Chapter 2

Section 2.1

Are You Prepared for This Section?

P1. The additive inverse of 3 is −3 because $3 + (-3) = 0$. The sum of a real number and its additive inverse is 0.

P2. The multiplicative inverse of $-\frac{4}{3}$ is $-\frac{3}{4}$ because $-\frac{4}{3}\left(-\frac{3}{4}\right) = 1$. The product of a number and its multiplicative inverse is 1.

P3. $\frac{2}{3}\left(\frac{3}{2}\right) = \frac{2 \cdot 3}{3 \cdot 2} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot \underset{1}{\cancel{2}}} = \frac{1 \cdot 1}{1 \cdot 1} = 1$

P4. $$\begin{aligned} -4(2x+3) &= -4 \cdot 2x + (-4) \cdot 3 \\ &= -8x + (-12) \\ &= -8x - 12 \end{aligned}$$

P5. $11 - (x + 6) = 11 - x - 6 = 5 - x$ or $-x + 5$

2.1 Quick Checks

1. The solution of a linear equation is the value or values of the variable that makes the equation a true statement.

2. $$\begin{aligned} a - 4 &= -7 \\ -3 - 4 &\stackrel{?}{=} -7 \\ -7 &= -7 \quad \text{True} \end{aligned}$$
Since the left side equals the right side when we replace a by −3, $a = -3$ is a solution of the equation.

3. $$\begin{aligned} 2x + 1 &= 11 \\ 2\left(\frac{21}{2}\right) + 1 &\stackrel{?}{=} 11 \\ 21 + 1 &\stackrel{?}{=} 11 \\ 22 &= 11 \quad \text{False} \end{aligned}$$
Since the left side does not equal the right side when we replace x by $\frac{21}{2}$, $x = \frac{21}{2}$ is *not* a solution of the equation.

4. $$\begin{aligned} 3x - (x + 4) &= 8 \\ 3(6) - (6 + 4) &\stackrel{?}{=} 8 \\ 3(6) - 10 &\stackrel{?}{=} 8 \\ 18 - 10 &\stackrel{?}{=} 8 \\ 8 &= 8 \quad \text{True} \end{aligned}$$
Since the left side equals the right side when we replace x by 6, $x = 6$ is a solution of the equation.

5. $$\begin{aligned} -9b + 3 + 7b &= -3b + 8 \\ -9(-3) + 3 + 7(-3) &\stackrel{?}{=} -3(-3) + 8 \\ 27 + 3 + (-21) &\stackrel{?}{=} 9 + 8 \\ 9 &= 17 \quad \text{False} \end{aligned}$$
Since the left side does not equal the right side when we replace b by −3, $b = -3$ is *not* a solution of the equation.

6. True

7. $$\begin{aligned} x - 11 &= 21 \\ x - 11 + 11 &= 21 + 11 \\ x &= 32 \end{aligned}$$
Check: $$\begin{aligned} x - 11 &= 21 \\ 32 - 11 &\stackrel{?}{=} 21 \\ 21 &= 21 \quad \text{True} \end{aligned}$$
Because $x = 32$ satisfies the original equation, the solution is 32, or the solution set is {32}.

8. $$\begin{aligned} y + 7 &= 21 \\ y + 7 - 7 &= 21 - 7 \\ y &= 14 \end{aligned}$$
Check: $$\begin{aligned} y + 7 &= 21 \\ 14 + 7 &\stackrel{?}{=} 21 \\ 21 &= 21 \quad \text{True} \end{aligned}$$
Because $y = 14$ satisfies the original equation, the solution is 14, or the solution set is {14}.

9. $$\begin{aligned} -8 + a &= 4 \\ -8 + a + 8 &= 4 + 8 \\ a &= 12 \end{aligned}$$
Check: $$\begin{aligned} -8 + a &= 4 \\ -8 + 12 &\stackrel{?}{=} 4 \\ 4 &= 4 \quad \text{True} \end{aligned}$$
Because $a = 12$ satisfies the original equation, the solution is 12, or the solution set is {12}.

10. $-3 = 12 + c$

$-3 - 12 = 12 + c - 12$

$-15 = c$

Check: $-3 = 12 + c$

$-3 \stackrel{?}{=} 12 + (-15)$

$-3 = -3$ True

Because $c = -15$ satisfies the original equation, the solution is -15, or the solution set is $\{-15\}$.

11. $z - \frac{2}{3} = \frac{5}{3}$

$z - \frac{2}{3} + \frac{2}{3} = \frac{5}{3} + \frac{2}{3}$

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

Check: $z - \frac{2}{3} = \frac{5}{3}$

$\frac{7}{3} - \frac{2}{3} \stackrel{?}{=} \frac{5}{3}$

$\frac{5}{3} = \frac{5}{3}$ True

Because $z = \frac{7}{3}$ satisfies the original equation, the solution is $\frac{7}{3}$, or the solution set is $\left\{\frac{7}{3}\right\}$.

12. $\frac{5}{4} + x = \frac{1}{6}$

$\frac{5}{4} + x - \frac{5}{4} = \frac{1}{6} - \frac{5}{4}$

$x = \frac{2}{12} - \frac{15}{12}$

$x = -\frac{13}{12}$

Check: $\frac{5}{4} + x = \frac{1}{6}$

$\frac{5}{4} + \left(-\frac{13}{12}\right) \stackrel{?}{=} \frac{1}{6}$

$\frac{15}{12} + \left(-\frac{13}{12}\right) \stackrel{?}{=} \frac{1}{6}$

$\frac{2}{12} \stackrel{?}{=} \frac{1}{6}$

$\frac{1}{6} = \frac{1}{6}$ True

Because $x = -\frac{13}{12}$ satisfies the original equation, the solution is $-\frac{13}{12}$, or the solution set is $\left\{-\frac{13}{12}\right\}$.

13. $p + 1472.25 = 13{,}927.25$

$p + 1472.25 - 1472.25 = 13{,}927.25 - 1472.25$

$p = 12{,}455$

Since $p = 12{,}455$, the price of the car was \$12,455 before the extra charges.

14. The Multiplication Property of Equality states that for real numbers a, b, and c, $c \neq 0$, if $a = b$, then $ac = bc$.

15. $8p = 16$

$\frac{1}{8}(8p) = \frac{1}{8}(16)$

$\left(\frac{1}{8} \cdot 8\right)p = \frac{1}{8}(16)$

$p = 2$

Check: $8p = 16$

$8(2) \stackrel{?}{=} 16$

$16 = 16$ True

Because $p = 2$ satisfies the original equation, the solution is 2, or the solution set is $\{2\}$.

16. $-7n = 14$

$-\frac{1}{7}(-7n) = -\frac{1}{7}(14)$

$\left(-\frac{1}{7} \cdot -7\right)n = -\frac{1}{7}(14)$

$n = -2$

Check: $-7n = 14$

$-7(-2) \stackrel{?}{=} 14$

$14 = 14$ True

Because $n = -2$ satisfies the original equation, the solution is -2, or the solution set is $\{-2\}$.

17. $6z = 15$

$\frac{1}{6}(6z) = \frac{1}{6}(15)$

$\left(\frac{1}{6} \cdot 6\right)z = \frac{15}{6}$

$z = \frac{5}{2}$

Check: $6z = 15$

$$6\left(\frac{5}{2}\right) \stackrel{?}{=} 15$$

$$\overset{3}{\cancel{6}}\left(\frac{5}{\cancel{2}_{1}}\right) \stackrel{?}{=} 15$$

$$15 = 15 \quad \text{True}$$

Because $z = \frac{5}{2}$ satisfies the original equation, the solution is $\frac{5}{2}$, or the solution set is $\left\{\frac{5}{2}\right\}$.

18. $-12b = 28$

$$-\frac{1}{12}(-12b) = -\frac{1}{12}(28)$$

$$\left(-\frac{1}{12}\cdot -12\right)b = -\frac{28}{12}$$

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

Check: $-12b = 28$

$$-12\left(-\frac{7}{3}\right) \stackrel{?}{=} 28$$

$$-\overset{4}{\cancel{12}}\left(-\frac{7}{\cancel{3}_{1}}\right) \stackrel{?}{=} 28$$

$$28 = 28 \quad \text{True}$$

Because $b = -\frac{7}{3}$ satisfies the original equation, the solution is $-\frac{7}{3}$, or the solution set is $\left\{-\frac{7}{3}\right\}$.

19. $\frac{4}{3}n = 12$

$$\frac{3}{4}\left(\frac{4}{3}n\right) = \frac{3}{4}(12)$$

$$\left(\frac{3}{4}\cdot\frac{4}{3}\right)n = \frac{3}{4}(12)$$

$$n = 9$$

Check: $\frac{4}{3}n = 12$

$$\frac{4}{3}(9) \stackrel{?}{=} 12$$

$$12 = 12 \quad \text{True}$$

Because $n = 9$ satisfies the original equation, the solution is 9, or the solution set is $\{9\}$.

20. $-21 = \frac{7}{3}k$

$$\frac{3}{7}(-21) = \frac{3}{7}\left(\frac{7}{3}k\right)$$

$$\frac{3}{7}(-21) = \left(\frac{3}{7}\cdot\frac{7}{3}\right)k$$

$$-9 = k$$

Check: $-21 = \frac{7}{3}k$

$$-21 \stackrel{?}{=} \frac{7}{3}(-9)$$

$$-21 = -21 \quad \text{True}$$

Because $k = -9$ satisfies the original equation, the solution is -9, or the solution set is $\{-9\}$.

21. $15 = -\frac{z}{2}$

$$-2(15) = -2\left(-\frac{z}{2}\right)$$

$$-30 = z$$

Check: $15 = -\frac{z}{2}$

$$15 \stackrel{?}{=} -\frac{-30}{2}$$

$$15 = 15 \quad \text{True}$$

Because $z = -30$ satisfies the original equation, the solution is -30 or the solution set is $\{-30\}$.

22. $\frac{3}{8}b = \frac{9}{4}$

$$\frac{8}{3}\left(\frac{3}{8}b\right) = \frac{8}{3}\cdot\frac{9}{4}$$

$$\left(\frac{8}{3}\cdot\frac{3}{8}\right)b = \frac{\overset{2}{\cancel{8}}}{\cancel{3}_{1}}\cdot\frac{\overset{3}{\cancel{9}}}{\cancel{4}_{1}}$$

$$b = 6$$

Check: $\frac{3}{8}b = \frac{9}{4}$

$$\frac{3}{8}(6) \stackrel{?}{=} \frac{9}{4}$$

$$\frac{3}{\cancel{8}_{4}}(\overset{3}{\cancel{6}}) \stackrel{?}{=} \frac{9}{4}$$

$$\frac{9}{4} = \frac{9}{4} \quad \text{True}$$

The solution is 6, or the solution set is $\{6\}$.

23. $-\frac{4}{9}=\frac{-t}{6}$

$-\frac{4}{9}=-\frac{1}{6}t$

$-6\left(-\frac{4}{9}\right)=-6\left(-\frac{1}{6}t\right)$

$-\cancel{6}^{2}\left(-\frac{4}{\cancel{9}_{3}}\right)=\left(-6\cdot-\frac{1}{6}\right)t$

$\frac{8}{3}=t$

Check: $-\frac{4}{9}=\frac{-t}{6}$

$-\frac{4}{9}\stackrel{?}{=}-\frac{1}{6}\left(\frac{8}{3}\right)$

$-\frac{4}{9}\stackrel{?}{=}-\frac{1}{\cancel{6}_{3}}\left(\frac{\cancel{8}^{4}}{3}\right)$

$-\frac{4}{9}=-\frac{4}{9}$ True

The solution is $\frac{8}{3}$, or the solution set is $\left\{\frac{8}{3}\right\}$.

24. $\frac{1}{4}=-\frac{7}{10}m$

$-\frac{10}{7}\left(\frac{1}{4}\right)=-\frac{10}{7}\left(-\frac{7}{10}m\right)$

$-\frac{\cancel{10}^{5}}{7}\left(\frac{1}{\cancel{4}_{2}}\right)=\left(-\frac{10}{7}\cdot-\frac{7}{10}\right)m$

$-\frac{5}{14}=m$

Check: $\frac{1}{4}=-\frac{7}{10}m$

$\frac{1}{4}\stackrel{?}{=}-\frac{7}{10}\left(-\frac{5}{14}\right)$

$\frac{1}{4}\stackrel{?}{=}-\frac{\cancel{7}^{1}}{\cancel{10}_{2}}\left(-\frac{\cancel{5}^{1}}{\cancel{14}_{2}}\right)$

$\frac{1}{4}=\frac{1}{4}$ True

The solution is $-\frac{5}{14}$, or the solution set is $\left\{-\frac{5}{14}\right\}$.

2.1 Exercises

26. $4t + 2 = 16$; $t = 3$

$4(3)+2\stackrel{?}{=}16$

$12+2\stackrel{?}{=}16$

$14=16$ False

No, $t = 3$ is not a solution of the equation.

28. $3(x + 1) - x = 5x - 9$; $x = -3$

$3(-3+1)-(-3)\stackrel{?}{=}5(-3)-9$

$3(-2)+3\stackrel{?}{=}-15-9$

$-6+3\stackrel{?}{=}-24$

$-3=-24$ False

No, $x = -3$ is not a solution of the equation.

30. $-15 = 3x - 16$; $x=\frac{1}{3}$

$-15\stackrel{?}{=}3\left(\frac{1}{3}\right)-16$

$-15\stackrel{?}{=}1-16$

$-15=-15$ True

Yes, $x=\frac{1}{3}$ is a solution of the equation.

32. $3s - 6 = 6s - 3.4$; $s = -1.2$

$3(-1.2)-6\stackrel{?}{=}6(-1.2)-3.4$

$-3.6-6\stackrel{?}{=}-7.2-3.4$

$-9.6=-10.6$ False

No, $s = -1.2$ is not a solution of the equation.

34. $y-8=2$

$y-8+8=2+8$

$y=10$

Check: $y-8=2$

$10-8\stackrel{?}{=}2$

$2=2$ True

The solution is 10, or the solution set is {10}.

36. $r+3=-1$

$r+3-3=-1-3$

$r=-4$

Check: $r+3=-1$

$-4+3\stackrel{?}{=}-1$

$-1=-1$ True

The solution is –4, or the solution set is {–4}.

38. $13 = u - 6$

$13 + 6 = u - 6 + 6$

$19 = u$

Check: $13 = u - 6$

$13 \stackrel{?}{=} 19 - 6$

$13 = 13$ True

The solution is 19 or the solution set is $\{19\}$.

40. $-2 = y + 13$

$-2 - 13 = y + 13 - 13$

$-15 = y$

Check: $-2 = y + 13$

$-2 \stackrel{?}{=} -15 + 13$

$-2 = -2$ True

The solution is -15 or the solution set is $\{-15\}$.

42. $x - \frac{1}{8} = \frac{3}{8}$

$x - \frac{1}{8} + \frac{1}{8} = \frac{3}{8} + \frac{1}{8}$

$x = \frac{4}{8}$

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

Check: $x - \frac{1}{8} = \frac{3}{8}$

$\frac{1}{2} - \frac{1}{8} \stackrel{?}{=} \frac{3}{8}$

$\frac{4}{8} - \frac{1}{8} \stackrel{?}{=} \frac{3}{8}$

$\frac{3}{8} = \frac{3}{8}$ True

The solution is $\frac{1}{2}$ or the solution set is $\left\{\frac{1}{2}\right\}$.

44. $n + \frac{3}{5} = \frac{7}{10}$

$n + \frac{3}{5} - \frac{3}{5} = \frac{7}{10} - \frac{3}{5}$

$n = \frac{7}{10} - \frac{6}{10}$

$n = \frac{1}{10}$

Check: $n + \frac{3}{5} = \frac{7}{10}$

$\frac{1}{10} + \frac{3}{5} \stackrel{?}{=} \frac{7}{10}$

$\frac{1}{10} + \frac{6}{10} \stackrel{?}{=} \frac{7}{10}$

$\frac{7}{10} = \frac{7}{10}$ True

The solution is $\frac{1}{10}$ or the solution set is $\left\{\frac{1}{10}\right\}$.

46. $\frac{3}{8} = y - \frac{1}{6}$

$\frac{3}{8} + \frac{1}{6} = y - \frac{1}{6} + \frac{1}{6}$

$\frac{9}{24} + \frac{4}{24} = y$

$\frac{13}{24} = y$

Check: $\frac{3}{8} = y - \frac{1}{6}$

$\frac{3}{8} \stackrel{?}{=} \frac{13}{24} - \frac{1}{6}$

$\frac{3}{8} \stackrel{?}{=} \frac{13}{24} - \frac{4}{24}$

$\frac{3}{8} \stackrel{?}{=} \frac{9}{24}$

$\frac{3}{8} = \frac{3}{8}$ True

The solution is $\frac{13}{24}$ or the solution set is $\left\{\frac{13}{24}\right\}$.

48. $z + 4.9 = -2.6$

$z + 4.9 - 4.9 = -2.6 - 4.9$

$z = -7.5$

Check: $z + 4.9 = -2.6$

$-7.5 + 4.9 \stackrel{?}{=} -2.6$

$-2.6 = -2.6$ True

The solution is -7.5 or the solution set is $\{-7.5\}$.

50. $8b = 48$

$\frac{8b}{8} = \frac{48}{8}$

$b = 6$

Check: $8b = 48$

$8(6) \stackrel{?}{=} 48$

$48 = 48$ True

The solution is 6 or the solution set is $\{6\}$.

52. $-8s = 40$

$$\frac{-8s}{-8} = \frac{40}{-8}$$

$$s = -5$$

Check: $-8s = 40$

$-8(-5) \stackrel{?}{=} 40$

$40 = 40$ True

The solution is -5 or the solution set is $\{-5\}$.

54. $4z = 30$

$$\frac{4z}{4} = \frac{30}{4}$$

$$z = \frac{15}{2}$$

Check: $4z = 30$

$4 \cdot \frac{15}{2} \stackrel{?}{=} 30$

$2 \cdot 15 \stackrel{?}{=} 30$

$30 = 30$ True

The solution is $\frac{15}{2}$ or the solution set is $\left\{\frac{15}{2}\right\}$.

56. $-8p = 20$

$$\frac{-8p}{-8} = \frac{20}{-8}$$

$$p = -\frac{5}{2}$$

Check: $-8p = 20$

$-8 \cdot \left(-\frac{5}{2}\right) \stackrel{?}{=} 20$

$4 \cdot 5 \stackrel{?}{=} 20$

$20 = 20$ True

The solution is $-\frac{5}{2}$ or the solution set is $\left\{-\frac{5}{2}\right\}$.

58. $\frac{4}{3}b = 16$

$$\frac{3}{4}\left(\frac{4}{3}b\right) = \frac{3}{4}(16)$$

$$b = 3 \cdot 4$$

$$b = 12$$

Check: $\frac{4}{3}b = 16$

$\frac{4}{3} \cdot 12 \stackrel{?}{=} 16$

$4 \cdot 4 \stackrel{?}{=} 16$

$16 = 16$ True

The solution is 12 or the solution set is $\{12\}$.

60. $-\frac{6}{5}n = -36$

$$-\frac{5}{6}\left(-\frac{6}{5}n\right) = -\frac{5}{6}(-36)$$

$$n = -5(-6)$$

$$n = 30$$

Check: $-\frac{6}{5}n = -36$

$-\frac{6}{5} \cdot 30 \stackrel{?}{=} -36$

$-6 \cdot 6 \stackrel{?}{=} -36$

$-36 = -36$ True

The solution is 30 or the solution set is $\{30\}$.

62. $-\frac{y}{6} = 3$

$$-\frac{6}{1} \cdot \frac{-y}{6} = -\frac{6}{1} \cdot 3$$

$$y = -18$$

Check: $\frac{-y}{6} = 3$

$-\frac{-18}{6} \stackrel{?}{=} 3$

$3 = 3$ True

The solution is -18, or the solution set is $\{-18\}$.

64. $\frac{9}{2} = 3b$

$$\frac{1}{3} \cdot \frac{9}{2} = \frac{1}{3} \cdot 3b$$

$$\frac{3}{2} = b$$

Check: $\frac{9}{2} = 3b$

$\frac{9}{2} \stackrel{?}{=} 3 \cdot \frac{3}{2}$

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

The solution is $\frac{3}{2}$ or the solution set is $\left\{\frac{3}{2}\right\}$.

66. $4r = -\frac{12}{5}$

$$\frac{1}{4} \cdot 4r = \frac{1}{4} \cdot \left(-\frac{12}{5}\right)$$

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

Check: $4r = -\frac{12}{5}$

$4\cdot\left(-\frac{3}{5}\right) \stackrel{?}{=} -\frac{12}{5}$

$-\frac{12}{5} = -\frac{12}{5}$ True

The solution is $-\frac{3}{5}$ or the solution set is $\left\{-\frac{3}{5}\right\}$.

68. $\frac{1}{4}w = \frac{7}{2}$

$4\cdot\frac{1}{4}w = 4\cdot\frac{7}{2}$

$w = 2\cdot 7$

$w = 14$

Check: $\frac{1}{4}w = \frac{7}{2}$

$\frac{1}{4}\cdot 14 \stackrel{?}{=} \frac{7}{2}$

$\frac{7}{2} = \frac{7}{2}$ True

The solution is 14 or the solution set is $\{14\}$.

70. $\frac{3}{10}q = -\frac{1}{6}$

$\frac{10}{3}\cdot\frac{3}{10}q = \frac{10}{3}\cdot\left(-\frac{1}{6}\right)$

$q = \frac{5}{3}\cdot\left(-\frac{1}{3}\right)$

$q = -\frac{5}{9}$

Check: $\frac{3}{10}q = -\frac{1}{6}$

$\frac{3}{10}\left(-\frac{5}{9}\right) \stackrel{?}{=} -\frac{1}{6}$

$\frac{1}{2}\left(-\frac{1}{3}\right) \stackrel{?}{=} -\frac{1}{6}$

$-\frac{1}{6} = -\frac{1}{6}$ True

The solution is $-\frac{5}{9}$ or the solution set is $\left\{-\frac{5}{9}\right\}$.

72. $\frac{11}{36} = -\frac{t}{9}$

$-9\cdot\frac{11}{36} = -9\cdot\left(-\frac{t}{9}\right)$

$-\frac{11}{4} = t$

Check: $\frac{11}{36} = -\frac{t}{9}$

$\frac{11}{36} \stackrel{?}{=} -\frac{-\frac{11}{4}}{9}$

$\frac{11}{36} \stackrel{?}{=} \frac{11}{4}\cdot\frac{1}{9}$

$\frac{11}{36} = \frac{11}{36}$ True

The solution is $-\frac{11}{4}$ or the solution set is $\left\{-\frac{11}{4}\right\}$.

74. $m - 6 = -9$

$m - 6 + 6 = -9 + 6$

$m = -3$

Check: $m - 6 = -9$

$-3 - 6 \stackrel{?}{=} -9$

$-9 = -9$ True

The solution is -3 or the solution set is $\{-3\}$.

76. $c + 4 = 1$

$c + 4 - 4 = 1 - 4$

$c = -3$

Check: $c + 4 = 1$

$-3 + 4 \stackrel{?}{=} 1$

$1 = 1$ True

The solution is -3 or the solution set is $\{-3\}$.

78. $9 = 5y$

$\frac{9}{5} = \frac{5y}{5}$

$\frac{9}{5} = y$

Check: $9 = 5y$

$9 \stackrel{?}{=} 5\cdot\frac{9}{5}$

$9 = 9$ True

The solution is $\frac{9}{5}$ or the solution set is $\left\{\frac{9}{5}\right\}$.

80. $-6m = 54$

$\frac{-6m}{-6} = \frac{54}{-6}$

$m = -9$

Check: $-6m = 54$

$-6(-9) \stackrel{?}{=} 54$

$54 = 54$ True

The solution is -9 or the solution set is $\{-9\}$.

82. $-637 = c - 142$

$-637 + 142 = c - 142 + 142$

$-495 = c$

Check: $-637 = c - 142$

$-637 \stackrel{?}{=} -495 - 142$

$-637 = -637$ True

The solution is –495 or the solution set is $\{-495\}$.

84. $-46 = -51 + q$

$51 - 46 = 51 - 51 + q$

$5 = q$

Check: $-46 = -51 + q$

$-46 \stackrel{?}{=} -51 + 5$

$-46 = -46$ True

The solution is 5 or the solution set is $\{5\}$.

86. $\frac{z}{3} = -12$

$3 \cdot \frac{z}{3} = 3 \cdot (-12)$

$z = -36$

Check: $\frac{z}{3} = -12$

$\frac{-36}{3} \stackrel{?}{=} -12$

$-12 = -12$ True

The solution is –36 or the solution set is $\{-36\}$.

88. $p - 26.4 = -471.3$

$p - 26.4 + 26.4 = -471.3 + 26.4$

$p = -444.9$

Check: $p - 26.4 = -471.3$

$-444.9 - 26.4 \stackrel{?}{=} -471.3$

$-471.3 = -471.3$ True

The solution is –444.9 or the solution set is $\{-444.9\}$.

90. $-45 = 12x$

$\frac{-45}{12} = \frac{12x}{12}$

$-\frac{15}{4} = x$

Check: $-45 = 12x$

$-45 \stackrel{?}{=} 12 \cdot \left(-\frac{15}{4}\right)$

$-45 \stackrel{?}{=} 3 \cdot (-15)$

$-45 = -45$ True

The solution is $-\frac{15}{4}$ or the solution set is $\left\{-\frac{15}{4}\right\}$.

92. $12 = -\frac{3}{2}n$

$-\frac{2}{3} \cdot 12 = -\frac{2}{3} \cdot \left(-\frac{3}{2}n\right)$

$-2 \cdot 4 = n$

$-8 = n$

Check: $12 = -\frac{3}{2}n$

$12 \stackrel{?}{=} -\frac{3}{2} \cdot (-8)$

$12 \stackrel{?}{=} -3 \cdot (-4)$

$12 = 12$ True

The solution is –8 or the solution set is $\{-8\}$.

94. $\frac{5}{9} = -\frac{h}{36}$

$-36 \cdot \frac{5}{9} = -36 \cdot \left(-\frac{h}{36}\right)$

$-4 \cdot 5 = h$

$-20 = h$

Check: $\frac{5}{9} = -\frac{h}{36}$

$\frac{5}{9} \stackrel{?}{=} -\frac{-20}{36}$

$\frac{5}{9} = \frac{5}{9}$ True

The solution is –20 or the solution set is $\{-20\}$.

96. $w - \frac{7}{20} = \frac{9}{20}$

$w - \frac{7}{20} + \frac{7}{20} = \frac{9}{20} + \frac{7}{20}$

$w = \frac{16}{20}$

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

Check: $w - \frac{7}{20} = \frac{9}{20}$

$\frac{4}{5} - \frac{7}{20} \stackrel{?}{=} \frac{9}{20}$

$\frac{16}{20} - \frac{7}{20} \stackrel{?}{=} \frac{9}{20}$

$\frac{9}{20} = \frac{9}{20}$ True

The solution is $\frac{4}{5}$ or the solution set is $\left\{\frac{4}{5}\right\}$.

98.
$$\frac{5}{2} = -\frac{13}{4} + y$$
$$\frac{13}{4} + \frac{5}{2} = \frac{13}{4} - \frac{13}{4} + y$$
$$\frac{13}{4} + \frac{10}{4} = y$$
$$\frac{23}{4} = y$$

Check: $\frac{5}{2} = -\frac{13}{4} + y$

$\frac{5}{2} \stackrel{?}{=} -\frac{13}{4} + \frac{23}{4}$

$\frac{5}{2} \stackrel{?}{=} \frac{10}{4}$

$\frac{5}{2} = \frac{5}{2}$ True

The solution is $\frac{23}{4}$ or the solution set is $\left\{\frac{23}{4}\right\}$.

100.
$$-\frac{4}{9} = \frac{8}{3}b$$
$$\frac{3}{8}\cdot\left(-\frac{4}{9}\right) = \frac{3}{8}\cdot\frac{8}{3}b$$
$$\frac{1}{2}\cdot\left(-\frac{1}{3}\right) = b$$
$$-\frac{1}{6} = b$$

Check: $-\frac{4}{9} = \frac{8}{3}b$

$-\frac{4}{9} \stackrel{?}{=} \frac{8}{3}\cdot\left(-\frac{1}{6}\right)$

$-\frac{4}{9} \stackrel{?}{=} -\frac{8}{18}$

$-\frac{4}{9} = -\frac{4}{9}$ True

The solution is $-\frac{1}{6}$ or the solution set is $\left\{-\frac{1}{6}\right\}$.

102.
$$k + 63.92 = 862.92$$
$$k + 63.92 - 63.92 = 862.92 - 63.92$$
$$k = 799$$

The cost of the kayak was \$799.

104.
$$c - 239 = 1230$$
$$c - 239 + 239 = 1230 + 239$$
$$c = 1469$$

The original price of the computer was \$1469.

106.
$$3p = 36$$
$$\frac{3p}{3} = \frac{36}{3}$$
$$p = 12$$

The price of each book was \$12.

108.
$$40 = \frac{4000}{12}r$$
$$\frac{12}{4000}\cdot 40 = \frac{12}{4000}\cdot\frac{4000}{12}r$$
$$\frac{480}{4000} = r$$
$$0.12 = r$$

The annual interest rate is 0.12 or 12%.

