}$$

The solution is 7.

10.
$$\begin{aligned} 6z + 3 &= 57 \\ 6z &= 54 \\ z &= 9 \end{aligned}$$

11.
$$\begin{aligned} 7t - 8 &= 27 \\ 7t - 8 + 8 &= 27 + 8 \quad \text{Adding 8 to both sides} \\ 7t &= 35 \\ \frac{7t}{7} &= \frac{35}{7} \quad \text{Dividing both sides by 7} \\ t &= 5 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{7t - 8 = 27} \\ \hline 7 \cdot 5 - 8 & 27 \\ 35 - 8 & \\ 27 & \stackrel{?}{=} 27 \quad \text{TRUE} \end{array}$$

The solution is 5.

12. $$\begin{aligned} 6x-3&=15\\ 6x&=18\\ x&=3 \end{aligned}$$

13. $$\begin{aligned} 3x-9&=33\\ 3x-9+9&=33+9\\ 3x&=42\\ \frac{3x}{3}&=\frac{42}{3}\\ x&=14 \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{3x-9=33} \\ \hline 3\cdot 14-9 & 33 \\ 42-9 & \\ 33 \stackrel{?}{=} 33 & \text{TRUE} \end{array}$$

The solution is 14.

14. $$\begin{aligned} 5x-9&=41\\ 5x&=50\\ x&=10 \end{aligned}$$

15. $$\begin{aligned} 8z+2&=-54\\ 8z+2-2&=-54-2\\ 8z&=-56\\ \frac{8z}{8}&=\frac{-56}{8}\\ z&=-7 \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{8z+2=-54} \\ \hline 8(-7)+2 & -54 \\ -56+2 & \\ -54 \stackrel{?}{=} -54 & \text{TRUE} \end{array}$$

The solution is -7.

16. $$\begin{aligned} 4x+3&=-21\\ 4x&=-24\\ x&=-6 \end{aligned}$$

17. $$\begin{aligned} -91&=9t+8\\ -91-8&=9t+8-8\\ -99&=9t\\ \frac{-99}{9}&=\frac{9t}{9}\\ -11&=t \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{-91=9t+8} \\ \hline -91 & 9(-11)+8 \\ & -99+8 \\ -91 \stackrel{?}{=} -91 & \text{TRUE} \end{array}$$

The solution is -11.

18. $$\begin{aligned} -39&=1+8x\\ -40&=8x\\ -5&=x \end{aligned}$$

19. $$\begin{aligned} 12-4x&=108\\ -12+12-4x&=-12+108\\ -4x&=96\\ \frac{-4x}{-4}&=\frac{96}{-4}\\ x&=-24 \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{12-4x=108} \\ \hline 12-4(-24) & 108 \\ 12+96 & \\ 108 \stackrel{?}{=} 108 & \text{TRUE} \end{array}$$

The solution is -24.

20. $$\begin{aligned} 9-4x&=37\\ -4x&=28\\ x&=-7 \end{aligned}$$

21. $$\begin{aligned} -6z-18&=-132\\ -6z-18+18&=-132+18\\ -6z&=-114\\ \frac{-6z}{-6}&=\frac{-114}{-6}\\ z&=19 \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{-6z-18=-132} \\ \hline -6\cdot 19-18 & -132 \\ -114-18 & \\ -132 \stackrel{?}{=} -132 & \text{TRUE} \end{array}$$

The solution is 19.

22. $$\begin{aligned} -7x-24&=-129\\ -7x&=-105\\ x&=15 \end{aligned}$$

23. $$\begin{aligned} 4x+5x&=10\\ 9x&=10 \quad \text{Combining like terms}\\ \frac{9x}{9}&=\frac{10}{9}\\ x&=\frac{10}{9} \end{aligned}$$

Check:
$$\begin{array}{l|l} \multicolumn{2}{c}{4x+5x=10} \\ \hline 4\cdot\frac{10}{9}+5\cdot\frac{10}{9} & 10 \\ \frac{40}{9}+\frac{50}{9} & \\ \frac{90}{9} & \\ 10 \stackrel{?}{=} 10 & \text{TRUE} \end{array}$$

The solution is $\frac{10}{9}$.

24. $$\begin{aligned} 13&=5x+7x\\ 13&=12x\\ \frac{13}{12}&=x \end{aligned}$$

25. $$\begin{aligned} 32-7x&=11\\ -32+32-7x&=-32+11\\ -7x&=-21\\ \frac{-7x}{-7}&=\frac{-21}{-7}\\ x&=3 \end{aligned}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{32 - 7x = 11} \\ \hline 32 - 7 \cdot 3 & 11 \\ 32 - 21 & \\ 11 & \stackrel{?}{=} 11 \quad \text{TRUE} \end{array}$$

The solution is 3.

26. $27 - 6x = 99$
$$-6x = 72$$
$$x = -12$$

27.
$$\frac{3}{5}t - 1 = 8$$
$$\frac{3}{5}t - 1 + 1 = 8 + 1$$
$$\frac{3}{5}t = 9$$
$$\frac{5}{3} \cdot \frac{3}{5}t = \frac{5}{3} \cdot 9$$
$$t = \frac{5 \cdot \cancel{3} \cdot 3}{\cancel{3} \cdot 1}$$
$$t = 15$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{\frac{3}{5}t - 1 = 8} \\ \hline \frac{3}{5} \cdot 15 - 1 & 8 \\ 9 - 1 & \\ 8 & \stackrel{?}{=} 8 \quad \text{TRUE} \end{array}$$

The solution is 15.

28. $\frac{2}{3}t - 1 = 5$
$$\frac{2}{3}t = 6$$
$$\frac{3}{2} \cdot \frac{2}{3}t = \frac{3}{2} \cdot 6$$
$$t = 9$$

29.
$$4 + \frac{7}{2}x = -10$$
$$-4 + 4 + \frac{7}{2}x = -4 - 10$$
$$\frac{7}{2}x = -14$$
$$\frac{2}{7} \cdot \frac{7}{2}x = \frac{2}{7}(-14)$$
$$x = -\frac{2 \cdot 2 \cdot \cancel{7}}{\cancel{7} \cdot 1}$$
$$x = -4$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{4 + \frac{7}{2}x = -10} \\ \hline 4 + \frac{7}{2}(-4) & -10 \\ 4 - 14 & \\ -10 & \stackrel{?}{=} -10 \quad \text{TRUE} \end{array}$$

The solution is -4.

30. $6 + \frac{5}{4}x = -4$
$$\frac{5}{4}x = -10$$
$$x = \frac{4}{5}(-10)$$
$$x = -8$$

31.
$$-\frac{3a}{4} - 5 = 2$$
$$-\frac{3a}{4} - 5 + 5 = 2 + 5$$
$$-\frac{3a}{4} = 7$$
$$-\frac{4}{3}\left(-\frac{3a}{4}\right) = -\frac{4}{3} \cdot 7$$
$$a = -\frac{28}{3}$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-\frac{3a}{4} - 5 = 2} \\ \hline -\frac{3}{4}\left(-\frac{28}{3}\right) - 5 & 2 \\ 7 - 5 & \\ 2 & \stackrel{?}{=} 2 \quad \text{TRUE} \end{array}$$

The solution is $-\frac{28}{3}$.

32. $-\frac{7a}{8} - 2 = 1$
$$-\frac{7a}{8} = 3$$
$$a = -\frac{8}{7} \cdot 3$$
$$a = -\frac{24}{7}$$

33. $-5z - 6z = -44$
$$-11z = -44 \quad \text{Combining like terms}$$
$$\frac{-11z}{-11} = \frac{-44}{-11}$$
$$z = 4$$

Check:
$$\begin{array}{c|c} \multicolumn{2}{c}{-5z - 6z = -44} \\ \hline -5 \cdot 4 - 6 \cdot 4 & -44 \\ -20 - 24 & \\ -44 & \stackrel{?}{=} -44 \quad \text{TRUE} \end{array}$$

The solution is 4.

34. $-3z + 8z = 45$
$$5z = 45$$
$$z = 9$$

35. $4x - 6 = 6x$
$$-6 = 6x - 4x \quad \text{Subtracting } 4x \text{ from both sides}$$
$$-6 = 2x \quad \text{Simplifying}$$
$$\frac{-6}{2} = \frac{2x}{2} \quad \text{Dividing both sides by 2}$$
$$-3 = x$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{4x-6=6x} \\ \hline 4(-3)-6 & 6(-3) \\ -12-6 & -18 \end{array}$$
$$-18 \stackrel{?}{=} -18 \qquad \text{TRUE}$$

The solution is -3.

36.
$$\begin{aligned} 9y-35&=4y \\ 9y&=4y+35 \\ 5y&=35 \\ y&=7 \end{aligned}$$

37.
$$\begin{aligned} 5y-2&=28-y \\ 5y-2+y&=28-y+y && \text{Adding } y \text{ to both sides} \\ 6y-2&=28 && \text{Simplifying} \\ 6y-2+2&=28+2 && \text{Adding 2 to both sides} \\ 6y&=30 && \text{Simplifying} \\ \frac{6y}{6}&=\frac{30}{6} && \text{Dividing both sides by 6} \\ y&=5 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{5y-2=28-y} \\ \hline 5\cdot 5-2 & 28-5 \\ 25-2 & 23 \end{array}$$
$$23 \stackrel{?}{=} 23 \qquad \text{TRUE}$$

The solution is 5.

38.
$$\begin{aligned} 6x-5&=7+2x \\ 4x&=12 && \text{Simplifying} \\ x&=3 \end{aligned}$$

39.
$$\begin{aligned} 7(2a-1)&=21 \\ 14a-7&=21 && \text{Using the distributive law} \\ 14a&=21+7 && \text{Adding 7} \\ 14a&=28 \\ a&=2 && \text{Dividing by 14} \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{7(2a-1)=21} \\ \hline 7(2\cdot 2-1) & 21 \\ 7(4-1) & \\ 7\cdot 3 & \end{array}$$
$$21 \stackrel{?}{=} 21 \qquad \text{TRUE}$$

The solution is 2.

40.
$$\begin{aligned} 5(2t-2)&=30 \\ 10t-10&=30 \\ 10t&=40 \\ t&=4 \end{aligned}$$

41. We can write $8=8(x+1)$ as $8\cdot 1=8(x+1)$. Then $1=x+1$, or $x=0$. The solution is 0.

42.
$$\begin{aligned} 9&=3(5x-2) \\ 9&=15x-6 \\ 15&=15x \\ 1&=x \end{aligned}$$

43.
$$\begin{aligned} 2(3+4m)-6&=48 \\ 6+8m-6&=48 \\ 8m&=48 && \text{Combining like terms} \\ m&=6 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{2(3+4m)-6=48} \\ \hline 2(3+4\cdot 6)-6 & 48 \\ 2(3+24)-6 & \\ 2\cdot 27-6 & \\ 54-6 & \end{array}$$
$$48 \stackrel{?}{=} 48 \qquad \text{TRUE}$$

The solution is 6.

44.
$$\begin{aligned} 3(5+3m)-8&=88 \\ 15+9m-8&=88 \\ 9m+7&=88 \\ 9m&=81 \\ m&=9 \end{aligned}$$

45.
$$\begin{aligned} 7r-(2r+8)&=32 \\ 7r-2r-8&=32 \\ 5r-8&=32 && \text{Combining like terms} \\ 5r&=32+8 \\ 5r&=40 \\ r&=8 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{7r-(2r+8)=32} \\ \hline 7\cdot 8-(2\cdot 8+8) & 32 \\ 56-(16+8) & \\ 56-24 & \end{array}$$
$$32 \stackrel{?}{=} 32 \qquad \text{TRUE}$$

The solution is 8.

46.
$$\begin{aligned} 6b-(3b+8)&=16 \\ 6b-3b-8&=16 \\ 3b-8&=16 \\ 3b&=24 \\ b&=8 \end{aligned}$$

47.
$$\begin{aligned} 6x+3&=2x+3 \\ 6x-2x&=3-3 \\ 4x&=0 \\ \frac{4x}{4}&=\frac{0}{4} \\ x&=0 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{6x+3=2x+3} \\ \hline 6\cdot 0+3 & 2\cdot 0+3 \\ 0+3 & 0+3 \end{array}$$
$$3 \stackrel{?}{=} 3 \qquad \text{TRUE}$$

The solution is 0.

48.
$$\begin{aligned} 5y+3&=2y+15 \\ 3y&=12 \\ y&=4 \end{aligned}$$

49.
$$\begin{aligned} 5-2x&=3x-7x+25 \\ 5-2x&=-4x+25 \\ 4x-2x&=25-5 \\ 2x&=20 \\ \frac{2x}{2}&=\frac{20}{2} \\ x&=10 \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{5-2x = 3x-7x+25} \\ \hline 5-2\cdot 10 & 3\cdot 10-7\cdot 10+25 \\ 5-20 & 30-70+25 \\ -15 & -40+25 \end{array}$$

$$-15 \stackrel{?}{=} -15 \qquad \text{TRUE}$$

The solution is 10.

50.
$$\begin{aligned} 10-3x &= 2x-8x+40 \\ 10-3x &= -6x+40 \\ 3x &= 30 \\ x &= 10 \end{aligned}$$

51.
$$\begin{aligned} 7+3x-6 &= 3x+5-x \\ 3x+1 &= 2x+5 \quad \text{Combining like terms on each side} \\ 3x-2x &= 5-1 \\ x &= 4 \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{7+3x-6 = 3x+5-x} \\ \hline 7+3\cdot 4-6 & 3\cdot 4+5-4 \\ 7+12-6 & 12+5-4 \\ 19-6 & 17-4 \end{array}$$

$$13 \stackrel{?}{=} 13 \qquad \text{TRUE}$$

The solution is 4.

52.
$$\begin{aligned} 5+4x-7 &= 4x-2-x \\ 4x-2 &= 3x-2 \\ x &= 0 \end{aligned}$$

53.
$$\begin{aligned} 4y-4+y+24 &= 6y+20-4y \\ 5y+20 &= 2y+20 \\ 5y-2y &= 20-20 \\ 3y &= 0 \\ y &= 0 \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{4y-4+y+24 = 6y+20-4y} \\ \hline 4\cdot 0-4+0+24 & 6\cdot 0+20-4\cdot 0 \\ 0-4+0+24 & 0+20-0 \end{array}$$

$$20 \stackrel{?}{=} 20 \qquad \text{TRUE}$$

The solution is 0.

54.
$$\begin{aligned} 5y-10+y &= 7y+18-5y \\ 6y-10 &= 2y+18 \\ 4y &= 28 \\ y &= 7 \end{aligned}$$

55.
$$\begin{aligned} 13-3(2x-1) &= 4 \\ 13-6x+3 &= 4 \\ 16-6x &= 4 \\ -6x &= 4-16 \\ -6x &= -12 \\ x &= 2 \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{13-3(2x-1) = 4} \\ \hline 13-3(2\cdot 2-1) & 4 \\ 13-3(4-1) & \\ 13-3\cdot 3 & \\ 13-9 & \end{array}$$

$$4 \stackrel{?}{=} 4 \qquad \text{TRUE}$$

The solution is 2.

56.
$$\begin{aligned} 5(d+4) &= 7(d-2) \\ 5d+20 &= 7d-14 \\ 34 &= 2d \\ 17 &= d \end{aligned}$$

57.
$$\begin{aligned} 7(5x-2) &= 6(6x-1) \\ 35x-14 &= 36x-6 \\ -14+6 &= 36x-35x \\ -8 &= x \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{7(5x-2) = 6(6x-1)} \\ \hline 7(5(-8)-2) & 6(6(-8)-1) \\ 7(-40-2) & 6(-48-1) \\ 7(-42) & 6(-49) \end{array}$$

$$-294 \stackrel{?}{=} -294 \qquad \text{TRUE}$$

The solution is -8.

58.
$$\begin{aligned} 5(t+3)+9 &= 3(t-2)+6 \\ 5t+15+9 &= 3t-6+6 \\ 5t+24 &= 3t \\ 24 &= -2t \\ -12 &= t \end{aligned}$$

59.
$$\begin{aligned} 19-(2x+3) &= 2(x+3)+x \\ 19-2x-3 &= 2x+6+x \\ 16-2x &= 3x+6 \\ 16-6 &= 3x+2x \\ 10 &= 5x \\ 2 &= x \end{aligned}$$

Check:

$$\begin{array}{r|l} \multicolumn{2}{c}{19-(2x+3) = 2(x+3)+x} \\ \hline 19-(2\cdot 2+3) & 2(2+3)+2 \\ 19-(4+3) & 2\cdot 5+2 \\ 19-7 & 10+2 \end{array}$$

$$12 \stackrel{?}{=} 12 \qquad \text{TRUE}$$

The solution is 2.

60.
$$\begin{aligned} 13-(2c+2) &= 2(c+2)+3c \\ 13-2c-2 &= 2c+4+3c \\ 11-2c &= 5c+4 \\ 7 &= 7c \\ 1 &= c \end{aligned}$$

61. $\frac{5}{4}x+\frac{1}{4}x = 2x+\frac{1}{2}+\frac{3}{4}x$

The number 4 is the least common denominator, so we multiply by 4 on both sides.

$$\begin{aligned} 4\Big(\frac{5}{4}x+\frac{1}{4}x\Big) &= 4\Big(2x+\frac{1}{2}+\frac{3}{4}x\Big) \\ 4\cdot\frac{5}{4}x+4\cdot\frac{1}{4}x &= 4\cdot 2x+4\cdot\frac{1}{2}+4\cdot\frac{3}{4}x \\ 5x+x &= 8x+2+3x \\ 6x &= 11x+2 \\ 6x-11x &= 2 \\ -5x &= 2 \\ \frac{-5x}{-5} &= \frac{2}{-5} \\ x &= -\frac{2}{5} \end{aligned}$$

Check:

$$\frac{5}{4}x+\frac{1}{4}x = 2x+\frac{1}{2}+\frac{3}{4}x$$

$$\begin{array}{r|l}
\frac{5}{4}\left(-\frac{2}{5}\right)+\frac{1}{4}\left(-\frac{2}{5}\right) & 2\left(-\frac{2}{5}\right)+\frac{1}{2}+\frac{3}{4}\left(-\frac{2}{5}\right) \\
-\frac{1}{2}-\frac{1}{10} & -\frac{4}{5}+\frac{1}{2}-\frac{3}{10} \\
-\frac{5}{10}-\frac{1}{10} & -\frac{8}{10}+\frac{5}{10}-\frac{3}{10} \\
-\frac{6}{10} \stackrel{?}{=} & -\frac{6}{10} \qquad \text{TRUE}
\end{array}$$

The solution is $-\frac{2}{5}$.

62. $\frac{7}{8}x-\frac{1}{4}+\frac{3}{4}x = \frac{1}{16}+x$

The least common denominator is 16.

$$\begin{aligned}
14x-4+12x &= 1+16x \\
26x-4 &= 1+16x \\
10x &= 5 \\
x &= \frac{1}{2}
\end{aligned}$$

63. $\frac{2}{3}+\frac{1}{4}t = 6$

The number 12 is the least common denominator, so we multiply by 12 on both sides.

$$\begin{aligned}
12\left(\frac{2}{3}+\frac{1}{4}t\right) &= 12\cdot 6 \\
12\cdot\frac{2}{3}+12\cdot\frac{1}{4}t &= 72 \\
8+3t &= 72 \\
3t &= 72-8 \\
3t &= 64 \\
t &= \frac{64}{3}
\end{aligned}$$

Check:

$$\frac{2}{3}+\frac{1}{4}t = 6$$

$$\begin{array}{r|l}
\frac{2}{3}+\frac{1}{4}\left(\frac{64}{3}\right) & 6 \\
\frac{2}{3}+\frac{16}{3} & \\
\frac{18}{3} & \\
6 \stackrel{?}{=} & 6 \qquad \text{TRUE}
\end{array}$$

The solution is $\frac{64}{3}$.

64. $-\frac{1}{2}+x = -\frac{5}{6}-\frac{1}{3}$

The least common denominator is 6.

$$\begin{aligned}
-3+6x &= -5-2 \\
-3+6x &= -7 \\
6x &= -4 \\
x &= -\frac{2}{3}
\end{aligned}$$

65. $\frac{2}{3}+4t = 6t-\frac{2}{15}$

The number 15 is the least common denominator, so we multiply by 15 on both sides.

$$\begin{aligned}
15\left(\frac{2}{3}+4t\right) &= 15\left(6t-\frac{2}{15}\right) \\
15\cdot\frac{2}{3}+15\cdot 4t &= 15\cdot 6t-15\cdot\frac{2}{15} \\
10+60t &= 90t-2 \\
10+2 &= 90t-60t \\
12 &= 30t \\
\frac{12}{30} &= t \\
\frac{2}{5} &= t
\end{aligned}$$

Check:

$$\frac{2}{3}+4t = 6t-\frac{2}{15}$$

$$\begin{array}{r|l}
\frac{2}{3}+4\cdot\frac{2}{5} & 6\cdot\frac{2}{5}-\frac{2}{15} \\
\frac{2}{3}+\frac{8}{5} & \frac{12}{5}-\frac{2}{15} \\
\frac{10}{15}+\frac{24}{15} & \frac{36}{15}-\frac{2}{15} \\
\frac{34}{15} \stackrel{?}{=} & \frac{34}{15} \qquad \text{TRUE}
\end{array}$$

The solution is $\frac{2}{5}$.