110.
$$x - \beta = 25$$
$$x - \beta + \beta = 25 + \beta$$
$$x = 25 + \beta$$

112.
$$\frac{2}{5} = \psi x$$
$$\frac{1}{\psi}\cdot\frac{2}{5} = \frac{1}{\psi}\cdot\psi x$$
$$\frac{2}{5\psi} = x$$

114. Let $x = -4.79$.
$$x - \beta = -13.6$$
$$-4.79 - \beta = -13.6$$
$$4.79 - 4.79 - \beta = 4.79 - 13.6$$
$$-\beta = -8.81$$
$$-1\cdot(-\beta) = -1\cdot(-8.81)$$
$$\beta = 8.81$$

116. Let $x = 2.98$.
$$-11.92 = \psi x$$
$$-11.92 = \psi\cdot(2.98)$$
$$\frac{-11.92}{2.98} = \frac{2.98\psi}{2.98}$$
$$-4 = \psi$$

118. Answers will vary. Multiplying by $\frac{1}{3}$ may be easier because simplifying $\frac{15}{4}\cdot\frac{1}{3}$ is easier than simplifying $\frac{\frac{15}{4}}{3}$.

120. To solve $12x = 4$, divide by 12, but the solution is $\frac{12x}{12} = \frac{4}{12} = \frac{1}{3}$.

Section 2.2

Are You Prepared for This Section?

P1. $6-(4+3x)+8 = 6-4-3x+8$
$= 6-4+8-3x$
$= 2+8-3x$
$= 10-3x$

P2. $2(3x+4)-5$ for $x=-1$:
$2[3(-1)+4]-5 = 2[-3+4]-5$
$= 2[1]-5$
$= 2-5$
$= -3$

2.2 Quick Checks

1. True; to solve the equation $2x - 11 = 40$, the first step is to add 11 to both sides of the equation.

2. $5x-4=11$
$5x-4+4=11+4$
$5x=15$
$\frac{5x}{5}=\frac{15}{5}$
$x=3$
Check: $5x-4=11$
$5(3)-4 \stackrel{?}{=} 11$
$15-4 \stackrel{?}{=} 11$
$11=11$ True
Because $x = 3$ satisfies the equation, the solution is $x = 3$, or the solution set is $\{3\}$.

3. $8=\frac{2}{3}k-4$
$8+4=\frac{2}{3}k-4+4$
$12=\frac{2}{3}k$
$\frac{3}{2}(12)=\frac{3}{2}\left(\frac{2}{3}k\right)$
$18=k$
Check: $8=\frac{2}{3}k-4$
$8 \stackrel{?}{=} \frac{2}{3}(18)-4$
$8 \stackrel{?}{=} 12-4$
$8=8$ True
Because $k = 18$ satisfies the equation, the solution is $k = 18$, or the solution set is $\{18\}$.

4. $8-5r=-2$
$-8+8-5r=-8+(-2)$
$-5r=-10$
$\frac{-5r}{-5}=\frac{-10}{-5}$
$r=2$
Check: $8-5r=-2$
$8-5(2) \stackrel{?}{=} -2$
$8-10 \stackrel{?}{=} -2$
$-2=-2$ True
Because $r = 2$ satisfies the equation, the solution is $r = 2$, or the solution set is $\{2\}$.

5. $-\frac{3}{2}n+2=-\frac{1}{4}$
$-\frac{3}{2}n+2-2=-\frac{1}{4}-2$
$-\frac{3}{2}n=-\frac{1}{4}-\frac{8}{4}$
$-\frac{3}{2}n=-\frac{9}{4}$
$-\frac{2}{3}\left(-\frac{3}{2}n\right)=-\frac{2}{3}\left(-\frac{9}{4}\right)$
$n=\frac{3}{2}$
Check: $-\frac{3}{2}n+2=-\frac{1}{4}$
$-\frac{3}{2}\left(\frac{3}{2}\right)+2 \stackrel{?}{=} -\frac{1}{4}$
$-\frac{9}{4}+2 \stackrel{?}{=} -\frac{1}{4}$
$-\frac{9}{4}+\frac{8}{4} \stackrel{?}{=} -\frac{1}{4}$
$-\frac{1}{4}=-\frac{1}{4}$ True
Because $n=\frac{3}{2}$ satisfies the equation, the solution is $n=\frac{3}{2}$, or the solution set is $\left\{\frac{3}{2}\right\}$.

6. $7b-3b+3=11$
$4b+3=11$
$4b+3-3=11-3$
$4b=8$
$\frac{4b}{4}=\frac{8}{4}$
$b=2$

Check: $7b-3b+3=11$
$7(2)-3(2)+3 \stackrel{?}{=} 11$
$14-6+3 \stackrel{?}{=} 11$
$11=11$ True

Since $b = 2$ results in a true statement, the solution of the equation is 2, or the solution set is $\{2\}$.

7. $-3a+4+4a=13-27$
$4+a=-14$
$-4+4+a=-4+(-14)$
$a=-18$

Check: $-3a+4+4a=13-27$
$-3(-18)+4+4(-18) \stackrel{?}{=} 13-27$
$54+4-72 \stackrel{?}{=} 13-27$
$-14=-14$ True

Since $a = -18$ results in a true statement, the solution of the equation is -18, or the solution set is $\{-18\}$.

8. $6c-2+2c=18$
$8c-2=18$
$8c-2+2=18+2$
$8c=20$
$\frac{8c}{8}=\frac{20}{8}$
$c=\frac{5}{2}$

Check: $6c-2+2c=18$
$6\left(\frac{5}{2}\right)-2+2\left(\frac{5}{2}\right) \stackrel{?}{=} 18$
$15-2+5 \stackrel{?}{=} 18$
$18=18$ True

Since $c=\frac{5}{2}$ results in a true statement, the solution of the equation is $\frac{5}{2}$, or the solution set is $\left\{\frac{5}{2}\right\}$.

9. $-12=5x-3x+4$
$-12=2x+4$
$-12-4=2x+4-4$
$-16=2x$
$\frac{-16}{2}=\frac{2x}{2}$
$-8=x$

Check: $-12=5x-3x+4$
$-12 \stackrel{?}{=} 5(-8)-3(-8)+4$
$-12 \stackrel{?}{=} -40+24+4$
$-12=-12$ True

Since $x = -8$ results in a true statement, the solution of the equation is -8, or the solution set is $\{-8\}$.

10. $2(y+5)-3=11$
$2y+10-3=11$
$2y+7=11$
$2y+7-7=11-7$
$2y=4$
$\frac{2y}{2}=\frac{4}{2}$
$y=2$

Check: $2(y+5)-3=11$
$2(2+5)-3 \stackrel{?}{=} 11$
$2(7)-3 \stackrel{?}{=} 11$
$14-3 \stackrel{?}{=} 11$
$11=11$ True

Since $y = 2$ results in a true statement, the solution of the equation is 2, or the solution set is $\{2\}$.

11. $\frac{1}{2}(4-6x)+5=3$
$2-3x+5=3$
$-3x+7=3$
$-3x+7-7=3-7$
$-3x=-4$
$\frac{-3x}{-3}=\frac{-4}{-3}$
$x=\frac{4}{3}$

Check: $\frac{1}{2}(4-6x)+5=3$
$\frac{1}{2}\left(4-6\cdot\frac{4}{3}\right)+5 \stackrel{?}{=} 3$
$\frac{1}{2}(4-8)+5 \stackrel{?}{=} 3$
$\frac{1}{2}(-4)+5 \stackrel{?}{=} 3$
$-2+5 \stackrel{?}{=} 3$
$3=3$ True

Since $x=\frac{4}{3}$ results in a true statement, the solution of the equation is $\frac{4}{3}$, or the solution set is $\left\{\frac{4}{3}\right\}$.

12. $4-(6-x)=11$

$4-6+x=11$

$-2+x=11$

$2-2+x=2+11$

$x=13$

Check: $4-(6-x)=11$

$4-(6-13) \stackrel{?}{=} 11$

$4-(-7) \stackrel{?}{=} 11$

$4+7 \stackrel{?}{=} 11$

$11=11$ True

Since $x = 13$ results in a true statement, the solution of the equation is 13, or the solution set is $\{13\}$.

13. $8+\frac{2}{3}(2n-9)=10$

$8+\frac{4}{3}n-6=10$

$\frac{4}{3}n+2=10$

$\frac{4}{3}n+2-2=10-2$

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

$\frac{3}{4}\left(\frac{4}{3}n\right)=\frac{3}{4}(8)$

$n=6$

Check: $8+\frac{2}{3}(2n-9)=10$

$8+\frac{2}{3}(2\cdot 6-9) \stackrel{?}{=} 10$

$8+\frac{2}{3}(12-9) \stackrel{?}{=} 10$

$8+\frac{2}{3}(3) \stackrel{?}{=} 10$

$8+2 \stackrel{?}{=} 10$

$10=10$ True

Since $n = 6$ results in a true statement, the solution of the equation is 6, or the solution set is $\{6\}$.

14. $\frac{1}{3}(2x+9)+\frac{x}{3}=5$

$\frac{2x}{3}+\frac{9}{3}+\frac{x}{3}=5$

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

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

$3+x=5$

$3-3+x=5-3$

$x=2$

Check: $\frac{1}{3}(2x+9)+\frac{x}{3}=5$

$\frac{1}{3}[2(2)+9]+\frac{2}{3} \stackrel{?}{=} 5$

$\frac{1}{3}(4+9)+\frac{2}{3} \stackrel{?}{=} 5$

$\frac{1}{3}(13)+\frac{2}{3} \stackrel{?}{=} 5$

$\frac{13}{3}+\frac{2}{3} \stackrel{?}{=} 5$

$\frac{15}{3} \stackrel{?}{=} 5$

$5=5$ True

Since $x = 2$ results in a true statement, the solution of the equation is 2, or the solution set is $\{2\}$.

15. $3x+4=5x-8$

$3x+4-3x=5x-8-3x$

$4=2x-8$

$4+8=2x-8+8$

$12=2x$

$\frac{12}{2}=\frac{2x}{2}$

$6=x$

Check: $3x+4=5x-8$

$3(6)+4 \stackrel{?}{=} 5(6)-8$

$18+4 \stackrel{?}{=} 30-8$

$22=22$ True

Since $x = 6$ results in a true statement, the solution of the equation is 6, or the solution set is $\{6\}$.

16. $10m+3=6m-11$
$10m+3-6m=6m-11-6m$
$4m+3=-11$
$4m+3-3=-11-3$
$4m=-14$
$\frac{4m}{4}=\frac{-14}{4}$
$m=-\frac{7}{2}$

Check: $10m+3=6m-11$
$10\left(-\frac{7}{2}\right)+3 \stackrel{?}{=} 6\left(-\frac{7}{2}\right)-11$
$-35+3 \stackrel{?}{=} -21-11$
$-32=-32$ True

Since $m=-\frac{7}{2}$ results in a true statement, the solution of the equation is $-\frac{7}{2}$, or the solution set is $\left\{-\frac{7}{2}\right\}$.

17. False: To solve the equation $13 - 2(7x + 1) + 8x = 12$, the first step is to remove the parentheses using the Distributive Property.

18. $-9x+3(2x-3)=-10-2x$
$-9x+6x-9=-10-2x$
$-3x-9=-10-2x$
$3x-3x-9=3x-10-2x$
$-9=x-10$
$-9+10=x-10+10$
$1=x$

The solution to the equation is $x = 1$, or the solution set is $\{1\}$.

19. $3-4(p+5)=5(p+2)-12$
$3-4p-20=5p+10-12$
$-4p-17=5p-2$
$4p-4p-17=4p+5p-2$
$-17=9p-2$
$-17+2=9p-2+2$
$-15=9p$
$\frac{-15}{9}=\frac{9p}{9}$
$-\frac{5}{3}=p$

The solution to the equation is $p=-\frac{5}{3}$, or the solution set is $\left\{-\frac{5}{3}\right\}$.

20. $600+30(h-40)=960$
$600+30h-1200=960$
$30h-600=960$
$30h-600+600=960+600$
$30h=1560$
$\frac{30h}{30}=\frac{1560}{30}$
$h=52$

Marcella worked 52 hours that week.

2.2 Exercises

22. $5t+1=11$
$5t+1-1=11-1$
$5t=10$
$\frac{5t}{5}=\frac{10}{5}$
$t=2$

Check: $5t+1=11$
$5(2)+1 \stackrel{?}{=} 11$
$10+1 \stackrel{?}{=} 11$
$11=11$ True

The solution is 2 or the solution set is $\{2\}$.

24. $6z-2=-8$
$6z-2+2=-8+2$
$6z=-6$
$\frac{6z}{6}=\frac{-6}{6}$
$z=-1$

Check: $6z-2=-8$
$6(-1)-2 \stackrel{?}{=} -8$
$-6-2 \stackrel{?}{=} -8$
$-8=-8$ True

The solution is -1 or the solution set is $\{-1\}$.

26. $-4x+3=15$

$-4x+3-3=15-3$

$-4x=12$

$\frac{-4x}{-4}=\frac{12}{-4}$

$x=-3$

Check: $-4x+3=15$

$-4(-3)+3 \stackrel{?}{=} 15$

$12+3 \stackrel{?}{=} 15$

$15=15$ True

The solution is -3, or the solution set is $\{-3\}$.

28. $6z-7=3$

$6z-7+7=3+7$

$6z=10$

$\frac{6z}{6}=\frac{10}{6}$

$z=\frac{5}{3}$

Check: $6z-7=3$

$6\left(\frac{5}{3}\right)-7 \stackrel{?}{=} 3$

$2\cdot 5-7 \stackrel{?}{=} 3$

$10-7 \stackrel{?}{=} 3$

$3=3$ True

The solution is $\frac{5}{3}$ or the solution set is $\left\{\frac{5}{3}\right\}$.

30. $1-3k=4$

$-1+1-3k=-1+4$

$-3k=3$

$\frac{-3k}{-3}=\frac{3}{-3}$

$k=-1$

Check: $1-3k=4$

$1-3(-1) \stackrel{?}{=} 4$

$1+3 \stackrel{?}{=} 4$

$4=4$ True

The solution is -1 or the solution set is $\{-1\}$.

32. $\frac{5}{4}a+3=13$

$\frac{5}{4}a+3-3=13-3$

$\frac{5}{4}a=10$

$\frac{4}{5}\cdot\frac{5}{4}a=\frac{4}{5}\cdot 10$

$a=8$

Check: $\frac{5}{4}a+3=13$

$\frac{5}{4}\cdot 8+3 \stackrel{?}{=} 13$

$10+3 \stackrel{?}{=} 13$

$13=13$ True

The solution is 8, or the solution set is $\{8\}$.

34. $\frac{1}{5}p-3=2$

$\frac{1}{5}p-3+3=2+3$

$\frac{1}{5}p=5$

$5\cdot\frac{1}{5}p=5\cdot 5$

$p=25$

Check: $\frac{1}{5}p-3=2$

$\frac{1}{5}\cdot 25-3 \stackrel{?}{=} 2$

$5-3 \stackrel{?}{=} 2$

$2=2$ True

The solution is 25 or the solution set is $\{25\}$.

36. $5r+2-3r=-14$

$2r+2=-14$

$2r+2-2=-14-2$

$2r=-16$

$\frac{2r}{2}=\frac{-16}{2}$

$r=-8$

Check: $5r+2-3r=-14$

$5(-8)+2-3(-8) \stackrel{?}{=} -14$

$-40+2+24 \stackrel{?}{=} -14$

$-14=-14$ True

The solution is -8, or the solution set is $\{-8\}$.

38. $2b+5-8b=23$

$5-6b=23$

$-5+5-6b=-5+23$

$-6b=18$

$\frac{-6b}{-6}=\frac{18}{-6}$

$b=-3$

Check: $2b+5-8b=23$

$2(-3)+5-8(-3) \stackrel{?}{=} 23$

$-6+5+24 \stackrel{?}{=} 23$

$23=23$ True

The solution is -3, or the solution set is $\{-3\}$.

40. $3(t-4)+7=-11$
$3(t-4)+7-7=-11-7$
$3(t-4)=-18$
$3t-12=-18$
$3t-12+12=-18+12$
$3t=-6$
$\frac{3t}{3}=\frac{-6}{3}$
$t=-2$

Check: $3(t-4)+7=-11$
$3(-2-4)+7 \stackrel{?}{=} -11$
$3(-6)+7 \stackrel{?}{=} -11$
$-18+7 \stackrel{?}{=} -11$
$-11=-11$ True

The solution is -2, or the solution set is $\{-2\}$.

42. $-5(6+z)=-20$
$-30-5z=-20$
$30-30-5z=30-20$
$-5z=10$
$\frac{-5z}{-5}=\frac{10}{-5}$
$z=-2$

Check: $-5(6+z)=-20$
$-5[6+(-2)] \stackrel{?}{=} -20$
$-5(4) \stackrel{?}{=} -20$
$-20=-20$ True

The solution is -2, or the solution set is $\{-2\}$.

44. $21=5-(2a-1)$
$21=5-2a+1$
$21=6-2a$
$-6+21=6-2a-6$
$15=-2a$
$\frac{15}{-2}=\frac{-2a}{-2}$
$-\frac{15}{2}=a$

Check: $21=5-(2a-1)$
$21 \stackrel{?}{=} 5-\left[2\left(-\frac{15}{2}\right)-1\right]$
$21 \stackrel{?}{=} 5-[-15-1]$
$21 \stackrel{?}{=} 5-[-16]$
$21 \stackrel{?}{=} 21$ True

Solution set is $-\frac{15}{2}$, or solution set is $\left\{-\frac{15}{2}\right\}$.

46. $-9=3-(6+4y)$
$-9=3-6-4y$
$-9=-3-4y$
$3-9=-3-4y+3$
$-6=-4y$
$\frac{-6}{-4}=\frac{-4y}{-4}$
$\frac{3}{2}=y$

Check: $-9=3-(6+4y)$
$-9 \stackrel{?}{=} 3-\left[6+4\left(\frac{3}{2}\right)\right]$
$-9 \stackrel{?}{=} 3-[6+6]$
$-9 \stackrel{?}{=} 3-12$
$-9=-9$ True

The solution is $\frac{3}{2}$, or the solution set is $\left\{\frac{3}{2}\right\}$.

48. $7z+13=6z+8$
$7z+13-6z=6z+8-6z$
$z+13=8$
$z+13-13=8-13$
$z=-5$

Check: $7z+13=6z+8$
$7(-5)+13 \stackrel{?}{=} 6(-5)+8$
$-35+13 \stackrel{?}{=} -30+8$
$-22=-22$ True

The solution is -5, or the solution set is $\{-5\}$.

50. $3+8x=21-x$
$3+8x+x=21-x+x$
$3+9x=21$
$3+9x-3=21-3$
$9x=18$
$\frac{9x}{9}=\frac{18}{9}$
$x=2$

Check: $3+8x=21-x$
$3+8(2) \stackrel{?}{=} 21-2$
$3+16 \stackrel{?}{=} 21-2$
$19=19$

The solution is 2, or the solution set is $\{2\}$.

52. $6-12m=-3m+3$

$6-12m+3m=-3m+3+3m$

$6-9m=3$

$-6+6-9m=-6+3$

$-9m=-3$

$\frac{-9m}{-9}=\frac{-3}{-9}$

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

Check: $6-12m=-3m+3$

$6-12\left(\frac{1}{3}\right)\stackrel{?}{=}-3\left(\frac{1}{3}\right)+3$

$6-4\stackrel{?}{=}-1+3$

$2=2$ True

The solution is $\frac{1}{3}$, or the solution set is $\left\{\frac{1}{3}\right\}$.

54. $-4(10-7x)=3x+10$

$-40+28x=3x+10$

$-40+28x-3x=3x+10-3x$

$-40+25x=10$

$40-40+25x=40+10$

$25x=50$

$\frac{25x}{25}=\frac{50}{25}$

$x=2$

Check: $-4(10-7x)=3x+10$

$-4(10-7\cdot 2)\stackrel{?}{=}3\cdot 2+10$

$-4(10-14)\stackrel{?}{=}6+10$

$-4(-4)\stackrel{?}{=}16$

$16=16$ True

The solution is 2, or the solution set is $\{2\}$.

56. $3(5+x)=2(2x+11)$

$15+3x=4x+22$

$15+3x-3x=4x+22-3x$

$15=x+22$

$15-22=x+22-22$

$-7=x$

Check: $3(5+x)=2(2x+11)$

$3[5+(-7)]\stackrel{?}{=}2[2(-7)+11]$

$3(-2)\stackrel{?}{=}2(-14+11)$

$-6\stackrel{?}{=}2(-3)$

$-6=-6$ True

The solution is -7, or the solution set is $\{-7\}$.

58. $-8+4(p+6)=10p$

$-8+4p+24=10p$

$4p+16=10p$

$-4p+4p+16=10p-4p$

$16=6p$

$\frac{16}{6}=\frac{6p}{6}$

$\frac{8}{3}=p$

Check: $-8+4(p+6)=10p$

$-8+4\left(\frac{8}{3}+6\right)\stackrel{?}{=}10\left(\frac{8}{3}\right)$

$-8+4\left(\frac{26}{3}\right)\stackrel{?}{=}\frac{80}{3}$

$-8+\frac{104}{3}\stackrel{?}{=}\frac{80}{3}$

$\frac{80}{3}=\frac{80}{3}$

The solution is $\frac{8}{3}$, or solution set is $\left\{\frac{8}{3}\right\}$.

60. $5(12-3w)+25w=2w$

$60-15w+25w=2w$

$60+10w=2w$

$60+10w-10w=2w-10w$

$60=-8w$

$\frac{60}{-8}=\frac{-8w}{-8}$

$-\frac{15}{2}=w$

Check:

$5(12-3w)+25w=2w$

$5\left[12-3\left(-\frac{15}{2}\right)\right]+25\left(-\frac{15}{2}\right)\stackrel{?}{=}2\left(-\frac{15}{2}\right)$

$5\left(12+\frac{45}{2}\right)-\frac{375}{2}\stackrel{?}{=}-15$

$5\left(\frac{69}{2}\right)-\frac{375}{2}\stackrel{?}{=}-15$

$\frac{345}{2}-\frac{375}{2}\stackrel{?}{=}-15$

$\frac{-30}{2}\stackrel{?}{=}-15$

$-15=-15$ True

The solution is $-\frac{15}{2}$, or the solution set is $\left\{-\frac{15}{2}\right\}$.

62. $-6n+14=-10$

$-6n+14-14=-10-14$

$-6n=-24$

$\frac{-6n}{-6}=\frac{-24}{-6}$

$n=4$

Check: $-6n+14=-10$

$-6\cdot 4+14 \stackrel{?}{=} -10$

$-24+14 \stackrel{?}{=} -10$

$-10=-10$ True

The solution is 4, or the solution set is $\{4\}$.

64. $7x+1=-9$

$7x+1-1=-9-1$

$7x=-10$

$\frac{7x}{7}=\frac{-10}{7}$

$x=-\frac{10}{7}$

Check: $7x+1=-9$

$7\left(-\frac{10}{7}\right)+1 \stackrel{?}{=} -9$

$-10+1 \stackrel{?}{=} -9$

$-9=-9$ True

The solution is $-\frac{10}{7}$, or the solution set is $\left\{-\frac{10}{7}\right\}$.

66. $-5(2n-3)=10$

$-10n+15=10$

$-10n+15-15=10-15$

$-10n=-5$

$\frac{-10n}{-10}=\frac{-5}{-10}$

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

Check: $-5(2n-3)=10$

$-5\left(2\cdot\frac{1}{2}-3\right) \stackrel{?}{=} 10$

$-5(1-3) \stackrel{?}{=} 10$

$-5(-2) \stackrel{?}{=} 10$

$10=10$ True

The solution is $\frac{1}{2}$, or the solution set is $\left\{\frac{1}{2}\right\}$.

68. $11w-(2-4w)=13+2(w-1)$

$11w-2+4w=13+2w-2$

$15w-2=11+2w$

$15w-2-2w=11+2w-2w$

$13w-2=11$

$13w-2+2=11+2$

$13w=13$

$\frac{13w}{13}=\frac{13}{13}$

$w=1$

Check: $11w-(2-4w)=13+2(w-1)$

$11(1)-(2-4\cdot 1) \stackrel{?}{=} 13+2(1-1)$

$11-(2-4) \stackrel{?}{=} 13+2(0)$

$11-(-2) \stackrel{?}{=} 13+0$

$13 \stackrel{?}{=} 13$ True

The solution is 1, or the solution set is $\{1\}$.

70. $7a-26=13a+2$

$7a-26-7a=13a+2-7a$

$-26=6a+2$

$-26-2=6a+2-2$

$-28=6a$

$\frac{-28}{6}=\frac{6a}{6}$

$-\frac{14}{3}=a$

Check: $7a-26=13a+2$

$7\left(-\frac{14}{3}\right)-26 \stackrel{?}{=} 13\left(-\frac{14}{3}\right)+2$

$-\frac{98}{3}-\frac{78}{3} \stackrel{?}{=} -\frac{182}{3}+\frac{6}{3}$

$-\frac{176}{3}=-\frac{176}{3}$ True

The solution is $-\frac{14}{3}$, or the solution set is $\left\{-\frac{14}{3}\right\}$.

72. $\frac{2}{3}(9a-12)=-6a-11$

$\frac{18}{3}a-\frac{24}{3}=-6a-11$

$6a-8=-6a-11$

$6a-8+6a=-6a-11+6a$

$12a-8=-11$

$12a-8+8=-11+8$

$12a=-3$

$\frac{12a}{12}=\frac{-3}{12}$

$a=-\frac{1}{4}$

Check: $\frac{2}{3}(9a-12)=-6a-11$

$\frac{2}{3}\left[9\left(-\frac{1}{4}\right)-12\right]\stackrel{?}{=}-6\left(-\frac{1}{4}\right)-11$

$\frac{2}{3}\left(-\frac{9}{4}-\frac{48}{4}\right)\stackrel{?}{=}\frac{6}{4}-\frac{44}{4}$

$\frac{2}{3}\left(-\frac{57}{4}\right)\stackrel{?}{=}\frac{-38}{4}$

$-\frac{38}{4}=-\frac{38}{4}$ True

The solution is $-\frac{1}{4}$, or the solution set is $\left\{-\frac{1}{4}\right\}$.

74. $\frac{4}{3}a-\left(\frac{7}{3}a+6\right)=-15$

$\frac{4}{3}a-\frac{7}{3}a-6=-15$

$-a-6=-15$

$-a-6+6=-15+6$

$-a=-9$

$\frac{-a}{-1}=\frac{-9}{-1}$

$a=9$

Check: $\frac{4}{3}a-\left(\frac{7}{3}a+6\right)=-15$

$\frac{4}{3}(9)-\left(\frac{7}{3}\cdot 9+6\right)\stackrel{?}{=}-15$

$12-(21+6)\stackrel{?}{=}-15$

$12-27\stackrel{?}{=}-15$

$-15=-15$ True

The solution is 9, or the solution set is $\{9\}$.

76. $-5(b+2)+3b=-2(1+5b)+6$

$-5b-10+3b=-2-10b+6$

$-10-2b=4-10b$

$-10-2b+2b=4-10b+2b$

$-10=4-8b$

$-4-10=-4+4-8b$

$-14=-8b$

$\frac{-14}{-8}=\frac{-8b}{-8}$

$\frac{7}{4}=b$

Check: $-5(b+2)+3b=-2(1+5b)+6$

$-5\left(\frac{7}{4}+2\right)+3\cdot\frac{7}{4}\stackrel{?}{=}-2\left(1+5\cdot\frac{7}{4}\right)+6$

$-5\left(\frac{15}{4}\right)+\frac{21}{4}\stackrel{?}{=}-2\left(\frac{39}{4}\right)+6$

$\frac{-75}{4}+\frac{21}{4}\stackrel{?}{=}\frac{-78}{4}+\frac{24}{4}$

$\frac{-54}{4}=\frac{-54}{4}$ True

The solution is $\frac{7}{4}$, or the solution set is $\left\{\frac{7}{4}\right\}$.

78. $x+(x-13)=41$

$x+x-13=41$

$2x-13=41$

$13+2x-13=41+13$

$2x=54$

$\frac{2x}{2}=\frac{54}{2}$

$x=27$

A Wendy's Apple-Pecan Chicken Salad contains 27 grams of fat and a Whataburger Apple and Cranberry Salad contains 14 grams of fat.

80. $2L+2\left(\frac{1}{2}L+1\right)=26$

$2L+L+2=26$

$3L+2=26$

$3L+2-2=26-2$

$3L=24$

$\frac{3L}{3}=\frac{24}{3}$

$L=8$

The length is 8 yards.

$\frac{1}{2}L+1=\frac{1}{2}\cdot 8+1=4+1=5$

The width is 5 yards.

82. $40x+6(1.5x)+4(2x)=855$

$$40x+9x+8x=855$$
$$57x=855$$
$$\frac{57x}{57}=\frac{855}{57}$$
$$x=15$$

Juan's hourly rate is \$15.

84. $x+(x+2)+(x+4)=210$

$$x+x+2+x+4=210$$
$$3x+6=210$$
$$3x+6-6=210-6$$
$$3x=204$$
$$\frac{3x}{3}=\frac{204}{3}$$
$$x=68$$

$x+2=70$

$x+4=72$

The lengths are 68 inches, 70 inches, and 72 inches.

86. $3[10-4(x-3)]+2[(3x+6)-2]=2x+360$

$$3(10-4x+12)+2(3x+6-2)=2x+360$$
$$3(-4x+22)+2(3x+4)=2x+360$$
$$-12x+66+6x+8=2x+360$$
$$-6x+74=2x+360$$
$$-2x-6x+74=-2x+2x+360$$
$$-8x+74=360$$
$$-8x+74-74=360-74$$
$$-8x=286$$
$$\frac{-8x}{-8}=\frac{286}{-8}$$
$$x=-\frac{143}{4}$$

Check: $3[10-4(x-3)]+2[(3x+6)-2]=2x+360$

$$3\left[10-4\left(-\frac{143}{4}-3\right)\right]+2\left[\left(3\left(-\frac{143}{4}\right)+6\right)-2\right]\stackrel{?}{=}2\left(-\frac{143}{4}\right)+360$$
$$3(10+143+12)+2\left(-\frac{429}{4}+6-2\right)\stackrel{?}{=}-\frac{143}{2}+360$$
$$3(165)+2\left(-\frac{413}{4}\right)\stackrel{?}{=}-\frac{143}{2}+\frac{720}{2}$$
$$495+\left(-\frac{413}{2}\right)\stackrel{?}{=}\frac{577}{2}$$
$$\frac{577}{2}=\frac{577}{2}\quad\text{True}$$

The solution is $-\frac{143}{4}$, or the solution set is $\left\{-\frac{143}{4}\right\}$.

88. $12(2.3-1.5x)-6=-3(18.4-3.5x)-6.1(4x+3)$
$27.6-18x-6=-55.2+10.5x-24.4x-18.3$
$-18x+21.6=-13.9x-73.5$
$13.9x-18x+21.6=13.9x-13.9x-73.5$
$-4.1x+21.6=-73.5$
$-4.1x+21.6-21.6=-73.5-21.6$
$-4.1x=-95.1$
$\frac{-4.1x}{-4.1}=\frac{-95.1}{-4.1}$
$x\approx 23.2$

90. $9\{3-[4(2.3z-1)]+6.5\}=-406.3$
$9[3-(9.2z-4)+6.5]=-406.3$
$9(3-9.2z+4+6.5)=-406.3$
$9(-9.2z+13.5)=-406.3$
$-82.8z+121.5=-406.3$
$-82.8z+121.5-121.5=-406.3-121.5$
$-82.8z=-527.8$
$\frac{-82.8z}{-82.8}=\frac{-527.8}{-82.8}$
$z\approx 6.37$

92. $5d-2x=-2;\ x=-6$
$5d-2(-6)=-2$
$5d+12=-2$
$5d+12-12=-2-12$
$5d=-14$
$\frac{5d}{5}=\frac{-14}{5}$
$d=-\frac{14}{5}$

94. $\frac{2}{5}x+3d=0;\ x=\frac{15}{8}$
$\frac{2}{5}\cdot\frac{15}{8}+3d=0$
$\frac{3}{4}+3d=0$
$-\frac{3}{4}+\frac{3}{4}+3d=-\frac{3}{4}+0$
$3d=-\frac{3}{4}$
$\frac{1}{3}\cdot 3d=\frac{1}{3}\cdot\left(-\frac{3}{4}\right)$
$d=-\frac{1}{4}$

96. The Addition Property of Equality states that you may add the same expression to both sides of an equation. The Multiplication Property of Equality states that you may multiply each side of an equation by the same non-zero number. The number must be non-zero because $0 \cdot a = 0$, where a is any real number.

98. Answers may vary. Possible answer: The Subtraction Property of Equality states that for real numbers a, b, and c, if $a = b$, then $a - c = b - c$. The Division Property of Equality states that for real numbers a, b, and c, where $c \neq 0$, if $a = b$, then $\frac{a}{c} = \frac{b}{c}$.

Since subtracting c is the same as adding $-c$, and dividing by c is the same as multiplying by $\frac{1}{c}$ (for $c \neq 0$), these properties were not needed.

Section 2.3

Are You Prepared for This Section?

P1. $5 = 5$
$4 = 2 \cdot 2$
$\text{LCD} = 2 \cdot 2 \cdot 5 = 20$
The LCD of $\frac{3}{5}$ and $\frac{3}{4}$ is 20.

P2. $8 = 2 \cdot 2 \cdot 2$
$12 = 2 \cdot 2 \cdot 3$
$\text{LCD} = 2 \cdot 2 \cdot 2 \cdot 3 = 24$
The LCD of $\frac{3}{8}$ and $-\frac{7}{12}$ is 24.

2.3 Quick Checks

1. To solve a linear equation containing fractions, we can multiply each side of the equation by the least common denominator to rewrite the equation without fractions.

2. The LCD of 5, 4, and 2 is 20.

$$\frac{2}{5}x - \frac{1}{4}x = \frac{3}{2}$$
$$20\left(\frac{2}{5}x - \frac{1}{4}x\right) = 20\left(\frac{3}{2}\right)$$
$$20\left(\frac{2}{5}x\right) - 20\left(\frac{1}{4}x\right) = 20\left(\frac{3}{2}\right)$$
$$8x - 5x = 30$$
$$3x = 30$$
$$\frac{3x}{3} = \frac{30}{3}$$
$$x = 10$$

Check: $\frac{2}{5}x - \frac{1}{4}x = \frac{3}{2}$

$$\frac{2}{5}(10) - \frac{1}{4}(10) \stackrel{?}{=} \frac{3}{2}$$
$$4 - \frac{5}{2} \stackrel{?}{=} \frac{3}{2}$$
$$\frac{8}{2} - \frac{5}{2} \stackrel{?}{=} \frac{3}{2}$$
$$\frac{3}{2} = \frac{3}{2} \quad \text{True}$$

The solution of the equation is 10, or the solution set is $\{10\}$.

3. The LCD of 6, 9, 3, and 18 is 18.

$$\frac{5}{6}x + \frac{2}{9} = -\frac{1}{3}x - \frac{5}{18}$$
$$18\left(\frac{5}{6}x + \frac{2}{9}\right) = 18\left(-\frac{1}{3}x - \frac{5}{18}\right)$$
$$18\left(\frac{5}{6}x\right) + 18\left(\frac{2}{9}\right) = 18\left(-\frac{1}{3}x\right) - 18\left(\frac{5}{18}\right)$$
$$15x + 4 = -6x - 5$$
$$6x + 15x + 4 = 6x - 6x - 5$$
$$21x + 4 = -5$$
$$21x + 4 - 4 = -5 - 4$$
$$21x = -9$$
$$\frac{21x}{21} = \frac{-9}{21}$$
$$x = -\frac{3}{7}$$

Check: $\frac{5}{6}x + \frac{2}{9} = -\frac{1}{3}x - \frac{5}{18}$

$$\frac{5}{6}\left(-\frac{3}{7}\right) + \frac{2}{9} \stackrel{?}{=} -\frac{1}{3}\left(-\frac{3}{7}\right) - \frac{5}{18}$$
$$-\frac{15}{42} + \frac{2}{9} \stackrel{?}{=} \frac{3}{21} - \frac{5}{18}$$
$$-\frac{135}{378} + \frac{84}{378} \stackrel{?}{=} \frac{54}{378} - \frac{105}{378}$$
$$-\frac{51}{378} = -\frac{51}{378} \quad \text{True}$$

The solution of the equation is $-\frac{3}{7}$, or the solution set is $\left\{-\frac{3}{7}\right\}$.

4. The result of multiplying the equation $\frac{1}{5}x + 7 = \frac{3}{10}$ by 10 is $2x + \underline{70} = 3$.

5. The LCD of 4 and 8 is 8.

$$\frac{2a+3}{4}+3=\frac{3a+19}{8}$$
$$8\left(\frac{2a+3}{4}+3\right)=8\left(\frac{3a+19}{8}\right)$$
$$8\left(\frac{2a+3}{4}\right)+8(3)=8\left(\frac{3a+19}{8}\right)$$
$$2(2a+3)+8(3)=3a+19$$
$$4a+6+24=3a+19$$
$$4a+30=3a+19$$
$$4a-3a+30=3a-3a+19$$
$$a+30=19$$
$$a+30-30=19-30$$
$$a=-11$$

Check: $\frac{2a+3}{4}+3=\frac{3a+19}{8}$

$$\frac{2(-11)+3}{4}+3 \stackrel{?}{=} \frac{3(-11)+19}{8}$$
$$\frac{-22+3}{4}+3 \stackrel{?}{=} \frac{-33+19}{8}$$
$$\frac{-19}{4}+\frac{12}{4} \stackrel{?}{=} \frac{-14}{8}$$
$$\frac{-7}{4}=\frac{-7}{4} \quad \text{True}$$

The solution is -11, or the solution set is $\{-11\}$.

6. The LCD of 4 and 5 is 20.

$$\frac{3x-2}{4}-1=\frac{6}{5}x$$
$$20\left(\frac{3x-2}{4}-1\right)=20\left(\frac{6}{5}x\right)$$
$$20\left(\frac{3x-2}{4}\right)-20(1)=20\left(\frac{6}{5}x\right)$$
$$5(3x-2)-20=4(6x)$$
$$15x-10-20=24x$$
$$15x-30=24x$$
$$15x-15x-30=24x-15x$$
$$-30=9x$$
$$\frac{-30}{9}=\frac{9x}{9}$$
$$-\frac{10}{3}=x$$

Check: $\frac{3x-2}{4}-1=\frac{6}{5}x$

$$\frac{3\left(-\frac{10}{3}\right)-2}{4}-1 \stackrel{?}{=} \frac{6}{5}\left(-\frac{10}{3}\right)$$
$$\frac{-10-2}{4}-1 \stackrel{?}{=} -4$$
$$\frac{-12}{4}-1 \stackrel{?}{=} -4$$
$$-3-1 \stackrel{?}{=} -4$$
$$-4=-4 \quad \text{True}$$

The solution is $-\frac{10}{3}$, or the solution set is $\left\{-\frac{10}{3}\right\}$.

7. To clear the decimals in the equation $0.25x + 5 = 7 - 0.3x$, multiply both sides of the equation by $\underline{100}$.

8.
$$0.2z=20$$
$$10\cdot 0.2z=10\cdot 20$$
$$2z=200$$
$$\frac{2z}{2}=\frac{200}{2}$$
$$z=100$$

Check: $0.2z=20$

$$0.2(100) \stackrel{?}{=} 20$$
$$20=20 \quad \text{True}$$

The solution is 100, or the solution set is $\{100\}$.

9.
$$0.15p-2.5=5$$
$$100(0.15p-2.5)=100(5)$$
$$100\cdot 0.15p-100\cdot 2.5=100\cdot 5$$
$$15p-250=500$$
$$15p-250+250=500+250$$
$$15p=750$$
$$\frac{15p}{15}=\frac{750}{15}$$
$$p=50$$

Check: $0.15p-2.5=5$

$$0.15(50)-2.5 \stackrel{?}{=} 5$$
$$7.5-2.5 \stackrel{?}{=} 5$$
$$5=5 \quad \text{True}$$

The solution is 50, or the solution set is $\{50\}$.

10. $n + 0.25n = \underline{1.25}n$

11. $p + 0.05p = 52.5$
$1p + 0.05p = 52.5$
$1.05p = 52.5$
$100 \cdot 1.05p = 100 \cdot 52.5$
$105p = 5250$
$\frac{105p}{105} = \frac{5250}{105}$
$p = 50$
The solution of the equation is 50, or the solution set is $\{50\}$.

12. $c - 0.25c = 120$
$1c - 0.25c = 120$
$0.75c = 120$
$100 \cdot 0.75c = 100 \cdot 120$
$75c = 12,000$
$\frac{75c}{75} = \frac{12,000}{75}$
$c = 160$
The solution of the equation is 160, or the solution set is $\{160\}$.

13. $0.36y - 0.5 = 0.16y + 0.3$
$0.20y - 0.5 = 0.3$
$0.2y = 0.8$
$10(0.2y) = 10(0.8)$
$2y = 8$
$y = 4$
The solution to the equation is 4, or the solution set is $\{4\}$.

14. $0.12x + 0.05(5000 - x) = 460$
$0.12x + 250 - 0.05x = 460$
$0.07x + 250 = 460$
$0.07x = 210$
$100(0.07x) = 100(210)$
$7x = 21,000$
$x = 3000$
The solution to the equation is 3000, or the solution set is $\{3000\}$.

15. A conditional equation is an equation that is true for some values of the variable and false for other values of the variable.

16. A(n) contradiction is an equation that is false for every value of the variable. A(n) identity is an equation that is satisfied for all values of the variable for which both sides of the equation are defined.

17. True

18. $3(x + 4) = 4 + 3x + 18$
$3x + 12 = 3x + 22$
$3x + 12 - 3x = 3x + 22 - 3x$
$12 = 22$
The statement 12 = 22 is false, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

19. $\frac{1}{3}(6x - 9) - 1 = 6x - [4x - (-4)]$
$2x - 3 - 1 = 6x - [4x + 4]$
$2x - 4 = 6x - 4x - 4$
$2x - 4 = 2x - 4$
$2x - 4 - 2x = 2x - 4 - 2x$
$-4 = -4$
The statement $-4 = -4$ is true for all real numbers x. The solution set is the set of all real numbers.

20. $-5 - (9x + 8) + 23 = 7 + x - (10x - 3)$
$-5 - 9x - 8 + 23 = 7 + x - 10x + 3$
$-9x + 10 = -9x + 10$
$-9x + 10 + 9x = -9x + 10 + 9x$
$10 = 10$
The statement 10 = 10 is true for all real numbers x. The solution set is the set of all real numbers.

21. $\frac{3}{2}x - 8 = x + 7 + \frac{1}{2}x$
$\frac{3}{2}x - 8 = \frac{2}{2}x + 7 + \frac{1}{2}x$
$\frac{3}{2}x - 8 = \frac{3}{2}x + 7$
$\frac{3}{2}x - 8 - \frac{3}{2}x = \frac{3}{2}x + 7 - \frac{3}{2}x$
$-8 = 7$
The statement $-8 = 7$ is false, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

22. $2(x - 7) + 8 = 6x - (4x + 2) - 4$
$2x - 14 + 8 = 6x - 4x - 2 - 4$
$2x - 6 = 2x - 6$
$2x - 6 - 2x = 2x - 6 - 2x$
$-6 = -6$
The statement $-6 = -6$ is true for all values of x, so the equation is an identity. The solution set is the set of all real numbers.

23. $\dfrac{4(7-x)}{3} = x$

$3\left(\dfrac{4(7-x)}{3}\right) = 3x$

$4(7-x) = 3x$

$28 - 4x = 3x$

$28 - 4x + 4x = 3x + 4x$

$28 = 7x$

$4 = x$

The equation has solution $x = 4$, so it is a conditional equation. The solution set is $\{4\}$.

24. $4(5x-4)+1 = 20x$

$20x - 16 + 1 = 20x$

$20x - 15 = 20x$

$20x - 15 - 20x = 20x - 20x$

$-15 = 0$

The statement $-15 = 0$ is false, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

25. $\dfrac{1}{2}(4x-6) = 6\left(\dfrac{1}{3}x - \dfrac{1}{2}\right) + 4$

$2x - 3 = 2x - 3 + 4$

$2x - 3 = 2x + 1$

$2x - 3 - 2x = 2x + 1 - 2x$

$-3 = 1$

The statement $-3 = 1$ is false, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

26. $0.03b + 0.06(b + 250) = 60$

$0.03b + 0.06b + 15 = 60$

$0.09b + 15 = 60$

$0.09b = 45$

$9b = 4500$

$b = 500$

She invested \$500 in the bond account.

2.3 Exercises

28. $\dfrac{3}{2}n - \dfrac{4}{11} = \dfrac{91}{22}$

$22\left(\dfrac{3}{2}n - \dfrac{4}{11}\right) = 22\left(\dfrac{91}{22}\right)$

$22\left(\dfrac{3}{2}n\right) - 22\left(\dfrac{4}{11}\right) = 91$

$33n - 8 = 91$

$33n - 8 + 8 = 91 + 8$

$33n = 99$

$\dfrac{33n}{33} = \dfrac{99}{33}$

$n = 3$

Check: $\dfrac{3}{2}n - \dfrac{4}{11} = \dfrac{91}{22}$

$\dfrac{3}{2}(3) - \dfrac{4}{11} \stackrel{?}{=} \dfrac{91}{22}$

$\dfrac{9}{2} - \dfrac{4}{11} \stackrel{?}{=} \dfrac{91}{22}$

$\dfrac{99}{22} - \dfrac{8}{22} \stackrel{?}{=} \dfrac{91}{22}$

$\dfrac{91}{22} = \dfrac{91}{22}$ True

The solution is 3, or the solution set is $\{3\}$.

30. $\dfrac{3}{2}b - \dfrac{4}{5}b = \dfrac{28}{5}$

$10\left(\dfrac{3}{2}b - \dfrac{4}{5}b\right) = 10\left(\dfrac{28}{5}\right)$

$10\left(\dfrac{3}{2}b\right) - 10\left(\dfrac{4}{5}b\right) = 2 \cdot 28$

$15b - 8b = 56$

$7b = 56$

$\dfrac{7b}{7} = \dfrac{56}{7}$

$b = 8$

Check: $\dfrac{3}{2}b - \dfrac{4}{5}b = \dfrac{28}{5}$

$\dfrac{3}{2} \cdot 8 - \dfrac{4}{5} \cdot 8 \stackrel{?}{=} \dfrac{28}{5}$

$12 - \dfrac{32}{5} \stackrel{?}{=} \dfrac{28}{5}$

$\dfrac{60}{5} - \dfrac{32}{5} \stackrel{?}{=} \dfrac{28}{5}$

$\dfrac{28}{5} = \dfrac{28}{5}$ True

The solution is 8, or the solution set is $\{8\}$.

32. $\dfrac{2x-3}{5} = \dfrac{3}{10}x$

$10\left(\dfrac{2x-3}{5}\right) = 10\left(\dfrac{3}{10}x\right)$

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

$4x - 6 = 3x$

$-4x + 4x - 6 = -4x + 3x$

$-6 = -x$

$\dfrac{-6}{-1} = \dfrac{-x}{-1}$

$6 = x$

Check: $\frac{2x-3}{5}=\frac{3}{10}x$

$\frac{2(6)-3}{5}\stackrel{?}{=}\frac{3}{10}(6)$

$\frac{12-3}{5}\stackrel{?}{=}\frac{18}{10}$

$\frac{9}{5}=\frac{9}{5}$ True

The solution is 6, or the solution set is $\{6\}$.

34. $\frac{3a+2}{5}=-1$

$5\left(\frac{3a+2}{5}\right)=5(-1)$

$3a+2=-5$

$3a+2-2=-5-2$

$3a=-7$

$\frac{3a}{3}=\frac{-7}{3}$

$a=-\frac{7}{3}$

Check: $\frac{3a+2}{5}=-1$

$\frac{3\left(-\frac{7}{3}\right)+2}{5}\stackrel{?}{=}-1$

$\frac{-7+2}{5}\stackrel{?}{=}-1$

$\frac{-5}{5}\stackrel{?}{=}-1$

$-1=-1$ True

The solution is $-\frac{7}{3}$, or the solution set is $\left\{-\frac{7}{3}\right\}$.

36. $\frac{4}{3}m-1=\frac{1}{9}$

$9\left(\frac{4}{3}m-1\right)=9\left(\frac{1}{9}\right)$

$9\left(\frac{4}{3}m\right)-9(1)=9\left(\frac{1}{9}\right)$

$12m-9=1$

$12m-9+9=1+9$

$12m=10$

$\frac{12m}{12}=\frac{10}{12}$

$m=\frac{5}{6}$

Check: $\frac{4}{3}m-1=\frac{1}{9}$

$\frac{4}{3}\left(\frac{5}{6}\right)-1\stackrel{?}{=}\frac{1}{9}$

$\frac{10}{9}-\frac{9}{9}\stackrel{?}{=}\frac{1}{9}$

$\frac{1}{9}=\frac{1}{9}$ True

The solution is $\frac{5}{6}$, or the solution set is $\left\{\frac{5}{6}\right\}$.

38. $\frac{2}{3}(6-x)=\frac{5}{6}x$

$6\cdot\frac{2}{3}(6-x)=6\cdot\frac{5}{6}x$

$4(6-x)=5x$

$24-4x=5x$

$24-4x+4x=5x+4x$

$24=9x$

$\frac{24}{9}=\frac{9x}{9}$

$\frac{8}{3}=x$

Check: $\frac{2}{3}(6-x)=\frac{5}{6}x$

$\frac{2}{3}\left(6-\frac{8}{3}\right)\stackrel{?}{=}\frac{5}{6}\left(\frac{8}{3}\right)$

$4-\frac{16}{9}\stackrel{?}{=}\frac{40}{18}$

$\frac{36}{9}-\frac{16}{9}\stackrel{?}{=}\frac{20}{9}$

$\frac{20}{9}=\frac{20}{9}$ True

The solution is $\frac{8}{3}$, or the solution set is $\left\{\frac{8}{3}\right\}$.

40.
$$\frac{p}{8}-1=\frac{7p}{6}+2$$
$$24\left(\frac{p}{8}-1\right)=24\left(\frac{7p}{6}+2\right)$$
$$24\left(\frac{p}{8}\right)-24(1)=24\left(\frac{7p}{6}\right)+24(2)$$
$$3p-24=28p+48$$
$$-3p+3p-24=-3p+28p+48$$
$$-24=25p+48$$
$$-24-48=25p+48-48$$
$$-72=25p$$
$$\frac{-72}{25}=\frac{25p}{25}$$
$$-\frac{72}{25}=p$$

Check:
$$\frac{p}{8}-1=\frac{7p}{6}+2$$
$$\frac{-\frac{72}{25}}{8}-1\stackrel{?}{=}\frac{7\cdot\left(-\frac{72}{25}\right)}{6}+2$$
$$-\frac{9}{25}-\frac{25}{25}\stackrel{?}{=}-\frac{84}{25}+\frac{50}{25}$$
$$-\frac{34}{25}=-\frac{34}{25}\quad\text{True}$$

The solution is $-\frac{72}{25}$, or the solution set is $\left\{-\frac{72}{25}\right\}$.

42.
$$\frac{3x+2}{4}-\frac{x}{12}=\frac{x}{3}-1$$
$$12\left(\frac{3x+2}{4}-\frac{x}{12}\right)=12\left(\frac{x}{3}-1\right)$$
$$12\left(\frac{3x+2}{4}\right)-12\left(\frac{x}{12}\right)=12\left(\frac{x}{3}\right)-12(1)$$
$$3(3x+2)-x=4x-12$$
$$9x+6-x=4x-12$$
$$8x+6=4x-12$$
$$-4x+8x+6=-4x+4x-12$$
$$4x+6=-12$$
$$4x+6-6=-12-6$$
$$4x=-18$$
$$\frac{4x}{4}=\frac{-18}{4}$$
$$x=-\frac{9}{2}$$

Check:
$$\frac{3x+2}{4}-\frac{x}{12}=\frac{x}{3}-1$$
$$\frac{3\left(-\frac{9}{2}\right)+2}{4}-\frac{\left(-\frac{9}{2}\right)}{12}\stackrel{?}{=}\frac{-\frac{9}{2}}{3}-1$$
$$-\frac{23}{8}+\frac{9}{24}\stackrel{?}{=}-\frac{3}{2}-1$$
$$-\frac{23}{8}+\frac{3}{8}\stackrel{?}{=}-\frac{3}{2}-\frac{2}{2}$$
$$-\frac{20}{8}\stackrel{?}{=}-\frac{5}{2}$$
$$-\frac{5}{2}=-\frac{5}{2}\quad\text{True}$$

The solution is $-\frac{9}{2}$, or the solution set is $\left\{-\frac{9}{2}\right\}$.

44.
$$0.3z=6$$
$$10(0.3z)=10(6)$$
$$3z=60$$
$$\frac{3z}{3}=\frac{60}{3}$$
$$z=20$$

Check:
$$0.3z=6$$
$$0.3(20)\stackrel{?}{=}6$$
$$6=6\quad\text{True}$$

The solution is 20, or the solution set is $\{20\}$.

46.
$$-1.7q=-8.5$$
$$10(-1.7q)=10(-8.5)$$
$$-17q=-85$$
$$\frac{-17q}{-17}=\frac{-85}{-17}$$
$$q=5$$

Check:
$$-1.7q=-8.5$$
$$-1.7(5)\stackrel{?}{=}-8.5$$
$$-8.5=-8.5\quad\text{True}$$

The solution is 5, or the solution set is $\{5\}$.

48.
$$1.06z=31.8$$
$$100(1.06z)=100(31.8)$$
$$106z=3180$$
$$\frac{106z}{106}=\frac{3180}{106}$$
$$z=30$$

Check:
$$1.06z=31.8$$
$$1.06(30)\stackrel{?}{=}31.8$$
$$31.8=31.8\quad\text{True}$$

The solution is 30, or the solution set is $\{30\}$.

50. $2.5a + a = 7$
$3.5a = 7$
$10(3.5a) = 10(7)$
$35a = 70$
$\frac{35a}{35} = \frac{70}{35}$
$a = 2$
Check: $2.5a + a = 7$
$2.5(2) + 2 \stackrel{?}{=} 7$
$5 + 2 \stackrel{?}{=} 7$
$7 = 7$ True
The solution is 2, or the solution set is $\{2\}$.

52. $p + 0.04p = 260$
$1.04p = 260$
$100(1.04p) = 100(260)$
$104p = 26{,}000$
$\frac{104p}{104} = \frac{26{,}000}{104}$
$p = 250$
Check: $p + 0.04p = 260$
$250 + 0.04(250) \stackrel{?}{=} 260$
$250 + 10 \stackrel{?}{=} 260$
$260 = 260$
The solution is 250, or the solution set is $\{250\}$.

54. $0.7y - 4.6 = 0.4y - 2.2$
$10(0.7y - 4.6) = 10(0.4y - 2.2)$
$10(0.7y) + 10(-4.6) = 10(0.4y) + 10(-2.2)$
$7y - 46 = 4y - 22$
$-4y + 7y - 46 = -4y + 4y - 22$
$3y - 46 = -22$
$3y - 46 + 46 = -22 + 46$
$3y = 24$
$\frac{3y}{3} = \frac{24}{3}$
$y = 8$
Check: $0.7y - 4.6 = 0.4y - 2.2$
$0.7(8) - 4.6 \stackrel{?}{=} 0.4(8) - 2.2$
$5.6 - 4.6 \stackrel{?}{=} 3.2 - 2.2$
$1 = 1$ True
The solution is 8, or the solution set is $\{8\}$.

56. $0.5n - 0.35n = 2.5n + 9.4$
$0.15n = 2.5n + 9.4$
$-2.5n + 0.15n = -2.5n + 2.5n + 9.4$
$-2.35n = 9.4$
$100(-2.35n) = 100(9.4)$
$-235n = 940$
$\frac{-235n}{-235} = \frac{940}{-235}$
$n = -4$
Check: $0.5n - 0.35n = 2.5n + 9.4$
$0.5(-4) - 0.35(-4) \stackrel{?}{=} 2.5(-4) + 9.4$
$-2 + 1.4 \stackrel{?}{=} -10 + 9.4$
$-0.6 = -0.6$ True
The solution is -4, or the solution set is $\{-4\}$.

58. $5 - 0.2(m - 2) = 3.6m + 1.6$
$5 - 0.2m + 0.4 = 3.6m + 1.6$
$-0.2m + 5.4 = 3.6m + 1.6$
$0.2m - 0.2m + 5.4 = 0.2m + 3.6m + 1.6$
$5.4 = 3.8m + 1.6$
$5.4 - 1.6 = 3.8m + 1.6 - 1.6$
$3.8 = 3.8m$
$10(3.8) = 10(3.8m)$
$38 = 38m$
$\frac{38}{38} = \frac{38m}{38}$
$1 = m$
Check: $5 - 0.2(m - 2) = 3.6m + 1.6$
$5 - 0.2(1 - 2) \stackrel{?}{=} 3.6(1) + 1.6$
$5 - 0.2(-1) \stackrel{?}{=} 3.6 + 1.6$
$5 + 0.2 \stackrel{?}{=} 3.6 + 1.6$
$5.2 = 5.2$ True
The solution is 1, or the solution set is $\{1\}$.

60. $0.3(6a - 4) = -0.10(2a - 8)$
$10[0.3(6a - 4)] = 10[-0.10(2a - 8)]$
$3(6a - 4) = -1(2a - 8)$
$18a - 12 = -2a + 8$
$2a + 18a - 12 = 2a - 2a + 8$
$20a - 12 = 8$
$20a - 12 + 12 = 8 + 12$
$20a = 20$
$\frac{20a}{20} = \frac{20}{20}$
$a = 1$
Check: $0.3(6a - 4) = -0.10(2a - 8)$
$0.3(6 \cdot 1 - 4) \stackrel{?}{=} -0.10(2 \cdot 1 - 8)$
$0.3(6 - 4) \stackrel{?}{=} -0.10(2 - 8)$
$0.3(2) \stackrel{?}{=} -0.10(-6)$
$0.6 = 0.6$ True
The solution is 1, or the solution set is $\{1\}$.

62. $0.03t + 0.025(1000 - t) = 27.25$
$0.03t + 25 - 0.025t = 27.25$
$0.005t + 25 = 27.25$
$0.005t + 25 - 25 = 27.25 - 25$
$0.005t = 2.25$
$1000(0.005t) = 1000(2.25)$
$5t = 2250$
$\frac{5t}{5} = \frac{2250}{5}$
$t = 450$

Check:
$0.03t + 0.025(1000 - t) = 27.25$
$0.03(450) + 0.025(1000 - 450) \stackrel{?}{=} 27.25$
$13.5 + 0.025(550) \stackrel{?}{=} 27.25$
$13.5 + 13.75 \stackrel{?}{=} 27.25$
$27.25 = 27.25$ True

The solution is 450, or the solution set is $\{450\}$.