66. $\frac{1}{2}+4m = 3m-\frac{5}{2}$

The least common denominator is 2.

$$\begin{aligned}
1+8m &= 6m-5 \\
2m &= -6 \\
m &= -3
\end{aligned}$$

67. $\frac{1}{3}x+\frac{2}{5} = \frac{4}{15}+\frac{3}{5}x-\frac{2}{3}$

The number 15 is the least common denominator, so we multiply by 15 on both sides.

$$\begin{aligned}
15\left(\frac{1}{3}x+\frac{2}{5}\right) &= 15\left(\frac{4}{15}+\frac{3}{5}x-\frac{2}{3}\right) \\
15\cdot\frac{1}{3}x+15\cdot\frac{2}{5} &= 15\cdot\frac{4}{15}+15\cdot\frac{3}{5}x-15\cdot\frac{2}{3} \\
5x+6 &= 4+9x-10 \\
5x+6 &= -6+9x \\
5x-9x &= -6-6 \\
-4x &= -12 \\
\frac{-4x}{-4} &= \frac{-12}{-4} \\
x &= 3
\end{aligned}$$

Check:

$$\begin{array}{c|c} \frac{1}{3}x+\frac{2}{5} & \frac{4}{15}+\frac{3}{5}x-\frac{2}{3} \\ \hline \frac{1}{3}\cdot 3+\frac{2}{5} & \frac{4}{15}+\frac{3}{5}\cdot 3-\frac{2}{3} \\ 1+\frac{2}{5} & \frac{4}{15}+\frac{9}{5}-\frac{2}{3} \\ \frac{5}{5}+\frac{2}{5} & \frac{4}{15}+\frac{27}{15}-\frac{10}{15} \\ \frac{7}{5} & \frac{21}{15} \end{array}$$

$$\frac{7}{5} \stackrel{?}{=} \frac{7}{5} \qquad \text{TRUE}$$

The solution is 3.

68. $1-\frac{2}{3}y = \frac{9}{5}-\frac{1}{5}y+\frac{3}{5}$

The least common denominator is 15.

$$\begin{aligned} 15-10y &= 27-3y+9 \\ 15-10y &= 36-3y \\ -7y &= 21 \\ y &= -3 \end{aligned}$$

69.

$$\begin{aligned} 2.1x+45.2 &= 3.2-8.4x \\ &\text{Greatest number of decimal places is 1} \\ 10(2.1x+45.2) &= 10(3.2-8.4x) \\ &\text{Multiplying by 10 to clear decimals} \\ 10(2.1x)+10(45.2) &= 10(3.2)-10(8.4x) \\ 21x+452 &= 32-84x \\ 21x+84x &= 32-452 \\ 105x &= -420 \\ x &= \frac{-420}{105} \\ x &= -4 \end{aligned}$$

Check:

$$\begin{array}{c|c} 2.1x+45.2 & 3.2-8.4x \\ \hline 2.1(-4)+45.2 & 3.2-8.4(-4) \\ -8.4+45.2 & 3.2+33.6 \end{array}$$

$$36.8 \stackrel{?}{=} 36.8 \qquad \text{TRUE}$$

The solution is -4.

70.

$$\begin{aligned} 0.91-0.2z &= 1.23-0.6z \\ 91-20z &= 123-60z \\ 40z &= 32 \\ z &= \frac{4}{5}, \text{ or } 0.8 \end{aligned}$$

71.

$$\begin{aligned} 0.76+0.21t &= 0.96t-0.49 \\ &\text{Greatest number of decimal places is 2} \\ 100(0.76+0.21t) &= 100(0.96t-0.49) \\ &\text{Multiplying by 100 to clear decimals} \\ 100(0.76)+100(0.21t) &= 100(0.96t)-100(0.49) \\ 76+21t &= 96t-49 \\ 76+49 &= 96t-21t \\ 125 &= 75t \\ \frac{125}{75} &= t \\ \frac{5}{3} &= t, \text{ or} \\ 1.\overline{6} &= t \end{aligned}$$

The answer checks. The solution is $\frac{5}{3}$, or $1.\overline{6}$.

72.

$$\begin{aligned} 1.7t+8-1.62t &= 0.4t-0.32+8 \\ 170t+800-162t &= 40t-32+800 \\ 8t+800 &= 40t+768 \\ -32t &= -32 \\ t &= 1 \end{aligned}$$

73. $\frac{2}{5}x-\frac{3}{2}x = \frac{3}{4}x+2$

The least common denominator is 20.

$$\begin{aligned} 20\Big(\frac{2}{5}x-\frac{3}{2}x\Big) &= 20\Big(\frac{3}{4}x+2\Big) \\ 20\cdot\frac{2}{5}x-20\cdot\frac{3}{2}x &= 20\cdot\frac{3}{4}x+20\cdot 2 \\ 8x-30x &= 15x+40 \\ -22x &= 15x+40 \\ -22x-15x &= 40 \\ -37x &= 40 \\ \frac{-37x}{-37} &= \frac{40}{-37} \\ x &= -\frac{40}{37} \end{aligned}$$

Check:

$$\begin{array}{c|c} \frac{2}{5}x-\frac{3}{2}x & \frac{3}{4}x+2 \\ \hline \frac{2}{5}\Big(-\frac{40}{37}\Big)-\frac{3}{2}\Big(-\frac{40}{37}\Big) & \frac{3}{4}\Big(-\frac{40}{37}\Big)+2 \\ -\frac{16}{37}+\frac{60}{37} & -\frac{30}{37}+\frac{74}{37} \end{array}$$

$$\frac{44}{37} \stackrel{?}{=} \frac{44}{37} \qquad \text{TRUE}$$

The solution is $-\frac{40}{37}$.

74. $\frac{5}{16}y+\frac{3}{8}y = 2+\frac{1}{4}y$

The least common denominator is 16.

$$\begin{aligned} 5y+6y &= 32+4y \\ 11y &= 32+4y \\ 7y &= 32 \\ y &= \frac{32}{7} \end{aligned}$$

75.
$$\begin{aligned}\frac{1}{3}(2x-1) &= 7\\ 3\cdot\frac{1}{3}(2x-1) &= 3\cdot 7\\ 2x-1 &= 21\\ 2x &= 22\\ x &= 11\end{aligned}$$

Check:
$$\begin{array}{c|c} \frac{1}{3}(2x-1) & = 7 \\ \hline \frac{1}{3}(2\cdot 11-1) & 7 \\ \frac{1}{3}\cdot 21 & \\ 7 & \overset{?}{=} 7 \quad \text{TRUE} \end{array}$$

The solution is 11.

76.
$$\begin{aligned}\frac{4}{3}(5x+1) &= 8\\ \frac{3}{4}\cdot\frac{4}{3}(5x+1) &= \frac{3}{4}\cdot 8\\ 5x+1 &= 6\\ 5x &= 5\\ x &= 1\end{aligned}$$

77.
$$\begin{aligned}\frac{3}{4}(3t-6) &= 9\\ \frac{4}{3}\cdot\frac{3}{4}(3t-6) &= \frac{4}{3}\cdot 9\\ 3t-6 &= 12\\ 3t &= 18\\ t &= 6\end{aligned}$$

Check:
$$\begin{array}{c|c} \frac{3}{4}(3t-6) & = 9 \\ \hline \frac{3}{4}(3\cdot 6-6) & 9 \\ \frac{3}{4}\cdot 12 & \\ 9 & \overset{?}{=} 9 \quad \text{TRUE} \end{array}$$

The solution is 6.

78.
$$\begin{aligned}\frac{3}{2}(2x+5) &= -\frac{15}{2}\\ \frac{2}{3}\cdot\frac{3}{2}(2x+5) &= \frac{2}{3}\left(-\frac{15}{2}\right)\\ 2x+5 &= -5\\ 2x &= -10\\ x &= -5\end{aligned}$$

79.
$$\begin{aligned}\frac{1}{6}\left(\frac{3}{4}x-2\right) &= -\frac{1}{5}\\ 30\cdot\frac{1}{6}\left(\frac{3}{4}x-2\right) &= 30\left(-\frac{1}{5}\right)\\ 5\left(\frac{3}{4}x-2\right) &= -6\\ \frac{15}{4}x-10 &= -6\\ \frac{15}{4}x &= 4\\ 4\cdot\frac{15}{4}x &= 4\cdot 4\\ 15x &= 16\\ x &= \frac{16}{15}\end{aligned}$$

Check:
$$\begin{array}{c|c} \frac{1}{6}\left(\frac{3}{4}x-2\right) & = -\frac{1}{5} \\ \hline \frac{1}{6}\left(\frac{3}{4}\cdot\frac{16}{15}-2\right) & -\frac{1}{5} \\ \frac{1}{6}\left(\frac{4}{5}-2\right) & \\ \frac{1}{6}\left(-\frac{6}{5}\right) & \\ -\frac{1}{5} & \overset{?}{=} -\frac{1}{5} \quad \text{TRUE} \end{array}$$

The solution is $\frac{16}{15}$.

80.
$$\begin{aligned}\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8} &= \frac{3}{8}\\ \frac{7}{12}-\frac{8}{3}x-\frac{5}{8} &= \frac{3}{8}\\ 14-64x-15 &= 9 \qquad \text{Multiplying by 24}\\ -64x-1 &= 9\\ -64x &= 10\\ x &= -\frac{10}{64}\\ x &= -\frac{5}{32}\end{aligned}$$

81.
$$\begin{aligned}0.7(3x+6) &= 1.1-(x+2)\\ 2.1x+4.2 &= 1.1-x-2\\ 10(2.1x+4.2) &= 10(1.1-x-2) \qquad \text{Clearing decimals}\\ 21x+42 &= 11-10x-20\\ 21x+42 &= -10x-9\\ 21x+10x &= -9-42\\ 31x &= -51\\ x &= -\frac{51}{31}\end{aligned}$$

The check is left to the student. The solution is $-\frac{51}{31}$.

82.
$$\begin{aligned} 0.9(2x+8) &= 20-(x+5) \\ 1.8x+7.2 &= 20-x-5 \\ 18x+72 &= 200-10x-50 \\ 18x+72 &= 150-10x \\ 28x &= 78 \\ x &= \frac{78}{28} \\ x &= \frac{39}{14} \end{aligned}$$

83.
$$\begin{aligned} a+(a-3) &= (a+2)-(a+1) \\ a+a-3 &= a+2-a-1 \\ 2a-3 &= 1 \\ 2a &= 1+3 \\ 2a &= 4 \\ a &= 2 \end{aligned}$$

Check: $a+(a-3) = (a+2)-(a+1)$

$$\begin{array}{r|l} 2+(2-3) & (2+2)-(2+1) \\ 2-1 & 4-3 \end{array}$$

$1 \stackrel{?}{=} 1$ TRUE

The solution is 2.

84.
$$\begin{aligned} 0.8-4(b-1) &= 0.2+3(4-b) \\ 0.8-4b+4 &= 0.2+12-3b \\ 8-40b+40 &= 2+120-30b \\ 48-40b &= 122-30b \\ -74 &= 10b \\ -7.4 &= b \end{aligned}$$

85. *Writing Exercise.* No; although it might be easier to use the addition and multiplication principles when an equation does not contain decimals, it is possible to use these principles when an equation does contain decimals.

86. *Writing Exercise.* Since the rules for order of operations tell us to multiply (and divide) before we add (and subtract), we "undo" multiplications and additions in the opposite order when we solve equations. That is, we add or subtract first and then multiply or divide to isolate the variable.

87. $3-5a = 3-5\cdot 2 = 3-10 = -7$

88. $12 \div 4 \cdot 5 = 3 \cdot 5 = 15$

89. $7x-2x = 7(-3)-2(-3) = -21+6 = -15$

90. $-2(8-3(-2)) = -2(8+6) = -2\cdot 14 = -28$

91. *Writing Exercise.* Multiply by 100 to clear decimals. Next multiply by 12 to clear fractions. (These steps could be reversed.) Then proceed as usual. The procedure could be streamlined by multiplying by 1200 to clear decimals and fractions in one step.

92. *Writing Exercise.* First multiply both sides of the equation by $\frac{1}{3}$ to "eliminate" the 3. Then proceed as shown:

$$\begin{aligned} 3x+4 &= -11 \\ \frac{1}{3}(3x+4) &= \frac{1}{3}(-11) \\ x+\frac{4}{3} &= -\frac{11}{3} \\ x &= -\frac{15}{3} \\ x &= -5 \end{aligned}$$

93.
$$\begin{aligned} 8.43x-2.5(3.2-0.7x) &= -3.455x+9.04 \\ 8.43x-8+1.75x &= -3.455x+9.04 \\ 10.18x-8 &= -3.455x+9.04 \\ 10.18x+3.455x &= 9.04+8 \\ 13.635x &= 17.04 \\ x &= 1.\overline{2497}, \text{ or } \frac{1136}{909} \end{aligned}$$

The solution is $1.\overline{2497}$, or $\frac{1136}{909}$.

94. Since we are using a calculator we will not clear the decimals.

$$\begin{aligned} 0.008+9.62x-42.8 &= 0.944x+0.0083-x \\ 9.62x-42.792 &= -0.056x+0.0083 \\ 9.676x &= 42.8003 \\ x &\approx 4.423346424 \end{aligned}$$

95.
$$\begin{aligned} -2[3(x-2)+4] &= 4(5-x)-2x \\ -2[3x-6+4] &= 20-4x-2x \\ -2[3x-2] &= 20-6x \\ -6x+4 &= 20-6x \\ 4 &= 20 \qquad \text{Adding } 6x \text{ to both sides} \end{aligned}$$

This is contradiction.

96.
$$\begin{aligned} 0 &= y-(-14)-(-3y) \\ 0 &= y+14+3y \\ 0 &= 4y+14 \\ -14 &= 4y \\ -\frac{7}{2} &= y \end{aligned}$$

97.
$$\begin{aligned} 3(x+4) &= 3(4+x) \\ 3x+12 &= 12+3x \\ 3x+12-12 &= 12+3x-12 \\ 3x &= 3x \end{aligned}$$

This is an identity.

98.
$$\begin{aligned} 5(x-7) &= 3(x-2)+2x \\ 5x-35 &= 3x-6+2x \\ 5x-35 &= 5x-6 \\ -35 &= -6 \end{aligned}$$

This is a contradiction.

99.
$$\begin{aligned} 2x(x+5)-3(x^2+2x-1) &= 9-5x-x^2 \\ 2x^2+10x-3x^2-6x+3 &= 9-5x-x^2 \\ -x^2+4x+3 &= 9-5x-x^2 \\ 4x+3 &= 9-5x \quad \text{Adding } x^2 \\ 4x+5x &= 9-3 \\ 9x &= 6 \\ x &= \frac{2}{3} \end{aligned}$$

The solution is $\frac{2}{3}$.

100.
$$\begin{aligned} x(x-4) &= 3x(x+1)-2(x^2+x-5) \\ x^2-4x &= 3x^2+3x-2x^2-2x+10 \\ x^2-4x &= x^2+x+10 \\ -4x &= x+10 \\ -5x &= 10 \\ x &= -2 \end{aligned}$$

101.
$$\begin{aligned} 9-3x &= 2(5-2x)-(1-5x) \\ 9-3x &= 10-4x-1+5x \\ 9-3x &= 9+x \\ 9-9 &= x+3x \\ 0 &= 4x \\ 0 &= x \end{aligned}$$

The solution is 0.

102.
$$\begin{aligned} 2(7-x)-20 &= 7x-3(2+3x) \\ 14-2x-20 &= 7x-6-9x \\ -2x-6 &= -2x-6 \end{aligned}$$

This is an identity.

103. $[7-2(8\div(-2))]x=0$

Since $7-2(8\div(-2))\neq 0$ and the product on the left side of the equation is 0, then x must be 0.

104.
$$\begin{aligned} \frac{x}{14}-\frac{5x+2}{49} &= \frac{3x-4}{7} \\ 98\left(\frac{x}{14}-\frac{5x+2}{49}\right) &= 98\left(\frac{3x-4}{7}\right) \\ 98\cdot\frac{x}{14}-98\left(\frac{5x+2}{49}\right) &= 42x-56 \\ 7x-10x-4 &= 42x-56 \\ -3x-4 &= 42x-56 \\ -4+56 &= 42x+3x \\ 52 &= 45x \\ \frac{52}{45} &= x \end{aligned}$$

105.
$$\begin{aligned} \frac{5x+3}{4}+\frac{25}{12} &= \frac{5+2x}{3} \\ 12\left(\frac{5x+3}{4}+\frac{25}{12}\right) &= 12\left(\frac{5+2x}{3}\right) \\ 12\left(\frac{5x+3}{4}\right)+12\cdot\frac{25}{12} &= 4(5+2x) \\ 3(5x+3)+25 &= 4(5+2x) \\ 15x+9+25 &= 20+8x \\ 15x+34 &= 20+8x \\ 7x &= -14 \\ x &= -2 \end{aligned}$$

The solution is -2.

Exercise Set 2.3

1. We substitute 10 for t and calculate M.

$M=\frac{1}{5}t=\frac{1}{5}\cdot 10=2$

The storm is 2 miles away.

2. $P=I\cdot V=30\cdot 115=3450$ watts.

3. We substitute 21,345 for n and calculate f.

$f=\frac{n}{15}=\frac{21,345}{15}=1423$

There are 1423 full-time equivalent students.

4. $w=\frac{344}{24}=\frac{43}{3}$ m/cycle, or $14.\overline{3}$ m/cycle

5. Substitute 1800 for a and calculate B.

$B=30a=30\cdot 1800=54,000$

The minimum furnace output is 54,000 Btu's.

6. $D=\frac{c}{w}=\frac{84}{8}=10.5$ calories/oz

7. Substitute 1 for t and calculate n.

$$\begin{aligned} n &= 0.5t^4+3.45t^3-96.65t^2+347.7t \\ &= 0.5(1)^4+3.45(1)^3-96.65(1)^2+347.7(1) \\ &= 0.5+3.45-96.65+347.7 \\ &= 255 \end{aligned}$$

255 mg of ibuprofen remains in the bloodstream.

8. $N=7^2-7=49-7=42$

9.
$$\begin{aligned} A &= bh \\ \frac{A}{h} &= \frac{bh}{h} \quad \text{Dividing both sides by } h \\ \frac{A}{h} &= b \end{aligned}$$

10. $\frac{A}{b}=h$

11.
$$\begin{aligned} d &= rt \\ \frac{d}{t} &= \frac{rt}{t} \quad \text{Dividing both sides by } t \\ \frac{d}{t} &= r \end{aligned}$$

12. $\dfrac{d}{r} = t$

13.
$$I = Prt$$
$$\frac{I}{rt} = \frac{Prt}{rt} \quad \text{Dividing both sides by } rt$$
$$\frac{I}{rt} = P$$

14. $\dfrac{I}{Pr} = t$

15.
$$H = 65 - m$$
$$H + m = 65 \quad \text{Adding } m \text{ to both sides}$$
$$m = 65 - H \quad \text{Subtracting } H \text{ from both sides}$$

16. $d + 64 = h$

17.
$$P = 2l + 2w$$
$$P - 2w = 2l + 2w - 2w \quad \text{Subtracting } 2w \text{ from both sides}$$
$$P - 2w = 2l$$
$$\frac{P - 2w}{2} = \frac{2l}{2} \quad \text{Dividing both sides by 2}$$
$$\frac{P - 2w}{2} = l, \text{ or}$$
$$\frac{P}{2} - w = l$$

18. $\dfrac{P}{2} - w = l$
$$P = 2l + 2w$$
$$P - 2l = 2w$$
$$\frac{P - 2l}{2} = w, \text{ or}$$
$$\frac{P}{2} - l = w$$

19.
$$A = \pi r^2$$
$$\frac{A}{r^2} = \frac{\pi r^2}{r^2}$$
$$\frac{A}{r^2} = \pi$$

20. $\dfrac{A}{\pi} = r^2$

21.
$$A = \frac{1}{2}bh$$
$$2A = 2 \cdot \frac{1}{2}bh \quad \text{Multiplying both sides by 2}$$
$$2A = bh$$
$$\frac{2A}{b} = \frac{bh}{b} \quad \text{Dividing both sides by } h$$
$$\frac{2A}{b} = h$$

22.
$$A = \frac{1}{2}bh$$
$$2A = bh$$
$$\frac{2A}{h} = b$$

23.
$$E = mc^2$$
$$\frac{E}{c^2} = \frac{mc^2}{c^2} \quad \text{Dividing both sides by } c^2$$
$$\frac{E}{c^2} = m$$

24. $\dfrac{E}{m} = c^2$

25.
$$Q = \frac{c + d}{2}$$
$$2Q = 2 \cdot \frac{c + d}{2} \quad \text{Multiplying both sides by 2}$$
$$2Q = c + d$$
$$2Q - c = c + d - c \quad \text{Subtracting } c \text{ from both sides}$$
$$2Q - c = d$$

26.
$$Q = \frac{p - q}{2}$$
$$2Q = p - q$$
$$2Q + q = p$$

27.
$$A = \frac{a + b + c}{3}$$
$$3A = 3 \cdot \frac{a + b + c}{3} \quad \text{Multiplying both sides by 3}$$
$$3A = a + b + c$$
$$3A - a - c = a + b + c - a - c \quad \text{Subtracting } a \text{ and } c \text{ from both sides}$$
$$3A - a - c = b$$

28.
$$A = \frac{a + b + c}{3}$$
$$3A = a + b + c$$
$$3A - a - b = c$$

29.
$$M = \frac{A}{s}$$
$$s \cdot M = s \cdot \frac{A}{s} \quad \text{Multiplying both sides by } s$$
$$sM = A$$

30.
$$P = \frac{ab}{c}$$
$$Pc = ab$$
$$\frac{Pc}{a} = b$$

31.
$$F = \frac{9}{5}C + 32$$
$$F - 32 = \frac{9}{5}C$$
$$\frac{5}{9}(F - 32) = \frac{5}{9} \cdot \frac{9}{5}C$$
$$\frac{5}{9}(F - 32) = C$$

32.
$$M = \frac{3}{7}n + 29$$
$$M - 29 = \frac{3}{7}n$$
$$\frac{7}{3}(M - 29) = n$$

33.
$$A = at + bt$$
$$A = t(a+b) \quad \text{Factoring}$$
$$\frac{A}{a+b} = t \quad \text{Dividing both sides by } a+b$$

34.
$$S = rx + sx$$
$$S = x(r+s)$$
$$\frac{S}{r+s} = x$$

35.
$$A = \frac{1}{2}ah + \frac{1}{2}bh$$
$$2A = 2\left(\frac{1}{2}ah + \frac{1}{2}bh\right)$$
$$2A = ah + bh$$
$$2A = h(a+b)$$
$$\frac{2A}{a+b} = h$$

36.
$$A = P + Prt$$
$$A = P(1+rt)$$
$$\frac{A}{1+rt} = P$$

37.
$$R = r + \frac{400(W-L)}{N}$$
$$N \cdot R = N\left(r + \frac{400(W-L)}{N}\right)$$
Multiplying both sides by N
$$NR = Nr + 400(W-L)$$
$$NR = Nr + 400W - 400L$$
$$NR + 400L = Nr + 400W \quad \text{Adding } 400L \text{ to both sides}$$
$$400L = Nr + 400W - NR \quad \text{Adding } -NR \text{ to both sides}$$
$$L = \frac{Nr + 400W - NR}{400}$$

38.
$$S = \frac{360A}{\pi r^2}$$
$$Sr^2 = \frac{360A}{\pi}$$
$$r^2 = \frac{360A}{\pi S}$$

39. *Writing Exercise.* Given the formula for converting Celsius temperature C to Fahrenheit temperature F, solve for C. This yields a formula for converting Fahrenheit temperature to Celsius temperature.

40. *Writing Exercise.* Answers may vary. A walker who knows how far and how long she walks each day wants to know her average speed each day.

41. 0.79(38.4)0

One factor is 0, so the product is 0.

42. 9.18

43.
$$20 \div (-4) \cdot 2 - 3$$
$$= -5 \cdot 2 - 3 \quad \text{Dividing and}$$
$$= -10 - 3 \quad \text{multiplying from left to right}$$
$$= -13 \quad \text{Subtracting}$$

44. $5|8-(2-7)| = 5|8-(-5)| = 5|13| = 5 \cdot 13 = 65$

45. *Writing Exercise.* Answers may vary. A decorator wants to have a carpet cut for a bedroom. The perimeter of the room is 54 ft and its length is 15 ft. How wide should the carpet be?

46. *Writing Exercise.* Since h occurs on both sides of the formula, Lea has not solved the formula for h. The letter being solved for should be alone on one side of the equation with no occurrence of that letter on the other side.

47.
$$K = 19.18w + 7h - 9.52a + 92.4$$
$$2627 = 19.18(82) + 7(185) - 9.52a + 92.4$$
$$2627 = 1572.76 + 1295 - 9.52a + 92.4$$
$$2627 = 2960.16 - 9.52a$$
$$-333.16 = -9.52a$$
$$35 \approx a$$

The man is about 35 years old.

48. To find the number of 100 meter rises in h meters we divide: $\frac{h}{100}$. Then

$$T = t - \frac{h}{100}.$$

Note that 12 km = 12 km $\cdot \frac{1000 \text{ m}}{1 \text{ km}} = 12,000$ m.

Thus, we have

$$T = t - \frac{h}{100},\ 0 \le h \le 12,000.$$

49. First we substitute 54 for A and solve for s to find the length of a side of the cube.

$$A = 6s^2$$
$$54 = 6s^2$$
$$9 = s^2$$
$$3 = s \quad \text{Taking the positive square root}$$

Now we substitute 3 for s in the formula for the volume of a cube and compute the volume.

$$V = s^3 = 3^3 = 27$$

The volume of the cube is 27 in^3.

50.
$$\begin{aligned} 8\text{ ft} &= 96\text{ in.} \\ 700 &= \frac{96g^2}{800} \\ 560,000 &= 96g^2 \\ \frac{560,000}{96} &= g^2 \\ 76.4 &\approx g \end{aligned}$$

The girth is about 76.4 in.

51.
$$\begin{aligned} c &= \frac{w}{a} \cdot d \\ ac &= a \cdot \frac{w}{a} \cdot d \\ ac &= wd \\ a &= \frac{wd}{c} \end{aligned}$$

52.
$$\begin{aligned} \frac{y}{z} \div \frac{z}{t} &= 1 \\ \frac{y}{z} \cdot \frac{t}{z} &= 1 \\ \frac{yt}{z^2} &= 1 \\ \frac{z^2}{t} \cdot \frac{yt}{z^2} &= \frac{z^2}{t} \cdot 1 \\ y &= \frac{z^2}{t} \end{aligned}$$

53.
$$\begin{aligned} ac &= bc + d \\ ac - bc &= d \\ c(a-b) &= d \\ c &= \frac{d}{a-b} \end{aligned}$$

54.
$$\begin{aligned} qt &= r(s+t) \\ qt &= rs + rt \\ qt - rt &= rs \\ t(q-r) &= rs \\ t &= \frac{rs}{q-r} \end{aligned}$$

55.
$$\begin{aligned} 3a &= c - a(b+d) \\ 3a &= c - ab - ad \\ 3a + ab + ad &= c \\ a(3+b+d) &= c \\ a &= \frac{c}{3+b+d} \end{aligned}$$

56. We subtract the minimum output for a well-insulated house with a square feet from the minimum output for a poorly-insulated house with a square feet. Let S represent the number of BTU's saved.

$$\begin{aligned} S &= 50a - 30a \\ S &= 20a \end{aligned}$$

57. $K = 917 + 6(2.2046w + 0.3937h - a)$

$K = 917 + 13.2276w + 2.3622h - 6a$

58. $K = 19.18\left(\frac{w}{2.2046}\right) + 7\left(\frac{h}{0.3937}\right) - 9.52a + 92.4$

$K = 8.70w + 17.78h - 9.52a + 92.4$

Exercise Set 2.4

1. "What percent of 57 is 23?" can be translated as $n \cdot 57 = 23$, so choice (d) is correct.

2. "What percent of 23 is 57?" can be translated as $n \cdot 23 = 57$, so choice (c) is correct.

3. "23 is 57% of what number?" can be translated as $23 = 0.57y$, so choice (e) is correct.

4. "57 is 23% of what number?" can be translated as $57 = 0.23y$, so choice (b) is correct.

5. "57 is what percent of 23?" can be translated as $n \cdot 23 = 57$, so choice (c) is correct.

6. "23 is what percent of 57?" can be translated as $n \cdot 57 = 23$, so choice (d) is correct.

7. "What is 23% of 57?" can be translated as $a = (0.23)57$, so choice (f) is correct.

8. "What is 57% of 23?" can be translated as $a = (0.57)23$, so choice (a) is correct.

9. "23% of what number is 57?" can be translated as $57 = 0.23y$, so choice (b) is correct.

10. "57% of what number is 23?" can be translated as $23 = 0.57y$, so choice (e) is correct.

11. $30\% = 30.0\%$

30%   0.30.0

Move the decimal point 2 places to the left.

$30\% = 0.30$, or 0.3

12. $70\% = 0.70$, or 0.7

13. $2\% = 2.0\%$

2%   0.02.0

Move the decimal point 2 places to the left.

$2\% = 0.02$

14. $7\% = 0.07$

15. $77\% = 77.0\%$

77%   0.77.0

Move the decimal point 2 places to the left.

$77\% = 0.77$

16. $66\% = 0.66$

17. $9\% = 9.0\%$

9% $\quad 0.09.0$

Move the decimal point 2 places to the left.

$9\% = 0.09$

18. $30\% = 0.30$, or 0.3

19. 62.58% $\quad 0.62.58$

Move the decimal point 2 places to the left.

$62.58\% = 0.6258$

20. $39.81\% = 0.3981$

21. 0.7% $\quad 0.00.7$

Move the decimal point 2 places to the left.

$0.7\% = 0.007$

22. $0.3\% = 0.003$

23. $125\% = 125.0\%$ $\quad 1.25.0$

Move the decimal point 2 places to the left.

$125\% = 1.25$

24. $150\% = 1.50$, or 1.5

25. 0.64

First move the decimal point	0.64.
two places to the right;	
then write a % symbol:	64%

26. $0.41 = 41\%$

27. 0.106

First move the decimal point	0.10.6
two places to the right;	
then write a % symbol:	10.6%

28. $0.67 = 67\%$

29. 0.42

First move the decimal point	0.42.
two places to the right;	
then write a % symbol:	42%

30. $0.19 = 19\%$

31. 0.9

First move the decimal point	0.90.
two places to the right;	
then write a % symbol:	90%

32. $0.88 = 88\%$

33. 0.0049

First move the decimal point	0.00.49
two places to the right;	
then write a % symbol:	0.49%

34. $0.0008 = 0.08\%$

35. 1.08

First move the decimal point	1.08.
two places to the right;	
then write a % symbol:	108%

36. $1.05 = 105\%$

37. 2.3

First move the decimal point	2.30.
two places to the right;	
then write a % symbol:	230%

38. $2.9 = 290\%$

39. $\frac{4}{5}$ $\quad \left(\text{Note: } \frac{4}{5} = 0.8\right)$

Move the decimal point	0.80.
two places to the right;	
then write a % symbol:	80%

40. $\frac{3}{4} = 0.75 = 75\%$

41. $\frac{8}{25}$ $\quad \left(\text{Note: } \frac{8}{25} = 0.32\right)$

First move the decimal point	0.32.
two places to the right;	
then write a % symbol:	32%

42. $\frac{3}{8} = 0.375 = 37.5\%$

43. ***Translate.***

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & 68 & \text{is} & 17? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ y & \cdot & 68 & = & 17 \end{array}$$

We solve the equation and then convert to percent notation.

$$y \cdot 68 = 17$$
$$y = \frac{17}{68}$$
$$y = 0.25 = 25\%$$

The answer is 25%.

44. Solve and convert to percent notation:

$$x \cdot 150 = 39$$
$$x = 0.26 = 26\%$$

45. ***Translate.***

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & 125 & \text{is} & 30? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ y & \cdot & 125 & = & 30 \end{array}$$

We solve the equation and then convert to percent notation.

$$y \cdot 125 = 30$$
$$y = \frac{30}{125}$$
$$y = 0.24 = 24\%$$

The answer is 24%.

46. Solve and convert to percent notation:

$$\begin{aligned} x\cdot 300 &= 57\\ x &= 0.19 = 19\% \end{aligned}$$

47. ***Translate***.

$$\begin{array}{ccccc} 14 & \text{is} & 30\% & \text{of} & \underbrace{\text{what number}}?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ 14 & = & 30\% & \cdot & y \end{array}$$

We solve the equation.

$$\begin{aligned} 14 &= 0.3y \qquad (30\% = 0.3)\\ \frac{14}{0.3} &= y\\ 46.\overline{6} &= y \end{aligned}$$

The answer is $46.\overline{6}$, or $46\frac{2}{3}$, or $\frac{140}{3}$.

48. Solve: $54 = 24\%\cdot x$
$225 = x$

49. ***Translate***.

$$\begin{array}{ccccc} 0.3 & \text{is} & 12\% & \text{of} & \underbrace{\text{what number}}?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ 0.3 & = & 12\% & \cdot & y \end{array}$$

We solve the equation.

$$\begin{aligned} 0.3 &= 0.12y \qquad (12\% = 0.12)\\ \frac{0.3}{0.12} &= y\\ 2.5 &= y \end{aligned}$$

The answer is 2.5.

50. Solve: $7 = 175\%\cdot x$
$4 = x$

51. ***Translate***.

$$\begin{array}{ccccc} \underbrace{\text{What number}} & \text{is} & 35\% & \text{of} & 240?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ y & = & 35\% & \cdot & 240 \end{array}$$

We solve the equation.

$$\begin{aligned} y &= 0.35\cdot 240 \qquad (35\% = 0.35)\\ y &= 84 \qquad \text{Multiplying} \end{aligned}$$

The answer is 84.

52. Solve: $x = 1\%\cdot 1,000,000$
$x = 10,000$

53. ***Translate***.

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & 60 & \text{is} & 75?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ y & \cdot & 60 & = & 75 \end{array}$$

We solve the equation and then convert to percent notation.

$$\begin{aligned} y\cdot 60 &= 75\\ y &= \frac{75}{60}\\ y &= 1.25 = 125\% \end{aligned}$$

The answer is 125%.

54. Any number is 100% of itself, so 70 is 100% of 70. We could also do this exercise as follows:

Solve and convert to percent notation:

$$\begin{aligned} x\cdot 70 &= 70\\ x &= 1 = 100\% \end{aligned}$$

55. ***Translate***.

$$\begin{array}{ccccc} \text{What} & \text{is} & 2\% & \text{of} & 40?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ x & = & 2\% & \cdot & 40 \end{array}$$

We solve the equation.

$$\begin{aligned} x &= 0.02\cdot 40 \qquad (2\% = 0.02)\\ x &= 0.8 \qquad \text{Multiplying} \end{aligned}$$

The answer is 0.8.

56. Solve: $z = 40\%\cdot 2$
$z = 0.8$

57. Observe that 25 is half of 50. Thus, the answer is 0.5, or 50%. We could also do this exercise by translating to an equation.

Translate.

$$\begin{array}{ccccc} 25 & \text{is} & \underbrace{\text{what percent}} & \text{of} & 50?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ 25 & = & y & \cdot & 50 \end{array}$$

We solve the equation and convert to percent notation.

$$\begin{aligned} 25 &= y\cdot 50\\ \frac{25}{50} &= y\\ 0.5 &= y,\ \text{or } 50\% = y \end{aligned}$$

The answer is 50%.

58. Solve: $8 = 2\%\cdot x$
$400 = x$

59. First we reword and translate, letting p represent the price of a dog.

$$\begin{array}{ccccc} \text{What} & \text{is} & 3\% & \text{of} & \$6600?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ p & = & 0.03 & \cdot & 6600 \end{array}$$

$$p = 0.03\cdot 6600 = 198$$

The price of the dog is $198.

60. Solve: $f = 0.36\cdot \$6600$
$f = \$2376$

61. First we reword and translate, letting v represent the amount spent on veterinary care.

$$\begin{array}{ccccc} \text{What} & \text{is} & 24\% & \text{of} & \$6600?\\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow\\ v & = & 0.24 & \cdot & 6600 \end{array}$$

$$v = 0.24\cdot 6600 = 1584$$

Veterinarian expenses are $1584.

62. Solve: $g = 0.17\cdot \$6600$
$g = \$1122$

63. First we reword and translate, letting s represent the cost of supplies.

$$\begin{array}{ccccc} \text{What is} & 8\% & \text{of} & \$6600? \\ \downarrow\ \ \downarrow & \downarrow & \downarrow & \downarrow \\ s\ \ = & 0.08 & \cdot & 6600 \end{array}$$

$s = 0.08 \cdot 6600 = 528$

The cost of supplies is \$528.

64. Solve: $t = 0.06 \cdot \$6600$
$t = \$396$

65. First we reword and translate, letting c represent the number of credits Frank has completed.

$$\begin{array}{ccccc} \text{What} & \text{is} & 60\% & \text{of} & 125? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & = & 0.6 & \cdot & 125 \end{array}$$

$c = 0.6 \cdot 125 = 75$

Frank has completed 75 credits.

66. Solve: $c = 0.2 \cdot 125$
$c = 25$ credits

67. First we reword and translate, letting b represent the number of at-bats.

$$\begin{array}{ccccc} 194 & \text{is} & 31\% & \text{of} & \underbrace{\text{what number}}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 194 & = & 0.31 & \cdot & b \end{array}$$

$\frac{194}{0.31} = b$

$626 \approx b$

Ichiro Suzuki had 626 at-bats.

68. Solve: $357 = 62.5\% \cdot p$
$571 \approx p$

69. a) First we reword and translate, letting p represent the unknown percent.

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & \$25 & \text{is} & \$4? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ p & \cdot & 25 & = & 4 \end{array}$$

$\frac{p \cdot 25}{25} = \frac{4}{25}$

$p = 0.16 = 16\%$

The tip was 16% of the cost of the meal.

b) We add to find the total cost of the meal, including tip:

$\$25 + \$4 = \$29$

70. a) Solve: $12.76 = p \cdot 58$
$0.22 = p$

The tip was 22% of the meal's cost.

b) $\$58 + \$12.76 = \$70.76$

71. To find the percent of cars manufactured in the U.S., we first reword and translate, letting p represent the unknown percent.

$$\begin{array}{ccccc} \underbrace{\text{6.0 million}} & \text{is} & \underbrace{\text{what percent}} & \text{of} & \underbrace{\text{8.3 million}}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 6.0 & = & p & \cdot & 8.3 \end{array}$$

$\frac{6.0}{8.3} = p$

$0.72 \approx p$

$72\% \approx p$

About 72% of the cars were manufactured in the U.S.

To find the percent of cars manufactured outside the U.S., we subtract:

$100\% - 72\% = 28\%.$

About 28% of the cars were manufactured outside the U.S.

72. Solve: $1.0 = p \cdot 2.3$
$0.43 \approx p$

About 43% of foreign cars were manufactured in Japan.

We subtract to find the number of foreign cars manufactured outside Japan:

$100\% - 43\% = 57\%$

About 57% of foreign cars were manufactured outside Japan.

73. Let $I =$ the amount of interest Sarah will pay. Then we have:

$$\begin{array}{ccccc} I & \text{is} & 8\% & \text{of} & \$3500. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ I & = & 0.08 & \cdot & \$3500 \end{array}$$

$I = \$280$

Sarah will pay \$280 interest.

74. Let $I =$ the amount of interest Paul will pay.

Solve: $I = 7\% \cdot \$2400$
$I = \$168$

75. If $n =$ the number of women who had babies in good or excellent health, we have:

$$\begin{array}{ccccc} n & \text{is} & 95\% & \text{of} & 300. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ n & = & 0.95 & \cdot & 300 \end{array}$$

$n = 285$

285 women had babies in good or excellent health.

76. Let $n =$ the number of women who had babies in good or excellent health.

Solve: $n = 8\% \cdot 300$
$n = 24$ women

77. A self-employed person must earn 120% as much as a non-self-employed person. Let $a =$ the amount Joy would need to earn, in dollars per hour, on her own for a comparable income. Then we have:

$$\begin{array}{lllll} a & \text{is} & 120\% & \text{of} & \$15. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ a & = & 1.2 & \cdot & 15 \\ a & = & 18 & & \end{array}$$

Joy would need to earn \$18 per hour on her own.

78. Let $a =$ the amount Ray would need to earn, in dollars per hour, on his own for a comparable income.

Solve: $a = 1.2(\$12)$

$a = \$14.40$ per hour

79. First we subtract to find the amount of the increase.

$$40,000 - 16,000 = 24,000$$

Then we reword and translate.

$$\begin{array}{cccccc} \underbrace{\text{What percent}} & \text{of} & 16,000 & \text{is} & 24,000? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ p & \cdot & 16,000 & = & 24,000 \end{array}$$

$$\frac{p \cdot 16,000}{16,000} = \frac{24,000}{16,000}$$

$$p = 1.5 = 150\%$$

The number of USA Triathlon members increased by 150% from 1993 to 2002.

80. Amount of decrease: $9.79 - 9.78 = 0.01$

Solve: $p \cdot 9.78 = 0.01$

$p \approx 0.001$

The record decreased by about 0.1%.

81. When the sales tax is 5%, the total amount paid is 105% of the cost of the merchandise. Let $c =$ the cost of the merchandise. Then we have:

$$\begin{array}{ccccc} \$37.80 & \text{is} & 105\% & \text{of} & c. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 37.80 & = & 1.05 & \cdot & c \end{array}$$

$$\frac{37.80}{1.05} = c$$

$$36 = c$$

The price of the merchandise was \$36.

82. Let $c =$ the cost of the building materials.

Solve: $\$987 = 105\% \cdot c$

$\$940 = c$

83. When the sales tax is 5%, the total amount paid is 105% of the cost of the merchandise. Let $c =$ the amount the school group owes, or the cost of the software without tax. Then we have:

$$\begin{array}{ccccc} \$157.41 & \text{is} & 106\% & \text{of} & c. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 157.41 & = & 1.06 & \cdot & c \end{array}$$

$$\frac{157.41}{1.06} = c$$

$$148.5 = c$$

The school group owes \$148.50.