64. $4(y-2) = 6(y+1) - 2y$
$4y - 8 = 6y + 6 - 2y$
$4y - 8 = 4y + 6$
$-4y + 4y - 8 = -4y + 4y + 6$
$-8 = 6$

This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

66. $-3x + 2 + 5x = 2(x+1)$
$2 + 2x = 2x + 2$
$-2x + 2 + 2x = -2x + 2x + 2$
$2 = 2$

This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

68. $7b + 2(b-4) = 8b - (3b+2)$
$7b + 2b - 8 = 8b - 3b - 2$
$9b - 8 = 5b - 2$
$-5b + 9b - 8 = -5b + 5b - 2$
$4b - 8 = -2$
$4b - 8 + 8 = -2 + 8$
$4b = 6$
$\frac{4b}{4} = \frac{6}{4}$
$b = \frac{3}{2}$

This is a conditional equation. The solution set is $\left\{\frac{3}{2}\right\}$.

70. $\frac{2m+1}{4} - \frac{m}{6} = \frac{m}{3} - 1$
$12\left(\frac{2m+1}{4} - \frac{m}{6}\right) = 12\left(\frac{m}{3} - 1\right)$
$12\left(\frac{2m+1}{4}\right) - 12\left(\frac{m}{6}\right) = 12\left(\frac{m}{3}\right) - 12(1)$
$3(2m+1) - 2m = 4m - 12$
$6m + 3 - 2m = 4m - 12$
$4m + 3 = 4m - 12$
$-4m + 4m + 3 = -4m + 4m - 12$
$3 = -12$

This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

72. $\frac{2y-7}{4} = \frac{3y-13}{6}$
$12\left(\frac{2y-7}{4}\right) = 12\left(\frac{3y-13}{6}\right)$
$3(2y-7) = 2(3y-13)$
$6y - 21 = 6y - 26$
$-6y + 6y - 21 = -6y + 6y - 26$
$-21 = -26$

This is a false statement, so the equation is a contradiction. The solution is $\varnothing$ or $\{\ \}$.

74. $\frac{2x}{3} + \frac{x+3}{12} = \frac{3x+1}{4}$
$12\left(\frac{2x}{3} + \frac{x+3}{12}\right) = 12\left(\frac{3x+1}{4}\right)$
$12\left(\frac{2x}{3}\right) + 12\left(\frac{x+3}{12}\right) = 3(3x+1)$
$8x + x + 3 = 9x + 3$
$9x + 3 = 9x + 3$
$-9x + 9x + 3 = -9x + 9x + 3$
$3 = 3$

This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

76. $-15(z-3) = 25z$
$-15z + 45 = 25z$
$15z - 15z + 45 = 15z + 25z$
$45 = 40z$
$\frac{45}{40} = \frac{40z}{40}$
$\frac{9}{8} = z$

The solution is $\frac{9}{8}$, or the solution set is $\left\{\frac{9}{8}\right\}$.

78. $5m-3(m+1)=2(m+1)-5$
$5m-3m-3=2m+2-5$
$2m-3=2m-3$
$-2m+2m-3=-2m+2m-3$
$-3=-3$
This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

80. $3-(x+10)=3x+7$
$3-x-10=3x+7$
$-x-7=3x+7$
$-3x-x-7=-3x+3x+7$
$-4x-7=7$
$-4x-7+7=7+7$
$-4x=14$
$\frac{-4x}{-4}=\frac{14}{-4}$
$x=-\frac{7}{2}$
The solution is $-\frac{7}{2}$, or the solution set is $\left\{-\frac{7}{2}\right\}$.

82. $\frac{1}{3}x=2+\frac{5}{6}x$
$6\cdot\frac{1}{3}x=6\left(2+\frac{5}{6}x\right)$
$2x=12+5x$
$2x-5x=12+5x-5x$
$-3x=12$
$\frac{-3x}{-3}=\frac{12}{-3}$
$x=-4$
The solution is -4, or the solution set is $\{-4\}$.

84. $\frac{x}{2}+4=\frac{x+7}{3}$
$6\left(\frac{x}{2}+4\right)=6\left(\frac{x+7}{3}\right)$
$6\left(\frac{x}{2}\right)+6(4)=2(x+7)$
$3x+24=2x+14$
$-2x+3x+24=-2x+2x+14$
$x+24=14$
$x+24-24=14-24$
$x=-10$
The solution is -10, or the solution set is $\{-10\}$.

86. $1.6z-4=2(z-1)-0.4z$
$1.6z-4=2z-2-0.4z$
$1.6z-4=1.6z-2$
$-1.6z+1.6z-4=-1.6z+1.6z-2$
$-4=-2$
This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

88. $0.2a=-6$
$10(0.2a)=10(-6)$
$2a=-60$
$\frac{2a}{2}=\frac{-60}{2}$
$a=-30$
The solution is -30, or the solution set is $\{-30\}$.

90. $\frac{4(2n+1)}{3}=2n-6$
$3\left[\frac{4(2n+1)}{3}\right]=3(2n-6)$
$4(2n+1)=3(2n-6)$
$8n+4=6n-18$
$-6n+8n+4=-6n+6n-18$
$2n+4=-18$
$2n+4-4=-18-4$
$2n=-22$
$\frac{2n}{2}=\frac{-22}{2}$
$n=-11$
The solution is -11, or the solution set is $\{-11\}$.

92. $0.3x-1=0.5(x+2)-0.2x$
$0.3x-1=0.5x+1-0.2x$
$0.3x-1=0.3x+1$
$-0.3x+0.3x-1=-0.3x+0.3x+1$
$-1=1$
This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

94. $\frac{x-1}{4}=\frac{x-4}{6}$
$12\left(\frac{x-1}{4}\right)=12\left(\frac{x-4}{6}\right)$
$3(x-1)=2(x-4)$
$3x-3=2x-8$
$-2x+3x-3=-2x+2x-8$
$x-3=-8$
$x-3+3=-8+3$
$x=-5$
The solution is -5, or the solution set is $\{-5\}$.

96. $0.3(z-10)-0.5z=-6$
$0.3z-3-0.5z=-6$
$-0.2z-3=-6$
$-0.2z-3+3=-6+3$
$-0.2z=-3$
$10(-0.2z)=10(-3)$
$-2z=-30$
$\frac{-2z}{-2}=\frac{-30}{-2}$
$z=15$
The solution is 15, or the solution set is $\{15\}$.

98. $\frac{2x-3}{4}+5=\frac{3(x+3)}{4}-\frac{x}{2}+2$
$4\left(\frac{2x-3}{4}+5\right)=4\left[\frac{3(x+3)}{4}-\frac{x}{2}+2\right]$
$2x-3+20=3(x+3)-2x+8$
$2x+17=3x+9-2x+8$
$2x+17=x+17$
$2x+17-17=x+17-17$
$2x=x$
$2x-x=x-x$
$x=0$
The solution is 0, or the solution set is $\{0\}$.

100. $\frac{1}{2}\left[3-\left(\frac{2x}{3}-1\right)+3x\right]=\frac{-4x+1}{3}+1$
$6\left\{\frac{1}{2}\left[3-\left(\frac{2x}{3}-1\right)+3x\right]\right\}=6\left[\frac{-4x+1}{3}+1\right]$
$3\left[3-\left(\frac{2x}{3}-1\right)+3x\right]=2(-4x+1)+6(1)$
$3\cdot 3-3\left(\frac{2x}{3}-1\right)+3\cdot 3x=-8x+2+6$
$9-2x+3+9x=-8x+8$
$12+7x=-8x+8$
$12+15x=8$
$15x=-4$
$x=-\frac{4}{15}$
The solution is $-\frac{4}{15}$, or the solution set is $\left\{-\frac{4}{15}\right\}$.

102. $-4.88x-5.7=2(-3.41x)+1.2$
$-4.88x-5.7=-6.82x+1.2$
$1.94x-5.7=1.2$
$1.94x=6.9$
$x=\frac{6.9}{1.94}$
$x\approx 4$

104. $-3x-2\{4+3[x-(1+x)]\}=12$
$-3x-2[4+3(x-1-x)]=12$
$-3x-2[4+3(-1)]=12$
$-3x-2(4-3)=12$
$-3x-2(1)=12$
$-3x-2=12$
$-3x=14$
$x=-\frac{14}{3}$
$x\approx -4.67$

106. $7.50h=37.50$
$10(7.50h)=10(37.50)$
$75h=375$
$\frac{75h}{75}=\frac{375}{75}$
$h=5$
Bob rented the tiller for 5 hours.

108. $k+0.055k=1266$
$1.055k=1266$
$1000(1.055k)=1000(1266)$
$1055k=1,266,000$
$\frac{1055k}{1055}=\frac{1,266,000}{1055}$
$k=1200$
The price of the kayak before taxes was $1200.

110. $w-0.06w=26.32$
$0.94w=26.32$
$w=\frac{26.32}{0.94}$
$w\approx 28$
The hourly wage was approximately $28.

112. $x-0.30x=33.60$
$0.7x=33.6$
$x=\frac{33.6}{0.7}$
$x=48$
The original price of the sweatshirt was $48.

114. $0.05n + 0.25(2n - 5) = 4.25$
$100[0.05n + 0.25(2n - 5)] = 100(4.25)$
$5n + 25(2n - 5) = 425$
$5n + 50n - 125 = 425$
$55n - 125 = 425$
$55n = 550$
$n = 10$
Pablo found 10 nickels.

116. $4x = 2\left(\frac{1}{2}x\right) + 2(x + 5)$
$4x = x + 2x + 10$
$4x = 3x + 10$
$x = 10$
The side of the square is 10 units.

118. $12,837.50 = 0.25(x - 74,900) + 10,312.50$
$100(12,837.50) = 100[0.25(x - 74,900) + 10,312.5]$
$1,283,750 = 25(x - 74,900) + 1,031,250$
$1,283,750 = 25x - 1,872,500 + 1,031,250$
$1,283,750 = 25x - 841,250$
$2,125,000 = 25x$
$85,000 = x$
The adjusted gross income of you and your spouse was $85,000.

120. Answers may vary. One possibility: The statement 24 = 2 indicates that the original equation is a contradiction. The solution set is ∅ or { }.

122. If the last line of the solution of an equation is a true statement, then the solution is all real numbers. If the last line of the solution of an equation is a false statement, then the solution is the empty set.

Section 2.4

Are You Prepared for This Section?

P1. $2L + 2W$ for $L = 7$ and $W = 5$: $2(7) + 2(5) = 14 + 10 = 24$

P2. In 0.5873, the number 8 is in the hundredths place. The number to the right of 8 is 7. Since 7 is greater than or equal to 5, round 0.5873 to 0.59.

2.4 Quick Checks

1. A formula is an equation that describes how two or more variables are related.

2. $F = \frac{9}{5}C + 32$
$F = \frac{9}{5}(15) + 32$
$F = 27 + 32$
$F = 59$
The temperature is 59° Fahrenheit.

3. $c = a + 30$
$c = 10 + 30$
$c = 40$
A size 10 dress in the United States is a Continental dress size 40.

4. $E = 250 + 0.05S$
$E = 250 + 0.05(1250)$
$E = 250 + 62.5$
$E = 312.5$
The earnings of the salesman were \$312.50.

5. $N = p + 0.06p$
$N = 5600 + 0.06(5600)$
$N = 5600 + 336$
$N = 5936$
The new population is 5936 persons.

6. The total amount borrowed in a loan is called principal. Interest is the money paid for the use of the money.

7. The amount Bill invested, P, is \$2500. The interest rate, r, is 1.5% = 0.015. Because 8 months is $\frac{2}{3}$ of a year, $t = \frac{2}{3}$.

$I = Prt$

$I = 2500 \cdot 0.015 \cdot \frac{2}{3}$

$I = 25$

Bill earned \$25 on his investment. At the end of 8 months he had \$2500 + \$25 = \$2525.

8. The perimeter is the sum of the lengths of all the sides of a figure.

9. The area is the amount of space enclosed by a two-dimensional figure, measured in square units.

10. The volume is the amount of space occupied by a three-dimensional figure, measured in cubic units.

11. The radius of a circle is the line segment that extends from the center of the circle to any point on the circle.

12. True

13. $A = \frac{1}{2}h(B + b)$

$A = \frac{1}{2} \cdot 4.5(9 + 7)$

$A = \frac{1}{2} \cdot 4.5 \cdot 16$

$A = 36$

The area of the trapezoid is 36 square inches.

14. **(a)** The radius of the circle is $\frac{1}{2}(4 \text{ feet}) = 2 \text{ feet}$.

Area of remaining garden
$= \text{Area of rectangle} - \text{Area of circle}$
$= lw - \pi r^2$
$= (20 \text{ feet})(10 \text{ feet}) - \pi(2 \text{ feet})^2$
$= 200 \text{ feet}^2 - 4\pi \text{ feet}^2$
$\approx 187 \text{ feet}^2$

Approximately 187 square feet of sod is required for the lawn.

(b) Cost for sod
$= 187 \text{ square feet} \cdot \frac{\$0.25}{1 \text{ square foot}}$
$= \$46.75$

The sod will cost \$46.75.

15. The radius of the pad is $\frac{1}{2}(6 \text{ feet}) = 3 \text{ feet}$.

$\text{Area} = \pi r^2$
$= \pi(3 \text{ feet})^2$
$= 9\pi \text{ feet}^2$
$\approx 28.27 \text{ feet}^2$

The area of the pad is about 28.27 square feet.

16. $\text{Area of 18" pizza} = \pi r^2$
$= \pi(9 \text{ inches})^2$
$= 81\pi \text{ inches}^2$
$\approx 254.47 \text{ inches}^2$

$\text{Area of 9" pizza} = \pi r^2$
$= \pi(4.5 \text{ inches})^2$
$= 20.25\pi \text{ inches}^2$
$\approx 63.62 \text{ inches}^2$

Cost per square inch of 18" pizza:
$\frac{\$16.99}{254.47} \approx \$0.07$

Cost per square inch of 9" pizza:

$$\frac{\$8.99}{63.62} \approx \$0.14$$

The 18" pizza is the better buy.

17. $d = rt$

$$\frac{d}{r} = \frac{rt}{r}$$

$$\frac{d}{r} = t \text{ or } t = \frac{d}{r}$$

18. $V = lwh$

$$\frac{V}{wh} = \frac{lwh}{wh}$$

$$\frac{V}{wh} = l \text{ or } l = \frac{V}{wh}$$

19. $F = \frac{9}{5}C + 32$

$$F - 32 = \frac{9}{5}C + 32 - 32$$

$$F - 32 = \frac{9}{5}C$$

$$\frac{5}{9}(F - 32) = \frac{5}{9}\left(\frac{9}{5}C\right)$$

$$\frac{5}{9}(F - 32) = C \text{ or } C = \frac{5}{9}(F - 32)$$

20. $S = 2\pi rh + 2\pi r^2$

$$S - 2\pi r^2 = 2\pi rh + 2\pi r^2 - 2\pi r^2$$

$$S - 2\pi r^2 = 2\pi rh$$

$$\frac{S - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$$

$$\frac{S - 2\pi r^2}{2\pi r} = h$$

21. $6x - 3y = 18$

$$6x - 3y - 6x = 18 - 6x$$

$$-3y = 18 - 6x$$

$$\frac{-3y}{-3} = \frac{18 - 6x}{-3}$$

$$y = \frac{18}{-3} - \frac{6x}{-3}$$

$$y = -6 + 2x$$

$$y = 2x - 6$$

22. $4x + 6y = 15$

$$-4x + 4x + 6y = -4x + 15$$

$$6y = -4x + 15$$

$$\frac{6y}{6} = \frac{-4x + 15}{6}$$

$$y = \frac{-4x + 15}{6}$$

$$y = -\frac{2}{3}x + \frac{5}{2}$$

2.4 Exercises

24. $H = 208 - 0.7a$

$a = 40$

$H = 208 - 0.7(40) = 180$

The heart rate is 180 beats per minute.

26. $S = P - 0.35P$; $P = 950$

$S = 950 - 0.35(950) = 950 - 332.5 = 617.5$

The sale price is \$617.50.

28. $E = 750 + 0.07S$; $S = 1200$

$E = 750 + 0.07(1200) = 750 + 84 = 834$

The earnings are \$834.

30. $F = \frac{9}{5}C + 32;\ C = 10$

$$F = \frac{9}{5}(10) + 32 = 18 + 32 = 50$$

The temperature is 50°F.

32. $I = Prt$; $P = 5000$, $r = 0.025$, $t = \frac{9}{12} = 0.75$

$I = 5000(0.025)(0.75)$

$I = 93.75$

Christopher's investment will earn \$93.75.

34. **(a)** $P = 2l + 2w$; $l = 32$, $w = 20$

$P = 2(32) + 2(20) = 64 + 40 = 104$

The perimeter is 104 units.

(b) $A = lw = 32(20) = 640$

The area is 640 square units.

36. **(a)** $P = 2l + 2w;\ l = \frac{3}{4},\ w = \frac{1}{2}$

$$P = 2\left(\frac{3}{4}\right) + 2\left(\frac{1}{2}\right) = \frac{3}{2} + 1 = 2\frac{1}{2}$$

The perimeter is $2\frac{1}{2}$ miles.

(b) $A = lw = \frac{3}{4} \cdot \frac{1}{2} = \frac{3}{8}$

The area is $\frac{3}{8}$ square miles.

38. (a) $P = 4s$; $s = 3.5$
$P = 4(3.5) = 14$
The perimeter is 14 units.

(b) $A = s^2 = (3.5)^2 = 12.25$
The area is 12.25 square units.

40. (a) $C = 2\pi r$; $r = 2.8$
$C = 2\pi(2.8) = 5.6\pi \approx 5.6(3.14) = 17.584$
The circumference is 5.6π yards, approximately 17.6 yards.

(b) $A = \pi r^2$
$= \pi(2.8)^2$
$= 7.84\pi$
$\approx 7.84(3.14)$
≈ 24.62
The area is 7.84π square yards, approximately 24.6 square yards.

42. $A = \pi r^2$; $r = 2.5$
$A = \pi(2.5)^2 = \pi(6.25) \approx 3.14(6.25) \approx 19.63$
The area is 19.63 square kilometers.

44. $A = lw$
$\frac{A}{l} = \frac{lw}{l}$
$\frac{A}{l} = w$

46. $F = mv^2$
$\frac{F}{v^2} = \frac{mv^2}{v^2}$
$\frac{F}{v^2} = m$

48. $v = LWH$
$\frac{v}{LH} = \frac{LWH}{LH}$
$\frac{v}{LH} = W$

50. $V = \frac{1}{3}Bh$
$\frac{3}{h} \cdot V = \frac{3}{h} \cdot \frac{1}{3}Bh$
$\frac{3V}{h} = B$

52. $S = a + b + c$
$S - a - c = a + b + c - a - c$
$S - a - c = b$

54. $P = 2l + 2w$
$P - 2w = 2l + 2w - 2w$
$P - 2w = 2l$
$\frac{P - 2w}{2} = \frac{2l}{2}$
$\frac{P - 2w}{2} = l$

56. $S = 2\pi r(r + h)$
$S = 2\pi r^2 + 2\pi rh$
$S - 2\pi r^2 = 2\pi r^2 + 2\pi rh - 2\pi r^2$
$S - 2\pi r^2 = 2\pi rh$
$\frac{S - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$
$\frac{S - 2\pi r^2}{2\pi r} = h$

58. $-2x + y = 18$
$2x - 2x + y = 2x + 18$
$y = 2x + 18$

60. $12x - 6y = 18$
$-12x + 12x - 6y = -12x + 18$
$-6y = -12x + 18$
$\frac{-6y}{-6} = \frac{-12x + 18}{-6}$
$y = 2x - 3$

62. $5x + 6y = 18$
$-5x + 5x + 6y = -5x + 18$
$6y = -5x + 18$
$\frac{6y}{6} = \frac{-5x + 18}{6}$
$y = -\frac{5}{6}x + 3$

64.
$$\frac{2}{3}x-\frac{5}{2}y=5$$
$$6\left(\frac{2}{3}x-\frac{5}{2}y\right)=6\cdot 5$$
$$6\left(\frac{2}{3}x\right)-6\left(\frac{5}{2}y\right)=30$$
$$4x-15y=30$$
$$-4x+4x-15y=-4x+30$$
$$-15y=-4x+30$$
$$\frac{-15y}{-15}=\frac{-4x+30}{-15}$$
$$y=\frac{4}{15}x-2$$

66. (a)
$$P=R-C$$
$$P+C=P-C+C$$
$$P+C=R$$

(b) $R = P + C$; $P = 4525$, $C = 1475$
$R = 4525 + 1475 = 6000$
The revenue is \$6000.

68. (a)
$$I=Prt$$
$$\frac{I}{Pr}=\frac{Prt}{Pr}$$
$$\frac{I}{Pr}=t$$

(b) $t=\dfrac{I}{Pr}$; $I = 42$, $P = 525$, $r = 4\% = 0.04$
$$t=\frac{42}{525(0.04)}=\frac{42}{21}=2$$
The time is 2 years.

70. (a)
$$P=mgh$$
$$\frac{P}{gh}=\frac{mgh}{gh}$$
$$\frac{P}{gh}=m$$

(b) $m=\dfrac{P}{gh}$; $P = 8192$, $g = 1$, $h = 32$
$$m=\frac{8192}{1(32)}=\frac{8192}{32}=256$$

72. (a)
$$F=\frac{9}{5}C+32$$
$$F-32=\frac{9}{5}C+32-32$$
$$F-32=\frac{9}{5}C$$
$$\frac{5}{9}(F-32)=\frac{5}{9}\cdot\frac{9}{5}C$$
$$\frac{5}{9}(F-32)=C \text{ or } C=\frac{5F-160}{9}$$

(b) $C=\dfrac{5}{9}(F-32)$; $F = 59$
$$C=\frac{5}{9}(59-32)=\frac{5}{9}(27)=5\cdot 3=15$$
The temperature is 15°C.

74. (a)
$$A=P+Prt$$
$$A-P=P+Prt-P$$
$$A-P=Prt$$
$$\frac{A-P}{Pr}=\frac{Prt}{Pr}$$
$$\frac{A-P}{Pr}=t$$

(b) $t=\dfrac{A-P}{Pr}$; $A = 249$, $P = 240$, $r = 0.025$
$$t=\frac{249-240}{240(0.025)}=\frac{9}{6}=1.5$$
The time is 1.5 years.

76. (a)
$$V=\frac{1}{3}\pi r^2h$$
$$3(V)=3\left(\frac{1}{3}\pi r^2h\right)$$
$$3V=\pi r^2h$$
$$\frac{3V}{\pi r^2}=\frac{\pi r^2h}{\pi r^2}$$
$$\frac{3V}{\pi r^2}=h$$

(b) $h=\dfrac{3V}{\pi r^2}$; $V = 75\pi$, $r = 5$
$$h=\frac{3(75\pi)}{\pi(5)^2}=\frac{225\pi}{25\pi}=9$$
The height is 9 inches.

78. **(a)** $A = \frac{1}{2}h(b+B)$

$$\frac{2}{b+B}\cdot A = \frac{2}{b+B}\cdot\left[\frac{1}{2}h(b+B)\right]$$

$$\frac{2A}{b+B} = h$$

(b) $h = \frac{2A}{b+B}$; $A = 99$, $b = 19$, $B = 3$

$$h = \frac{2(99)}{19+3} = \frac{198}{22} = 9$$

The height is 9 centimeters.

80. $A = 40$, $H = 168$, $W = 57$

$$\begin{aligned} E &= 665.1 + 9.56W + 1.85H - 4.68A \\ &= 665.1 + 9.56(57) + 1.85(168) - 4.68(40) \\ &= 665.1 + 544.92 + 310.8 - 187.2 \\ &= 1333.62 \end{aligned}$$

The basal energy expenditure is 1333.62 calories.

82. **(a)** $S = 2\pi rh + 2\pi r^2$

$$S - 2\pi r^2 = 2\pi rh + 2\pi r^2 - 2\pi r^2$$

$$S - 2\pi r^2 = 2\pi rh$$

$$\frac{S - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$$

$$\frac{S - 2\pi r^2}{2\pi r} = h$$

(b) $h = \frac{S - 2\pi r^2}{2\pi r}$; $S = 19.5\pi$, $r = 1.5$

$$\begin{aligned} h &= \frac{19.5\pi - 2\pi(1.5)^2}{2\pi(1.5)} \\ &= \frac{\pi[19.5 - 2(1.5)^2]}{\pi\cdot 2(1.5)} \\ &= 5 \end{aligned}$$

The height is 5 inches.

84.

Size	Area: $A = \pi r^2$	Price per square inch
16”	$A = \pi(8)^2 \approx 200.96$	$\frac{\$13.99}{200.96} \approx \$0.07$
8”	$A = \pi(4)^2 \approx 50.24$	$\frac{\$12.99}{2(50.24)} \approx \$0.13$

Since \$0.07 < \$0.13, the large 16” pizza is the best deal.

86. **(a)** $d = rt$

$$\frac{d}{r} = \frac{rt}{r}$$

$$\frac{d}{r} = t$$

Let $d = 2(145) = 290$, $r = 58$

$$t = \frac{290}{58} = 5$$

Messai expects the trip to take 5 hours.

(b) $5(32) = 160$

Messai expects \$160.

88. Region = Parallelogram + Triangle

$$\begin{aligned} \text{Area} &= bh + \frac{1}{2}bh \\ &= 9(7) + \frac{1}{2}(9)(3) \\ &= 63 + \frac{27}{2} \\ &= 76.5 \end{aligned}$$

The area is 76.5 square centimeters.

90. $\text{Figure} = \text{Rectangle} + \frac{1}{2}\cdot\text{circle}$

$$\begin{aligned} \text{Area} &= lw + \frac{1}{2}\cdot\pi r^2 \\ &= 6(4) + \frac{1}{2}(3.14)(2)^2 \\ &= 24 + 6.28 \\ &= 30.28 \end{aligned}$$

The area is 30.28 square feet.

92. **(a)** $G = \frac{a+b+2c+2d}{6}$

$$6G = 6\cdot\frac{a+b+2c+2d}{6}$$

$$6G = a+b+2c+2d$$

$$6G - a - b - 2c = a + b + 2c + 2d - a - b - 2c$$

$$\frac{6G - a - b - 2c}{2} = \frac{2d}{2}$$

$$\frac{6G - a - b - 2c}{2} = d$$

(b) $d = \dfrac{6G - a - b - 2c}{2}$

$= \dfrac{6(84) - 78 - 74 - 2(84)}{2}$

$= \dfrac{504 - 78 - 74 - 168}{2}$

$= \dfrac{184}{2}$

$= 92$

Jose must earn a score of 92 on his final exam.

94. Two walls measure 8 feet by 10 feet:
$A = 8 \times 10 = 80$
Two walls measure 12 feet by 10 feet:
$A = 12 \times 10 = 120$
Each wall requires 2 coats.
$A = 2[2(80) + 2(120)]$
$= 2(160 + 240)$
$= 2(400)$
$= 800$
$\dfrac{800}{500} = 1.6$
You need to purchase 2 gallons.

96. (a) Region = Yard − Pool
Area $= lw - lw$
$= (80)(40) - (12)(24)$
$= 3200 - 288$
$= 2912$
The lawn area requiring sod is 2912 square feet.

(b) $\dfrac{2912}{500} = 5.824$
5.824 = 6 pallets are required.

(c) 6(96) = 576
The sod will cost \$576.

98. (a) $l = 9$ yd $= 9 \times 3$ ft $= 27$ ft; $w = 8$ ft
$A = lw = 27(8) = 216$
The area is 216 square feet

(b) $l = 9$ yd; $w = 8$ ft $= \dfrac{8}{3}$ yd

$A = lw = 9\left(\dfrac{8}{3}\right) = 24$

The area is 24 square yards.

100. To convert from square yards to square feet, multiply square yards by $\dfrac{9 \text{ ft}^2}{1 \text{ yd}^2}$.

102. Answers may vary.

Putting the Concepts Together (Sections 2.1–2.4)

1. (a) $4 - (6 - x) = 5x - 8$; $x = \dfrac{3}{2}$

$4 - \left(6 - \dfrac{3}{2}\right) \stackrel{?}{=} 5\left(\dfrac{3}{2}\right) - 8$

$4 - \left(\dfrac{12}{2} - \dfrac{3}{2}\right) \stackrel{?}{=} \dfrac{15}{2} - 8$

$\dfrac{8}{2} - \dfrac{9}{2} \stackrel{?}{=} \dfrac{15}{2} - \dfrac{16}{2}$

$-\dfrac{1}{2} = -\dfrac{1}{2}$ True

Yes, $x = \dfrac{3}{2}$ is a solution of the equation.

(b) $4 - (6 - x) = 5x - 8$; $x = -\dfrac{5}{2}$

$4 - \left[6 - \left(-\dfrac{5}{2}\right)\right] \stackrel{?}{=} 5\left(-\dfrac{5}{2}\right) - 8$

$4 - \left(\dfrac{12}{2} + \dfrac{5}{2}\right) \stackrel{?}{=} \dfrac{-25}{2} - 8$

$\dfrac{8}{2} - \dfrac{17}{2} \stackrel{?}{=} -\dfrac{25}{2} - \dfrac{16}{2}$

$-\dfrac{9}{2} = -\dfrac{41}{2}$ False

No, $x = -\dfrac{5}{2}$ is *not* a solution of the equation.

2. (a) $\dfrac{1}{2}(x - 4) + 3x = x + \dfrac{1}{2}$; $x = -4$

$\dfrac{1}{2}(-4 - 4) + 3(-4) \stackrel{?}{=} -4 + \dfrac{1}{2}$

$\dfrac{1}{2}(-8) + (-12) \stackrel{?}{=} -\dfrac{8}{2} + \dfrac{1}{2}$

$-4 + (-12) \stackrel{?}{=} -\dfrac{7}{2}$

$-16 = -\dfrac{7}{2}$ False

No, $x = -4$ is *not* a solution of the equation.

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

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

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

$-\frac{3}{2}+\frac{6}{2} \stackrel{?}{=} \frac{3}{2}$

$\frac{3}{2}=\frac{3}{2}$ True

Yes, $x = 1$ is a solution of the equation.

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

$6\left(x+\frac{1}{2}\right)=6\left(-\frac{1}{6}\right)$

$6x+3=-1$

$6x+3-3=-1-3$

$6x=-4$

$\frac{6x}{6}=\frac{-4}{6}$

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

Check: $x+\frac{1}{2}=-\frac{1}{6}$

$-\frac{2}{3}+\frac{1}{2} \stackrel{?}{=} -\frac{1}{6}$

$-\frac{4}{6}+\frac{3}{6} \stackrel{?}{=} -\frac{1}{6}$

$-\frac{1}{6}=-\frac{1}{6}$ True

The solution is $-\frac{2}{3}$ or the solution set is $\left\{-\frac{2}{3}\right\}$.

4. $-0.4m = 16$

$10(-0.4m) = 10(16)$

$-4m = 160$

$\frac{-4m}{-4}=\frac{160}{-4}$

$m = -40$

Check: $-0.4m = 16$

$-0.4(-40) \stackrel{?}{=} 16$

$16 = 16$ True

The solution is –40, or the solution set is {–40}.

5. $14 = -\frac{7}{3}p$

$-\frac{3}{7}\cdot 14 = -\frac{3}{7}\cdot\left(-\frac{7}{3}p\right)$

$-3\cdot 2 = p$

$-6 = p$

Check: $14 = -\frac{7}{3}p$

$14 \stackrel{?}{=} -\frac{7}{3}(-6)$

$14 = 14$ True

The solution is –6, or the solution set is {–6}.

6. $8n-11=13$

$8n-11+11=13+11$

$8n=24$

$\frac{8n}{8}=\frac{24}{8}$

$n=3$

Check: $8n-11=13$

$8(3)-11 \stackrel{?}{=} 13$

$24-11 \stackrel{?}{=} 13$

$13=13$ True

The solution is 3, or the solution set is {3}.

7. $\frac{5}{2}n-4=-19$

$\frac{5}{2}n-4+4=-19+4$

$\frac{5}{2}n=-15$

$\frac{2}{5}\cdot\frac{5}{2}n=\frac{2}{5}\cdot(-15)$

$n=-6$

Check: $\frac{5}{2}n-4=-19$

$\frac{5}{2}\cdot(-6)-4 \stackrel{?}{=} -19$

$-15-4 \stackrel{?}{=} -19$

$-19=-19$ True

The solution is –6, or the solution set is {–6}.

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

$-5+x=10x+16$

$-16-5+x=10x+16-16$

$-21+x=10x$

$-21+x-x=10x-x$

$-21=9x$

$\frac{-21}{9}=\frac{9x}{9}$

$-\frac{7}{3}=x$

Check: $-(5-x)=2(5x+8)$

$-\left[5-\left(-\frac{7}{3}\right)\right] \stackrel{?}{=} 2\left[5\left(-\frac{7}{3}\right)+8\right]$

$-\left(\frac{15}{3}+\frac{7}{3}\right) \stackrel{?}{=} 2\left(-\frac{35}{3}+\frac{24}{3}\right)$

$-\frac{22}{3} \stackrel{?}{=} 2\left(-\frac{11}{3}\right)$

$-\frac{22}{3}=-\frac{22}{3}$ True

The solution is $-\frac{7}{3}$, or the solution set is $\left\{-\frac{7}{3}\right\}$.

9. $7(x+6)=2x+3x-15$

$7x+42=5x-15$

$7x+42-42=5x-15-42$

$7x=5x-57$

$-5x+7x=-5x+5x-57$

$2x=-57$

$\frac{2x}{2}=\frac{-57}{2}$

$x=-\frac{57}{2}$

Check: $7(x+6)=2x+3x-15$

$7\left(-\frac{57}{2}+6\right) \stackrel{?}{=} 2\left(-\frac{57}{2}\right)+3\left(-\frac{57}{2}\right)-15$

$7\left(-\frac{45}{2}\right) \stackrel{?}{=} -\frac{114}{2}-\frac{171}{2}-\frac{30}{2}$

$-\frac{315}{2}=-\frac{315}{2}$ True

The solution is $-\frac{57}{2}$, or the solution set is $\left\{-\frac{57}{2}\right\}$.

10. $-7a+5+8a=2a+8-28$

$5+a=2a-20$

$5+a+20=2a-20+20$

$25+a=2a$

$25+a-a=2a-a$

$25=a$

Check: $-7a+5+8a=2a+8-28$

$-7(25)+5+8(25) \stackrel{?}{=} 2(25)+8-28$

$-175+5+200 \stackrel{?}{=} 50+8-28$

$30=30$ True

The solution is 25, or the solution set is $\{25\}$.

11. $-\frac{1}{2}(x-6)+\frac{1}{6}(x+6)=2$

$6\left[-\frac{1}{2}(x-6)+\frac{1}{6}(x+6)\right]=6\cdot 2$

$-3(x-6)+1(x+6)=12$

$-3x+18+x+6=12$

$-2x+24=12$

$-2x+24-24=12-24$

$-2x=-12$

$\frac{-2x}{-2}=\frac{-12}{-2}$

$x=6$

Check: $-\frac{1}{2}(x-6)+\frac{1}{6}(x+6)=2$

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

$-\frac{1}{2}(0)+\frac{1}{6}(12) \stackrel{?}{=} 2$

$0+2 \stackrel{?}{=} 2$

$2=2$ True

The solution is 6, or the solution set is $\{6\}$.

12. $0.3x-1.4=-0.2x+6$

$10(0.3x-1.4)=10(-0.2x+6)$

$3x-14=-2x+60$

$3x-14+14=-2x+60+14$

$3x=-2x+74$

$2x+3x=2x-2x+74$

$5x=74$

$\frac{5x}{5}=\frac{74}{5}$

$x=14.8$

Check: $0.3x-1.4=-0.2x+6$

$0.3(14.8)-1.4 \stackrel{?}{=} -0.2(14.8)+6$

$4.44-1.4 \stackrel{?}{=} -2.96+6$

$3.04=3.04$ True

The solution is $\frac{74}{5}=14.8$, or the solution set is $\{14.8\}$.

13. $5+3(2x+1)=5x+x-10$
$5+6x+3=5x+x-10$
$8+6x=6x-10$
$8+6x-6x=6x-10-6x$
$8=-10$
This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or { }.

14. $3-2(x+5)=-2(x+2)-3$
$3-2x-10=-2x-4-3$
$-2x-7=-2x-7$
$2x-2x-7=2x-2x-7$
$-7=-7$
This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

15. $0.024x+0.04(7500-x)=220$
$0.024x+300-0.04x=220$
$300-0.016x=220$
$-300+300-0.016x=-300+220$
$-0.016x=-80$
$1000(-0.016x)=1000(-80)$
$-16x=-80,000$
$x=5000$
You should invest \$5000 in the CD.

16. **(a)** $A=\frac{1}{2}h(B+b)$
$\frac{2}{h}\cdot A=\frac{2}{h}\cdot\frac{1}{2}h(B+b)$
$\frac{2A}{h}=B+b$
$\frac{2A}{h}-B=B+b-B$
$\frac{2A}{h}-B=b$

(b) $b=\frac{2A}{h}-B;\ A=76,\ h=8,\ B=13$
$b=\frac{2(76)}{8}-13=\frac{152}{8}-13=19-13=6$
The length of base b is 6 inches.

17. **(a)** $V=\pi r^2h$
$\frac{V}{\pi r^2}=\frac{\pi r^2h}{\pi r^2}$
$\frac{V}{\pi r^2}=h$

(b) $h=\frac{V}{\pi r^2};\ V=117\pi,\ r=3$
$h=\frac{117\pi}{\pi(3)^2}=\frac{117\pi}{9\pi}=13$
The height is 13 inches.

18. $3x+2y=14$
$-3x+3x+2y=-3x+14$
$2y=-3x+14$
$\frac{2y}{2}=\frac{-3x+14}{2}$
$y=-\frac{3}{2}x+7$

Section 2.5

Are You Prepared for This Section?

P1. $x+34.95=60.03$
$x+34.95-34.95=60.03-34.95$
$x=25.08$
The solution set is {25.08}.

P2. $x+0.25x=60$
$1x+0.25x=60$
$1.25x=60$
$100\cdot1.25x=100\cdot60$
$125x=6000$
$\frac{125x}{125}=\frac{6000}{125}$
$x=48$
The solution set is {48}.

2.5 Quick Checks

1. The sum of 5 and 17 is represented mathematically as 5 + 17.

2. The difference of 7 and 4 is represented mathematically as 7 − 4.

3. The quotient of 25 and 3 is represented mathematically as $\frac{25}{3}$.

4. The product of −2 and 6 is represented mathematically as $-2\cdot6$.

5. Twice a less 2 is represented mathematically as $2a-2$.

6. Five times the difference of m and 6 is represented mathematically as $5(m-6)$.

7. Anne earned $z + 50$ dollars.

8. Melissa paid $x - 15$ dollars for her sociology book.

9. Tim has $75 - d$ quarters.

10. The width of the platform is $3l - 2$ feet.

11. The number of dimes is $2q + 3$.

12. The number of red M&Ms in the bowl is $3b - 5$.

13. In mathematics, English statements can be represented symbolically as equations.

14. "The product of 3 and y is equal to 21" is represented mathematically as $3y = 21$.

15. "The difference of x and 10 equals the quotient of x and 2" is represented mathematically as $x - 10 = \frac{x}{2}$.

16. "Three times the sum of n and 2 is 15" is represented mathematically as $3(n + 2) = 15$.

17. "The sum of three times n and 2 is 15" is represented mathematically as $3n + 2 = 15$.

18. Letting variables represent unknown quantities and then expressing relationships among the variables in the form of equations is called mathematical modeling.

19. Find how much each person paid for the pizza. Let s be the amount that Sean pays. Then Connor pays $\frac{2}{3}s$. The total amount they pay is \$15, so

$$s + \frac{2}{3}s = 15.$$

$$s + \frac{2}{3}s = 15$$
$$\frac{5}{3}s = 15$$
$$s = \frac{3}{5}(15)$$
$$s = 9$$
$$\frac{2}{3}s = \frac{2}{3}(9) = 6$$

Sean pays \$9 for the pizza, and Connor pays \$6.

20. False: If n represents the first of three consecutive odd integers, then $n + 2$ and $n + 4$ represent the next two odd integers.

21. Find three consecutive even integers that sum to 270. Let n be the first even integer. Then the next even integer is $n + 2$, and the even integer after that is $n + 4$.

$$n + (n + 2) + (n + 4) = 270$$
$$n + n + 2 + n + 4 = 270$$
$$3n + 6 = 270$$
$$3n = 264$$
$$n = 88$$

$n + 2 = 88 + 2 = 90$
$n + 4 = 88 + 4 = 92$
The integers are 88, 90, and 92.

22. Find four consecutive odd integers that sum to 72. Let n be the first odd integers. Then the next three odd integers are $n + 2$, $n + 4$, and $n + 6$.

$$n + (n + 2) + (n + 4) + (n + 6) = 72$$
$$4n + 12 = 72$$
$$4n + 12 - 12 = 72 - 12$$
$$4n = 60$$
$$\frac{4n}{4} = \frac{60}{4}$$
$$n = 15$$

The integers are 15, 17, 19, and 21.

23. Find the lengths of the three pieces of ribbon. Let x be the length of the shortest piece. Then the length of the longest piece is $x + 24$, and the length of the third piece is $\frac{1}{2}(x + 24)$. The sum of the lengths of the pieces is the length of the original ribbon, 76 inches.

$$x + (x + 24) + \frac{1}{2}(x + 24) = 76$$
$$x + x + 24 + \frac{1}{2}x + 12 = 76$$
$$2\left(x + x + 24 + \frac{1}{2}x + 12\right) = 2(76)$$
$$2x + 2x + 48 + x + 24 = 152$$
$$5x + 72 = 152$$
$$5x = 80$$
$$x = 16$$

$x + 24 = 16 + 24 = 40$
$\frac{1}{2}(x + 24) = \frac{1}{2}(16 + 24) = \frac{1}{2}(40) = 20$
The lengths of the pieces are 16 inches, 20 inches, and 40 inches.

24. Find the amount invested in each type of investment. Let s be the amount invested in stocks. Then the amount invested in bonds is $2s$. The total amount invested is \$18,000.

$$s + 2s = 18,000$$
$$3s = 18,000$$
$$s = 6000$$

$2s = 2(6000) = 12,000$

The amount invested in stocks is \$6000, and the amount invested in bonds is \$12,000.

25. Find the number of miles for which the rental costs are the same. Let m be the number of miles driven. Renting from E-Z Rental would cost $30 + 0.15m$. Renting from Do It Yourself Rental would cost $15 + 0.25m$.

$$30 + 0.15m = 15 + 0.25m$$
$$30 = 15 + 0.10m$$
$$15 = 0.1m$$
$$10 \cdot 15 = 10 \cdot 0.1m$$
$$150 = m$$

The costs are the same if 150 miles are driven.

26. Find the number of hours for which the charges are the same. Let h be the number of hours. A repair call from Carl's Appliance Repair Shop would cost $69.99 + 30h$. A repair call from Terry's Appliance Repair Shop would cost $54.99 + 40h$.

$$69.99 + 30h = 54.99 + 40h$$
$$69.99 = 54.99 + 10h$$
$$15 = 10h$$
$$1.5 = h$$

The repair charges are the same for 1.5 hours.

2.5 Exercises

28. a number increased by 32.3: $x + 32.3$

30. the product of -2 and a number: $-2 \cdot x$ or $-2x$

32. double a number: $2x$

34. 8 less than a number: $x - 8$

36. the quotient of -14 and a number: $\dfrac{-14}{x}$

38. $\dfrac{4}{5}$ of a number: $\dfrac{4}{5}x$

40. 21 more than 4 times a number: $4x + 21$

42. 50 less than half of a number: $\dfrac{1}{2}x - 50$

44. the sum of twice a number and 45: $2x + 45$

46. Let r be the number of runs scored by the Tampa Bay Rays. Then $r - 3$ is the number of runs scored by the Toronto Blue Jays.

48. Let R be the amount Ralph has. Then $3R + 0.25$ is the amount Beryl has.

50. Let j be the amount Juan will get. Then $1500 - j$ is the amount Emilio will get.

52. Let p be the number of paid tickets. Then $12,765 - p$ is the number of special promotion tickets.

54. $43 + x = -72$

56. $49 = 2x - 3$

58. $\dfrac{x}{-6} - 15 = 30$

60. $2(x + 5) = x + 7$

62. **(a)** Let x be the number of Facebook users in the United States and Canada, in millions. Then $x + 98$ is the number of Facebook users in Europe, in millions.

(b) The total number of Facebook users in the United States, Canada, and Europe is 532 million, so $x + (x + 98) = 532$.

64. **(a)** Let m be the number of magnolia trees. Then the number of oak trees is $2m - 10$.

(b) The total number of magnolia and oak trees is 110, so $m + (2m - 10) = 110$.

66. **(a)** Let b be the amount Professor Betzel receives. then Professor Crawford will receive $b - 1000$ and Professor MacLean will receive $b + 2000$.

(b) The total amount the professors will receive is \$10,000, so $b + (b - 1000) + (b + 2000) = 10,000$.

68. Let n be the number.

$$n-13=-29$$
$$n=-16$$

Is the difference between -16 and 13 equal to -29? Yes. The number is -16.

70. Find three consecutive odd integers that sum to 81. Let n be the first integer. Then the other integers are $n + 2$ and $n + 4$, respectively.

$$n+(n+2)+(n+4)=81$$
$$n+n+2+n+4=81$$
$$3n+6=81$$
$$3n=75$$
$$n=25$$

If $n = 25$, then $n + 2 = 27$, and $n + 4 = 29$. Are 25, 27, and 29 consecutive odd integers? Yes. Do they sum to 81? Yes. The numbers are 25, 27, and 29.

72. Find the number of floors in each tower. If x is the number of floors in the Burj Khalifa, then the number of floors in the Shanghai Tower is $x - 35$.

$$x+(x-35)=291$$
$$2x-35=291$$
$$2x=326$$
$$x=163$$

If $x = 163$, then $x - 35 = 128$. Is 128 equal to 35 less than 163? Yes. Do 163 and 128 sum to 291? Yes. The Burj Khalifa has 163 floors and the Shanghai Tower has 128 floors.

74. Find the price of the desk. Let d be the price of the desk. Then the chair cost $\frac{1}{4}d$. The total price for the desk and chair is \$336.25.

$$d+\frac{1}{4}d=336.25$$
$$\frac{5}{4}d=336.25$$
$$d=269$$

Is 269 plus $\frac{1}{4}(269)$ equal to 336.25? Yes.

The price of the desk is \$269.

76. Find the amount each person receives. Let x be the amount Sean receives. Then $x - 3000$ is the amount George receives. The total is 10,000.

$$x+(x-3000)=10,000$$
$$2x-3000=10,000$$
$$2x=13,000$$
$$x=6500$$
$$x-3000=3500$$

Is \$3500 \$3000 less than \$6500? Yes. Is the sum of \$6500 and \$3500 equal to \$10,000? Yes. Sean will receive \$6500 and George will receive \$3500.

78. Find the amount invested in each type of investment. Let x be the amount invested in stocks. Then $\frac{2}{3}x$ is the amount invested in bonds. The total invested is 40,000.

$$x+\frac{2}{3}x=40,000$$
$$\frac{3}{3}x+\frac{2}{3}x=40,000$$
$$\frac{5}{3}x=40,000$$
$$\frac{3}{5}\cdot\frac{5}{3}x=\frac{3}{5}\cdot 40,000$$
$$x=24,000$$
$$\frac{2}{3}x=16,000$$

Is 16,000 $\frac{2}{3}$ of 24,000? Yes. Is the sum of 24,000 and 16,000 equal to 40,000? Yes. Jack and Diane should invest \$24,000 in stocks and \$16,000 in bonds.

80. Find the cost of the paperback book. Let x be the cost of the hardback book. Then $x - 12.50$ is the cost of the paperback. The sum of the prices is 37.40.

$$x+(x-12.50)=37.40$$
$$2x-12.50=37.40$$
$$2x=49.90$$
$$x=24.95$$
$$x-12.50=12.45$$

Is \$12.45 \$12.50 less than \$24.95? Yes. Do \$24.95 and \$12.45 sum to \$37.40? Yes. The paperback book costs \$12.45.

82. Find the cost of the bathing suit. Let x be the cost of the shorts. Then $x + 8$ is the cost of the bathing suit and $x - 2$ is the cost of the T-shirt. Their costs total \$60.

$$x+(x+8)+(x-2)=60$$
$$3x+6=60$$
$$3x=54$$
$$x=18$$

If $x = 18$, then $x + 8 = 26$ and $x - 2 = 16$. Is \$26 \$8 more than \$18? Yes. Is \$16 \$2 less than \$18? Yes. Do \$18, \$26, and \$16 sum to \$60? Yes. The bathing suit costs \$26.

84. Find the number of monthly minutes for which the cost is the same. Let x be the number of minutes. Then Company A charges $12 + 0.1x$ and Company B charges $0.15x$.

$$\begin{aligned} 12 + 0.1x &= 0.15x \\ 12 &= 0.05x \\ 240 &= x \end{aligned}$$

If 240 minutes are used, then Company A charges $12 + 0.1(240) = 12 + 24 = \$36$ and Company B charges $0.15(240) = \$36$, so the charges are the same. The cost is the same when 240 minutes are used.

86. Find the number of vacuums sold for which the jobs pay the same. Let x be the number of vacuums sold. The first job pays $2000 + 50x$ and the second job pays $1200 + 60x$.

$$\begin{aligned} 2000 + 50x &= 1200 + 60x \\ 2000 &= 1200 + 10x \\ 800 &= 10x \\ 80 &= x \end{aligned}$$

If 80 vacuums are sold, the first job pays $2000 + 50(80) = 2000 + 4000 = \$6000$ and the second job pays $1200 + 60(80) = 1200 + 4800 = \$6000$, so they are the same. The jobs pay the same for 80 vacuums sold.

88. Find the cost of each item. Let x be the cost of the lantern. Then $x + 30$ is the cost of the cookware and $x + 34$ is the cost of the cook stove. The total cost is \$199.

$$\begin{aligned} x + (x + 30) + (x + 34) &= 199 \\ 3x + 64 &= 199 \\ 3x &= 135 \\ x &= 45 \end{aligned}$$

If $x = 45$, then $x + 30$ is 75 and $x + 34$ is 79. Is \$75 \$30 more than \$45? Yes. Is \$79 \$34 more than \$45? Yes. Is the sum of \$45, \$75, and \$79 equal to \$199? Yes. The lantern cost \$45, the cookware cost \$75, and the cook stove cost \$79.

90. Find the score Brooke needs on the final exam. There are 5 tests, plus the final exam which is worth two tests, for a total of 7 tests. The average must be 80.

$$\begin{aligned} \frac{80 + 83 + 71 + 61 + 95 + 2x}{7} &= 80 \\ \frac{390 + 2x}{7} &= 80 \\ 390 + 2x &= 560 \\ 2x &= 170 \\ x &= 85 \end{aligned}$$

Do the test scores have an average of 80? Yes. Brooke needs a score of 85.

92. Answers may vary.

94. Answers may vary.

96. Let x be the measure of the smallest angle. Then one angle measures $3x + 1$ and the third angle measures $2(3x + 1) - 13$. Their measures sum to 180°.

$$\begin{aligned} x + (3x + 1) + [2(3x + 1) - 13] &= 180 \\ x + 3x + 1 + 6x + 2 - 13 &= 180 \\ 10x - 10 &= 180 \\ 10x &= 190 \\ x &= 19 \end{aligned}$$

If $x = 19$, then $3x + 1 = 3(19) + 1 = 57 + 1 = 58$, and $2(3x + 1) - 13 = 2(58) - 13 = 116 - 13 = 103$. Is 58 one more than three times 19? Yes. Is 103 13 less than twice 58? Yes. Is the sum of 19, 58, and 103 equal to 180? Yes. The angles measure 19°, 58°, and 103°.

98. An algebraic expression (no equal sign) is related to an English phrase. An algebraic equation (contains an equal sign) is related to an English statement.

100. Answers may vary. For example:
Evaluate $3x + 5$ when $x = 10$. Solve the equation $3x + 5 = 23$.

Section 2.6

Are You Prepared for This Section?

P1. $45\% = 45\% \cdot \frac{1}{100\%} = \frac{45}{100} = 0.45$

P2. $0.2875 = 0.2875 \cdot \frac{100\%}{1} = 28.75\%$

P3. **(a)**

$$\begin{array}{r} 50 \\ \times\ 0.4 \quad \text{one digit to the right of the decimal point} \\ \hline 20.0 \quad \text{one digit to the right of the decimal point} \end{array}$$

(b) $\frac{15}{0.3} = \frac{15}{0.3} \cdot \frac{10}{10} = \frac{150}{3} = 50$

P4. $p + 0.05p = 1p + 0.05p = 1.05p$

2.6 Quick Checks

1. Percent means "divided by 100."

2. True

3. Find the unknown number. Let n represent the number.
$n = 0.6 \cdot 90$
$n = 54$
54 is 60% of 90.

4. Find the unknown number. Let n represent the number.
$n = 0.03 \cdot 80$
$n = 2.4$
2.4 is 3% of 80.

5. Find the unknown number. Let n represent the number.
$n = 1.50 \cdot 24$
$n = 36$
36 is 150% of 24.

6. Find the unknown number. Let n represent the number.
$8\% = 0.08$
$n = 0.08 \cdot 40$
$n = 3.2$
3.2 is 82% of 40.

7. Find the percentage. Let x represent the percent.
$$8 = x \cdot 20$$
$$\frac{8}{20} = \frac{20x}{20}$$
$$0.4 = x$$
$$40\% = x$$
The number 8 is 40% of 20.

8. Find the percentage. Let x represent the percent.
$$15 = x \cdot 40$$
$$\frac{15}{40} = \frac{40x}{40}$$
$$0.375 = x$$
$$37.5\% = x$$
The number 15 is 37.5% of 40.

9. Find the percentage. Let x represent the percent.
$$44 = x \cdot 40$$
$$\frac{44}{40} = \frac{40x}{40}$$
$$1.10 = x$$
$$110\% = x$$
The number 44 is 110% of 40.

10. Find the unknown number. Let x represent the number.
$$14 = 0.28 \cdot x$$
$$\frac{14}{0.28} = \frac{0.28x}{0.28}$$
$$50 = x$$
14 is 28% of 50.

11. Find the unknown number. Let x represent the number.
$$14.8 = 0.185 \cdot x$$
$$\frac{14.8}{0.185} = \frac{0.185x}{0.185x}$$
$$80 = x$$
14.8 is 18.5% of 80.

12. Find the unknown number. Let x represent the number.
$$102 = 1.36 \cdot x$$
$$\frac{102}{1.36} = \frac{1.36x}{1.36}$$
$$75 = x$$
102 is 136% of 75.

13. Find the number of U.S. residents aged 25 years or older in 2014 who had bachelor's degrees. Let x represent the number of people aged 25 years or older in 2014 who had bachelor's degrees.
$$0.19 \cdot 214{,}000{,}000 = x$$
$$40{,}660{,}000 = x$$
The number of U.S. residents 25 years or older in 2014 who had bachelor's degrees was 40,660,000.

14. Find the price of the car before the sales tax. Let p represent the price of the car. The sales tax is 7% of the price of the car before sales tax.
$$p + 0.7p = 7811$$
$$1.07p = 7811$$
$$\frac{1.07p}{1.07} = \frac{7811}{1.07}$$
$$p = 7300$$
The price of the car before sales tax was $7300.

15. Find Janet's new salary. Let n represent her new salary, which is her old salary plus the 2.5% raise.
$n = 59{,}000 + 0.025 \cdot 59{,}000$
$n = 59{,}000 + 1475$
$n = 60{,}475$
Janet's new salary is $60,475.

16. Find the wholesale price of the gasoline. Let p represent the wholesale price of the gasoline. The selling price is the sum of the wholesale price and the markup.

$$p + 0.10p = 2.64$$
$$1.10p = 2.64$$
$$\frac{1.10p}{1.10} = \frac{2.64}{1.10}$$
$$p = 2.4$$

The gas station pays \$2.40 per gallon for the gasoline.

17. Find the original price of the recliners. Let p represent the original price. The sale price is the original price less the 25% discount.

$$p - 0.25p = 494.25$$
$$0.75p = 494.25$$
$$\frac{0.75p}{0.75} = \frac{494.25}{0.75}$$
$$p = 659$$

The original price of the recliners was \$659.

18. Find the value of Albert's house one year ago. Let x represent the value one year ago. The value now is the value a year ago minus the 2% loss.

$$x - 0.02x = 148{,}000$$
$$0.98x = 148{,}000$$
$$\frac{0.98x}{0.98} = \frac{148{,}000}{0.98}$$
$$x \approx 151{,}020$$

Albert's house was worth \$151,020 one year ago.

2.6 Exercises

20. $n = 0.80(50)$
$n = 40$
40 is 80% of 50.

22. $0.75(20) = n$
$15 = n$
75% of 20 is 15.

24. $n = 1.50(9)$
$n = 13.5$
13.5 is 150% of 9.

26. $0.40x = 122$
$$\frac{0.40x}{0.40} = \frac{122}{0.40}$$
$$x = 305$$

40% of 305 is 122.

28. $0.45x = 900$
$$\frac{0.45x}{0.45} = \frac{900}{0.45}$$
$$x = 2000$$

45% of 2000 is 900.

30. $11 = 0.055x$
$$\frac{11}{0.055} = \frac{0.055x}{0.055}$$
$$200 = x$$

11 is 5.5% of 200.

32. $15 = p \cdot 75$
$$\frac{15}{75} = \frac{75p}{75}$$
$$0.2 = p$$
$$20\% = p$$

15 is 20% of 75.

34. $4 = p \cdot 25$
$$\frac{4}{25} = \frac{25p}{25}$$
$$0.16 = p$$
$$16\% = p$$

4 is 16% of 25.

36. $p \cdot 16 = 12$
$$\frac{16p}{16} = \frac{12}{16}$$
$$p = 0.75 \text{ or } 75\%$$

75% of 16 is 12.

38. Let x be the cost of the car before tax. Then the sales tax is $0.075x$. The total cost is \$8600.

$$x + 0.075x = 8600$$
$$1.075x = 8600$$
$$x = \frac{8600}{1.075}$$
$$x = 8000$$

The Honda Civic cost \$8000 before tax.