84. Let $a =$ the amount the charity should pay.

Solve: $\$145.90 = 105\% \cdot a$

$a \approx \$138.95$

85. First we reword and translate.

$$\begin{array}{ccccc} \text{What} & \text{is} & 16.5\% & \text{of} & 191? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ a & = & 0.165 & \cdot & 191 \end{array}$$

Solve. We convert 16.5% to decimal notation and multiply.

$$a = 0.165 \cdot 191$$

$$a = 31.515 \approx 31.5$$

About 31.5 lb of the author's body weight is fat.

86. Let $a =$ the area of Arizona.

Solve: $a = 19\% \cdot 586,400$

$a = 111,416 \text{ mi}^2$

87. Let $b =$ the number of brochures the business can expect to be opened and read. Then we have:

$$\begin{array}{ccccc} b & \text{is} & 78\% & \text{of} & 9500. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ b & = & 0.78 & \cdot & 9500 \\ b & = & 7410 & & \end{array}$$

The business can expect 7410 brochures to be opened and read.

88. Let $p =$ the percent of people who will catch the cold.

Solve: $56 = p \cdot 800$

$p = 0.07$, or 7%

89. The number of calories in a serving of Light Style Bread is 85% of the number of calories in a serving of regular bread. Let $c =$ the number of calories in a serving of regular bread. Then we have:

$$\begin{array}{ccccc} \underbrace{140 \text{ calories}} & \text{is} & 85\% & \text{of} & c. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 140 & = & 0.85 & \cdot & c \end{array}$$

$$\frac{140}{0.85} = c$$

$$165 \approx c$$

There are about 165 calories in a serving of regular bread.

90. Let $f =$ the number of calories of fat in a serving of the leading shortbread cookie.

Solve: $35 = 60\% \cdot f$

$f \approx 58$ calories

91. *Writing Exercise.* The book is marked up \$30. Since Campus Bookbuyers paid \$30 for the book, this is a 100% markup.

92. *Writing Exercise.* \$12 is $13\frac{1}{3}\%$ of \$90. He would be considered to be stingy, since the standard tip rate is 15%.

93. Let n represent "some number." Then we have $n + 5$, or $5 + n$.

94. Let w represent Tino's weight. Then we have $w - 4$.

95. $8 \cdot 2a$, or $2a \cdot 8$.

96. Let m and n represent the numbers. Then we have $mn+1$, or $1 + mn$.

97. *Writing Exercise.* No; although over 26% of home burglaries occur between Memorial Day and Labor Day, it is possible that a larger percent occur during a different season. For example, it is possible that 30% of home burglaries occur between Labor Day and Thanksgiving.

98. *Writing Exercise.* No; Erin paid 75% of the original price and was offered credit for 125% of this amount, not to be used on sale items. Now 125% of 75% is 93.75%, so Erin would have a credit of 93.75% of the original price. Since this credit can be applied only to non-sale items, she has less purchasing power than if the amount she paid were refunded and she could spend it on sale items.

99. Let $p =$ the population of Bardville. Then we have:

$$\begin{array}{ccccccc} 1332 & \text{is} & 15\% & \text{of} & 48\% & \text{of} & \underbrace{\text{the population.}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1332 & = & 0.15 & \cdot & 0.48 & \cdot & p \end{array}$$

$$\frac{1332}{0.15(0.48)} = p$$

$$18,500 = p$$

The population of Bardville is 18,500.

100. Since 6 ft $= 6 \times 1$ ft $= 6 \times 12$ in. $= 72$ in., we can express 6 ft 4 in. as 72 in. $+$ 4 in., or 76 in.

Solve: $96.1\% \cdot b = 76$

$$b \approx 79$$

Note that 79 in. $=$ 72 in. $+$ 7 in. $=$ 6 ft 7 in.

Jaraan's final adult height will be about 6 ft 7 in.

101. Since 4 ft $= 4 \times 1$ ft $= 4 \times 12$ in. $= 48$ in., we can express 4 ft 8 in. as 48 in. $+$ 8 in., or 56 in. We reword and translate. Let $a =$ Dana's final adult height.

$$\begin{array}{ccccc} \underbrace{56 \text{ in.}} & \text{is} & 84.4\% & \text{of} & \underbrace{\text{adult height}}. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 56 & = & 0.844 & \cdot & a \end{array}$$

$$\frac{56}{0.844} = \frac{0.844 \cdot a}{0.844}$$

$$66 \approx a$$

Note that 66 in. $=$ 60 in. $+$ 6 in. $=$ 5 ft 6 in. Dana's final adult height will be about 5 ft 6 in.

102. The birth rate dropped by $14.1 - 13.9$, or 0.2 babies per 1000 women.

Solve: $0.2 = p \cdot 14.1$

$$0.014 \approx p$$

The birth rate dropped by about 1.4% between 2001 and 2002.

Assuming that the birth rate will continue to decline by the same percentage each year, we estimate the birth rates for 2003 and 2004 as follows. If the birth rate drops by about 1.4% per year, then the birth rate in a given year is $(100 - 1.4)\%$, or 98.6%, of the rate in the previous year. Thus for 2003 we have:

$$\begin{array}{ccccc} \text{What} & \text{is} & 98.6\% & \text{of} & 13.9? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ r & = & 0.986 & \cdot & 13.9 \end{array}$$

$$r \approx 13.7$$

We estimate that the birth rate was about 13.7 per 1000 women in 2003.

For 2004 we have:

$$\begin{array}{ccccc} \text{What} & \text{is} & 98.6\% & \text{of} & 13.7? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ r & = & 0.986 & \cdot & 13.7 \end{array}$$

$$r \approx 13.5$$

We estimate that the birth rate was about 13.5 per 1000 women in 2004.

103. Using the formula for the area A of a rectangle with length l and width w, $A = l \cdot w$, we first find the area of the photo.

$$A = 8 \text{ in.} \times 6 \text{ in.} = 48 \text{ in}^2$$

Next we find the area of the photo that will be visible using a mat intended for a 5-in. by 7-in. photo.

$$A = 7 \text{ in.} \times 5 \text{ in.} = 35 \text{ in}^2$$

Then the area of the photo that will be hidden by the mat is $48 \text{ in}^2 - 35 \text{ in}^2$, or 13 in^2.

We find what percentage of the area of the photo this represents.

$$\begin{array}{ccccc} \underbrace{\text{What percent}} & \text{of} & \underbrace{48 \text{ in}^2} & \text{is} & \underbrace{13 \text{ in}^2}? \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ p & \cdot & 48 & = & 13 \end{array}$$

$$\frac{p \cdot 48}{48} = \frac{13}{48}$$

$$p \approx 0.27$$

$$p \approx 27\%$$

The mat will hide about 27% of the photo.

104. *Writing Exercise.* The end result is the same either way. If s is the original salary, the new salary after a 5% raise followed by an 8% raise is $1.08(1.05s)$. If the raises occur in the opposite order, the new salary is $1.05(1.08s)$. By the commutative and associative laws of multiplication we see that these are equal. However, it would be better to receive the 8% raise first, because this increase yields a higher new salary the first year than a 5% raise.

105. *Writing Exercise.* Suppose Herb has x dollars of taxable income. If he makes a \$50 tax-deductible contribution, then he pays tax of $0.3(x - \$50)$, or $0.3x - \$15$ and his assets are reduced by $0.3x - \$15 + \$50$, or $0.3x + \$35$. If he makes a \$40 non-tax-deductible contribution, he pays tax of $0.3x$ and his assets are reduced by $0.3x + \$40$. Thus, it costs him less to make a \$50 tax-deductible contribution.

Exercise Set 2.5

1. ***Familiarize***. Let $n =$ the number. Then two fewer than ten times the number is $10n - 2$.

Translate.

$$\begin{array}{ccc} \underbrace{\text{Two fewer than ten times a number}} & \text{is} & 78. \\ \downarrow & \downarrow & \downarrow \\ 10n - 2 & = & 78 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} 10n-2&=78 \\ 10n&=80 &&\text{Adding 2} \\ n&=8 &&\text{Dividing by 10} \end{aligned}$$

Check. Ten times 8 is 80 and two fewer than 80 is 78. The answer checks.

State. The number is 8.

2. Let $n =$ the number.

Solve: $2n-3=19$
$n=11$

3. ***Familiarize***. Let $a =$ the number. Then "five times the sum of 3 and some number" translates to $5(a+3)$.

Translate.

$$\begin{array}{ccc} \underbrace{\text{Five times the sum of 3 and some number}} & \text{is} & 70. \\ \downarrow & \downarrow & \downarrow \\ 5(a+3) & = & 70 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} 5(a+3)&=70 \\ 5a+15&=70 &&\text{Using the distributive law} \\ 5a&=55 &&\text{Subtracting 15} \\ a&=11 &&\text{Dividing by 5} \end{aligned}$$

Check. The sum of 3 and 11 is 14, and $5\cdot 14=70$. The answer checks.

State. The number is 11.

4. Let $x =$ the number.

Solve: $2(x+4)=34$
$x=13$

5. ***Familiarize***. Let $p =$ the regular price of the shoes. At 15% off, Amy paid $(100-15)\%$, or 85% of the regular price.

Translate.

$$\begin{array}{ccccc} \$72.25 & \text{is} & 85\% & \text{of} & \underbrace{\text{the regular price.}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 72.25 & = & 0.85 & \cdot & p \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} 72.25&=0.85p \\ \frac{72.25}{0.85}&=p &&\text{Dividing both sides by 0.85} \\ 85&=p \end{aligned}$$

Check. 85% of \$85, or 0.85(\$85), is \$72.25. The answer checks.

State. The regular price was \$85.

6. Let $p =$ the regular price of the CD player. The sale price is 80% of the regular price.

Solve: $\$72=0.8p$
$\$90=p$

7. ***Familiarize***. Let $c =$ the price of the graphing calculator itself. When the sales tax rate is 5%, the tax paid on the calculator is 5% of c, or $0.05c$.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Price of calculator}} & \text{plus} & \underbrace{\text{sales tax}} & \text{is} & \$89.25. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ c & + & 0.05b & = & 89.25 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} c+0.05c&=89.25 \\ 1.05c&=89.25 \\ c&=\frac{89.25}{1.05} \\ c&=85 \end{aligned}$$

Check. 5% of \$85, or 0.05(\$85), is \$4.25 and \$85 + \$4.25 is \$89.25, the total cost. The answer checks.

State. The graphing calculator itself cost \$85.

8. Let $p =$ the price of the printer itself.

Solve: $p+0.06p=\$100.70$
$p=\$95$

9. ***Familiarize***. Let $d =$ Kouros' distance, in miles, from the start after 8 hr. Then the distance from the finish line is $2d$.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Distance from start}} & \text{plus} & \underbrace{\text{distance from finish}} & \text{is} & \text{188 mi.} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ d & + & 2d & = & 188 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} d+2d&=188 \\ 3d&=188 \\ d&=\frac{188}{3},\ \text{or } 62\frac{2}{3} \end{aligned}$$

Check. If Kouros is $\frac{188}{3}$ mi from the start, then he is $2\cdot\frac{188}{3}$, or $\frac{376}{3}$ mi from the finish. Since $\frac{188}{3}+\frac{376}{3}=\frac{564}{3}=188$, the total distance run, the answer checks.

State. Kouros had run approximately $62\frac{2}{3}$ mi.

10. Let $d =$ the distance from Nome, in miles. Then $2d =$ the distance from Anchorage.

Solve: $d+2d=1049$
$d=\frac{1049}{3}$

The musher has traveled $2\cdot\frac{1049}{3}$, or $699\frac{1}{3}$ mi.

11. ***Familiarize***. Let $d =$ the distance Wheldon had traveled, in miles, at the given point. This is the distance from the start. The corresponding distance from the finish was $300-d$ miles.

Translate. We reword and translate.

$$\begin{array}{ccccc} \underbrace{\text{Distance to finish}} & \text{plus} & \underbrace{\text{80 mi more}} & \text{was} & \underbrace{\text{distance to start.}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 300-d & + & 80 & = & d \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} 300-d+80 &= d \\ 380-d &= d \\ 380 &= 2d \\ 190 &= d \end{aligned}$$

Check. If Wheldon was 190 mi from the start, he was $300-190$, or 110 mi, from the finish. Since 190 is 80 more than 110, the answer checks.

State. Wheldon had traveled 190 mi at the given point.

12. Let $d =$ the distance Gordon had traveled, in miles, at the given point.

Solve: $\quad 400-d+70 = d$
$\qquad\qquad d = 235$ mi

13. ***Familiarize***. Let $n =$ the number of Joan's apartment. Then $n+1 =$ the number of her next-door neighbor's apartment.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Joan's number}} & \text{plus} & \underbrace{\text{neighbor's number}} & \text{is} & 2409. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ n & + & (n+1) & = & 2409 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} n+(n+1) &= 2409 \\ 2n+1 &= 2409 \\ 2n &= 2408 \\ n &= 1204 \end{aligned}$$

If Joan's apartment number is 1204, then her next-door neighbor's number is $1204+1$, or 1205.

Check. 1204 and 1205 are consecutive numbers whose sum is 2409. The answer checks.

State. The apartment numbers are 1204 and 1205.

14. Let $n =$ the number of Vincent's apartment. Then $n+1 =$ the number of his next-door neighbor's apartment.

Solve: $\quad n+(n+1) = 1419$
$\qquad\qquad n = 709$

The apartment numbers are 709 and $709+1$, or 709 and 710.

15. ***Familiarize***. Let $n =$ the smaller house number. Then $n+2 =$ the larger number.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Smaller number}} & \text{plus} & \underbrace{\text{larger number}} & \text{is} & 794. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ n & + & (n+2) & = & 794 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} n+(n+2) &= 794 \\ 2n+2 &= 794 \\ 2n &= 792 \\ n &= 396 \end{aligned}$$

If the smaller number is 396, then the larger number is $396+2$, or 398.

Check. 396 and 398 are consecutive even numbers and $396+398 = 794$. The answer checks.

State. The house numbers are 396 and 398.

16. Let $n =$ the smaller house number. Then $n+2 =$ the larger number.

Solve: $\quad n+(n+2) = 572$
$\qquad\qquad n = 285$

The house numbers are 285 and $285+2$, or 285 and 287.

17. ***Familiarize***. Let $x =$ the first page number. Then $x+1 =$ the second page number, and $x+2 =$ the third page number.

Translate.

$$\begin{array}{ccc} \underbrace{\text{The sum of three consecutive page numbers}} & \text{is} & 60. \\ \downarrow & \downarrow & \downarrow \\ x+(x+1)+(x+2) & = & 60 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} x+(x+1)+(x+2) &= 60 \\ 3x+3 &= 60 && \text{Combining like terms} \\ 3x &= 57 && \text{Subtracting 3 from both sides} \\ x &= 19 && \text{Dividing both sides by 3} \end{aligned}$$

If x is 19, then $x+1$ is 20 and $x+2 = 21$.

Check. 19, 20, and 21 are consecutive integers, and $19+20+21 = 60$. The result checks.

State. The page numbers are 19, 20, and 21.

18. Let x, $x+1$ and $x+2$ represent the first, second, and third page numbers, respectively.

Solve: $\quad x+(x+1)+(x+2) = 99$
$\qquad\qquad x = 32$

If x is 32, then $x+1$ is 33, and $x+2$ is 34. The page numbers are 32, 33, and 34.

19. ***Familiarize***. Let $g =$ the groom's age. Then $g+19 =$ the bride's age.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Groom's age}} & \text{plus} & \underbrace{\text{bride's age}} & \text{is} & 185. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ g & + & (g+19) & = & 185 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} g+(g+19) &= 185 \\ 2g+19 &= 185 \\ 2g &= 166 \\ g &= 83 \end{aligned}$$

If g is 83, then $g+19$ is 102.

Check. 102 is 19 more than 83, and $83+102 = 185$. The answer checks.

State. The groom was 83 yr old, and the bride was 102 yr old.

20. Let $m =$ the man's age. Then $m - 2 =$ the woman's age.

Solve: $m + (m - 2) = 190$
$m = 96$

If m is 96, then $m - 2$ is 94. The man was 96 yr old, and the woman was 94 yr old.

21. ***Familiarize***. Let $a =$ the amount spent to remodel bathrooms, in billions of dollars. Then $2a =$ the amount spent to remodel kitchens. The sum of these two amounts is \$35 billion.

Translate.

$$\underbrace{\begin{array}{c}\text{Amount}\\ \text{spent on}\\ \text{bathrooms}\end{array}}_{\substack{\downarrow\\ a}} \quad \underset{\substack{\downarrow\\ +}}{\text{plus}} \quad \underbrace{\begin{array}{c}\text{amount}\\ \text{spent on}\\ \text{kitchens}\end{array}}_{\substack{\downarrow\\ 2a}} \quad \underset{\substack{\downarrow\\ =}}{\text{is}} \quad \underset{\substack{\downarrow\\ 35}}{\$35} \text{ billion.}$$

Carry out. We solve the equation.

$$\begin{aligned} a + 2a &= 35 \\ 3a &= 35 \qquad \text{Combining like terms} \\ a &= \frac{35}{3}, \text{ or } 11\frac{2}{3} \end{aligned}$$

If $a = \dfrac{35}{3}$, then $2a = 2 \cdot \dfrac{35}{3} = \dfrac{70}{3} = 23\dfrac{1}{3}$.

Check. $\dfrac{70}{3}$ is twice $\dfrac{35}{3}$, and $\dfrac{35}{3} + \dfrac{70}{3} = \dfrac{105}{3} = 35$. The answer checks.

State. \$$11\dfrac{2}{3}$ billion was spent to remodel bathrooms, and \$$23\dfrac{1}{3}$ billion was spent to remodel kitchens.

22. Let $d =$ the amount spent on dresses, in billions of dollars. Then $d + 0.2 =$ the amount spent on blouses.

Solve: $d + (d + 0.2) = 12.8$
$d = 6.3$

If $d = 6.3$, then $d + 0.2 = 6.3 + 0.2 = 6.5$. Then \$6.3 billion was spent on dresses and \$6.5 billion was spent on blouses.

23. ***Familiarize.*** The page numbers are consecutive integers. If we let $x =$ the smaller number, then $x + 1 =$ the larger number.

Translate. We reword the problem.

$$\underbrace{\text{First integer}}_{\substack{\downarrow\\ x}} \quad \underset{\substack{\downarrow\\ +}}{+} \quad \underbrace{\text{Second integer}}_{\substack{\downarrow\\ (x+1)}} \quad \underset{\substack{\downarrow\\ =}}{=} \underset{\substack{\downarrow\\ 281}}{281}$$

Carry out. We solve the equation.

$$\begin{aligned} x + (x + 1) &= 281 \\ 2x + 1 &= 281 \quad \text{Combining like terms} \\ 2x &= 280 \quad \text{Adding } -1 \text{ on both sides} \\ x &= 140 \quad \text{Dividing on both sides by 2} \end{aligned}$$

Check. If $x = 140$, then $x + 1 = 141$. These are consecutive integers, and $140 + 141 = 281$. The answer checks.

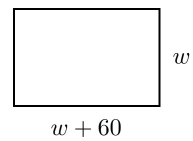
State. The page numbers are 140 and 141.

24. Let $s =$ the length of the shortest side, in mm. Then $s + 2$ and $s + 4$ represent the lengths of the other two sides.

Solve: $s + (s + 2) + (s + 4) = 195$
$s = 63$

If $s = 63$, then $s + 2 = 65$ and $s + 4 = 67$. The lengths of the sides are 63 mm, 65 mm, and 67 mm.

25. ***Familiarize***. We draw a picture. Let $w =$ the width of the rectangle, in feet. Then $w + 60 =$ the length.



The perimeter is twice the length plus twice the width, and the area is the product of the length and the width.

Translate.

$$\underbrace{\begin{array}{c}\text{Twice the}\\ \text{length}\end{array}}_{\substack{\downarrow\\ 2(w+60)}} \quad \underset{\substack{\downarrow\\ +}}{\text{plus}} \quad \underbrace{\begin{array}{c}\text{twice the}\\ \text{width}\end{array}}_{\substack{\downarrow\\ 2w}} \quad \underset{\substack{\downarrow\\ =}}{\text{is}} \quad \underbrace{520 \text{ ft}}_{\substack{\downarrow\\ 520}}.$$

Carry out. We solve the equation.

$$\begin{aligned} 2(w + 60) + 2w &= 520 \\ 2w + 120 + 2w &= 520 \\ 4w + 120 &= 520 \\ 4w &= 400 \\ w &= 100 \end{aligned}$$

Then $w + 60 = 100 + 60 = 160$, and the area is $160 \text{ ft} \cdot 100 \text{ ft} = 16,000 \text{ ft}^2$.

Check. The length, 160 ft, is 60 ft more than the width, 100 ft. The perimeter is $2 \cdot 160$ ft $+ 2 \cdot 100$ ft, or 320 ft + 200 ft, or 520 ft. We can check the area by doing the calculation again. The answer checks.