40. Let x be MaryBeth's previous hourly rate. Then $0.05x$ is the amount of the raise.

$$x + 0.05x = 29.40$$
$$1.05x = 29.40$$
$$x \approx 28$$

MaryBeth's previous hourly rate was \$28.

42. Let x be the value of the home one year ago. Then $0.04x$ is the increase in value.

$$x + 0.04x = 208{,}000$$
$$1.04x = 208{,}000$$
$$x = 200{,}000$$

The home was valued at \$200,000 one year ago.

44. Let x be the sale price.

$x = 28{,}000 - 0.15(28{,}000)$
$x = 28{,}000 - 4200$
$x = 23{,}800$
The sale price of the truck is \$23,800.

46. Let x be the amount the bookstore paid. Then $0.30x$ is the markup amount.

$$x + 0.30x = 117$$
$$1.30x = 117$$
$$x \approx 90$$

The bookstore paid \$90 for the book.

48. Let x be the price of the vacation package before the sale. Then $0.13x$ is the discount amount.

$$x - 0.13x = 1007$$
$$0.87x = 1007$$
$$x \approx 1157$$

The vacation package was priced at \$1157 before the 13%-off sale.

50. Let p be the number of Democrats on the committee. Then there are $2p$ Republicans on the committee. Also, $0.3(2p)$ Republicans and $0.2p$ Democrats voted in favor of a bill.

$$0.3(2p) + 0.2p = 8$$
$$0.6p + 0.2p = 8$$
$$0.8p = 8$$
$$p = 10$$

$2p = 20$
There are 20 Republicans and 10 Democrats or 30 people on the committee.

52. Let f be the number of full-page ads. Then $2f$ is the number of half-page ads. He receives 0.08(450) for each full-page ad and 0.05(300) for each half-page ad.

$$0.08(450)f + 0.05(300)(2f) = 5610$$
$$36f + 30f = 5610$$
$$66f = 5610$$
$$f = 85$$
$$2f = 170$$

Mario brought in 85 full-page ads and 170 half-page ads.

54. Let x be the number of students in the class. Then $0.15x$ of the students received an A.

$$0.15x = 6$$
$$x = 40$$

There were 40 students in his astronomy class.

56. Let x be the number that have never married.

$x = 0.17(125)$
$x = 21.25$
Therefore, 21 million females aged 18 years or older had never married.

58. Let x = percent of population that held an associate's degree in 2004.

$$x = \frac{13{,}244}{186{,}534} \cdot 100\% \approx 7.1\%$$

Let y = percent of population that held an associate's degree in 2015.

$$y = \frac{20{,}867}{212{,}132} \cdot 100\% \approx 9.8\%$$

The percent in 2004 was 7.1% and in 2015 was 9.8%.

60. The amount of change is $2825 - 2500 = 325$.

$$\frac{325}{2500} = 0.13$$

The percent increase is 13%.

62. The amount of change is $86{,}000 - 77{,}000 = 9000$.

$$\frac{9000}{77{,}000} \approx 0.117$$

The percent increase is 11.7%.

64. The amount of change is $160.52 - 157.37 = 3.15$.

$$\frac{3.15}{157.37} \approx 0.0200$$

The percent increase is 2.00%.

66. Answers may vary. One possibility: If an item sells for p dollars, the tax on the item is $0.06p$, so the total purchase price is $p + 0.06p = 1.06p$.

68. Reducing an item by 10% and then reducing that same item by 20% is not the same as reducing the item by 30%. Reducing an item whose original cost is x by 10% produces a new price of $0.9x$. Reducing that price by 20% yields a new price of $(0.9x)(0.8) = 0.72x$.

Section 2.7

Are You Prepared for This Section?

P1. $q + 2q - 30 = 180$
$3q - 30 = 180$
$3q = 210$
$q = 70$
The solution set is $\{70\}$.

P2. $30w + 20(w + 5) = 300$
$30w + 20w + 100 = 300$
$50w + 100 = 300$
$50w = 200$
$w = 4$
The solution set is $\{4\}$.

2.7 Quick Checks

1. Complementary angles are angles whose measures have a sum of 90 degrees.

2. This is a complementary angle problem. We are looking for the measures of two angles whose sum is 90°. Let x represent the measure of the smaller angle. Then $x + 12$ represents the measure of the larger angle.
$x + (x + 12) = 90$
$2x + 12 = 90$
$2x = 78$
$x = 39$
$x + 12 = 39 + 12 = 51$
The two complementary angles measure 39° and 51°.

3. This is a supplementary angle problem. We are looking for the measures of two angles whose sum is 180°. Let x represent the measure of the smaller angle. Then $2x - 30$ represents the measure of the larger angle.
$x + (2x - 30) = 180$
$3x - 30 = 180$
$3x = 210$
$x = 70$
$2x - 30 = 2(70) - 30 = 140 - 30 = 110$
The two supplementary angles measure 70° and 110°.

4. The sum of the measures of the angles of a triangle is 180 angles.

5. This is an "angles of a triangle" problem. We know that the sum of the measures of the interior angles of a triangle is 180°. Let x represent the measure of the largest angle. Then $\frac{1}{3}x$ represents the measure of the smallest angle, and $x - 65$ represents the measure of the middle angle.
$x + \left(\frac{1}{3}x\right) + (x - 65) = 180$
$2\frac{1}{3}x - 65 = 180$
$\frac{7}{3}x = 245$
$x = 105$
$\frac{1}{3}x = \frac{1}{3}(105) = 35$
$x - 65 = 105 - 65 = 40$
The measures of the angles of the triangle are 35°, 40°, and 105°.

6. True

7. False; the perimeter of a rectangle can be found by adding twice the length of the rectangle to twice the width of the rectangle.

8. This is a perimeter problem. We want to find the width and length of a garden. Let w represent the width of the garden. Then $2w$ represents the length of the garden. We know that the perimeter is 9 feet, and that the formula for the perimeter of a rectangle is $P = 2l + 2w$.
$2(2w) + 2w = 9$
$4w + 2w = 9$
$6w = 9$
$w = \frac{9}{6}$
$w = \frac{3}{2}$
$2w = 2\left(\frac{3}{2}\right) = 3$
The width of the garden is $\frac{3}{2} = 1.5$ feet and the length is 3 feet.

9. This problem is about the surface area of a rectangular box. The formula for the surface area of a rectangular box is $SA = 2lw + 2lh + 2hw$, where l is the length of the box, w is the width of the box, and h is the height of the box. We are given the surface area, the length, and the width of the rectangular box.

$$SA = 2lw + 2lh + 2hw$$
$$62 = 2 \cdot 3 \cdot 2 + 2 \cdot 3 \cdot h + 2 \cdot h \cdot 2$$
$$62 = 12 + 6h + 4h$$
$$62 = 12 + 10h$$
$$50 = 10h$$
$$5 = h$$

The height of the box is 5 feet.

10. False; when using $d = rt$ to calculate the distance traveled, it is necessary to travel at a constant speed.

11. This is a uniform motion problem. We want to know the average speed of each biker. Let r represent the average speed of Luis. Then $r + 5$ represents Mariko's average speed. Each biker rides for 3 hours.

	Rate	·	**Time**	= **Distance**
Luis	r		3	$3r$
Mariko	$r + 5$		3	$3(r + 5)$

Since the bikers are 63 miles apart after 3 hours, the sum of the distances they biked is 63.

$$3r + 3(r + 5) = 63$$
$$3r + 3r + 15 = 63$$
$$6r + 15 = 63$$
$$6r = 48$$
$$r = 8$$

$r + 5 = 8 + 5 = 13$

Luis' average speed was 8 miles per hour and Mariko's average speed was 13 miles per hour.

12. This is a uniform motion problem. We want to know how long it takes to catch up with Tanya, and how far you are from your house when you catch her. Let x represent the amount of time you drive before catching Tanya. Then $x + 2$ represents the number of hours that Tanya runs before you catch her.

	Rate	·	**Time**	= **Distance**
Tanya	8		$x + 2$	$8(x + 2)$
You	40		x	$40x$

When you catch up with Tanya, the distances the two of you have traveled is the same.

$$8(x + 2) = 40x$$
$$8x + 16 = 40x$$
$$16 = 32x$$
$$\frac{1}{2} = x$$

You catch up to Tanya after driving for $\frac{1}{2}$ hour.

$$40x = 40\left(\frac{1}{2}\right) = 20$$

You and Tanya are 20 miles from your house when you catch up to her.

2.7 Exercises

14. We are looking for the measures of two angles whose sum is 180°. Let x represent the measure of the second angle. Then $4x$ represents the measure of the first angle.

$$4x + x = 180$$
$$5x = 180$$
$$x = 36$$

$4x = 4(36) = 144$

The angles measure 36° and 144°.

16. We are looking for the measures of two angles whose sum is 90°. Let x represent the measure of the second angle. Then $x - 25$ represents the measure of the second angle.

$$(x - 25) + x = 90$$
$$2x - 25 = 90$$
$$2x = 115$$
$$x = 57.5$$

$x - 25 = 57.5 - 25 = 32.5$

The angles measure 57.5° and 32.5°.

18. $$x + (2x + 1) + \left(\frac{5}{2}x + 3\right) = 180$$
$$\frac{2}{2}x + \frac{4}{2}x + 1 + \frac{5}{2}x + 3 = 180$$
$$\frac{11}{2}x + 4 = 180$$
$$\frac{11}{2}x = 176$$
$$x = 32$$

The angles are 32°, $(2 \cdot 32 + 1)° = 65°$, and $\left(\frac{5}{2} \cdot 32 + 3\right)° = 83°$.

20. We want to find the measures of the angles of a triangle. The measures of the angles of a triangle sum to 180°. Let x be the measure of the first angle. Then $x + 2$ and $x + 4$ are the measures of the next two angles, respectively.

$$\begin{aligned} x + (x+2) + (x+4) &= 180 \\ 3x + 6 &= 180 \\ 3x &= 174 \\ x &= 58 \end{aligned}$$

If $x = 58$, then $x + 2 = 60$, and $x + 4 = 62$. Do 58, 60, and 62 sum to 180? Yes. The measures of the angles are 58°, 60°, and 62°.

22. We want to find the dimensions of a rectangle. The perimeter of a rectangle is twice the length plus twice the width. Let l be the length of the rectangle. Then the width is $l - 10$. The perimeter is 56 meters.

$$\begin{aligned} 2l + 2(l-10) &= 56 \\ 2l + 2l - 20 &= 56 \\ 4l &= 76 \\ l &= 19 \end{aligned}$$

If $l = 19$, then $19 - 10 = 9$. Is the sum of twice 19 and twice 9 equal to 56? Yes. The length of the rectangle is 19 meters and the width is 9 meters.

24. We want to find the dimensions of the rectangular plot. Let w be the width (shorter dimension) of the original plot. Then the length of the plot is $3w$ and the sides of the smaller square field are all w. There are 9 lengths of w that need fencing (3 for each long side, 1 for each end, and one to divide) and 279 meters of fencing was used.

$$\begin{aligned} 9w &= 279 \\ w &= 31 \end{aligned}$$

If $w = 31$, then $3w = 93$. Would it require 279 meters of fencing to enclose a plot that is 31 feet by 93 feet and divide it into two parcels? Yes. The plot is 31 meters by 93 meters.

26. We want to find the dimensions of the parallelogram. The perimeter is 120 inches. Let x be the length of the shorter side. Then $x + 10$ is the length of the longer side.

$$\begin{aligned} P &= 2l + 2w \\ 120 &= 2(x+10) + 2x \\ 120 &= 2x + 20 + 2x \\ 120 &= 4x + 20 \\ 100 &= 4x \\ 25 &= x \end{aligned}$$

If $x = 25$, then $x + 10 = 35$. Is twice 25 plus twice 35 equal to 120? Yes. The parallelogram is 25 inches by 35 inches.

28. **(a)** Let t be the time since the trains left Albuquerque. The distance traveled by the faster train is $72t$.

(b) The distance traveled by the slower train is $66t$.

(c) The difference in distance is $72t - 66t$.

(d) An equation is $72t - 66t = 45$.

30.

	rate	· time	= distance
beginning of trip	r	2	$2r$
rest of the trip	$r - 10$	3	$3(r - 10)$
total		5	580

$2r + 3(r - 10) = 580$

32. We want to find the sides of a triangle. The perimeter of a triangle is the sum of the lengths of the legs. Let x be the length of each of the congruent legs. The base is 17 centimeters and the perimeter is 95 centimeters.

$$2x+17=95$$
$$2x=78$$
$$x=39$$

Is the sum of 39, 39, and 17 equal to 95? Yes. Each leg is 39 centimeters.

34. **(a)** Let w be the width of the room. Then the length is $2w$. The perimeter is 54 ft.

$$2w+2(2w)=54$$
$$2w+4w=54$$
$$6w=54$$
$$w=9$$

If $w = 9$, then $2w = 18$. The width is 9 feet and the length is 18 feet.

(b) Two walls are 9 by 8 and two walls are 18 by 8.

$$2(9\times8)+2(18\times8)=2(72)+2(144)$$
$$=144+288$$
$$=432$$

She needs 432 square feet of wallpaper.

(c) 1 square yard = (3 ft × 3 ft) = 9 square feet

$$\frac{432}{9}=48$$

She needs 48 square yards.

36. The area of a triangle is $A=\frac{1}{2}bh,$ where b is the base and h is the height.

$$A=\frac{1}{2}bh$$
$$54=\frac{1}{2}(9)h$$
$$12=h$$

The height is 12 feet.

38. Let w be the width of the rectangular table. Then the length is $w + 18$. The perimeter is 180 inches.

$$2w+2(w+18)=180$$
$$2w+2w+36=180$$
$$4w=144$$
$$w=36$$

If $w = 36$, then $w + 18 = 54$. The width of the rectangular table is 36 inches and the length is 54 inches.

40. Let r be the speed of the eastbound cyclist. Then $r + 4$ is the speed of the westbound cyclist. After 5 hours, each will have traveled $5r$ and $5(r + 4)$ miles. Their combined distances is 200 miles.

$$5r+5(r+4)=200$$
$$5r+5r+20=200$$
$$10r=180$$
$$r=18$$

The eastbound cyclist is traveling at 18 mph.

42. Let f be the speed of the freight train. Then $2f$ is the speed of the passenger train. The distances traveled after 45 minutes (or 0.75 hour) are $0.75f$ and $0.75(2f)$. The difference between their distances is 30 miles.

$$0.75(2f)-0.75f=30$$
$$1.5f-0.75f=30$$
$$0.75f=30$$
$$f=40$$

If $f = 40$, then $2f = 80$. The freight train is traveling at 40 mph and the passenger train is traveling at 80 mph.

44. Let s be his speed to the islands.

	rate	· time	= distance
out	s	2	$2s$
back	$s + 5$	1	$1(s + 5)$
total			41

$$2s+(s+5)=41$$
$$3s+5=41$$
$$3s=36$$
$$s=12$$

$s + 5 = 12 + 5 = 17$

The speed of the boat to the islands was 12 miles per hour and the speed on the return trip was 17 miles per hour.

46. Let t be the time it takes them to get to school.

	rate	· time	= distance
Dien	40	t	$40t$
Mom	48	$t-\frac{1}{12}$	$48\left(t-\frac{1}{12}\right)$

$$40t = 48\left(t - \frac{1}{12}\right)$$
$$40t = 48t - 4$$
$$4 = 8t$$
$$\frac{1}{2} = t$$

Since $t = \frac{1}{2}$, the distance traveled is $40\left(\frac{1}{2}\right) = 20$ miles.

48. Let x = measure of each base angle.
$2x - 4$ = measure of third angle.
180 = sum of all angles.

$$x + x + (2x - 4) = 180$$
$$x + x + 2x - 4 = 180$$
$$4x - 4 = 180$$
$$4 + 4x - 4 = 180 + 4$$
$$4x = 184$$
$$\frac{4x}{4} = \frac{184}{4}$$
$$x = 46°$$

$2x - 4 = 88°$
46°, 46°, 88°

50. The marked angles are equal in measure because they are corresponding angles.

$$3x - 10 = 10x - 80$$
$$-10 = 7x - 80$$
$$70 = 7x$$
$$10 = x$$

52. The marked angles are equal in measure because they are alternate interior angles.

$$2x + 20 = 6x - 46$$
$$20 = 4x - 46$$
$$66 = 4x$$
$$16.5 = x$$

54. The marked angles are supplementary because they are interior angles on the same side of the transversal.

$$\left(\frac{1}{2}x + 30\right) + (x + 60) = 180$$
$$\frac{1}{2}x + 30 + x + 60 = 180$$
$$\frac{3}{2}x + 90 = 180$$
$$\frac{3}{2}x = 90$$
$$x = 60$$

56. The area of a rectangle is the number of square units that the rectangle contains. The perimeter of a rectangle is the sum of the lengths of the sides.

Section 2.8

Are You Prepared for This Section?

P1. Since 4 is to the left of 19 on the number line, $4 < 19$.

P2. Since -11 is to the right of -24 on the number line, $-11 > -24$.

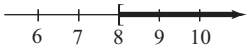
P3. $\frac{1}{4} = 0.25$

P4. Since $\frac{5}{6} = \frac{25}{30}$, $\frac{4}{5} = \frac{24}{30}$, and $25 > 24$, then $\frac{5}{6} > \frac{4}{5}$.

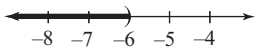
2.8 Quick Checks

1. True: When graphing an inequality that contains a > or a < symbol, we use parentheses.

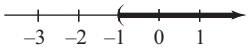
2. $n \geq 8$



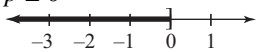
3. $a < -6$



4. $x > -1$



5. $p \leq 0$



6. False; $x \geq 3$ is written $[3, \infty)$.

7. False; the inequality $x < -4$ is written in interval notation as $(-\infty, -4)$.

8. $[-3, \infty)$

9. $(-\infty, 12)$

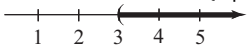
10. $(-\infty, 2.5]$

11. $(125, \infty)$

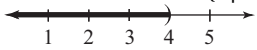
12. To solve an inequality means to find the set of all replacement values of the variable for which the statement is true.

13.
$$\begin{aligned} 3 &< 8 \\ 3+7 &< 8+7 \\ 10 &< 15 \end{aligned}$$
This illustrates the Addition Property of Inequality.

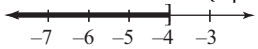
14.
$$\begin{aligned} n-2 &> 1 \\ n-2+2 &> 1+2 \\ n &> 3 \end{aligned}$$
The solution set is $\{n|n > 3\}$ or $(3, \infty)$.



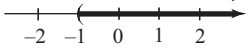
15.
$$\begin{aligned} -2x+3 &< 7-3x \\ -2x+3+3x &< 7-3x+3x \\ x+3 &< 7 \\ x+3-3 &< 7-3 \\ x &< 4 \end{aligned}$$
The solution set is $\{x|x < 4\}$ or $(-\infty, 4)$.



16.
$$\begin{aligned} 5n+8 &\le 4n+4 \\ 5n+8-4n &\le 4n+4-4n \\ n+8 &\le 4 \\ n+8-8 &\le 4-8 \\ n &\le -4 \end{aligned}$$
The solution set is $\{n|n \le -4\}$ or $(-\infty, -4]$.



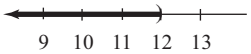
17.
$$\begin{aligned} 3(4x-8)+12 &> 11x-13 \\ 12x-24+12 &> 11x-13 \\ 12x-12 &> 11x-13 \\ 12x-12-11x &> 11x-13-11x \\ x-12 &> -13 \\ x-12+12 &> -13+12 \\ x &> -1 \end{aligned}$$
The solution set is $\{x|x > -1\}$ or $(-1, \infty)$.



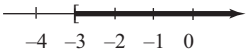
18.
$$\begin{aligned} 3 &< 12 \\ \frac{1}{3}\cdot 3 &< \frac{1}{3}\cdot 12 \\ 1 &< 4 \end{aligned}$$
This illustrates the Multiplication Property of Inequality.

19.
$$\begin{aligned} 6 &> 10 \\ \frac{6}{-2} &< \frac{10}{-2} \\ -3 &< -5 \end{aligned}$$
This illustrates the Multiplication Property of Inequality.

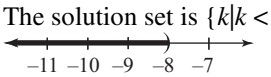
20.
$$\begin{aligned} \frac{1}{6}k &< 2 \\ 6\cdot\frac{1}{6}k &< 6\cdot 2 \\ k &< 12 \end{aligned}$$
The solution set is $\{k|k < 12\}$ or $(-\infty, 12)$.



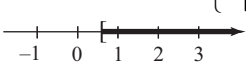
21.
$$\begin{aligned} 2n &\ge -6 \\ \frac{2n}{2} &\ge \frac{-6}{2} \\ n &\ge -3 \end{aligned}$$
The solution set is $\{n|n \ge -3\}$ or $[-3, \infty)$.



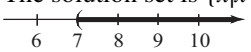
22.
$$\begin{aligned} -\frac{3}{2}k &> 12 \\ -\frac{2}{3}\left(-\frac{3}{2}k\right) &< -\frac{2}{3}(12) \\ k &< -8 \end{aligned}$$
The solution set is $\{k|k < -8\}$ or $(-\infty, -8)$.



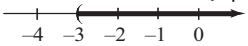
23.
$$\begin{aligned} -\frac{4}{3}p &\le -\frac{4}{5} \\ -\frac{3}{4}\left(-\frac{4}{3}p\right) &\ge -\frac{3}{4}\left(-\frac{4}{5}\right) \\ p &\ge \frac{3}{5} \end{aligned}$$
The solution set is $\left\{p \middle| p \ge \frac{3}{5}\right\}$ or $\left[\frac{3}{5}, \infty\right)$.



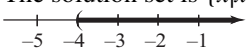
24.
$$\begin{aligned} 3x-7 &> 14 \\ 3x-7+7 &> 14+7 \\ 3x &> 21 \\ \frac{3x}{3} &> \frac{21}{3} \\ x &> 7 \end{aligned}$$
The solution set is $\{x|x > 7\}$ or $(7, \infty)$.



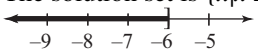
25.
$$\begin{aligned} -4n-3 &< 9 \\ -4n-3+3 &< 9+3 \\ -4n &< 12 \\ \frac{-4n}{-4} &> \frac{12}{-4} \\ n &> -3 \end{aligned}$$
The solution set is $\{n|n > -3\}$ or $(-3, \infty)$.



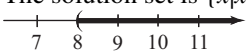
26.
$$\begin{aligned} 2x-6 &< 3(x+1)-5 \\ 2x-6 &< 3x+3-5 \\ 2x-6 &< 3x-2 \\ 2x-6-2x &< 3x-2-2x \\ -6 &< x-2 \\ -6+2 &< x-2+2 \\ -4 &< x \end{aligned}$$
The solution set is $\{x|x > -4\}$ or $(-4, \infty)$.



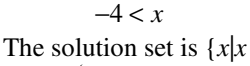
27.
$$\begin{aligned} -4(x+6)+18 &\geq -2x+6 \\ -4x-24+18 &\geq -2x+6 \\ -4x-6 &\geq -2x+6 \\ -4x-6+2x &\geq -2x+6+2x \\ -2x-6 &\geq 6 \\ -2x-6+6 &\geq 6+6 \\ -2x &\geq 12 \\ \frac{-2x}{-2} &\leq \frac{12}{-2} \\ x &\leq -6 \end{aligned}$$
The solution set is $\{x|x \leq -6\}$ or $(-\infty, -6]$.



28.
$$\begin{aligned} \frac{1}{2}(x+2) &> \frac{1}{5}(x+17) \\ 10\left[\frac{1}{2}(x+2)\right] &> 10\left[\frac{1}{5}(x+17)\right] \\ 5(x+2) &> 2(x+17) \\ 5x+10 &> 2x+34 \\ 5x+10-2x &> 2x+34-2x \\ 3x+10 &> 34 \\ 3x+10-10 &> 34-10 \\ 3x &> 24 \\ \frac{3x}{3} &> \frac{24}{3} \\ x &> 8 \end{aligned}$$
The solution set is $\{x|x > 8\}$ or $(8, \infty)$.



29.
$$\begin{aligned} \frac{4}{3}x-\frac{2}{3} &\leq \frac{4}{5}x+\frac{3}{5} \\ 15\left(\frac{4}{3}x-\frac{2}{3}\right) &\leq 15\left(\frac{4}{5}x+\frac{3}{5}\right) \\ 20x-10 &\leq 12x+9 \\ 20x-10-12x &\leq 12x+9-12x \\ 8x-10 &\leq 9 \\ 8x-10+10 &\leq 9+10 \\ 8x &\leq 19 \\ \frac{8x}{8} &\leq \frac{19}{8} \\ x &\leq \frac{19}{8} \end{aligned}$$
The solution set is $\left\{x \middle| x \leq \frac{19}{8}\right\}$ or $\left(-\infty, \frac{19}{8}\right]$.

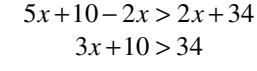


30. True

31. True

32.
$$\begin{aligned} -2x+7(x+5) &\leq 6x+32 \\ -2x+7x+35 &\leq 6x+32 \\ 5x+35 &\leq 6x+32 \\ 5x+35-5x &\leq 6x+32-5x \\ 35 &\leq x+32 \\ 35-32 &\leq x+32-32 \\ 3 &\leq x \end{aligned}$$
The solution set is $\{x|x \geq 3\}$ or $[3, \infty)$.

33.
$$\begin{aligned} -x+7-8x &\geq 2(8-5x)+x \\ -9x+7 &\geq 16-10x+x \\ -9x+7 &\geq 16-9x \\ -9x+7+9x &\geq 16-9x+9x \\ 7 &\geq 16 \end{aligned}$$
The statement $7 \geq 16$ is a false statement, so this inequality has no solution. The solution set is $\varnothing$ or $\{\ \}$.



34. $\frac{3}{2}x+5-\frac{5}{2}x<4x-3(x+1)$

$-\frac{2}{2}x+5<4x-3x-3$

$-x+5<x-3$

$-x+5+x<x-3+x$

$5<2x-3$

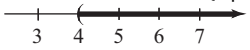
$5+3<2x-3+3$

$8<2x$

$\frac{8}{2}<\frac{2x}{2}$

$4<x$

The solution set is $\{x|x>4\}$ or $(4, \infty)$.



35. $x+3(x+4)\geq 2x+5+3x-x$

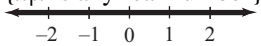
$x+3x+12\geq 4x+5$

$4x+12\geq 4x+5$

$4x+12-4x\geq 4x+5-4x$

$12\geq 5$

Since 12 is always greater than or equal to 12, the solution set for this inequality is $\{x|x \text{ is any real number}\}$ or $(-\infty, \infty)$.



36. We want to know the maximum number of boxes of supplies that the worker can move on the elevator. Let b represent the number of boxes. Then the weight of the boxes is $91b$, and the weight of the worker and the boxes is $180 + 91b$. This weight cannot be more than 2000 pounds.

$180+91b\leq 2000$

$91b\leq 1820$

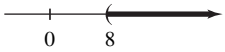
$\frac{91b}{91}\leq\frac{1820}{91}$

$b\leq 20$

The number of boxes must be less than or equal to 20, so the maximum number of boxes the worker can move in the elevator is 20.

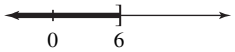
2.8 Exercises

38. $n > 8$



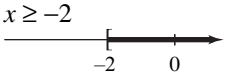
$(8, \infty)$

40. $x \leq 6$



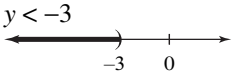
$(-\infty, 6]$

42. $x \geq -2$



$[-2, \infty)$

44. $y < -3$



$(-\infty, -3)$

46. $[-1, \infty)$

48. $(-\infty, 3]$

50. $(-2, \infty)$

52. Adding 2 to each side does not change the direction of the inequality symbol. The symbol remains >. We used the Addition Principle of Inequality.

54. Multiplying each side by $\frac{3}{5}$, a positive number, does not change the direction of the inequality symbol. The symbol remains ≥. We used the Multiplication Principle of Inequality.

56. Subtracting 1 or adding −1 to each side does not change the direction of the inequality symbol. The symbol remains ≤. We used the Addition Principle of Inequality.

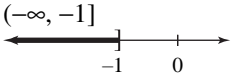
58. Dividing each side by −4 or multiplying each side by $-\frac{1}{4}$, a negative number, reverses the direction of the inequality symbol. The symbol becomes >. We used the Multiplication Principle of Inequality.

60. $x+4\leq 3$

$x\leq -1$

$\{x|x\leq -1\}$

$(-\infty, -1]$

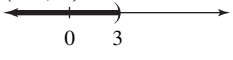


62. $x-2<1$

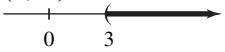
$x<3$

$\{x|x<3\}$

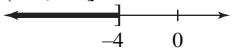
$(-\infty, 3)$



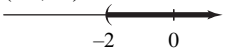
64. $4x > 12$
$x > 3$
$\{x|x > 3\}$
$(3, \infty)$



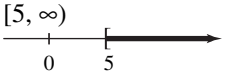
66. $-7x \geq 28$
$x \leq -4$
$\{x|x \leq -4\}$
$(-\infty, -4]$



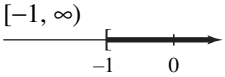
68. $2x + 5 > 1$
$2x > -4$
$x > -2$
$\{x|x > -2\}$
$(-2, \infty)$



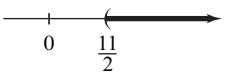
70. $2x - 2 \geq 3 + x$
$x - 2 \geq 3$
$x \geq 5$
$\{x|x \geq 5\}$
$[5, \infty)$



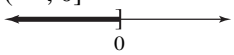
72. $2 - 3x \leq 5$
$-3x \leq 3$
$x \geq -1$
$\{x|x \geq -1\}$
$[-1, \infty)$



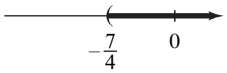
74. $-3(1 - x) > x + 8$
$-3 + 3x > x + 8$
$-3 + 2x > 8$
$2x > 11$
$x > \frac{11}{2}$
$\left\{x \middle| x > \frac{11}{2}\right\}$
$\left(\frac{11}{2}, \infty\right)$



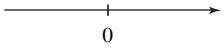
76. $8 - 4(2 - x) \leq -2x$
$8 - 8 + 4x \leq -2x$
$4x \leq -2x$
$6x \leq 0$
$x \leq 0$
$\{x|x \leq 0\}$
$(-\infty, 0]$



78. $3x + 4 > \frac{1}{3}(x - 2)$
$3x + 4 > \frac{1}{3}x - \frac{2}{3}$
$\frac{9}{3}x + 4 > \frac{1}{3}x - \frac{2}{3}$
$\frac{8}{3}x + 4 > -\frac{2}{3}$
$\frac{8}{3}x > -\frac{2}{3} - \frac{12}{3}$
$\frac{8}{3}x > -\frac{14}{3}$
$x > -\frac{14}{8}$
$x > -\frac{7}{4}$
$\left\{x \middle| x > -\frac{7}{4}\right\}$

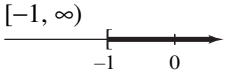


80. $2y - 5 + y < 3(y - 2)$
$3y - 5 < 3y - 6$
$-5 < -6$
This is a false statement. Therefore, there is no solution. The solution set is $\varnothing$ or $\{\ \}$.

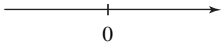


82. $3(p + 1) - p \geq 2(p + 1)$
$3p + 3 - p \geq 2p + 2$
$2p + 3 \geq 2p + 2$
$3 \geq 2$
The solution to this inequality is all real numbers since 3 is always greater than 2.
$\{p|p$ is any real number$\}$
$(-\infty, \infty)$

84. $4x-5(x+1)\le x-3$
$4x-5x-5\le x-3$
$-x-5\le x-3$
$-2x-5\le -3$
$-2x\le 2$
$x\ge -1$
$\{x|x\ge -1\}$
$[-1,\infty)$



86. $3q-(q+2)>2(q-1)$
$3q-q-2>2q-2$
$2q-2>2q-2$
$-2>-2$
This is a false statement. Therefore, there is no solution. The solution set is $\varnothing$ or $\{\ \}$.



88. $8x-3(x-2)\ge x+4(x+1)$
$8x-3x+6\ge x+4x+4$
$5x+6\ge 5x+4$
$6\ge 4$
The solution to this inequality is all real numbers, since 6 is always greater than 4.
$\{x|x$ is any real number$\}$
$(-\infty,\infty)$

90. $x\le 120{,}000$

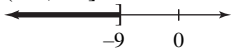
92. $x\ge 250$

94. $x\le 25$

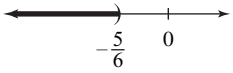
96. $x\ge 0$

98. $x<0$

100. $6\ge x+15$
$-9\ge x$
$\{x|x\le -9\}$
$(-\infty,-9]$

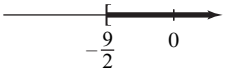


102. $-\frac{5}{8}x>\frac{25}{48}$
$-\frac{8}{5}\cdot\left(-\frac{5}{8}\right)x<-\frac{8}{5}\cdot\frac{25}{48}$
$x<-\frac{5}{6}$
$\left\{x\middle|x<-\frac{5}{6}\right\}$
$\left(-\infty,-\frac{5}{6}\right)$

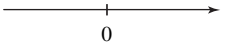


104. $5(x-2)<3(x+1)+2x$
$5x-10<3x+3+2x$
$5x-10<5x+3$
$-10<3$
The solution to this inequality is all real numbers, since −10 is always less than 3.
$\{x|x$ is any real number$\}$
$(-\infty,\infty)$

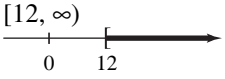
106. $-5b+2(b-1)\le 6-(3b-1)+2b$
$-5b+2b-2\le 6-3b+1+2b$
$-3b-2\le -b+7$
$-2b-2\le 7$
$-2b\le 9$
$b\ge -\frac{9}{2}$
$\left\{b\middle|b\ge -\frac{9}{2}\right\}$
$\left[-\frac{9}{2},\infty\right)$



108. $2k-(k-4)\ge 3k+10-2k$
$2k-k+4\ge k+10$
$k+4\ge k+10$
$4\ge 10$
This is a false statement. Therefore, there is no solution. The solution set is $\varnothing$ or $\{\ \}$.



110. $\frac{x}{3}\ge 2+\frac{x}{6}$
$\frac{x}{6}\ge 2$
$x\ge 12$
$\{x|x\ge 12\}$
$[12,\infty)$



112. $\frac{3z-1}{4}+1 \le \frac{6z+5}{2}+2$

$\frac{3}{4}z-\frac{1}{4}+1 \le 3z+\frac{5}{2}+2$

$\frac{3}{4}z+\frac{3}{4} \le \frac{12}{4}z+\frac{18}{4}$

$\frac{3}{4} \le \frac{9}{4}z+\frac{18}{4}$

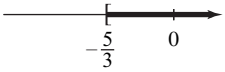
$-\frac{15}{4} \le \frac{9}{4}z$

$\frac{4}{9}\cdot\left(-\frac{15}{4}\right) \le \frac{4}{9}\cdot\frac{9}{4}z$

$-\frac{5}{3} \le z$

$\left\{z \middle| z \ge -\frac{5}{3}\right\}$

$\left[-\frac{5}{3}, \infty\right)$



114. $2(4a-3) \le 5a-(2-3a)$

$8a-6 \le 5a-2+3a$

$8a-6 \le 8a-2$

$-6 \le -2$

The solution to this inequality is all real numbers, since −6 is always less than −2.

$\{a|a$ is any real number$\}$

$(-\infty, \infty)$

116. $4.9+2.6x < 4.2x-4.7$

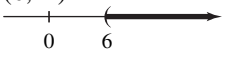
$4.9 < 1.6x-4.7$

$9.6 < 1.6x$

$6 < x$

$\{x|x > 6\}$

$(6, \infty)$



118. Let x be the number of miles. Then the charge for 1 week is $(80 + 0.28x)$ dollars.

$80+0.28x \le 100$

$0.28x \le 20$

$x \le 71.4$

The truck can be driven at most 71 miles.

120. Let f be Elizabeth's score on the final exam. Then she has six scores (85, 83, 90, 96, f, and f) in her total.

$85+83+90+96+f+f \ge 540$

$354+2f \ge 540$

$2f \ge 186$

$f \ge 93$

Elizabeth must score at least 93 points on the final exam.

122. (a) $15{,}000 + 0.01S$

(b) $15{,}000+0.01S > 150{,}000$

$0.01S > 135{,}000$

$S > 13{,}500{,}000$

The total sales must be more than $13,500,000.

124. $2.1A+224 \ge 350$

$2.1A \ge 126$

$A \ge 60$

The amount spent on advertising must be at least $60,000.

126. Let p be the number of packages. Then $p + 15$ is the number of letters.

$10+3(p+15)+8p \le 85$

$10+3p+45+8p \le 85$

$55+11p \le 85$

$11p \le 30$

$p \le 2.7$

If $p = 2$, then $p + 15 = 17$. A maximum of 2 packages and 17 letters can be delivered.

128. $-41 \le x-37 \le 26$

$-4 \le x \le 63$

The solution set is $\{x|-4 \le x \le 63\}$.

130. $-4 < \frac{8x}{9} < 12$

$-36 < 8x < 108$

$-4.5 < x < 13.5$

The solution set is $\{x|-4.5 < x < 13.5\}$.

132. $4 < 3x+7 \le 28$

$-3 < 3x \le 21$

$-1 < x \le 7$

The solution set is $\{x|-1 < x \le 7\}$.

134.
$$-1 \le 5 - \frac{x}{3} < 1$$
$$-6 \le -\frac{x}{3} < -4$$
$$-3(-6) \ge -3\left(-\frac{x}{3}\right) > -3(-4)$$
$$18 \ge x > 12$$
This is the same as $12 < x \le 18$.
The solution set is $\{x|12 < x \le 18\}$.

136. The direction of the inequality sign is reversed when each side is multiplied or divided by a negative number.

138. The notation $[-7, -\infty)$ is incorrect for several reasons. The interval should be written in order from smaller to larger. Since we want values greater than -7, the interval should go to positive infinity. The left symbol should be a parenthesis. The correct notation is $(-7, \infty)$.

Chapter 2 Review

1. $3x + 2 = 7$; $x = 5$
$3(5) + 2 \stackrel{?}{=} 7$
$15 + 2 \stackrel{?}{=} 7$
$17 = 7$ False
No, $x = 5$ is *not* a solution to the equation.

2. $5m - 1 = 17$; $m = 4$
$5(4) - 1 \stackrel{?}{=} 17$
$20 - 1 \stackrel{?}{=} 17$
$19 = 17$ False
No, $m = 4$ is *not* a solution to the equation.

3. $6x + 6 = 12$; $x = \frac{1}{2}$
$6\left(\frac{1}{2}\right) + 6 \stackrel{?}{=} 12$
$3 + 6 \stackrel{?}{=} 12$
$9 = 12$ False
No, $x = \frac{1}{2}$ is *not* a solution to the equation.

4. $9k + 3 = 9$; $k = \frac{2}{3}$
$9\left(\frac{2}{3}\right) + 3 \stackrel{?}{=} 9$
$6 + 3 \stackrel{?}{=} 9$
$9 = 9$ True
Yes, $k = \frac{2}{3}$ is a solution to the equation.

5.
$$n - 6 = 10$$
$$n - 6 + 6 = 10 + 6$$
$$n = 16$$
Check: $n - 6 = 10$
$16 - 16 \stackrel{?}{=} 10$
$10 = 10$ True
The solution is 16, or the solution set is $\{16\}$.

6.
$$n - 8 = 12$$
$$n - 8 + 8 = 12 + 8$$
$$n = 20$$
Check: $n - 8 = 12$
$20 - 8 \stackrel{?}{=} 12$
$12 = 12$ True
The solution is 20, or the solution set is $\{20\}$.

7.
$$x + 6 = -10$$
$$x + 6 - 6 = -10 - 6$$
$$x = -16$$
Check: $x + 6 = -10$
$-16 + 6 \stackrel{?}{=} -10$
$-10 = -10$ True
The solution is -16, or the solution set is $\{-16\}$.

8.
$$x + 2 = -5$$
$$x + 2 - 2 = -5 - 2$$
$$x = -7$$
Check: $x + 2 = -5$
$-7 + 2 \stackrel{?}{=} -5$
$-5 = -5$ True
The solution is -7, or the solution set is $\{-7\}$.

9.
$$-100 = m - 5$$
$$-100 + 5 = m - 5 + 5$$
$$-95 = m$$
Check: $-100 = m - 5$
$-100 \stackrel{?}{=} -95 - 5$
$-100 = -100$ True
The solution is -95, or the solution set is $\{-95\}$.

10. $-26 = m - 76$

$-26 + 76 = m - 76 + 76$

$50 = m$

Check: $-26 = m - 76$

$-26 \stackrel{?}{=} 50 - 76$

$-26 = -26$ True

The solution is 50, or the solution set is $\{50\}$.

11. $\frac{2}{3}y = 16$

$\frac{3}{2} \cdot \frac{2}{3}y = \frac{3}{2} \cdot 16$

$y = 3 \cdot 8$

$y = 24$

Check: $\frac{2}{3}y = 16$

$\frac{2}{3} \cdot 24 \stackrel{?}{=} 16$

$2 \cdot 8 \stackrel{?}{=} 16$

$16 = 16$ True

The solution is 24, or the solution set is $\{24\}$.

12. $\frac{x}{4} = 20$

$4 \cdot \frac{x}{4} = 4 \cdot 20$

$x = 80$

Check: $\frac{x}{4} = 20$

$\frac{80}{4} \stackrel{?}{=} 20$

$20 = 20$ True

The solution is 80, or the solution set is $\{80\}$.

13. $-6x = 36$

$\frac{-6x}{-6} = \frac{36}{-6}$

$x = -6$

Check: $-6x = 36$

$-6(-6) \stackrel{?}{=} 36$

$36 = 36$ True

The solution is -6 or the solution set is $\{-6\}$.

14. $-4x = -20$

$\frac{-4x}{-4} = \frac{-20}{-4}$

$x = 5$

Check: $-4x = -20$

$-4 \cdot 5 \stackrel{?}{=} -20$

$-20 = -20$ True

The solution is 5, or the solution set is $\{5\}$.

15. $z + \frac{5}{6} = \frac{1}{2}$

$z + \frac{5}{6} - \frac{5}{6} = \frac{1}{2} - \frac{5}{6}$

$z = \frac{3}{6} - \frac{5}{6}$

$z = -\frac{2}{6}$

$z = -\frac{1}{3}$

Check: $z + \frac{5}{6} = \frac{1}{2}$

$-\frac{1}{3} + \frac{5}{6} \stackrel{?}{=} \frac{1}{2}$

$-\frac{2}{6} + \frac{5}{6} \stackrel{?}{=} \frac{1}{2}$

$\frac{3}{6} \stackrel{?}{=} \frac{1}{2}$

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

The solution is $-\frac{1}{3}$ or the solution set is $\left\{-\frac{1}{3}\right\}$.

16. $m - \frac{1}{8} = \frac{1}{4}$

$m - \frac{1}{8} + \frac{1}{8} = \frac{1}{4} + \frac{1}{8}$

$m = \frac{2}{8} + \frac{1}{8}$

$m = \frac{3}{8}$

Check: $m - \frac{1}{8} = \frac{1}{4}$

$\frac{3}{8} - \frac{1}{8} \stackrel{?}{=} \frac{1}{4}$

$\frac{2}{8} \stackrel{?}{=} \frac{1}{4}$

$\frac{1}{4} = \frac{1}{4}$ True

The solution is $\frac{3}{8}$ or the solution set is $\left\{\frac{3}{8}\right\}$.

17. $1.6x = 6.4$

$\frac{1.6x}{1.6} = \frac{6.4}{1.6}$

$x = 4$

Check: $1.6x = 6.4$

$1.6(4) \stackrel{?}{=} 6.4$

$6.4 = 6.4$ True

The solution is 4, or the solution set is $\{4\}$.

18. $1.8m = 9$

$$\frac{1.8m}{1.8} = \frac{9}{1.8}$$

$$m = 5$$

Check: $1.8m = 9$

$1.8(5) \stackrel{?}{=} 9$

$9 = 9$ True

The solution is 5, or the solution set is $\{5\}$.

19. $p - 1200 = 22,275$

$p - 1200 + 1200 = 22,275 + 1200$

$p = 23,475$

The original price was \$23,475.

20. $3c = 7.65$

$$\frac{3c}{3} = \frac{7.65}{3}$$

$$c = 2.55$$

Each cup of coffee cost \$2.55.

21. $5x - 1 = -21$

$5x - 1 + 1 = -21 + 1$

$5x = -20$

$$\frac{5x}{5} = \frac{-20}{5}$$

$x = -4$

Check: $5x - 1 = -21$

$5(-4) - 1 \stackrel{?}{=} -21$

$-20 - 1 \stackrel{?}{=} -21$

$-21 = -21$ True

The solution is -4, or the solution set is $\{-4\}$.

22. $-3x + 7 = -5$

$-3x + 7 - 7 = -5 - 7$

$-3x = -12$

$$\frac{-3x}{-3} = \frac{-12}{-3}$$

$x = 4$

Check: $-3x + 7 = -5$

$-3(4) + 7 \stackrel{?}{=} -5$

$-12 + 7 \stackrel{?}{=} -5$

$-5 = -5$ True

The solution is 4, or the solution set is $\{4\}$.

23. $\frac{2}{3}x + 5 = 11$

$\frac{2}{3}x + 5 - 5 = 11 - 5$

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

$\frac{3}{2} \cdot \frac{2}{3}x = \frac{3}{2} \cdot 6$

$x = 9$

Check: $\frac{2}{3}x + 5 = 11$

$\frac{2}{3} \cdot 9 + 5 \stackrel{?}{=} 11$

$6 + 5 \stackrel{?}{=} 11$

$11 = 11$ True

The solution is 9, or the solution set is $\{9\}$.

24. $\frac{5}{7}x - 2 = -17$

$\frac{5}{7}x - 2 + 2 = -17 + 2$

$\frac{5}{7}x = -15$

$\frac{7}{5} \cdot \frac{5}{7}x = \frac{7}{5} \cdot (-15)$

$x = -21$

Check: $\frac{5}{7}x - 2 = -17$

$\frac{5}{7}(-21) - 2 \stackrel{?}{=} -17$

$-15 - 2 \stackrel{?}{=} -17$

$-17 = -17$ True

The solution is -21, or the solution set is $\{-21\}$.

25. $-2x + 5 + 6x = -11$

$4x + 5 = -11$

$4x + 5 - 5 = -11 - 5$

$4x = -16$

$$\frac{4x}{4} = \frac{-16}{4}$$

$x = -4$

Check: $-2x + 5 + 6x = -11$

$-2(-4) + 5 + 6(-4) \stackrel{?}{=} -11$

$8 + 5 - 24 \stackrel{?}{=} -11$

$-11 = -11$ True

The solution is -4, or the solution set is $\{-4\}$.

26. $3x-5x+6=18$
$-2x+6=18$
$-2x+6-6=18-6$
$-2x=12$
$\frac{-2x}{-2}=\frac{12}{-2}$
$x=-6$
Check: $3x+5x+6=18$
$3(-6)-5(-6)+6 \stackrel{?}{=} 18$
$-18+30+6 \stackrel{?}{=} 18$
$18=18$ True
The solution is -6, or the solution set is $\{-6\}$.

27. $2m+0.5m=10$
$2.5m=10$
$10\cdot 2.5m=10\cdot 10$
$25m=100$
$\frac{25m}{25}=\frac{100}{25}$
$m=4$
Check: $2m+0.5m=10$
$2(4)+0.5(4) \stackrel{?}{=} 10$
$8+2 \stackrel{?}{=} 10$
$10=10$ True
The solution is 4, or the solution set is $\{4\}$.

28. $1.4m+m=-12$
$2.4m=-12$
$\frac{2.4m}{2.4}=\frac{-12}{2.4}$
$m=-5$
Check: $1.4m+m=-12$
$1.4(-5)+(-5) \stackrel{?}{=} -12$
$-7+(-5) \stackrel{?}{=} -12$
$-12=-12$ True
The solution is -5, or the solution set is $\{-5\}$.

29. $-2(x+5)=-22$
$-2x-10=-22$
$-2x-10+10=-22+10$
$-2x=-12$
$\frac{-2x}{-2}=\frac{-12}{-2}$
$x=6$
Check: $-2(x+5)=-22$
$-2(6+5) \stackrel{?}{=} -22$
$-2(11) \stackrel{?}{=} -22$
$-22=-22$ True
The solution is 6, or the solution set is $\{6\}$.

30. $3(2x+5)=-21$
$6x+15=-21$
$6x+15-15=-21-15$
$6x=-36$
$\frac{6x}{6}=\frac{-36}{6}$
$x=-6$
Check: $3(2x+5)=-21$
$3[2(-6)+5] \stackrel{?}{=} -21$
$3(-12+5) \stackrel{?}{=} -21$
$3(-7) \stackrel{?}{=} -21$
$-21=-21$ True
The solution is -6, or the solution set is $\{-6\}$.

31. $5x+4=-7x+20$
$5x+4-4=-7x+20-4$
$5x=-7x+16$
$7x+5x=7x-7x+16$
$12x=16$
$\frac{12x}{12}=\frac{16}{12}$
$x=\frac{4}{3}$
Check: $5x+4=-7x+20$
$5\left(\frac{4}{3}\right)+4 \stackrel{?}{=} -7\left(\frac{4}{3}\right)+20$
$\frac{20}{3}+\frac{12}{3} \stackrel{?}{=} \frac{-28}{3}+\frac{60}{3}$
$\frac{32}{3}=\frac{32}{3}$ True
The solution is $\frac{4}{3}$, or the solution set is $\left\{\frac{4}{3}\right\}$.

32. $-3x+5=x-15$
$-3x+5-5=x-15-5$
$-3x=x-20$
$-x-3x=-x+x-20$
$-4x=-20$
$\frac{-4x}{-4}=\frac{-20}{-4}$
$x=5$
Check: $-3x+5=x-15$
$-3(5)+5 \stackrel{?}{=} 5-15$
$-15+5 \stackrel{?}{=} -10$
$-10=-10$ True
The solution is 5, or the solution set is $\{5\}$.

33.
$$\begin{aligned} 4(x-5) &= -3x+5x-16 \\ 4x-20 &= 2x-16 \\ -2x+4x-20 &= -2x+2x-16 \\ 2x-20 &= -16 \\ 2x-20+20 &= -16+20 \\ 2x &= 4 \\ \frac{2x}{2} &= \frac{4}{2} \\ x &= 2 \end{aligned}$$

Check: $4(x-5) = -3x+5x-16$

$4(2-5) \stackrel{?}{=} -3(2)+5(2)-16$

$4(-3) \stackrel{?}{=} -6+10-16$

$-12 = -12$ True

The solution is 2, or the solution set is $\{2\}$.

34.
$$\begin{aligned} 4(m+1) &= m+5m-10 \\ 4m+4 &= 6m-10 \\ -4m+4m+4 &= -4m+6m-10 \\ 4 &= 2m-10 \\ 4+10 &= 2m-10+10 \\ 14 &= 2m \\ \frac{14}{2} &= \frac{2m}{2} \\ 7 &= m \end{aligned}$$

Check: $4(m+1) = m+5m-10$

$4(7+1) \stackrel{?}{=} 7+5(7)-10$

$4(8) \stackrel{?}{=} 7+35-10$

$32 = 32$ True

The solution is 7, or the solution set is $\{7\}$.

35.
$$\begin{aligned} x+x+4 &= 24 \\ 2x+4 &= 24 \\ 2x+4-4 &= 24-4 \\ 2x &= 20 \\ \frac{2x}{2} &= \frac{20}{2} \\ x &= 10 \end{aligned}$$

$x + 4 = 14$

Skye is 14 years old.

36.
$$\begin{aligned} 2w+2(w+10) &= 96 \\ 2w+2w+20 &= 96 \\ 4w+20 &= 96 \\ 4w+20-20 &= 96-20 \\ 4w &= 76 \\ \frac{4w}{4} &= \frac{76}{4} \\ w &= 19 \end{aligned}$$

$w + 10 = 29$

The width is 19 yards and the length is 29 yards.

37.
$$\begin{aligned} \frac{6}{7}x+3 &= \frac{1}{2} \\ 14\left(\frac{6}{7}x+3\right) &= 14\left(\frac{1}{2}\right) \\ 14\left(\frac{6}{7}x\right)+14(3) &= 7 \\ 12x+42 &= 7 \\ 12x+42-42 &= 7-42 \\ 12x &= -35 \\ \frac{12x}{12} &= \frac{-35}{12} \\ x &= -\frac{35}{12} \end{aligned}$$

Check: $\frac{6}{7}x+3 = \frac{1}{2}$

$\frac{6}{7}\left(-\frac{35}{12}\right)+3 \stackrel{?}{=} \frac{1}{2}$

$-\frac{5}{2}+\frac{6}{2} \stackrel{?}{=} \frac{1}{2}$

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

The solution is $-\frac{35}{12}$, or the solution set is $\left\{-\frac{35}{12}\right\}$.

38.
$$\begin{aligned} \frac{1}{4}x+6 &= \frac{5}{6} \\ 12\left(\frac{1}{4}x+6\right) &= 12\left(\frac{5}{6}\right) \\ 12\left(\frac{1}{4}x\right)+12(6) &= 2\cdot 5 \\ 3x+72 &= 10 \\ 3x+72-72 &= 10-72 \\ 3x &= -62 \\ \frac{3x}{3} &= \frac{-62}{3} \\ x &= -\frac{62}{3} \end{aligned}$$

Check: $\frac{1}{4}x+6=\frac{5}{6}$

$\frac{1}{4}\left(-\frac{62}{3}\right)+6 \stackrel{?}{=} \frac{5}{6}$

$-\frac{31}{6}+\frac{36}{6} \stackrel{?}{=} \frac{5}{6}$

$\frac{5}{6}=\frac{5}{6}$ True

The solution is $-\frac{62}{3}$, or the solution set is $\left\{-\frac{62}{3}\right\}$.

39. $\frac{n}{2}+\frac{2}{3}=\frac{n}{6}$

$6\left(\frac{n}{2}+\frac{2}{3}\right)=6\left(\frac{n}{6}\right)$

$6\left(\frac{n}{2}\right)+6\left(\frac{2}{3}\right)=n$

$3n+4=n$

$-3n+3n+4=-3n+n$

$4=-2n$

$\frac{4}{-2}=\frac{-2n}{-2}$

$-2=n$

Check: $\frac{n}{2}+\frac{2}{3}=\frac{n}{6}$

$\frac{-2}{2}+\frac{2}{3} \stackrel{?}{=} \frac{-2}{6}$

$-\frac{3}{3}+\frac{2}{3} \stackrel{?}{=} -\frac{1}{3}$

$-\frac{1}{3}=-\frac{1}{3}$ True

The solution is -2, or the solution set is $\{-2\}$.

40. $\frac{m}{8}+\frac{m}{2}=\frac{3}{4}$

$8\left(\frac{m}{8}+\frac{m}{2}\right)=8\left(\frac{3}{4}\right)$

$8\left(\frac{m}{8}\right)+8\left(\frac{m}{2}\right)=2\cdot 3$

$m+4m=6$

$5m=6$

$\frac{5m}{5}=\frac{6}{5}$

$m=\frac{6}{5}$

Check: $\frac{m}{8}+\frac{m}{2}=\frac{3}{4}$

$\frac{\frac{6}{5}}{8}+\frac{\frac{6}{5}}{2} \stackrel{?}{=} \frac{3}{4}$

$\frac{3}{20}+\frac{6}{10} \stackrel{?}{=} \frac{3}{4}$

$\frac{15}{20}=\frac{15}{20}$ True

The solution is $\frac{6}{5}$, or the solution set is $\left\{\frac{6}{5}\right\}$.

41. $1.2r=-1+2.8$

$1.2r=1.8$

$10(1.2r)=10(1.8)$

$12r=18$

$\frac{12r}{12}=\frac{18}{12}$

$r=\frac{3}{2}$

Check: $1.2r=-1+2.8$

$1.2\left(\frac{3}{2}\right) \stackrel{?}{=} 1.8$

$1.8=1.8$ True

The solution is $\frac{3}{2}$, or the solution set is $\left\{\frac{3}{2}\right\}$.

42. $0.2x+0.5x=2.1$

$0.7x=2.1$

$10(0.7x)=10(2.1)$

$7x=21$

$\frac{7x}{7}=\frac{21}{7}$

$x=3$

Check: $0.2x+0.5x=2.1$

$0.2(3)+0.5(3) \stackrel{?}{=} 2.1$

$0.6+1.5 \stackrel{?}{=} 2.1$

$2.1=2.1$ True

The solution is 3, or the solution set is $\{3\}$.

43. $1.2m-3.2=0.8m-1.6$

$10(1.2m-3.2)=10(0.8m-1.6)$

$12m-32=8m-16$

$-8m+12m-32=-8m+8m-16$

$4m-32=-16$

$4m-32+32=-16+32$

$4m=16$

$\frac{4m}{4}=\frac{16}{4}$

$m=4$

Check: $1.2m-3.2=0.8m-1.6$
$1.2(4)-3.2 \stackrel{?}{=} 0.8(4)-1.6$
$4.8-3.2 \stackrel{?}{=} 3.2-1.6$
$1.6=1.6$ True
The solution is 4, or the solution set is $\{4\}$.

44. $0.3m+0.8=0.5m+1$
$10(0.3m+0.8)=10(0.5m+1)$
$3m+8=5m+10$
$-3m+3m+8=-3m+5m+10$
$8=2m+10$
$8-10=2m+10-10$
$-2=2m$
$\frac{-2}{2}=\frac{2m}{2}$
$-1=m$
Check: $0.3m+0.8=0.5m+1$
$0.3(-1)+0.8 \stackrel{?}{=} 0.5(-1)+1$
$-0.3+0.8 \stackrel{?}{=} -0.5+1$
$0.5=0.5$ True
The solution is -1, or the solution set is $\{-1\}$.

45. $\frac{1}{2}(x+5)=\frac{3}{4}$
$4\cdot\frac{1}{2}(x+5)=4\cdot\frac{3}{4}$
$2(x+5)=3$
$2x+10=3$
$2x+10-10=3-10$
$2x=-7$
$\frac{2x}{2}=\frac{-7}{2}$
$x=-\frac{7}{2}$
Check: $\frac{1}{2}(x+5)=\frac{3}{4}$
$\frac{1}{2}\left(-\frac{7}{2}+5\right) \stackrel{?}{=} \frac{3}{4}$
$\frac{1}{2}\left(-\frac{7}{2}+\frac{10}{2}\right) \stackrel{?}{=} \frac{3}{4}$
$\frac{1}{2}\left(\frac{3}{2}\right) \stackrel{?}{=} \frac{3}{4}$
$\frac{3}{4}=\frac{3}{4}$ True
The solution is $-\frac{7}{2}$, or the solution set is $\left\{-\frac{7}{2}\right\}$.