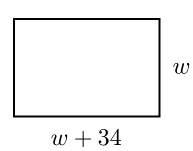
State. The length is 160 ft, the width is 100 ft, and the area is 16,000 ft^2.

26. Let $l =$ the length, in miles. Then $l - 90 =$ the width.

Solve: $2l + 2(l - 90) = 1280$
$l = 365$

Then $l - 90 = 275$. The length of the state is 365 mi, and the width is 275 mi.

27. ***Familiarize***. We draw a picture. Let $w =$ the width of the court, in feet. Then $w + 34 =$ the length.



The perimeter is twice the length plus twice the width.

Translate.

$$\begin{array}{ccccc}
\underbrace{\text{Twice the length}} & \text{plus} & \underbrace{\text{twice the width}} & \text{is} & \underbrace{268\text{ ft}}. \\
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
2(w+34) & + & 2w & = & 268
\end{array}$$

Carry out. We solve the equation.

$$\begin{aligned}
2(w+34)+2w &= 268 \\
2w+68+2w &= 268 \\
4w+68 &= 268 \\
4w &= 200 \\
w &= 50
\end{aligned}$$

Then $w+34 = 50+34 = 84$.

Check. The length, 84 ft, is 34 ft more than the width, 50 ft. The perimeter is $2\cdot 84\text{ ft}+2\cdot 50\text{ ft} = 168\text{ ft}+100\text{ ft} = 268\text{ ft}$. The answer checks.

State. The length of the court is 84 ft, and the width is 50 ft.

28. Let w = the width, in meters. Then $w+4$ = the length.

Solve: $2w+2(w+4) = 92$
$w = 21$

Then $w+4 = 21+4 = 25$. The length of the garden is 25 m, and the width is 21 m.

29. ***Familiarize***. Let w = the width, in inches. Then $2w$ = the length. The perimeter is twice the length plus twice the width. We express $10\frac{1}{2}$ as 10.5.

Translate.

$$\begin{array}{ccccc}
\underbrace{\text{Twice the length}} & \text{plus} & \underbrace{\text{twice the width}} & \text{is} & \underbrace{10.5\text{ in.}} \\
\downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\
2\cdot 2w & + & 2w & = & 10.5
\end{array}$$

Carry out. We solve the equation.

$$\begin{aligned}
2\cdot 2w+2w &= 10.5 \\
4w+2w &= 10.5 \\
6w &= 10.5 \\
w &= 1.75, \text{ or } 1\frac{3}{4}
\end{aligned}$$

Then $2w = 2(1.75) = 3.5$, or $3\frac{1}{2}$.

Check. The length, $3\frac{1}{2}$ in., is twice the width, $1\frac{3}{4}$ in.
The perimeter is $2\left(3\frac{1}{2}\text{ in.}\right)+2\left(1\frac{3}{4}\text{ in.}\right) =$
$7\text{ in.}+3\frac{1}{2}\text{ in.} = 10\frac{1}{2}$ in. The answer checks.

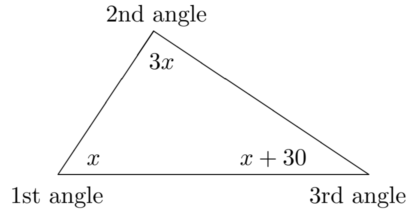
State. The actual dimensions are $3\frac{1}{2}$ in. by $1\frac{3}{4}$ in.

30. Let w = the width, in feet. Then $3w+6$ = the length.

Solve: $2(3w+6)+2w = 124$
$w = 14$

Then $3w+6 = 3\cdot 14+6 = 42+6 = 48$. The billboard is 48 ft long and 14 ft wide.

31. ***Familiarize.*** We draw a picture. We let x = the measure of the first angle. Then $3x$ = the measure of the second angle, and $x+30$ = the measure of the third angle.



Recall that the measures of the angles of any triangle add up to 180°.

Translate.

$$\begin{array}{cccc}
\underbrace{\text{Measure of first angle}} & + & \underbrace{\text{measure of second angle}} & + \\
\downarrow & \downarrow & \downarrow & \downarrow \\
x & + & 3x & +
\end{array}$$

$$\begin{array}{ccc}
\underbrace{\text{measure of third angle}} & \text{is} & \underbrace{180^\circ}. \\
\downarrow & \downarrow & \downarrow \\
x+30 & = & 180
\end{array}$$

Carry out. We solve the equation.

$$\begin{aligned}
x+3x+(x+30) &= 180 \\
5x+30 &= 180 \\
5x &= 150 \\
x &= 30
\end{aligned}$$

Possible answers for the angle measures are as follows:

First angle: $x = 30^\circ$

Second angle: $3x = 3(30)^\circ = 90^\circ$

Third angle: $x+30^\circ = 30^\circ+30^\circ = 60^\circ$

Check. Consider 30°, 90°, and 60°. The second angle is three times the first, and the third is 30° more than the first. The sum of the measures of the angles is 180°. These numbers check.

State. The measure of the first angle is 30°, the measure of the second angle is 90°, and the measure of the third angle is 60°.

32. Let x = the measure of the first angle. Then $4x$ = the measure of the second angle, and $x+4x-45$, or $5x-45$ = the measure of the third angle.

Solve: $x+4x+(5x-45) = 180$
$x = 22.5$

If x is 22.5, then $4x$ is 90, and $5x-45$ is 67.5, so the measures of the first, second, and third angles are 22.5°, 90°, and 67.5°, respectively.

33. ***Familiarize***. Let x = the measure of the first angle. Then $3x$ = the measure of the second angle, and $x+3x+10 = 4x+10$ = the measure of the third angle. Recall that the sum of the measures of the angles of a triangle is 180°.

Translate.

$$\underbrace{\begin{matrix}\text{Measure of}\\ \text{first angle}\end{matrix}}_{x} \underbrace{+}_{+} \underbrace{\begin{matrix}\text{measure of}\\ \text{second angle}\end{matrix}}_{3x} \underbrace{+}_{+} \underbrace{\begin{matrix}\text{measure of}\\ \text{third angle}\end{matrix}}_{(4x+10)} \underbrace{\text{is}}_{=} \underbrace{180^\circ}_{180}.$$

Carry out. We solve the equation.

$$\begin{aligned} x + 3x + (4x + 10) &= 180 \\ 8x + 10 &= 180 \\ 8x &= 170 \\ x &= 21.25 \end{aligned}$$

If x is 21.25, then $3x$ is 63.75, and $4x + 10$ is 95.

Check. Consider 21.25°, 63.75°, and 95°. The second is three times the first, and the third is 10° more than the sum of the other two. The sum of the measures of the angles is 180°. These numbers check.

State. The measure of the third angle is 95°.

34. Let x = the measure of the first angle. Then $4x$ = the measure of the second angle, and $x + 4x + 5$, or $5x + 5$ = the measure of the third angle.

Solve: $\quad x + 4x + (5x + 5) = 180$

$\qquad\qquad x = 17.5$

If x is 17.5°, then the measure of the second angle is $4(17.5^\circ) = 70^\circ$.

35. ***Familiarize***. Let b = the length of the bottom section of the rocket, in feet. Then $\frac{1}{6}b$ = the length of the top section, and $\frac{1}{2}b$ = the length of the middle section.

Translate.

$$\underbrace{\begin{matrix}\text{Length}\\ \text{of top}\\ \text{section}\end{matrix}}_{\frac{1}{6}b} \underbrace{+}_{+} \underbrace{\begin{matrix}\text{length of}\\ \text{middle}\\ \text{section}\end{matrix}}_{\frac{1}{2}b} \underbrace{+}_{+} \underbrace{\begin{matrix}\text{length of}\\ \text{bottom}\\ \text{section}\end{matrix}}_{b} \;\; \text{is} \;\; \underbrace{240 \text{ ft}}.$$

$$\frac{1}{6}b \quad + \quad \frac{1}{2}b \quad + \quad b \quad = \quad 240$$

Carry out. We solve the equation. First we multiply by 6 on both sides to clear the fractions.

$$\begin{aligned} \frac{1}{6}b + \frac{1}{2}b + b &= 240 \\ 6\left(\frac{1}{6}b + \frac{1}{2}b + b\right) &= 6 \cdot 240 \\ 6 \cdot \frac{1}{6}b + 6 \cdot \frac{1}{2}b + 6 \cdot b &= 1440 \\ b + 3b + 6b &= 1440 \\ 10b &= 1440 \\ b &= 144 \end{aligned}$$

Then $\frac{1}{6}b = \frac{1}{6} \cdot 144 = 24$ and $\frac{1}{2}b = \frac{1}{2} \cdot 144 = 72$.

Check. 24 ft is $\frac{1}{6}$ of 144 ft, and 72 ft is $\frac{1}{2}$ of 144 ft. The sum of the lengths of the sections is
24 ft + 72 ft + 144 ft = 240 ft. The answer checks.

State. The length of the top section is 24 ft, the length of the middle section is 72 ft, and the length of the bottom section is 144 ft.

36. Let s = the part of the sandwich Jenny gets, in inches. Then the lengths of Demi's and Sarah's portions are $\frac{1}{2}s$ and $\frac{3}{4}s$, respectively.

Solve: $\quad s + \frac{1}{2}s + \frac{3}{4}s = 18$

$\qquad\qquad s = 8$

Then $\frac{1}{2}s = \frac{1}{2} \cdot 8 = 4$ and $\frac{3}{4}s = \frac{3}{4} \cdot 8 = 6$. Jenny gets 8 in., Demi gets 4 in., and Sarah gets 6 in.

37. ***Familiarize***. Let m = the number of miles that can be traveled on a \$18 budget. Then the total cost of the taxi ride, in dollars, is $1.90 + 1.60m$, or $1.9 + 1.6m$.

Translate.

$$\underbrace{\text{Cost of taxi ride}}_{1.9 + 1.6m} \; \underbrace{\text{is}}_{=} \; \underbrace{\$18.}_{18}$$

Carry out. We solve the equation.

$$\begin{aligned} 1.9 + 1.6m &= 18 \\ 1.6m &= 16.1 \\ m &= \frac{16.1}{1.6} = \frac{161}{16} = 10\frac{1}{16} \end{aligned}$$

Check. The mileage change is $\$1.60\left(10\frac{1}{16}\right)$, or \$16.10, and the total cost of the ride is
\$1.90 + \$16.10 = \$18. The answer checks.

State. Debbie and Alex can travel $10\frac{1}{16}$ mi on their budget.

38. Let m = the number of miles that can be traveled for \$17.50.

Solve: $\quad 2.5 + 2m = 17.5$

$\qquad\qquad m = 7.5$

Ralph can travel 7.5 mi.

39. ***Familiarize***. The total cost is the daily charge plus the mileage charge. Let d = the distance that can be traveled, in miles, in one day for \$100. The mileage charge is the cost per mile times the number of miles traveled, or $0.39d$.

Translate.

$$\underbrace{\text{Daily rate}}_{49.95} \; \underbrace{\text{plus}}_{+} \; \underbrace{\text{mileage charge}}_{0.39d} \; \underbrace{\text{is}}_{=} \; \underbrace{\$100.}_{100}$$

Carry out. We solve the equation.

$$\begin{aligned} 49.95 + 0.39d &= 100 \\ 0.39d &= 50.05 \\ d &= 128.\overline{3}, or 128\frac{1}{3} \end{aligned}$$

Check. For a trip of $128\frac{1}{3}$ mi, the mileage charge is $\$0.39\left(128\frac{1}{3}\right)$, or \$50.05, and $\$49.95+\$50.05 = \$100$. The answer checks.

State. They can travel $128\frac{1}{3}$ mi in one day and stay within their budget.

40. Let $d =$ the distance, in miles, that Judy can travel in one day for \$70.

Solve: $42 + 0.35d = 70$
$d = 80$ mi

41. ***Familiarize***. Let $x =$ the measure of one angle. Then $90 - x =$ the measure of its complement.

Translate.

$$\underbrace{\text{Measure of one angle}}_{x} \;\underbrace{\text{is}}_{=}\; \underbrace{15°}_{15} \;\underbrace{\text{more than}}_{+}\; \underbrace{\text{twice the measure of its complement.}}_{2(90-x)}$$

Carry out. We solve the equation.

$$\begin{aligned} x &= 15 + 2(90 - x) \\ x &= 15 + 180 - 2x \\ x &= 195 - 2x \\ 3x &= 195 \\ x &= 65 \end{aligned}$$

If x is 65, then $90 - x$ is 25.

Check. The sum of the angle measures is 90°. Also, 65° is 15° more than twice its complement, 25°. The answer checks.

State. The angle measures are 65° and 25°.

42. Let $x =$ the measure of one angle. Then $180 - x =$ the measure of its supplement.

Solve: $x = 2(180 - x) - 45$
$x = 105$

If x is 105, then $180 - x$ is 75. The angle measures are 105° and 75°.

43. ***Familiarize***. Let $l =$ the length of the paper, in cm. Then $l - 6.3 =$ the width. The perimeter is twice the length plus twice the width.

Translate.

$$\underbrace{\text{Twice the length}}_{2l} \;\underbrace{\text{plus}}_{+}\; \underbrace{\text{twice the width}}_{2(l-6.3)} \;\underbrace{\text{is}}_{=}\; \underbrace{99 \text{ cm}}_{99}.$$

Carry out. We solve the equation.

$$\begin{aligned} 2l + 2(l - 6.3) &= 99 \\ 2l + 2l - 12.6 &= 99 \\ 4l - 12.6 &= 99 \\ 4l &= 111.6 \\ l &= 27.9 \end{aligned}$$

Then $l - 6.3 = 27.9 - 6.3 = 21.6$.

Check. The width, 21.6 cm, is 6.3 cm less than the length, 27.9 cm. The perimeter is $2(27.9 \text{ cm}) + 2(21.6 \text{ cm}) = 55.8 \text{ cm} + 43.2 \text{ cm} = 99$ cm. The answer checks.

State. The length of the paper is 27.9 cm, and the width is 21.6 cm.

44. Let $a =$ the amount Sarah invested.

Solve: $a + 0.28a = 448$
$a = \$350$

45. ***Familiarize***. Let $a =$ the amount Sharon invested. Then the simple interest for one year is $6\% \cdot a$, or $0.06a$.

Translate.

$$\underbrace{\text{Amount invested}}_{a} \;\underbrace{\text{plus}}_{+}\; \underbrace{\text{interest}}_{0.06a} \;\underbrace{\text{is}}_{=}\; \underbrace{\$6996.}_{6996}$$

Carry out. We solve the equation.

$$\begin{aligned} a + 0.06a &= 6996 \\ 1.06a &= 6996 \\ a &= 6600 \end{aligned}$$

Check. An investment of \$6600 at 6% simple interest earns 0.06(\$6600), or \$396, in one year. Since $\$6600 + \$396 = \$6996$, the answer checks.

State. Sharon invested \$6600.

46. Let $b =$ the balance at the beginning of the month.

Solve: $b + 0.02b = 870$
$b = \$852.94$

47. ***Familiarize***. Let $w =$ the winning score. Then $w - 796 =$ the losing score.

Translate.

$$\underbrace{\text{Winning score}}_{w} \;\underbrace{\text{plus}}_{+}\; \underbrace{\text{losing score}}_{w-796} \;\underbrace{\text{was}}_{=}\; \underbrace{1302 \text{ points}}_{1302}.$$

Carry out. We solve the equation.

$$\begin{aligned} w + w - 796 &= 1302 \\ 2w - 796 &= 1302 \\ 2w &= 2098 \\ w &= 1049 \end{aligned}$$

Then $w - 796 = 1049 - 796 = 253$.

Check. The winning score, 1049, is 796 points more than the losing score, 253. The total of the two scores is $1049 + 253$, or 1302 points. The answer checks.

State. The winning score was 1049 points.

48. Let $c =$ the number of copies that can be made for \$1400.

Solve: $3(225) + 0.012c = 1400$
$c = 60,416.\overline{6}$

We must round down to keep the cost within the amount budgeted. The law firm can make 60,416 copies.

49. ***Familiarize***. We will use the equation

$$T = \frac{1}{4}N + 40.$$

Translate. We substitute 80 for T.

$$80 = \frac{1}{4}N + 40$$

Carry out. We solve the equation.

$$\begin{aligned} 80 &= \frac{1}{4}N + 40 \\ 40 &= \frac{1}{4}N \\ 160 &= N \qquad \text{Multiplying by 4 on both sides} \end{aligned}$$

Check. When $N = 160$, we have $T = \frac{1}{4} \cdot 160 + 40 = 40 + 40 = 80$. The answer checks.

State. A cricket chirps 160 times per minute when the temperature is 80°F.

50. Solve: $18.0 = -0.028t + 20.8$
$100 = t$

The record will be 18.0 sec 100 yr after 1920, or in 2020.

51. *Writing Exercise*. Although many of the problems in this section might be solved by guessing, using the five-step problem-solving process to solve them would give the student practice is using a technique that can be used to solve other problems whose answers are not so readily guessed.

52. *Writing Exercise*. Either approach will work. Some might prefer to let a represent the bride's age because the groom's age is given in terms of the bride's age. When choosing a variable it is important to specify what it represents.

53. Since -9 is to the left of 5 on the number line, we have $-9 < 5$.

54. $1 < 3$

55. Since -4 is to the left of 7 on the number line, we have $-4 < 7$.

56. $-9 > -12$

57. *Writing Exercise*. Answers may vary.

The sum of three consecutive odd integers is 375. What are the integers?

58. *Writing Exercise*. Answers may vary.

Acme Rentals rents a 12-foot truck at a rate of \$35 plus 20¢ per mile. Audrey has a truck-rental budget of \$45 for her move to a new apartment. How many miles can she drive the rental truck without exceeding her budget?

59. ***Familiarize***. Let c = the amount the meal originally cost. The 15% tip is calculated on the original cost of the meal, so the tip is $0.15c$.

Translate.

$$\underbrace{\text{Original cost}}\ \text{plus}\ \ \text{tip}\ \ \text{less}\ \$10\ \ \text{is}\ \ \$32.55.$$
$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$c \quad + \quad 0.15c \quad - \quad 10 \quad = \quad 32.55$$

Carry out. We solve the equation.

$$\begin{aligned} c + 0.15c - 10 &= 32.55 \\ 1.15c - 10 &= 32.55 \\ 1.15c &= 42.55 \\ c &= 37 \end{aligned}$$

Check. If the meal originally cost \$37, the tip was 15% of \$37, or 0.15(\$37), or \$5.55. Since \$37 + \$5.55 − \$10 = \$32.55, the answer checks.

State. The meal originally cost \$37.

60. Let m = the number of multiple-choice questions Pam got right. Note that she got $4 - 1$, or 3 fill-ins right.

Solve: $3 \cdot 7 + 3m = 78$
$m = 19$ questions

61. ***Familiarize***. Let s = one score. Then four score = $4s$ and four score and seven = $4s + 7$.

Translate. We reword .

$$\underbrace{1776}\ \ \text{plus}\ \ \underbrace{\text{four score and seven}}\ \ \text{is}\ \ \underbrace{1863}$$
$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$1776 \quad + \quad (4s + 7) \quad = \quad 1863$$

Carry out. We solve the equation.

$$\begin{aligned} 1776 + (4s + 7) &= 1863 \\ 4s + 1783 &= 1863 \\ 4s &= 80 \\ s &= 20 \end{aligned}$$

Check. If a score is 20 years, then four score and seven represents 87 years. Adding 87 to 1776 we get 1863. This checks.

State. A score is 20.

62. Let y = the larger number. Then 25% of y, or $0.25y$ = the smaller.

Solve: $y = 0.25y + 12$
$y = 16$

The numbers are 16 and 0.25(16), or 4.

63. ***Familiarize***. Let n = the number of half dollars. Then the number of quarters is $2n$; the number of dimes is $2 \cdot 2n$, or $4n$; and the number of nickels is $3 \cdot 4n$, or $12n$. The total value of each type of coin, in dollars, is as follows.

Half dollars: $0.5n$

Quarters: $0.25(2n)$, or $0.5n$

Dimes: $0.1(4n)$, or $0.4n$

Nickels: $0.05(12n)$, or $0.6n$

Then the sum of these amounts is $0.5n + 0.5n + 0.4n + 0.6n$, or $2n$.

Translate.

$$\underbrace{\text{Total amount of change}}\ \ \text{is}\ \ \$10.$$
$$\downarrow \qquad \downarrow \quad \downarrow$$
$$2n \qquad = \quad 10$$

Carry out. We solve the equation.

$$2n = 10$$
$$n = 5$$

Then $2n = 2\cdot 5 = 10$, $4n = 4\cdot 5 = 20$, and $12n = 12\cdot 5 = 60$.

Check. If there are 5 half dollars, 10 quarters, 20 dimes, and 60 nickels, then there are twice as many quarters as half dollars, twice as many dimes as quarters, and 3 times as many nickels as dimes. The total value of the coins is $\$0.5(5)+\$0.25(10)+\$0.1(20)+\$0.05(60) = \$2.50+\$2.50+\$2+\$3 = \$10$. The answer checks.

State. The shopkeeper got 5 half dollars, 10 quarters, 20 dimes, and 60 nickels.

64. Let x = the length of the original rectangle. Then $\frac{3}{4}x$ = the width. The length and width of the enlarged rectangle are $x + 2$ and $\frac{3}{4}x + 2$, respectively. Solve:

$$\left(\frac{3}{4}x+2\right)+\left(\frac{3}{4}x+2\right)+(x+2)+(x+2) = 50$$
$$x = 12$$

If x is 12, then $\frac{3}{4}x$ is 9. The length and width of the rectangle are 12 cm and 9 cm, respectively.

65. ***Familiarize***. Let a = the original number of apples in the basket.

Translate.

$$\underbrace{\text{One third of the apples}}_{\frac{1}{3}a} \underset{+}{+} \underbrace{\text{one fourth of the apples}}_{\frac{1}{4}a} \underset{+}{+}$$

$$\underbrace{\text{one eighth of the apples}}_{\frac{1}{8}a} \underset{+}{+} \underbrace{\text{one fifth of the apples}}_{\frac{1}{5}a} \underset{+}{+} \underbrace{\text{10 apples}}_{10} \underset{+}{+}$$

$$\underbrace{\text{1 apple}}_{1} \underset{=}{\text{is}} \underbrace{\text{the original number of apples.}}_{a}$$

Carry out. We solve the equation. Note that the LCD is 120.

$$\frac{1}{3}a+\frac{1}{4}a+\frac{1}{8}a+\frac{1}{5}a+10+1 = a$$
$$\frac{1}{3}a+\frac{1}{4}a+\frac{1}{8}a+\frac{1}{5}a+11 = a$$
$$120\left(\frac{1}{3}a+\frac{1}{4}a+\frac{1}{8}a+\frac{1}{5}a+11\right) = 120\cdot a$$
$$40a+30a+15a+24a+1320 = 120a$$
$$109a+1320 = 120a$$
$$1320 = 11a$$
$$120 = a$$

Check. $\frac{1}{3}\cdot 120 = 40$, $\frac{1}{4}\cdot 120 = 30$, $\frac{1}{8}\cdot 120 = 15$, and $\frac{1}{5}\cdot 120 = 24$. Then $40 + 30 + 15 + 24 + 10 + 1 = 120$. The result checks.

State. There were originally 120 apples in the basket.

66. Let p = the price before the two discounts. With the first 10% discount, the price becomes 90% of p, or $0.9p$. With the second 10% discount, the final price is 90% of $0.9p$, or $0.9(0.9p)$.

Solve: $0.9(0.9p) = 77.75$
$$p = \$95.99$$

67. ***Familiarize***. Let x = the number of additional games the Falcons will have to play. Then $\frac{x}{2}$ = the number of those games they will win, $15+\frac{x}{2}$ = the total number of games won, and $20+x$ = the total number of games played.

Translate.

$$\underbrace{\text{Number of games won}}_{15+\frac{x}{2}} \ \underset{=}{\text{is}}\ \underset{0.6}{\text{60\%}}\ \underset{\cdot}{\text{of}}\ \underbrace{\text{total number of games.}}_{20+x}$$

Carry out. We solve the equation.

$$15+\frac{x}{2} = 0.6(20+x)$$
$$15+0.5x = 12+0.6x \quad \left(\frac{x}{2} = \frac{1}{2}x = 0.5x\right)$$
$$15 = 12+0.1x$$
$$3 = 0.1x$$
$$30 = x$$

Check. If the Falcons play an additional 30 games, then they play a total of $20+30$, or 50, games. If they win half of the 30 additional games, or 15 games, then their wins total $15+15$, or 30. Since 60% of 50 is 30, the answer checks.

State. The Falcons will have to play 30 more games in order to win 60% of the total number of games.

68. Let n = the number of CD's purchased. Assume that two or more CD's were purchased. Then the first CD costs \$8.49 and the total cost of the remaining $n-1$ CD's is $\$3.99(n-1)$. The shipping and handling costs are \$2.47 for the first CD, \$2.28 for the second, and a total of $\$1.99(n-2)$ for the remaining $n-2$ CD's. Then the total cost of the shipment is $\$8.49+\$3.99(n-1)+\$2.47+\$2.28+\$1.99(n-2)$.

Solve:

$$8.49+3.99(n-1)+2.47+2.28+1.99(n-2) = 65.07$$
$$n = 10 \text{ CD's}$$

69. ***Familiarize***. Let s = Ella's score on the third test. Her average score on the first two tests is 85, so she had a total of $2\cdot 85$ points on those tests.

Translate. The average score on the three tests is the sum of the three scores divided by 3.

$$\frac{2\cdot 85+s}{3} = 82$$

Carry out. We solve the equation.

$$\begin{aligned} \frac{2\cdot 85+s}{3} &= 82\\ \frac{170+s}{3} &= 82\\ 170+s &= 246 \quad \text{Multiplying by 3}\\ s &= 76 \end{aligned}$$

Check. If the score on the third test is 76, Ella's average score is $\frac{2\cdot 85+76}{3}=\frac{246}{3}=82$. The answer checks.

State. Ella's score on the third test was 76.

70. At \$0.40 per $\frac{1}{5}$ mile, the mileage charge can also be given as 5(\$0.40), or \$2 per mile. Since it took 20 min to complete what is usually a 10-min drive, the taxi was stopped in traffic for $20-10$, or 10, min. Let $d=$ the distance, in miles, that Glenda traveled.

Solve: $2.5+2d+0.2(10)=16.5$

$d=6$ mi

71. *Writing Exercise*. If the school can invest the \$2000 so that it earns at least 7.5% and thus grows to at least \$2150 by the end of the year, the second option should be selected. If not, the first option is preferable.

72. *Writing Exercise*. Yes; the page numbers must be consecutive integers. The only consecutive integers whose sum is 191 are 95 and 96. These cannot be the numbers of facing pages, however, because the left-hand page of a book is even-numbered.

73. ***Familiarize***. Let $w=$ the width of the rectangle, in cm. Then $w+4.25=$ the length.

Translate.

$$\underbrace{\text{The perimeter}}\ \ \text{is}\ \ \underbrace{101.74\text{ cm.}}$$
$$\downarrow \qquad\qquad \downarrow \qquad \downarrow$$
$$2(w+4.25)+2w = \quad 101.74$$

Carry out. We solve the equation.

$$\begin{aligned} 2(w+4.25)+2w &= 101.74\\ 2w+8.5+2w &= 101.74\\ 4w+8.5 &= 101.74\\ 4w &= 93.24\\ w &= 23.31 \end{aligned}$$

Then $w+4.25=23.31+4.25=27.56$.

Check. The length, 27.56 cm, is 4.25 cm more than the width, 23.31 cm. The perimeter is 2(27.56) cm + 2(23.31 cm) = 55.12 cm + 46.62 cm = 101.74 cm. The answer checks.

State. The length of the rectangle is 27.56 cm, and the width is 23.31 cm.

74. Let $s=$ the length of the first side, in cm. Then $s+3.25=$ the length of the second side, and $(s+3.25)+4.35$, or $s+7.6=$ the length of the third side.

Solve: $s+(s+3.25)+(s+7.6)=26.87$

$s=5.34$

The lengths of the sides are 5.34 cm, 5.34+3.25, or 8.59 cm, and $5.34+7.6$, or 12.94 cm.

Exercise Set 2.6

1. $-5x\le 30$

$x\ge -6$ Dividing by -5 and reversing the inequality symbol

2. $-7t\ge 56$

$t\le -8$

3. $-2t>-14$

$t<7$ Dividing by -2 and reversing the inequality symbol

4. $-3x<-15$

$x>5$

5. $x<-2$ and $-2>x$ are equivalent.

6. $t>-1$ and $-1<t$ are equivalent.

7. If we add 1 to both sides of $-4x-1\le 15$, we get $-4x\le 16$. The two given inequalities are equivalent.

8. If we add 3 to both sides of $-2t\ge 14$, we get $-2t+3\ge 17$. The two given inequalities are not equivalent.

9. $x>-2$

a) Since $5>-2$ is true, 5 is a solution.

b) Since $0>-2$ is true, 0 is a solution.

c) Since $-1.9>-2$ is true, -1.9 is a solution.

d) Since $-7.3>-2$ is false, -7.3 is not a solution.

e) Since $1.6>-2$ is true, 1.6 is a solution.

10. a) Yes, b) No, c) Yes, d) Yes, e) No

11. $x\ge 6$

a) Since $-6\ge 6$ is false, -6 is not a solution.

b) Since $0\ge 6$ is false, 0 is not a solution.

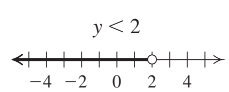
c) Since $6\ge 6$ is true, 6 is a solution.

d) Since $6.01\ge 6$ is true, 6.01 is a solution.

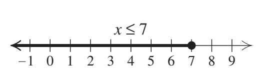
e) Since $-3\frac{1}{2}\ge 6$ is false, $-3\frac{1}{2}$ is not a solution.

12. a) Yes, b) Yes, c) Yes, d) No, e) Yes

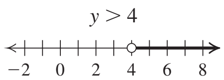
13. The solutions of $y<2$ are those numbers less than 2. They are shown on the graph by shading all points to the left of 2. The open circle at 2 indicates that 2 is not part of the graph.



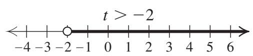
14. The solutions of $x\le 7$ are those numbers less than or equal to 7. They are shown on the graph by shading the point 7 and all points to the left of 7. The closed circle at 7 indicates that 7 is part of the graph.



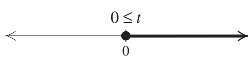
15. The solutions of $y > 4$ are those numbers greater than 4. They are shown on the graph by shading all points to the right of 4. The open circle at 4 indicates that 4 is not part of the graph.



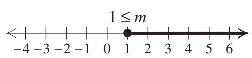
16. The solutions of $t > -2$ are those numbers greater than -2. They are shown on the graph by shading all points to the right of -2. The open circle at -2 indicates that -2 is not part of the graph.



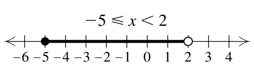
17. The solutions of $0 \le t$, or $t \ge 0$, are those numbers greater than or equal to zero. They are shown on the graph by shading the point 0 and all points to the right of 0. The closed circle at 0 indicates that 0 is part of the graph.



18. The solutions of $1 \le m$, or $m \ge 1$, are those numbers greater than or equal to 1. They are shown on the graph by shading the point 1 and all points to the right of 1. The closed circle at 1 indicates that 1 is part of the graph.

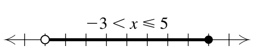


19. In order to be solution of the inequality $-5 \le x < 2$, a number must be a solution of both $-5 \le x$ and $x < 2$. The solution set is graphed as follows:



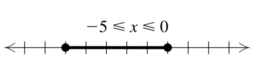
The closed circle at -5 means that -5 is part of the graph. The open circle at 2 means that 2 is not part of the graph.

20. In order to be a solution of the inequality $-3 < x \le 5$, a number must be a solution of both $-3 < x$ and $x \le 5$. The solution set is graphed as follows:



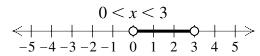
The open circle at -3 means that -3 is not part of the graph. The closed circle at 5 means that 5 is part of the graph.

21. In order to be a solution of the inequality $-5 \le x \le 0$, a number must be a solution of both $-5 \le x$ and $x \le 0$. The solution set is graphed as follows:



The closed circles at -5 and 0 mean that -5 and 0 are both part of the graph.

22. In order to be a solution of the inequality $0 < x < 3$, a number must be a solution of both $0 < x$ and $x < 3$. The solution set is graphed as follows:



The open circles at 0 and at 3 mean that 0 and 3 are not part of the graph.

23. All points to the right of -4 are shaded. The open circle at -4 indicates that -4 is not part of the graph. Using set-builder notation we have $\{x|x > -4\}$.

24. $\{x|x < 3\}$

25. The point 2 and all points to the left of 2 are shaded. Using set-builder notation we have $\{x|x \le 2\}$.

26. $\{x|x \ge -2\}$

27. All points to the left of -1 are shaded. The open circle at -1 indicates that -1 is not part of the graph. Using set-builder notation we have $\{x|x < -1\}$.

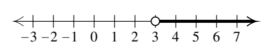
28. $\{x|x > 1\}$

29. The point 0 and all points to the right of 0 are shaded. Using set-builder notation we have $\{x|x \ge 0\}$.

30. $\{x|x \le 0\}$

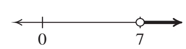
31.
$$\begin{aligned} y+6 &> 9 & \\ y+6-6 &> 9-6 & \text{Adding } -6 \text{ to both sides} \\ y &> 3 & \text{Simplifying} \end{aligned}$$

The solution set is $\{y|y > 3\}$. The graph is as follows:



32.
$$\begin{aligned} y+2 &> 9 & \\ y+2-2 &> 9-2 & \text{Adding } -2 \text{ to both sides} \\ y &> 7 & \text{Simplifying} \end{aligned}$$

The solution set is $\{y|y > 7\}$. The graph is as follows:



33.
$$\begin{aligned} x+9 &\le -12 & \\ x+9-9 &\le -12-9 & \text{Adding } -9 \text{ to both sides} \\ x &\le -21 & \text{Simplifying} \end{aligned}$$

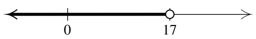
The solution set is $\{x|x \le -21\}$. The graph is as follows:

34.
$$\begin{aligned} x+8 &\le -10 & \\ x+8-8 &\le -10-8 & \text{Subtracting 8 from both sides} \\ x &\le -18 & \text{Simplifying} \end{aligned}$$

The solution set is $\{x|x \le -18\}$. The graph is as follows:

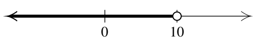
35.
$$\begin{aligned} x-3 &< 14 \\ x-3+3 &< 14+3 \quad \text{Adding 3 to both sides} \\ x &< 17 \quad \text{Simplifying} \end{aligned}$$

The solution set is $\{x|x < 17\}$. The graph is as follows:



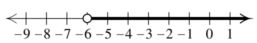
36.
$$\begin{aligned} x-3 &< 7 \\ x-3+3 &< 7+3 \\ x &< 10 \end{aligned}$$

The solution set is $\{x|x < 10\}$. The graph is as follows:



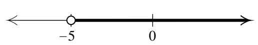
37.
$$\begin{aligned} y-10 &> -16 \\ y-10+10 &> -16+10 \\ y &> -6 \end{aligned}$$

The solution set is $\{y|y > -6\}$. The graph is as follows:



38.
$$\begin{aligned} y-7 &> -12 \\ y-7+7 &> -12+7 \\ y &> -5 \end{aligned}$$

The solution set is $\{y|y > -5\}$. The graph is as follows:



39.
$$\begin{aligned} 2x &\le x+9 \\ 2x-x &\le x+9-x \\ x &\le 9 \end{aligned}$$

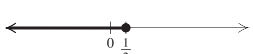
The solution set is $\{x|x \le 9\}$. The graph is as follows:

40.
$$\begin{aligned} 3x &\le 2x+7 \\ 3x-2x &\le 2x+7-2x \\ x &\le 7 \end{aligned}$$

The solution set is $\{x|x \le 7\}$. The graph is as follows:

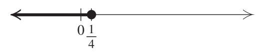
41.
$$\begin{aligned} y+\frac{1}{3} &\le \frac{5}{6} \\ y+\frac{1}{3}-\frac{1}{3} &\le \frac{5}{6}-\frac{1}{3} \\ y &\le \frac{5}{6}-\frac{2}{6} \\ y &\le \frac{3}{6} \\ y &\le \frac{1}{2} \end{aligned}$$

The solution set is $\left\{y\middle|y \le \frac{1}{2}\right\}$. The graph is as follows:



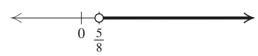
42.
$$\begin{aligned} x+\frac{1}{4} &\le \frac{1}{2} \\ x &\le \frac{1}{4} \end{aligned}$$

$$\left\{x\middle|x \le \frac{1}{4}\right\}$$



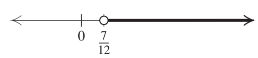
43.
$$\begin{aligned} t-\frac{1}{8} &> \frac{1}{2} \\ t-\frac{1}{8}+\frac{1}{8} &> \frac{1}{2}+\frac{1}{8} \\ t &> \frac{4}{8}+\frac{1}{8} \\ t &> \frac{5}{8} \end{aligned}$$

The solution set is $\left\{t\middle|t > \frac{5}{8}\right\}$. The graph is as follows:



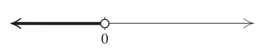
44.
$$\begin{aligned} y-\frac{1}{3} &> \frac{1}{4} \\ y &> \frac{7}{12} \end{aligned}$$

$$\left\{y\middle|y > \frac{7}{12}\right\}$$



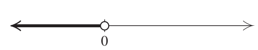
45.
$$\begin{aligned} -9x+17 &> 17-8x \\ -9x+17-17 &> 17-8x-17 \quad \text{Adding } -17 \\ -9x &> -8x \\ -9x+9x &> -8x+9x \quad \text{Adding } 9x \\ 0 &> x \end{aligned}$$

The solution set is $\{x|x < 0\}$. The graph is as follows:



46.
$$\begin{aligned} -8n+12 &> 12-7n \\ -8n &> -7n \\ 0 &> n \end{aligned}$$

$\{n|n < 0\}$



47. $-23 < -t$

The inequality states that the opposite of 23 is less than the opposite of t. Thus, t must be less than 23, so the solution set is $\{t|t < 23\}$. To solve this inequality using the addition principle, we would proceed as follows:

$$\begin{aligned} -23 &< -t \\ t-23 &< 0 \quad \text{Adding } t \text{ to both sides} \\ t &< 23 \quad \text{Adding 23 to both sides} \end{aligned}$$

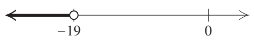
The solution set is $\{t|t < 23\}$. The graph is as follows:

48. $19 < -x$

$x + 19 < 0$

$x < -19$

$\{x|x < -19\}$

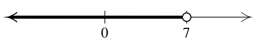


49. $5x < 35$

$\frac{1}{5} \cdot 5x < \frac{1}{5} \cdot 35$ Multiplying by $\frac{1}{5}$

$x < 7$

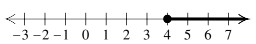
The solution set is $\{x|x < 7\}$. The graph is as follows:



50. $8x \geq 32$

$x \geq 4$

$\{x|x \geq 4\}$



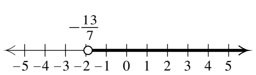
51. $-7x<13$

$-\frac{1}{7} \cdot (-7x)>-\frac{1}{7} \cdot 13$ Multiplying by $-\frac{1}{7}$

The symbol has to be reversed.

$x>-\frac{13}{7}$ Simplifying

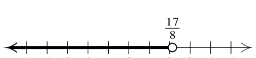
The solution set is $\left\{x\middle|x > -\frac{13}{7}\right\}$.



52. $8y < 17$

$y < \frac{17}{8}$

$\left\{y\middle|y < \frac{17}{8}\right\}$



53. $-24 > 8t$

$-3 > t$

The solution set is $\{t|t < -3\}$.

54. $-16x < -64$

$x > 4$

$\{x|x > 4\}$

55. $7y \geq -2$

$\frac{1}{7} \cdot 7y \geq \frac{1}{7}(-2)$ Multiplying by $\frac{1}{7}$

$y \geq -\frac{2}{7}$

The solution set is $\left\{y\middle|y \geq -\frac{2}{7}\right\}$.

56. $5x > -3$

$x > -\frac{3}{5}$

$\left\{x\middle|x > -\frac{3}{5}\right\}$

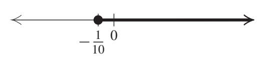
57. $-2y \leq \frac{1}{5}$

$-\frac{1}{2} \cdot (-2y) \geq -\frac{1}{2} \cdot \frac{1}{5}$

The symbol has to be reversed.

$y \geq -\frac{1}{10}$

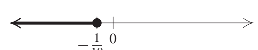
The solution set is $\left\{y\middle|y \geq -\frac{1}{10}\right\}$.



58. $-2x \geq \frac{1}{5}$

$x \leq -\frac{1}{10}$

$\left\{x\middle|x \leq -\frac{1}{10}\right\}$



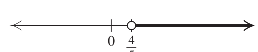
59. $-\frac{8}{5} > -2x$

$-\frac{1}{2} \cdot \left(-\frac{8}{5}\right) < -\frac{1}{2} \cdot (-2x)$

$\frac{8}{10} < x$

$\frac{4}{5} < x$, or $x > \frac{4}{5}$

The solution set is $\left\{x\middle|\frac{4}{5} < x\right\}$, or $\left\{x\middle|x > \frac{4}{5}\right\}$.

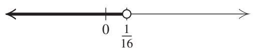


60. $-\frac{5}{8} < -10y$

$-\frac{1}{10}\left(-\frac{5}{8}\right) > y$

$\frac{1}{16} > y$

$\left\{y \middle| y < \dfrac{1}{16}\right\}$



61.
$$\begin{aligned} 7+3x &< 34 \\ 7+3x-7 &< 34-7 && \text{Adding } -7 \text{ to both sides} \\ 3x &< 27 && \text{Simplifying} \\ x &< 9 && \text{Multiplying both sides by } \frac{1}{3} \end{aligned}$$

The solution set is $\{x|x < 9\}$.