46. $-\frac{1}{6}(x-1)=\frac{2}{3}$
$-6\cdot\left[-\frac{1}{6}(x-1)\right]=-6\cdot\frac{2}{3}$
$x-1=-4$
$x-1+1=-4+1$
$x=-3$
Check: $-\frac{1}{6}(x-1)=\frac{2}{3}$
$-\frac{1}{6}(-3-1) \stackrel{?}{=} \frac{2}{3}$
$-\frac{1}{6}(-4) \stackrel{?}{=} \frac{2}{3}$
$\frac{2}{3}=\frac{2}{3}$
The solution is -3, or the solution set is $\{-3\}$.

47. $0.1(x+80)=-0.2+14$
$10[0.1(x+80)]=10(-0.2+14)$
$1(x+80)=-2+140$
$x+80=138$
$x+80-80=138-80$
$x=58$
Check: $0.1(x+80)=-0.2+14$
$0.1(58+80) \stackrel{?}{=} -0.2+14$
$0.1(138) \stackrel{?}{=} 13.8$
$13.8=13.8$ True
The solution is 58, or the solution set is $\{58\}$.

48. $0.35(x+6)=0.45(x+7)$
$100[0.35(x+6)]=100[0.45(x+7)]$
$35(x+6)=45(x+7)$
$35x+210=45x+315$
$-35x+35x+210=-35x+45x+315$
$210=10x+315$
$210-315=10x+315-315$
$-105=10x$
$\frac{-105}{10}=\frac{10x}{10}$
$-10.5=x$
Check: $0.35(x+6)=0.45(x+7)$
$0.35(-10.5+6) \stackrel{?}{=} 0.45(-10.5+7)$
$0.35(-4.5) \stackrel{?}{=} 0.45(-3.5)$
$-1.575=-1.575$ True
The solution is -10.5, or the solution set is $\{-10.5\}$.

49. $4x+2x-10=6x+5$
$6x-10=6x+5$
$-6x+6x-10=-6x+6x+5$
$-10=5$
This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or { }.

50. $-2(x+5)=-5x+3x+2$
$-2x-10=-2x+2$
$2x-2x-10=2x-2x+2$
$-10=2$
This is a false statement, so the equation is a contradiction. The solution set is $\varnothing$ or { }.

51. $-5(2n+10)=6n-50$
$-10n-50=6n-50$
$10n-10n-50=10n+6n-50$
$-50=16n-50$
$-50+50=16n-50+50$
$0=16n$
$\frac{0}{16}=\frac{16n}{16}$
$0=n$
This is a conditional equation. The solution set is $\{0\}$.

52. $8m+10=-2(7m-5)$
$8m+10=-14m+10$
$14m+8m+10=14m-14m+10$
$22m+10=10$
$22m+10-10=10-10$
$22m=0$
$\frac{22m}{22}=\frac{0}{22}$
$m=0$
This is a conditional equation. The solution set is $\{0\}$.

53. $10x-2x+18=2(4x+9)$
$8x+18=8x+18$
$-8x+8x+18=-8x+8x+18$
$18=18$
This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

54. $-3(2x-8)=-3x-3x+24$
$-6x+24=-6x+24$
$6x-6x+24=6x-6x+24$
$24=24$
This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

55. $p-0.20p=12.60$
$0.8p=12.60$
$10(0.8p)=10(12.60)$
$8p=126$
$\frac{8p}{8}=\frac{126}{8}$
$p=15.75$
The shirt's original price was \$15.75.

56. $0.10d+0.05(2d-1)=0.55$
$0.10d+0.10d-0.05=0.55$
$0.2d-0.05=0.55$
$0.2d=0.6$
$10\cdot 0.2d=10\cdot 0.6$
$2d=6$
$\frac{2d}{2}=\frac{6}{2}$
$d=3$
Juanita found 3 dimes.

57. $A=lw$; $l=8$, $w=6$
$A=8(6)=48$
The area is 48 square inches.

58. $P=4s$; $s=16$
$P=4(16)=64$
The perimeter is 64 centimeters.

59. $P=2l+2w$; $P=16$, $l=\frac{13}{2}$
$16=2\left(\frac{13}{2}\right)+2w$
$16=13+2w$
$-13+16=-13+13+2w$
$3=2w$
$\frac{3}{2}=\frac{2w}{2}$
$\frac{3}{2}=w$
The width is $\frac{3}{2}$ yards.

60. $C=\pi d$; $d=\frac{15}{\pi}$
$C=\pi\left(\frac{15}{\pi}\right)=15$
The circumference is 15 millimeters.

61. $V = LWH$

$$\frac{V}{LW} = \frac{LWH}{LW}$$

$$\frac{V}{LW} = H$$

62. $I = Prt$

$$\frac{I}{rt} = \frac{Prt}{rt}$$

$$\frac{I}{rt} = P$$

63. $S = 2LW + 2LH + 2WH$

$$S - 2LH = 2LW + 2LH + 2WH - 2LH$$

$$S - 2LH = 2LW + 2WH$$

$$S - 2LH = W(2L + 2H)$$

$$\frac{S - 2LH}{2L + 2H} = \frac{W(2L + 2H)}{2L + 2H}$$

$$\frac{S - 2LH}{2L + 2H} = W$$

64. $\rho = mv + MV$

$$\rho - mv = mv + MV - mv$$

$$\rho - mv = MV$$

$$\frac{\rho - mv}{V} = \frac{MV}{V}$$

$$\frac{\rho - mv}{V} = M$$

65. $2x + 3y = 10$

$$-2x + 2x + 3y = -2x + 10$$

$$3y = -2x + 10$$

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

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

66. $6x - 3y = 15$

$$6x - 6x - 3y = 15 - 6x$$

$$-3y = 15 - 6x$$

$$\frac{-3y}{-3} = \frac{15 - 6x}{-3}$$

$$y = \frac{15}{-3} - \frac{6x}{-3}$$

$y = -5 + 2x$ or $y = 2x - 5$

67. (a) $A = P(1 + r)^t$

$$\frac{A}{(1 + r)^t} = \frac{P(1 + r)^t}{(1 + r)^t}$$

$$\frac{A}{(1 + r)^t} = P$$

(b) $P = \dfrac{A}{(1 + r)^t}$; $A = 3000$, $t = 6$, $r = 5\% = 0.05$

$$P = \frac{3000}{(1 + 0.05)^6} = \frac{3000}{1.05^6} \approx 2238.65$$

You would have to deposit \$2238.65.

68. (a) $A = 2\pi rh + 2\pi r^2$

$$A - 2\pi r^2 = 2\pi rh + 2\pi r^2 - 2\pi r^2$$

$$A - 2\pi r^2 = 2\pi rh$$

$$\frac{A - 2\pi r^2}{2\pi r} = \frac{2\pi rh}{2\pi r}$$

$$\frac{A - 2\pi r^2}{2\pi r} = h$$

(b) $h = \dfrac{A - 2\pi r^2}{2\pi r}$; $A = 72\pi$, $r = 4$

$$h = \frac{72\pi - 2\pi(4^2)}{2\pi(4)}$$

$$h = \frac{\pi(72 - 32)}{\pi(8)}$$

$$h = \frac{40}{8}$$

$$h = 5$$

The height is 5 centimeters.

69. $I = Prt$; $P = 500$, $r = 2\% = 0.02$, $t = \dfrac{9}{12} = \dfrac{3}{4}$

$$I = 500(0.02)\left(\frac{3}{4}\right) = 7.5$$

Samuel's investment will earn \$7.50.

70. $d = 3$, $r = \dfrac{3}{2}$

$$A = \pi r^2 = \pi\left(\frac{3}{2}\right)^2 = \frac{9}{4}\pi \approx 7.069$$

The area is $\dfrac{9}{4}\pi$ square feet, approximately 7.1 square feet.

71. the difference between a number and 6: $x - 6$

72. eight subtracted from a number: $x - 8$

73. the product of −8 and a number: $-8x$

74. the quotient of a number and 10: $\frac{x}{10}$

75. twice the sum of 6 and a number: $2(6 + x)$

76. four times the difference of 5 and a number: $4(5 - x)$

77. $6 + x = 2x + 5$

78. $6x - 10 = 2x + 1$

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

80. $\frac{6}{x} = 10 + x$

81. $4(2x + 8) = 16$

82. $5(2x - 8) = -24$

83. Let s be Sarah's age. Then $s + 7$ is Jacob's age.

84. Let c be Consuelo's speed. Then $2c$ is Maria's speed.

85. Let m be Max's amount. Then $m - 6$ is Irene's amount.

86. Let v be Victor's amount. Then $350 - v$ is Larry's amount.

87. We want to find Lee Lai's weight one year ago. Let n be the weight.

$$n - 28 = 125$$
$$n = 153$$

Is the difference between 153 and 125 28? Yes. Lee Lai's weight was 153 pounds one year ago.

88. We want to find three consecutive integers. Let n be the first integer. Then $n + 1$ and $n + 2$ are the next two integers.

$$n + (n+1) + (n+2) = 39$$
$$3n + 3 = 39$$
$$3n = 36$$
$$n = 12$$

If $n = 12$, then $n + 1 = 13$ and $n + 2 = 14$. Are the numbers 12, 13, 14 consecutive integers? Yes. Do they sum to 39? Yes. The integers are 12, 13, and 14.

89. We want to find how much each will receive. Let j be the amount received by Juan. Then $j - 2000$ is the amount received by Roberto.

$$j + (j - 2000) = 20{,}000$$
$$2j - 2000 = 20{,}000$$
$$2j = 22{,}000$$
$$j = 11{,}000$$

If $j = 11{,}000$, then $j - 2000 = 9000$. Do 11,000 and 9000 differ by 2000? Yes. Do 11,000 and 9000 sum to 20,000? Yes. Juan will receive \$11,000 and Roberto will receive \$9000.

90. We want to find the number of miles for which the cost will be the same. Let x be the number of miles driven. ABC-Rental charges $30 + 0.15x$ and U-Do-It Rental charges $15 + 0.3x$.

$$30 + 0.15x = 15 + 0.3x$$
$$30 = 15 + 0.15x$$
$$15 = 0.15x$$
$$100 = x$$

ABC-Rental's cost will be $30 + 0.15(100) = 30 + 15 = \$45$ and U-Do-It-Rental's cost will be $15 + 0.3(100) = 15 + 30 = \$45$, and they are the same. The cost will be the same for 100 miles.

91. $x = 0.065(80)$
$x = 5.2$
5.2 is 6.5% of 80.

92. $18 = 0.3x$
$\frac{18}{0.3} = \frac{0.3x}{0.3}$
$60 = x$
18 is 30% of 60.

93. $15.6 = p \cdot 120$
$\frac{15.6}{120} = \frac{120p}{120}$
$0.13 = p$
$13\% = p$
15.6 is 13% of 120.

94. $1.1 \cdot x = 55$
$\frac{1.1x}{1.1} = \frac{55}{1.1}$
$x = 50$
110% of 50 is 55.

95. Let x be the cost before tax. Then $0.06x$ is the tax amount.

$$x + 0.06x = 19.61$$
$$1.06x = 19.61$$
$$x = 18.5$$

The leotard cost $18.50 before sales tax.

96. Let x be the previous hourly fee. Then $0.085x$ is the amount of the increase.

$$x + 0.085x = 32.55$$
$$1.085x = 32.55$$
$$x = 30$$

Mei Ling's previous hourly fee was $30.

97. Let x be the sweater's original price. Then $0.70x$ is the discounted amount.

$$x - 0.70x = 12$$
$$0.3x = 12$$
$$x = 40$$

The sweater's original price was $40.

98. Let x be the store's price. Then $0.80x$ is the markup amount.

$$x + 0.80x = 360$$
$$1.8x = 360$$
$$x = 200$$

The store paid $200 for the suit.

99. Let x be the total value of the computers. Then Tanya earns $500 plus $0.02x$.

$$500 + 0.02x = 3000$$
$$0.02x = 2500$$
$$x = 125{,}000$$

Tanya must sell computers worth a total of $125,000.

100. Let x be the winner's amount. Then $0.80x$ is the loser's amount.

$$x + 0.80x = 900$$
$$1.8x = 900$$
$$x = 500$$

If $x = 500$, then $0.8(500) = 400$. The winner received 500 votes, whereas the loser received 400 votes.

101. We want to find complementary angles. The measures of complementary angles sum to 90°. Let x be the measure of the second angle. Then $6x + 20$ is the measure of the first angle.

$$x + (6x + 20) = 90$$
$$7x + 20 = 90$$
$$7x = 70$$
$$x = 10$$

If $x = 10$, then $6x + 20 = 6(10) + 20 = 60 + 20 = 80$. The measures of the angles are 10° and 80°.

102. We want to find supplementary angles. The measures of supplementary angles sum to 180°. Let x be the measure of the second angle. Then $2x - 60$ is the measure of the first angle.

$$x + (2x - 60) = 180$$
$$3x - 60 = 180$$
$$3x = 240$$
$$x = 80$$

If $x = 80$, then $2x - 60 = 2(80) - 60 = 160 - 60 = 100$. The measures of the angles are 80° and 100°.

103. We want to find the measures of the angles of the triangle. The measures of the angles of a triangle sum to 180°. Let x be the measure of the first angle. Then $2x$ is the measure of the second and $2x + 30$ is the measure of the third.

$$x + (2x) + (2x + 30) = 180$$
$$5x + 30 = 180$$
$$5x = 150$$
$$x = 30$$

If $x = 30$, then $2x = 60$, and $2x + 30 = 60 + 30 = 90$. The measures of the angles are 30°, 60°, and 90°.

104. We want to find the measures of the angles of the triangle. The measures of the angles of a triangle sum to 180°. Let x be the measure of the first angle. Then $x - 5$ is the measure of the second angle and $2(x - 5) - 5$ is the measure of the third angle.

$$x + (x - 5) + 2(x - 5) - 5 = 180$$
$$x + x - 5 + 2x - 10 - 5 = 180$$
$$4x - 20 = 180$$
$$4x = 200$$
$$x = 50$$

If $x = 50$, then $x - 5 = 45$ and $2(x - 5) - 5 = 2(45) - 5 = 85$. The measures of the angles are 50°, 45°, and 85°.

105. We want to find the dimensions of the rectangle. Let w be the width of the rectangle. Then $2w + 15$ is the length of the rectangle. The perimeter of a rectangle is the sum of twice the length and twice the width. The perimeter is 78 inches.

$$2(2w + 15) + 2w = 78$$
$$4w + 30 + 2w = 78$$
$$6w + 30 = 78$$
$$6w = 48$$
$$w = 8$$

If $w = 8$, then $2w + 15 = 2(8) + 15 = 31$. The length is 31 inches and the width is 8 inches.

106. We want to find the dimensions of the rectangle. Let w be the width of the rectangle. Then $4w$ is the length of the rectangle. The perimeter of a rectangle is the sum of twice the length and twice the width. The perimeter is 70 cm.

$$\begin{aligned} 2(4w)+2w &= 70 \\ 8w+2w &= 70 \\ 10w &= 70 \\ w &= 7 \end{aligned}$$

If $w = 7$, then $4w = 28$. The width of the rectangle is 7 cm and the length is 28 cm.

107. **(a)** We want to find the dimensions of the rectangular garden. Let l be the length. Then the width is $2l$. The perimeter is twice the length plus twice the width and is 120 feet.

$$\begin{aligned} 2l+2(2l) &= 120 \\ 2l+4l &= 120 \\ 6l &= 120 \\ l &= 20 \end{aligned}$$

If $l = 20$, then $2l = 40$. The garden's length is 20 feet and the width is 40 feet.

(b) $A = lw = 20(40) = 800$
The area of the garden is 800 square feet.

108. The area of a trapezoid is $A = \frac{1}{2}h(B+b)$, where h is the height and the bases are B and b. Let B be the longer base. Then $B - 10$ is the shorter base. The height is 80 feet and the area is 3600 square feet.

$$\begin{aligned} \frac{1}{2}(80)[B+(B-10)] &= 3600 \\ 40(2B-10) &= 3600 \\ 80B-400 &= 3600 \\ 80B &= 4000 \\ B &= 50 \end{aligned}$$

If $B = 50$, then $B - 10 = 40$. The bases are 50 feet and 40 feet.

109. Let t be the time at which they are 35 miles apart.

	Rate	· Time	= Distance
slow	18	t	$18t$
fast	25	t	$25t$

The difference of the distances is 35, since they are traveling in the same direction.

$$\begin{aligned} 25t-18t &= 35 \\ 7t &= 35 \\ t &= 5 \end{aligned}$$

They will be 35 miles apart after 5 hours.

110. Let r be the speed of the faster train.

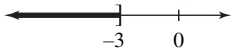
	Rate	· Time	= Distance
East	r	6	$6r$
West	$r - 10$	6	$6(r - 10)$

The sum of their distances is 720, since they are traveling in opposite directions.

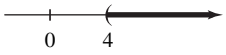
$$\begin{aligned} 6r+6(r-10) &= 720 \\ 6r+6r-60 &= 720 \\ 12r &= 780 \\ r &= 65 \end{aligned}$$

The faster train is traveling at 65 mph.

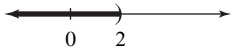
111. $x \le -3$



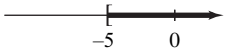
112. $x > 4$



113. $m < 2$

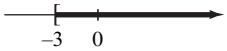


114. $m \ge -5$



115. $0 < n$

116. $-3 \le n$



117. $x < -4$
$(-\infty, -4)$

118. $x \ge 7$
$[7, \infty)$

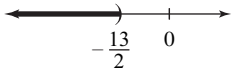
119. $[2, \infty)$

120. $(-\infty, 3)$

121. $4x+3<2x-10$
$2x+3<-10$
$2x<-13$
$x<-\frac{13}{2}$

$\left\{x \middle| x<-\frac{13}{2}\right\}$

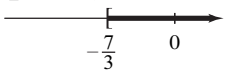
$\left(-\infty, -\frac{13}{2}\right)$



122. $3x-5\geq -12$
$3x\geq -7$
$x\geq -\frac{7}{3}$

$\left\{x \middle| x\geq -\frac{7}{3}\right\}$

$\left[-\frac{7}{3}, \infty\right)$

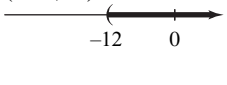


123. $-4(x-1)\leq x+8$
$-4x+4\leq x+8$
$-5x+4\leq 8$
$-5x\leq 4$
$x\geq -\frac{4}{5}$

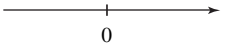
$\left\{x \middle| x\geq -\frac{4}{5}\right\}$

$\left[-\frac{4}{5}, \infty\right)$

124. $6x-10<7x+2$
$-10<x+2$
$-12<x$
$\{x|x>-12\}$
$(-12, \infty)$

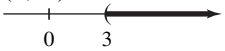


125. $-3(x+7)>-x-2x$
$-3x-21>-3x$
$-21>0$
This is a false statement. Therefore, there is no solution. The solution set is $\varnothing$ or { }.



126. $4x+10\leq 2(2x+7)$
$4x+10\leq 4x+14$
$10\leq 14$
The solution to this inequality is all real numbers, since 10 is always less than or equal to 14.
$\{x|x$ is any real number$\}$

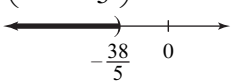
127. $\frac{1}{2}(3x-1)>\frac{2}{3}(x+3)$
$6\cdot\frac{1}{2}(3x-1)>6\cdot\frac{2}{3}(x+3)$
$3(3x-1)>4(x+3)$
$9x-3>4x+12$
$5x-3>12$
$5x>15$
$x>3$
$\{x|x>3\}$
$(3, \infty)$



128. $\frac{5}{4}x+2<\frac{5}{6}x-\frac{7}{6}$
$12\left(\frac{5}{4}x+2\right)<12\left(\frac{5}{6}x-\frac{7}{6}\right)$
$15x+24<10x-14$
$5x+24<-14$
$5x<-38$
$x<-\frac{38}{5}$

$\left\{x \middle| x<-\frac{38}{5}\right\}$

$\left(-\infty, -\frac{38}{5}\right)$



129. Let m be the number of miles driven.
$19.95+0.2m\leq 32.95$
$0.2m\leq 13$
$m\leq 65$
A customer can drive at most 65 miles.

130. Let s be the score on his third game.

$$\frac{148+155+s}{3} > 151$$
$$\frac{303+s}{3} > 151$$
$$303+s > 453$$
$$s > 150$$

Travis must score more than 150.

Chapter 2 Test

1. $x+3=-14$
$x+3-3=-14-3$
$x=-17$

Check:
$x+3=-14$
$-17+3 \stackrel{?}{=} -14$
$-14=-14$ True

The solution is -17, or the solution set is $\{-17\}$.

2. $-\frac{2}{3}m=\frac{8}{27}$
$-\frac{3}{2}\cdot\left(-\frac{2}{3}m\right)=-\frac{3}{2}\cdot\frac{8}{27}$
$m=-\frac{4}{9}$

Check: $-\frac{2}{3}m=\frac{8}{27}$
$-\frac{2}{3}\cdot\left(-\frac{4}{9}\right) \stackrel{?}{=} \frac{8}{27}$
$\frac{8}{27}=\frac{8}{27}$ True

The solution is $-\frac{4}{9}$, or the solution set is $\left\{-\frac{4}{9}\right\}$.

3. $5(2x-4)=5x$
$10x-20=5x$
$-10x+10x-20=-10x+5x$
$-20=-5x$
$\frac{-20}{-5}=\frac{-5x}{-5}$
$4=x$

Check: $5(2x-4)=5x$
$5(2\cdot 4-4) \stackrel{?}{=} 5\cdot 4$
$5(8-4) \stackrel{?}{=} 20$
$5(4) \stackrel{?}{=} 20$
$20=20$ True

The solution is 4, or the solution set is $\{4\}$.

4. $-2(x-5)=5(-3x+4)$
$-2x+10=-15x+20$
$2x-2x+10=2x-15x+20$
$10=-13x+20$
$10-20=-13x+20-20$
$-10=-13x$
$\frac{-10}{-13}=\frac{-13x}{-13}$
$\frac{10}{13}=x$

Check: $-2(x-5)=5(-3x+4)$
$-2\left(\frac{10}{13}-5\right) \stackrel{?}{=} 5\left(-3\cdot\frac{10}{13}+4\right)$
$-2\left(\frac{10}{13}-\frac{65}{13}\right) \stackrel{?}{=} 5\left(-\frac{30}{13}+\frac{52}{13}\right)$
$-2\left(-\frac{55}{13}\right) \stackrel{?}{=} 5\left(\frac{22}{13}\right)$
$\frac{110}{13}=\frac{110}{13}$ True

The solution is $\frac{10}{13}$ or the solution set is $\left\{\frac{10}{13}\right\}$.

5. $-\frac{2}{3}x+\frac{3}{4}=\frac{1}{3}$
$12\left(-\frac{2}{3}x+\frac{3}{4}\right)=12\left(\frac{1}{3}\right)$
$12\left(-\frac{2}{3}x\right)+12\left(\frac{3}{4}\right)=12\left(\frac{1}{3}\right)$
$-8x+9=4$
$-8x+9-9=4-9$
$-8x=-5$
$\frac{-8x}{8}=\frac{-5}{-8}$
$x=\frac{5}{8}$

Check: $-\frac{2}{3}x+\frac{3}{4}=\frac{1}{3}$
$-\frac{2}{3}\left(\frac{5}{8}\right)+\frac{3}{4} \stackrel{?}{=} \frac{1}{3}$
$-\frac{5}{12}+\frac{9}{12} \stackrel{?}{=} \frac{1}{3}$
$\frac{4}{12} \stackrel{?}{=} \frac{1}{3}$
$\frac{1}{3}=\frac{1}{3}$ True

The solution is $\frac{5}{8}$ or the solution set is $\left\{\frac{5}{8}\right\}$.

6.
$$\begin{aligned} -0.6+0.4y &= 1.4 \\ 10(-0.6+0.4y) &= 10(1.4) \\ -6+4y &= 14 \\ 6-6+4y &= 6+14 \\ 4y &= 20 \\ \frac{4y}{4} &= \frac{20}{4} \\ y &= 5 \end{aligned}$$

Check: $-0.6+0.4y = 1.4$
$-0.6+0.4(5) \stackrel{?}{=} 1.4$
$-0.6+2 \stackrel{?}{=} 1.4$
$1.4 = 1.4$ True

The solution is 5, or the solution set is $\{5\}$.

7.
$$\begin{aligned} 8x+3(2-x) &= 5(x+2) \\ 8x+6-3x &= 5x+10 \\ 6+5x &= 5x+10 \\ 6+5x-5x &= 5x+10-5x \\ 6 &= 10 \end{aligned}$$

This is a false statement. The equation is a contradiction. The solution set is $\varnothing$ or $\{\ \}$.

8.
$$\begin{aligned} 2(x+7) &= 2x-2+16 \\ 2x+14 &= 2x+14 \\ -2x+2x+14 &= -2x+2x+14 \\ 14 &= 14 \end{aligned}$$

This is a true statement. The equation is an identity. The solution set is the set of all real numbers.

9. (a)
$$\begin{aligned} V &= lwh \\ \frac{V}{wh} &= \frac{lwh}{wh} \\ \frac{V}{wh} &= l \end{aligned}$$

(b) $l = \dfrac{V}{wh}$; $V = 540$, $w = 6$, $h = 10$

$$l = \frac{540}{6(10)} = \frac{540}{60} = 9$$

The length is 9 inches.

10. (a)
$$\begin{aligned} 2x+3y &= 12 \\ -2x+2x+3y &= -2x+12 \\ 3y &= -2x+12 \\ \frac{3y}{3} &= \frac{-2x+12}{3} \\ y &= -\frac{2}{3}x+4 \end{aligned}$$

(b) $y = -\dfrac{2}{3}x+4$; $x = 8$

$$\begin{aligned} y &= -\frac{2}{3}(8)+4 \\ y &= -\frac{16}{3}+\frac{12}{3} \\ y &= -\frac{4}{3} \end{aligned}$$

11. Let x be the number.
$6(x-8) = 2x-5$

12.
$$\begin{aligned} 18 &= 0.30x \\ \frac{18}{0.30} &= \frac{0.30x}{0.30} \\ 60 &= x \end{aligned}$$

18 is 30% of 60.

13. We want to find three consecutive integers. Let n be the first integer. Then $n+1$ and $n+2$ are the next two integers, respectively. They sum to 48.
$$\begin{aligned} n+(n+1)+(n+2) &= 48 \\ 3n+3 &= 48 \\ 3n &= 45 \\ n &= 15 \end{aligned}$$

If $n = 15$, then $n+1 = 16$ and $n+2 = 17$. Do 15, 16, and 17 sum to 48? Yes. Are 15, 16, and 17 consecutive integers? Yes. The integers are 15, 16, and 17.

14. We need to find the lengths of the three sides. Let m be the length of the middle side. Then the length of the longest side is $m+2$, and the length of the shortest side is $m-14$. The perimeter, or the sum of the three sides, is 60.
$$\begin{aligned} m+(m+2)+(m-14) &= 60 \\ 3m-12 &= 60 \\ 3m &= 72 \\ m &= 24 \end{aligned}$$

If $m = 24$, then $m+2 = 26$, and $m-14 = 10$. Do 24, 26, and 10 sum to 60? Yes. The lengths of the sides are 10 inches, 24 inches, and 26 inches.

15. Let t be the time at which they are 350 miles apart.

	Rate	· Time	= Distance
Kimberly	40	t	$40t$
Clay	60	t	$60t$

The sum of their distances is 350 since they are traveling in opposite directions.

$$40t + 60t = 350$$
$$100t = 350$$
$$t = 3.5$$

They will be 350 miles apart in 3.5 hours.

16. Let x be the length of the shorter piece. Then $3x + 1$ is the length of the longer piece. The sum of the lengths of the pieces is 21.

$$x + (3x + 1) = 21$$
$$4x + 1 = 21$$
$$4x = 20$$
$$x = 5$$

$3x + 1 = 3(5) + 1 = 15 + 1 = 16$

The shorter piece is 5 feet and the longer piece is 16 feet.

17. Let x be the original price of the backpack. Then the discount amount was $0.20x$

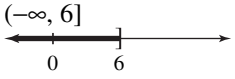
$$x - 0.20x = 28.80$$
$$0.80x = 28.80$$
$$10 \cdot 0.8x = 10 \cdot 28.8$$
$$8x = 288$$
$$x = 36$$

The original price of the backpack was \$36.

18.
$$3(2x - 5) \le x + 15$$
$$6x - 15 \le x + 15$$
$$5x - 15 \le 15$$
$$5x \le 30$$
$$x \le 6$$

$\{x | x \le 6\}$

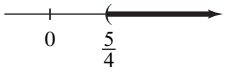
$(-\infty, 6]$



19.
$$-6x - 4 < 2(x - 7)$$
$$-6x - 4 < 2x - 14$$
$$-4 < 8x - 14$$
$$10 < 8x$$
$$\frac{5}{4} < x$$

$\left\{x \middle| x > \frac{5}{4}\right\}$

$\left(\frac{5}{4}, \infty\right)$



20. Let m be the number of miles Danielle can drive.

$$260 + 0.6m \le 500$$
$$0.6m \le 240$$
$$m \le 400$$

She can drive at most 400 miles.