62.
$$\begin{aligned} 5+4y &< 37 \\ 4y &< 32 \\ y &< 8 \end{aligned}$$

$\{y|y < 8\}$

63.
$$\begin{aligned} 6+5y &\geq 26 \\ 6+5y-6 &\geq 26-6 && \text{Adding } -6 \\ 5y &\geq 20 \\ y &\geq 4 && \text{Multiplying by } \frac{1}{5} \end{aligned}$$

The solution set is $\{y|y \geq 4\}$.

64.
$$\begin{aligned} 7+8x &\geq 71 \\ 8x &\geq 64 \\ x &\geq 8 \end{aligned}$$

$\{x|x \geq 8\}$

65.
$$\begin{aligned} 4t-5 &\leq 23 \\ 4t-5+5 &\leq 23+5 && \text{Adding 5 to both sides} \\ 4t &\leq 28 \\ \frac{1}{4}\cdot 4t &\leq \frac{1}{4}\cdot 28 && \text{Multiplying both sides by } \frac{1}{4} \\ t &\leq 7 \end{aligned}$$

The solution set is $\{t|t \leq 7\}$.

66.
$$\begin{aligned} 13x-7 &< -7 \\ 13x &< 0 \\ x &< 0 \end{aligned}$$

The solution set is $\{x|x < 0\}$.

67.
$$\begin{aligned} 16 &< 4-3y \\ 16-4 &< 4-3y-4 && \text{Adding } -4 \text{ to both sides} \\ 12 &< -3y \\ -\frac{1}{3}\cdot 12 &> -\frac{1}{3}\cdot(-3y) && \text{Multiplying by } -\frac{1}{3} \\ & && \text{The symbol has to be reversed.} \\ -4 &> y \end{aligned}$$

The solution set is $\{y|-4 > y\}$, or $\{y|y < -4\}$.

68.
$$\begin{aligned} 22 &< 6-8x \\ 16 &< -8x \\ -2 &> x \end{aligned}$$

$\{x|-2 > x\}$, or $\{x|x < -2\}$

69.
$$\begin{aligned} 39 &> 3-9x \\ 39-3 &> 3-9x-3 && \text{Adding } -3 \\ 36 &> -9x \\ -\frac{1}{9}\cdot 36 &< -\frac{1}{9}\cdot(-9x) && \text{Multiplying by } -\frac{1}{9} \\ & && \text{The symbol has to be reversed.} \\ -4 &< x \end{aligned}$$

The solution set is $\{x|-4 < x\}$, or $\{x|x > -4\}$.

70.
$$\begin{aligned} 5 &> 5-7y \\ 0 &> -7y \\ 0 &< y \end{aligned}$$

$\{y|0 < y\}$, or $\{y|y > 0\}$

71.
$$\begin{aligned} 5-6y &> 25 \\ -5+5-6y &> -5+25 \\ -6y &> 20 \\ -\frac{1}{6}\cdot(-6y) &< -\frac{1}{6}\cdot 20 \\ & && \text{The symbol has to be reversed.} \\ y &< -\frac{20}{6} \\ y &< -\frac{10}{3} \end{aligned}$$

The solution set is $\left\{y \middle| y < -\dfrac{10}{3}\right\}$.

72.
$$\begin{aligned} 8-2y &> 14 \\ -2y &> 6 \\ y &< -3 \end{aligned}$$

$\{y|y < -3\}$

73.
$$\begin{aligned} -3 &< 8x+7-7x \\ -3 &< x+7 && \text{Collecting like terms} \\ -3-7 &< x+7-7 \\ -10 &< x \end{aligned}$$

The solution set is $\{x|-10 < x\}$, or $\{x|x > -10\}$.

74.
$$\begin{aligned} -5 &< 9x+8-8x \\ -5 &< x+8 \\ -13 &< x \end{aligned}$$

$\{x|-13 < x\}$, or $\{x|x > -13\}$

75.
$$\begin{aligned} 6-4y &> 4-3y \\ 6-4y+4y &> 4-3y+4y && \text{Adding } 4y \\ 6 &> 4+y \\ -4+6 &> -4+4+y && \text{Adding } -4 \\ 2 &> y, \text{ or } y < 2 \end{aligned}$$

The solution set is $\{y|2 > y\}$, or $\{y|y < 2\}$.

76.
$$\begin{aligned} 7-8y &> 5-7y \\ 2 &> y \end{aligned}$$

$\{y|2 > y\}$, or $\{y|y < 2\}$

77.
$$\begin{aligned} 7-9y &\leq 4-8y \\ 7-9y+9y &\leq 4-8y+9y \\ 7 &\leq 4+y \\ -4+7 &\leq -4+4+y \\ 3 &\leq y, \text{ or } y \geq 3 \end{aligned}$$

The solution set is $\{y|3 \leq y\}$, or $\{y|y \geq 3\}$.

78. $6 - 13y \leq 4 - 12y$
$2 \leq y$
$\{y|2 \leq y\}$, or $\{y|y \geq 2\}$

79.
$$\begin{aligned} 33 - 12x &< 4x + 97 \\ 33 - 12x - 97 &< 4x + 97 - 97 \\ -64 - 12x &< 4x \\ -64 - 12x + 12x &< 4x + 12x \\ -64 &< 16x \\ -4 &< x \end{aligned}$$
The solution set is $\{x| -4 < x\}$, or $\{x|x > -4\}$.

80.
$$\begin{aligned} 27 - 11x &> 14x - 18 \\ 45 &> 25x \\ \frac{9}{5} &> x \end{aligned}$$
$\left\{x\middle|x < \frac{9}{5}\right\}$

81.
$$\begin{aligned} 2.1x + 43.2 &> 1.2 - 8.4x \\ 10(2.1x + 43.2) &> 10(1.2 - 8.4x) && \text{Multiplying by 10 to clear decimals} \\ 21x + 432 &> 12 - 84x \\ 21x + 84x &> 12 - 432 && \text{Adding } 84x \text{ and } -432 \\ 105x &> -420 \\ x &> -4 && \text{Multiplying by } \frac{1}{105} \end{aligned}$$
The solution set is $\{x|x > -4\}$.

82.
$$\begin{aligned} 0.96y - 0.79 &\leq 0.21y + 0.46 \\ 96y - 79 &\leq 21y + 46 \\ 75y &\leq 125 \\ y &\leq \frac{5}{3} \end{aligned}$$
$\left\{y\middle|y \leq \frac{5}{3}\right\}$

83.
$$\begin{aligned} 0.7n - 15 + n &\geq 2n - 8 - 0.4n \\ 1.7n - 15 &\geq 1.6n - 8 && \text{Collecting like terms} \\ 10(1.7n - 15) &\geq 10(1.6n - 8) && \text{Multiplying by 10} \\ 17n - 150 &\geq 16n - 80 \\ 17n - 16n &\geq -80 + 150 && \text{Adding } -16n \text{ and } 150 \\ n &\geq 70 \end{aligned}$$
The solution set is $\{n|n \geq 70\}$

84.
$$\begin{aligned} 1.7t + 8 - 1.62t &< 0.4t - 0.32 + 8 \\ 0.08t + 8 &< 0.4t + 7.68 \\ 8t + 800 &< 40t + 768 \\ 32 &< 32t \\ 1 &< t \end{aligned}$$
$\{t|1 < t\}$, or $\{t|t > 1\}$

85.
$$\begin{aligned} \frac{x}{3} - 4 &\leq 1 \\ 3\left(\frac{x}{3} - 4\right) &\leq 3 \cdot 1 && \text{Multiplying by 3 to to clear the fraction} \\ x - 12 &\leq 3 && \text{Simplifying} \\ x &\leq 15 && \text{Adding 12} \end{aligned}$$
The solution set is $\{x|x \leq 15\}$.

86.
$$\begin{aligned} \frac{2}{3} - \frac{x}{5} &< \frac{4}{15} \\ 10 - 3x &< 4 \\ -3x &< -6 \\ x &> 2 \end{aligned}$$
$\{x|x > 2\}$

87.
$$\begin{aligned} 3 &< 5 - \frac{t}{7} \\ -2 &< -\frac{t}{7} \\ -7(-2) &> -7\left(-\frac{t}{7}\right) \\ 14 &> t \end{aligned}$$
The solution set is $\{t|t < 14\}$.

88.
$$\begin{aligned} 2 &> 9 - \frac{x}{5} \\ -7 &> -\frac{x}{5} \\ 35 &< x \end{aligned}$$
$\{x|x > 35\}$

89.
$$\begin{aligned} 4(2y - 3) &< 36 \\ 8y - 12 &< 36 && \text{Removing parentheses} \\ 8y &< 48 && \text{Adding 12} \\ y &< 6 && \text{Multiplying by } \frac{1}{8} \end{aligned}$$
The solution set is $\{y|y < 6\}$.

90.
$$\begin{aligned} 3(2y - 3) &> 21 \\ 6y - 9 &> 21 \\ 6y &> 30 \\ y &> 5 \end{aligned}$$
$\{y|y > 5\}$

91.
$$\begin{aligned} 3(t - 2) &\geq 9(t + 2) \\ 3t - 6 &\geq 9t + 18 \\ 3t - 9t &> 18 + 6 \\ -6t &\geq 24 \\ t &\leq -4 && \text{Multiplying by } -\frac{1}{6} \text{ and reversing the symbol} \end{aligned}$$
The solution set is $\{t|t \leq -4\}$.

92.
$$\begin{aligned} 8(2t + 1) &> 4(7t + 7) \\ 16t + 8 &> 28t + 28 \\ -12t &> 20 \\ t &< -\frac{5}{3} \end{aligned}$$
$\left\{t|t < -\frac{5}{3}\right\}$

93.
$$\begin{aligned} 3(r - 6) + 2 &< 4(r + 2) - 21 \\ 3r - 18 + 2 &< 4r + 8 - 21 \\ 3r - 16 &< 4r - 13 \\ -16 + 13 &< 4r - 3r \\ -3 &< r, \text{ or } r > -3 \end{aligned}$$
The solution set is $\{r|r > -3\}$.

94. $$\begin{aligned}5(t+3)+9 &> 3(t-2)+6\\ 5t+15+9 &> 3t-6+6\\ 5t+24 &> 3t\\ 24 &> -2t\\ -12 &< t\end{aligned}$$

$\{t|t > -12\}$

95. $$\begin{aligned}\frac{2}{3}(2x-1) &\geq 10\\ \frac{3}{2}\cdot\frac{2}{3}(2x-1) &\geq \frac{3}{2}\cdot 10 \quad \text{Multiplying by } \frac{3}{2}\\ 2x-1 &\geq 15\\ 2x &\geq 16\\ x &\geq 8\end{aligned}$$

The solution set is $\{x|x \geq 8\}$.

96. $$\begin{aligned}\frac{4}{5}(3x+4) &\leq 20\\ 3x+4 &\leq 25\\ 3x &\leq 21\\ x &\leq 7\end{aligned}$$

$\{x|x \leq 7\}$

97. $$\begin{aligned}\frac{3}{4}\left(3x-\frac{1}{2}\right)-\frac{2}{3} &< \frac{1}{3}\\ \frac{3}{4}\left(3x-\frac{1}{2}\right) &< 1 \quad \text{Adding } \frac{2}{3}\\ \frac{9}{4}x-\frac{3}{8} &< 1 \quad \text{Removing parentheses}\\ 8\cdot\left(\frac{9}{4}x-\frac{3}{8}\right) &< 8\cdot 1 \quad \text{Clearing fractions}\\ 18x-3 &< 8\\ 18x &< 11\\ x &< \frac{11}{18}\end{aligned}$$

The solution set is $\left\{x\middle|x < \frac{11}{18}\right\}$.

98. $$\begin{aligned}\frac{2}{3}\left(\frac{7}{8}-4x\right)-\frac{5}{8} &< \frac{3}{8}\\ \frac{2}{3}\left(\frac{7}{8}-4x\right) &< 1\\ \frac{7}{12}-\frac{8}{3}x &< 1\\ 7-32x &< 12\\ -32x &< 5\\ x &> -\frac{5}{32}\end{aligned}$$

$\left\{x\middle|x > -\frac{5}{32}\right\}$

99. *Writing Exercise.* The inequalities $x > -3$ and $x \geq -2$ are not equivalent because they do not have the same solution set. For example, -2.5 is a solution of $x > -3$, but it is not a solution of $x \geq -2$.

100. *Writing Exercise.* The inequalities $t < -7$ and $t \leq -8$ are not equivalent because they do not have the same solution set. For example, -7.1 is a solution of $t < -7$, but it is not a solution of $t \leq -8$.

101. Let n represent "some number." Then we have $n+3$, or $3+n$.

102. Let x and y represent the numbers. Then we have $2(x+y)$.

103. Let x represent "a number." Then we have $2x-3$.

104. Let y represent "a number." Then we have $2y+5$, or $5+2y$.

105. *Writing Exercise.* The graph of an inequality of the form $a \leq x \leq a$ consists of just one number, a.

106. *Writing Exercise.* For any pair of numbers, their relative position on the number line is reversed when both are multiplied by the same negative number. For example, -3 is to the left of 5 on the number line, but 12 is to the right of -20. That is, $-3 < 5$, but $-3(-4) > 5(-4)$.

107. $x < x+1$

When any real number is increased by 1, the result is greater than the original number. Thus the solution set is $\{x|x \text{ is a real number}\}$.

108. $$\begin{aligned}6[4-2(6+3t)] &> 5[3(7-t)-4(8+2t)]-20\\ 6[4-12-6t] &> 5[21-3t-32-8t]-20\\ 6[-8-6t] &> 5[-11-11t]-20\\ -48-36t &> -55-55t-20\\ -48-36t &> -75-55t\\ -36t+55t &> -75+48\\ 19t &> -27\\ t &> -\frac{27}{19}\end{aligned}$$

The solution set is $\left\{t\middle|t > -\frac{27}{19}\right\}$.

109. $$\begin{aligned}27-4[2(4x-3)+7] &\geq 2[4-2(3-x)]-3\\ 27-4[8x-6+7] &\geq 2[4-6+2x]-3\\ 27-4[8x+1] &\geq 2[-2+2x]-3\\ 27-32x-4 &\geq -4+4x-3\\ 23-32x &\geq -7+4x\\ 23+7 &= 4x+32x\\ 30 &\geq 36x\\ \frac{5}{6} &\geq x\end{aligned}$$

The solution set is $\left\{x\middle|x \leq \frac{5}{6}\right\}$.

110. $$\begin{aligned}-(x+5) &\geq 4a-5\\ -x-5 &\geq 4a-5\\ -x &\geq 4a-5+5\\ -x &\geq 4a\\ -1(-x) &\leq -1\cdot 4a\\ x &\leq -4a\end{aligned}$$

The solution set is $\{x|x \leq -4a\}$.

111. $$\begin{aligned}\frac{1}{2}(2x+2b) &> \frac{1}{3}(21+3b)\\ x+b &> 7+b\\ x+b-b &> 7+b-b\\ x &> 7\end{aligned}$$

The solution set is $\{x|x > 7\}$.

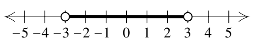
112.
$$\begin{aligned} y &< ax+b && \text{Assume } a>0. \\ y-b &< ax \\ \frac{y-b}{a} &< x && \text{Since } a>0, \text{ the inequality symbol stays the same.} \end{aligned}$$

The solution set is $\left\{x \middle| x > \dfrac{y-b}{a}\right\}$.

113.
$$\begin{aligned} y &< ax+b && \text{Assume } a<0. \\ y-b &< ax \\ \frac{y-b}{a} &> x && \text{Since } a<0, \text{ the inequality symbol must be reversed.} \end{aligned}$$

The solution set is $\left\{x \middle| x < \dfrac{y-b}{a}\right\}$.

114.



115. $|x| > -3$

Since absolute value is always nonnegative, the absolute value of any real number will be greater than -3. Thus, the solution set is $\{x|x \text{ is a real number}\}$.

116. $|x| < 0$

For any real number x, $|x| \geq 0$. Thus, the solution set is $\emptyset$.

Exercise Set 2.7

1. a is at least b can be translated as $b \leq a$.

2. a exceeds b can be translated as $b < a$.

3. a is at most b can be translated as $a \leq b$.

4. a is exceeded by b can be translated as $a < b$.

5. b is no more than a can be translated as $b \leq a$.

6. b is no less than a can be translated as $a \leq b$.

7. b is less than a can be translated as $b < a$.

8. b is more than a can be translated as $a < b$.

9. Let n represent the number. Then we have

$n \geq 8$.

10. Let n represent the number. Then we have

$n \geq 4$.

11. Let t represent the temperature. Then we have

$t \leq -3$.

12. Let d represent the average credit card debt. Then we have

$d > 4000$.

13. Let p represent the price of Pat's PT Cruiser. Then we have

$p > 21{,}900$.

14. Let t represent the time of the test. Then we have

$45 < t < 55$.

15. Let d represent the distance to Normandale Community College. Then we have

$d \leq 15$.

16. Let w represent Tamia's weight. Then we have

$w < 110$.

17. Let n represent the number. Then we have

$n > -2$.

18. Let c represent the costs of production. Then we have

$c \leq 12{,}500$.

19. Let p represent the number of people attending the Million Man March. Then we have

$400{,}000 < p < 1{,}200{,}000$.

20. Let c represent the cost per gallon of gasoline. Then we have

$c \leq 2$.

21. ***Familiarize***. Let s = the length of the service call, in hours. The total charge is \$25 plus \$30 times the number of hours RJ's was there.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{\$25 charge}} & \text{plus} & \underbrace{\text{hourly rate}} & \text{times} & \underbrace{\text{number of hours}} & \underbrace{\text{is greater than}} & \underbrace{\text{\$100}}. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 25 & + & 30 & \cdot & s & > & 100 \end{array}$$

Carry out. We solve the inequality.

$$\begin{aligned} 25+30x &> 100 \\ 30x &> 75 \\ s &> 2.5 \end{aligned}$$

Check. As a partial check, we show that the cost of a 2.5 hour service call is \$100.

$$\$25 + \$30(2.5) = \$25 + \$75 = \$100$$

State. The length of the service call was more than 2.5 hr.

22. Let c = the number of courses for which Karen registers.

Solve: $35 + 375c \leq 1000$

$c \leq 2.57\overline{3}$

Rounding down, we find that Karen can register for 2 courses at most.

23. ***Familiarize***. Let t = the number of one-way trips made per month.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Cost per trip}} & \text{times} & \underbrace{\text{number of trips}} & \underbrace{\text{is greater than}} & \underbrace{\text{\$21}}. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 1\cdot 15 & \cdot & t & > & 21 \end{array}$$

Carry out. We solve the inequality.

$$\begin{aligned} 1.15t &> 21 \\ t &> 18.3 && \text{Rounding} \end{aligned}$$

Check. As a partial check we show that the total cost of 18 trips is less than \$21 and the total cost of 19 trips is more than \$21. For 18 trips the cost is \$1.15(18) = \$20.70. For 19 trips the cost is \$1.15(19) = \$21.85.

State. Gail should make more than 18 one-way trips per month in order for the pass to save her money.

24. Let $s =$ Nadia's score on the last test.

Solve: $\dfrac{82+76+78+s}{4} \geq 80$

$s \geq 84$

25. ***Familiarize.*** The average of the five scores is their sum divided by the number of tests, 5. We let s represent Rod's score on the last test.

Translate. The average of the five scores is given by

$$\frac{73+75+89+91+s}{5}.$$

Since this average must be at least 85, this means that it must be greater than or equal to 85. Thus, we can translate the problem to the inequality

$$\frac{73+75+89+91+s}{5} \geq 85.$$

Carry out. We first multiply by 5 to clear the fraction.

$$\begin{aligned} 5\left(\frac{73+75+89+91+s}{5}\right) &\geq 5\cdot 85 \\ 73+75+89+91+s &\geq 425 \\ 328+s &\geq 425 \\ s &\geq 97 \end{aligned}$$

Check. As a partial check, we show that Rod can get a score of 97 on the fifth test and have an average of at least 85:

$$\frac{73+75+89+91+97}{5} = \frac{425}{5} = 85.$$

State. Scores of 97 and higher will earn Rod an average quiz grade of at least 85.

26. Let $s =$ the number of servings of fruits or vegetables Dale eats on Saturday.

Solve: $\dfrac{4+6+7+4+6+4+s}{7} \geq 5$

$s \geq 4$ servings

27. ***Familiarize.*** Let $c =$ the number of credits Millie must complete in the fourth quarter.

Translate.

$$\underbrace{\text{Average number of credits}}_{\displaystyle\downarrow} \ \underbrace{\text{is at least}}_{\displaystyle\downarrow} \ \underset{\displaystyle\downarrow}{7.}$$

$$\frac{5+7+8+c}{4} \qquad \geq \qquad 7$$

Carry out. We solve the inequality.

$$\begin{aligned} \frac{5+7+8+c}{4} &\geq 7 \\ 4\left(\frac{5+7+8+c}{4}\right) &\geq 4\cdot 7 \\ 5+7+8+c &\geq 28 \\ 20+c &\geq 28 \\ c &\geq 8 \end{aligned}$$

Check. As a partial check, we show that Millie can complete 8 credits in the fourth quarter and average 7 credits per quarter.

$$\frac{5+7+8+8}{4} = \frac{28}{4} = 7$$

State. Millie must complete 8 credits or more in the fourth quarter.

28. Let $m =$ the number of minutes Monroe must practice on the seventh day.

Solve: $\dfrac{15+28+30+0+15+25+m}{7} \geq 20$

$m \geq 27$ min

29. ***Familiarize***. The average number of calls per week is the sum of the calls for the three weeks divided by the number of weeks, 3. We let c represent the number of calls made during the third week.

Translate. The average of the three weeks is given by

$$\frac{17+22+c}{3}.$$

Since the average must be at least 20, this means that it must be greater than or equal to 20. Thus, we can translate the problem to the inequality

$$\frac{17+22+c}{3} \geq 20.$$

Carry out. We first multiply by 3 to clear the fraction.

$$\begin{aligned} 3\left(\frac{17+22+c}{3}\right) &\geq 3\cdot 20 \\ 17+22+c &\geq 60 \\ 39+c &\geq 60 \\ c &\geq 21 \end{aligned}$$

Check. Suppose c is a number greater than or equal to 21. Then by adding 17 and 22 on both sides of the inequality we get

$$\begin{aligned} 17+22+c &\geq 17+22+21 \\ 17+22+c &\geq 60 \end{aligned}$$

so

$$\frac{17+22+c}{3} \geq \frac{60}{3}, \text{ or } 20.$$

State. 21 calls or more will maintain an average of at least 20 for the three-week period.

30. Let $l =$ the length of the rectangle.

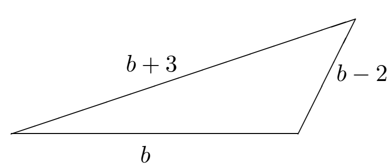
At least 200 ft: Solve $2l+16 \geq 200$

$l \geq 92$ ft

At most 200 ft: Solve $2l+16 \leq 200$

$l \leq 92$ ft

31. ***Familiarize***. We first make a drawing. We let b represent the length of the base. Then the lengths of the other sides are $b-2$ and $b+3$.



The perimeter is the sum of the lengths of the sides or $b+b-2+b+3$, or $3b+1$.

Translate.

$$\underbrace{\text{The perimeter}}_{\substack{\downarrow \\ 3b+1}} \quad \underbrace{\text{is greater than}}_{\substack{\downarrow \\ >}} \quad \underbrace{\text{19 cm.}}_{\substack{\downarrow \\ 19}}$$

Carry out.

$$\begin{aligned} 3b+1 &> 19 \\ 3b &> 18 \\ b &> 6 \end{aligned}$$

Check. We check to see if the solution seems reasonable.

When $b=5$, the perimeter is $3\cdot 5+1$, or 16 cm.

When $b=6$, the perimeter is $3\cdot 6+1$, or 19 cm.

When $b=7$, the perimeter is $3\cdot 7+1$, or 22 cm.

From these calculations, it would appear that the solution is correct.

State. For lengths of the base greater than 6 cm the perimeter will be greater than 19 cm.

32. Let $w=$ the width of the pool.

Solve: $2(2w)+2w \le 70$

$$w \le \frac{35}{3} \text{ ft, or } 11\frac{2}{3} \text{ ft}$$

33. ***Familiarize.*** Let $d=$ the depth of the well, in feet. Then the cost on the pay-as-you-go plan is $\$500+\$8d$. The cost of the guaranteed-water plan is \$4000. We want to find the values of d for which the pay-as-you-go plan costs less than the guaranteed-water plan.

Translate.

$$\underbrace{\begin{matrix}\text{Cost of pay-as-}\\ \text{you-go plan}\end{matrix}}_{\substack{\downarrow \\ 500+8d}} \quad \underbrace{\text{is less than}}_{\substack{\downarrow \\ <}} \quad \underbrace{\begin{matrix}\text{cost of}\\ \text{guaranteed-}\\ \text{water plan}\end{matrix}}_{\substack{\downarrow \\ 4000}}$$

Carry out.

$$\begin{aligned} 500+8d &< 4000 \\ 8d &< 3500 \\ d &< 437.5 \end{aligned}$$

Check. We check to see that the solution is reasonable.

When $d=437$, $\$500+\$8\cdot 437=\$3996<\$4000$

When $d=437.5$, $\$500+\$8(437.5)=\$4000$

When $d=438$, $\$500+\$8(438)=\$4004>\$4000$

From these calculations, it appears that the solution is correct.

State. It would save a customer money to use the pay-as-you-go plan for a well of less than 437.5 ft.

34. Let $t=$ the number of 15-min units of time for a road call.

Solve: $50+15t<70+10t$

$$t<4$$

It would be more economical to call Rick's for a service call of less than 4 15-min time units, or of less than 1 hr.

35. ***Familiarize.*** Let $v=$ the blue book value of the car. Since the car was repaired, we know that \$8500 does not exceed $0.8v$ or, in other words, $0.8v$ is at least \$8500.

Translate.

$$\underbrace{\begin{matrix}\text{80\% of the}\\ \text{blue book value}\end{matrix}}_{\substack{\downarrow \\ 0.8v}} \quad \underbrace{\text{is at least}}_{\substack{\downarrow \\ \ge}} \quad \underset{\substack{\downarrow \\ 8500}}{\text{\$8500.}}$$

Carry out.

$$\begin{aligned} 0.8v &\ge 8500 \\ v &\ge \frac{8500}{0.8} \\ v &\ge 10,625 \end{aligned}$$

Check. As a partial check, we show that 80% of \$10,625 is at least \$8500:

$$0.8(\$10,625)=\$8500$$

State. The blue book value of the car was at least \$10,625.

36. Let $c=$ the cost of the repair.

Solve: $c>0.8(21,000)$

$c>\$16,800$

37. ***Familiarize.*** As in the drawing in the text, we let $L=$ the length of the envelope. Recall that the area of a rectangle is the product of the length and the width.

Translate.

$$\underbrace{\text{Length}}_{\substack{\downarrow \\ L}} \quad \underset{\substack{\downarrow \\ \cdot}}{\text{times}} \quad \underbrace{\text{width}}_{\substack{\downarrow \\ 3\frac{1}{2}}} \quad \underbrace{\text{is at least}}_{\substack{\downarrow \\ \ge}} \quad \underbrace{17\tfrac{1}{2}\text{ in}^2}_{\substack{\downarrow \\ 17\frac{1}{2}}}$$

Carry out.

$$\begin{aligned} L\cdot 3\frac{1}{2} &\ge 17\frac{1}{2} \\ L\cdot\frac{7}{2} &\ge \frac{35}{2} \\ L\cdot\frac{7}{2}\cdot\frac{2}{7} &\ge \frac{35}{2}\cdot\frac{2}{7} \\ L &\ge 5 \end{aligned}$$

The solution set is $\{L|L\ge 5\}$.

Check. We can obtain a partial check by substituting a number greater than or equal to 5 in the inequality. For example, when $L=6$:

$$L\cdot 3\frac{1}{2}=6\cdot 3\frac{1}{2}=6\cdot\frac{7}{2}=21\ge 17\frac{1}{2}$$

The result appears to be correct.

State. Lengths of 5 in. or more will satisfy the constraints. The solution set is $\{L|L\ge 5 \text{ in.}\}$.

38. Solve: $L+53\le 165$

$L\le 112$ in.

39. ***Familiarize.*** We will use the formula $F=\frac{9}{5}C+32$.

Translate.

$$\underbrace{\text{Fahrenheit temperature}}_{\downarrow \atop F} \quad \underbrace{\text{is above}}_{\downarrow \atop >} \quad \underset{\downarrow \atop 98.6}{98.6^\circ.}$$

Substituting $\frac{9}{5}C + 32$ for F, we have

$\frac{9}{5}C + 32 > 98.6.$

Carry out. We solve the inequality.

$$\begin{aligned}\frac{9}{5}C + 32 &> 98.6\\ \frac{9}{5}C &> 66.6\\ C &> \frac{333}{9}\\ C &> 37\end{aligned}$$

Check. We check to see if the solution seems reasonable.

When $C = 36$, $\frac{9}{5} \cdot 36 + 32 = 96.8$.

When $C = 37$, $\frac{9}{5} \cdot 37 + 32 = 98.6$.

When $C = 38$, $\frac{9}{5} \cdot 38 + 32 = 100.4$.

It would appear that the solution is correct, considering that rounding occurred.

State. The human body is feverish for Celsius temperatures greater than 37°.

40. Solve: $\frac{9}{5}C + 32 < 1945.4$

$C < 1063°\text{C}$

41. ***Familiarize***. Let h = the height of the triangle, in ft. Recall that the formula for the area of a triangle with base b and height h is $A = \frac{1}{2}bh$.

Translate.

$$\underset{\downarrow \atop \frac{1}{2}\left(1\frac{1}{2}\right)h}{\text{Area}} \quad \underbrace{\text{is at least}}_{\downarrow \atop \geq} \quad \underbrace{3\text{ ft}^2.}_{\downarrow \atop 3}$$

Carry out. We solve the inequality.

$$\begin{aligned}\frac{1}{2}\left(1\frac{1}{2}\right)h &\geq 3\\ \frac{1}{2} \cdot \frac{3}{2} \cdot h &\geq 3\\ \frac{3}{4}h &\geq 3\\ h &\geq \frac{4}{3} \cdot 3\\ h &\geq 3\end{aligned}$$

Check. As a partial check, we show that the area of the triangle is 3 ft^2 when the height is 4 ft.

$\frac{1}{2}\left(1\frac{1}{2}\right)(4) = \frac{1}{2} \cdot \frac{3}{2} \cdot \frac{4}{1} = 3$

State. The height should be at least 4 ft.

42. Let h = the height of the triangle, in ft.

Solve: $\frac{1}{2} \cdot 8 \cdot h \leq 12$

$h \leq 3$ ft

43. ***Familiarize***. Let r = the amount of fat in a serving of the regular peanut butter, in grams. If reduced fat peanut butter has at least 25% less fat than regular peanut butter, then it has at most 75% as much fat as the regular peanut butter.

Translate.

$$\underbrace{\text{12 g of fat}}_{\downarrow \atop 12} \quad \underbrace{\text{is at most}}_{\downarrow \atop \leq} \quad \underset{\downarrow \atop 0.75}{75\%} \quad \underset{\downarrow \atop \cdot}{\text{of}} \quad \underbrace{\text{the amount of fat in regular peanut butter.}}_{\downarrow \atop r}$$

Carry out.

$12 \leq 0.75r$

$16 \leq r$

Check. As a partial check, we show that 12 g of fat does not exceed 75% of 16 g of fat:

$0.75(16) = 12$

State. Regular peanut butter contains at least 16 g of fat per serving.

44. Let r = the amount of fat in a serving of regular cookies, in grams.

Solve: $5 \leq 0.75r$ (See Exercise 35.)

$r \geq 6\frac{2}{3}$ g

45. ***Familiarize***. Let d = the number of days after September 5.

Translate.

$$\underbrace{\text{Weight on September 5}}_{\downarrow \atop 532} \quad \underset{\downarrow \atop +}{\text{plus}} \quad \underbrace{\text{26 lb per day}}_{\downarrow \atop 26} \quad \underset{\downarrow \atop \cdot}{\text{times}}$$

$$\underbrace{\text{number of days}}_{\downarrow \atop d} \quad \underset{\downarrow \atop >}{\text{exceeds}} \quad \underbrace{\text{818 lb.}}_{\downarrow \atop 818}$$

Carry out. We solve the inequality.

$$\begin{aligned}532 + 26d &> 818\\ 26d &> 286\\ d &> 11\end{aligned}$$

Check. As a partial check, we can show that the weight of the pumpkin is 818 lb 11 days after September 5.

$532 + 26 \cdot 11 = 532 + 286 = 818$ lb

State. The pumpkin's weight will exceed 818 lb more than 11 days after September 5, or on dates after September 16.

46. Let w = the number of weeks after July 1.

Solve: $25 - \frac{2}{3}w \leq 21.$

$w \geq 6$

The water level will not exceed 21 ft for dates at least 6 weeks after July 1, or on August 12 and later.

47. ***Familiarize.*** Let $c =$ the number of copies Myra has made. The total cost of the copies is the setup fee of \$6 plus \$4 times the number of copies, or $\$4 \cdot c$.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Setup fee}} & \text{plus} & \underbrace{\text{copying cost}} & \underbrace{\text{cannot exceed}} & \$65. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 6 & + & 4c & \leq & 65 \end{array}$$

Carry out. We solve the inequality.

$$6 + 4c \leq 65$$
$$4c \leq 59$$
$$c \leq 14.75$$

Check. As a partial check, we show that Myra can have 14 copies made and not exceed her \$65 budget.

$$\$6 + \$4 \cdot 14 = \$6 + \$56 = \$62$$

State. Myra can have 14 or fewer copies made and stay within her budget.

48. Let $n =$ the number of people who attend the banquet.

Solve: $40 + 16n \leq 450$

$$n \leq 25.625$$

At most, 25 people can attend the banquet.

49. ***Familiarize.*** We will use the formula $R = -0.0065t + 4.3222$.

Translate.

$$\begin{array}{ccc} \underbrace{\text{The world record}} & \underbrace{\text{is less than}} & \underbrace{\text{3.7 minutes}}. \\ \downarrow & \downarrow & \downarrow \\ -0.0065t + 4.3222 & < & 3.7 \end{array}$$

Carry out. We solve the inequality.

$$-0.0065t + 4.3222 < 3.7$$
$$-0.0065t < -0.6222$$
$$t > 95.7$$

Check. As a partial check, we can show that the record is more than 3.7 min 95 yr after 1900 and is less than 3.7 min 96 yr after 1900.

For $t = 95$, $R = -0.0065(95) + 4.3222 = 3.7047$.

For $t = 96$, $R = -0.0065(96) + 4.3222 = 3.6982$.

State. The world record in the mile run is less than 3.7 min more than 95 yr after 1900, or in years after 1995.

50. Solve: $-0.0223t + 4.4078 < 3.5$

$$t > 40.7$$

The world record in the 1500-m run will be less than 3.5 min more than 40 yr after 1930, or in years after 1970.

51. ***Familiarize.*** We will use the equation $y = 0.03x + 0.21$.

Translate.

$$\begin{array}{ccc} \underbrace{\text{The cost}} & \underbrace{\text{is at most}} & \$6. \\ \downarrow & \downarrow & \downarrow \\ 0.03x + 0.21 & \leq & 6 \end{array}$$

Carry out. We solve the inequality.

$$0.03x + 0.21 \leq 6$$
$$0.03x \leq 5.79$$
$$x \leq 193$$

Check. As a partial check, we show that the cost for driving 193 mi is \$6.

$$0.03(193) + 0.21 = 6$$

State. The cost will be at most \$6 for mileages less than or equal to 193 mi.

52. Solve: $0.227Y - 448.71 \geq 7$

$$Y \geq 2007.5$$

The average price of a movie ticket will be at least \$7 in 2007 and following years.

53. *Writing Exercise.* Answers may vary. Fran is more than 3 years older than Todd.

54. *Writing Exercise.* Let n represent "a number." Then "five more than a number" translates to $n + 5$, or $5 + n$, and "five is more than a number" translates to $5 > n$.

55. $\dfrac{9-5}{6-4} = \dfrac{4}{2} = 2$

56. $\dfrac{8-5}{12-6} = \dfrac{3}{6} = \dfrac{1}{2}$

57. $\dfrac{8-(-2)}{1-4} = \dfrac{10}{-3}$, or $-\dfrac{10}{3}$

58. $\dfrac{7-9}{4-(-6)} = \dfrac{-2}{10} = -\dfrac{1}{5}$

59. *Writing Exercise.* Answers may vary.

A boat has a capacity of 2800 lb. How many passengers can go on the boat if each passenger is considered to weigh 150 lb.

60. *Writing Exercise.* Answers may vary.

Acme rents a truck at a daily rate of \$46.35 plus \$0.43 per mile. The Rothmans want a one-day truck rental, but they must stay within an \$85 budget. What mileage will allow them to stay within their budget? Round to the nearest mile.

61. ***Familiarize.*** We use the formula $F = \dfrac{9}{5}C + 32$.

Translate. We are interested in temperatures such that $5° < F < 15°$. Substituting for F, we have:

$$5 < \frac{9}{5}C + 32 < 15$$

Solve.

$$5 < \frac{9}{5}C + 32 < 15$$
$$5 \cdot 5 < 5\left(\frac{9}{5}C + 32\right) < 5 \cdot 15$$
$$25 < 9C + 160 < 75$$
$$-135 < 9C < -85$$
$$-15 < C < -9\frac{4}{9}$$

Check. The check is left to the student.

State. Green ski wax works best for temperatures between $-15°\text{C}$ and $-9\frac{4}{9}°\text{C}$.

62. Let $h =$ the number of hours the car has been parked.

Solve: $4 + 2.5(h-1) > 16.5$
$$h > 6 \text{ hr}$$

63. Since $8^2 = 64$, the length of a side must be less than or equal to 8 cm (and greater than 0 cm, of course). We can also use the five-step problem-solving procedure.

Familiarize. Let s represent the length of a side of the square. The area s is the square of the length of a side, or s^2.

Translate.

$$\underbrace{\text{The area}}_{s^2} \ \underbrace{\text{is no more than}}_{\leq} \ \underbrace{64 \text{ cm}^2.}_{64}$$

Carry out.

$$s^2 \leq 64$$
$$s^2 - 64 \leq 0$$
$$(s+8)(s-8) \leq 0$$

We know that $(s+8)(s-8) = 0$ for $s = -8$ or $s = 8$. Now $(s+8)(s-8) < 0$ when the two factors have opposite signs. That is:

$s+8>0$ *and* $s-8<0$ *or* $s+8<0$ *and* $s-8>0$

$s>-8$ *and* $s<8$ *or* $s<-8$ *and* $s>8$

This can be expressed as $-8 < s < 8$. This is not possible.

Then $(s+8)(s-8) \leq 0$ for $-8 \leq s \leq 8$.

Check. Since the length of a side cannot be negative we only consider positive values of s, or $0 < s \leq 8$. We check to see if this solution seems reasonable.

When $s = 7$, the area is 7^2, or 49 cm^2.

When $s = 8$, the area is 8^2, or 64 cm^2.

When $s = 9$, the area is 9^2, or 81 cm^2.

From these calculations, it appears that the solution is correct.

State. Sides of length 8 cm or less will allow an area of no more than 64 cm^2. (Of course, the length of a side must be greater than 0 also.)

64. Because we are considering odd integers we know that the larger integer cannot be greater than 49. $(51 + 49$ is not less than 100.) Then the smaller integer is $49 - 2$, or 47. We can also do this exercise as follows:

Let $x =$ the smaller integer. Then $x + 2 =$ the larger integer.

Solve: $x + (x+2) < 100$
$$x < 49$$

The largest odd integer less than 49 is 47, so the integers are 47 and 49.

65. ***Familiarize***. Let $f =$ the fat content of a serving of regular tortilla chips, in grams. A product that contains 60% less fat than another product has 40% of the fat content of that product. If Reduced Fat Tortilla Pops cannot be labeled lowfat, then they contain at least 3 g of fat.

Translate.

$$\underbrace{40\%}_{0.4}\ \underbrace{\text{of}}_{\cdot}\ \underbrace{\text{the fat content of regular tortilla chips}}_{f}\ \underbrace{\text{is at least}}_{\geq}\ \underbrace{\text{3 grams of fat}}_{3}$$

Carry out.

$$0.4f \geq 3$$
$$f \geq 7.5$$

Check. As a partial check, we show that 40% of 7.5 g is not less than 3 g.

$$0.4(7.5) = 3$$

State. A serving of regular tortilla chips contains at least 7.5 g of fat.

66. Let $h =$ the number of hours the car has been parked. Then $h - 1 =$ the number of hours after the first hour.

Solve: $14 < 4 + 2.50(h-1) < 24$
$$5 \text{ hr} < h < 9 \text{ hr}$$

67. ***Familiarize***. Let $p =$ the price of Neoma's tenth book. If the average price of each of the first 9 books is \$12, then the total price of the 9 books is $9 \cdot \$12$, or \$108. The average price of the first 10 books will be $\frac{\$108 + p}{10}$.

Translate.

$$\underbrace{\text{The average price of 10 books}}_{\frac{108+p}{10}}\ \underbrace{\text{is at least}}_{\geq}\ \underbrace{\$15.}_{15}$$

Carry out. We solve the inequality.

$$\frac{108+p}{10} \geq 15$$
$$108 + p \geq 150$$
$$p \geq 42$$

Check. As a partial check, we show that the average price of the 10 books is \$15 when the price of the tenth book is \$42.

$$\frac{\$108 + \$42}{10} = \frac{\$150}{10} = \$15$$

State. Neoma's tenth book should cost at least \$42 if she wants to select a \$15 book for her free book.

68. *Writing Exercise.* Let $s =$ Blythe's score on the tenth quiz. We determine the score required to improve her average at least 2 points. Solving $\frac{9 \cdot 84 + s}{10} \geq 86$, we get $s \geq 104$. Since the maximum possible score is 100, Blythe cannot improve her average two points with the next quiz.

69. *Writing Exercise.* Let p = the total purchases for the year. Solving $10\%p > 25$, we get $p > 250$. Thus, when a customer's purchases are more than $250 for the year, the customer saves money by purchasing a card.