

Chapter 2

Linear Equations and Inequalities in One Variable

2.1 Check Points

1. $x - 5 = 12$

$$x - 5 + 5 = 12 + 5$$

$$x + 0 = 17$$

$$x = 17$$

Check:

$$x - 5 = 12$$

$$17 - 5 = 12$$

$$12 = 12$$

The solution set is $\{17\}$.

2. $z + 2.8 = 5.09$

$$z + 2.8 - 2.8 = 5.09 - 2.8$$

$$z + 0 = 2.29$$

$$z = 2.29$$

Check:

$$z + 2.8 = 5.09$$

$$2.29 + 2.8 = 5.09$$

$$5.09 = 5.09$$

The solution set is $\{2.29\}$.

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

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

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

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

Check:

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

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

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

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

The solution set is $\left\{\frac{1}{4}\right\}$.

4. $8y + 7 - 7y - 10 = 6 + 4$

$$y - 3 = 10$$

$$y - 3 + 3 = 10 + 3$$

$$y = 13$$

Check:

$$8y + 7 - 7y - 10 = 6 + 4$$

$$8(13) + 7 - 7(13) - 10 = 6 + 4$$

$$104 + 7 - 91 - 10 = 10$$

$$111 - 101 = 10$$

$$10 = 10$$

The solution set is $\{13\}$.

5. $7x = 12 + 6x$

$$7x - 6x = 12 + 6x - 6x$$

$$x = 12$$

Check:

$$7(12) = 12 + 6(12)$$

$$84 = 12 + 72$$

$$84 = 84$$

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

6. $3x - 6 = 2x + 5$

$$3x - 2x - 6 = 2x - 2x + 5$$

$$x - 6 = 5$$

$$x - 6 + 6 = 5 + 6$$

$$x = 11$$

Check:

$$3x - 6 = 2x + 5$$

$$3(11) - 6 = 2(11) + 5$$

$$33 - 6 = 22 + 5$$

$$27 = 27$$

The solution set is $\{11\}$.

7. $V + 900 = 60A$

$$V + 900 = 60(50)$$

$$V + 900 = 3000$$

$$V + 900 - 900 = 3000 - 900$$

$$V = 2100$$

At 50 months, a child will have a vocabulary of 2100 words.

2.1 Concept and Vocabulary Check

1. solving
2. linear
3. equivalent
4. $b + c$
5. subtract; solution
6. adding 7
7. subtracting $6x$

2.1 Exercise Set

2. linear
4. not linear
6. not linear
8. linear
10. not linear

12. $y - 5 = -18$
 $y - 5 + 5 = -18 + 5$
 $y = -13$
 Check:
 $-13 - 5 = -18$
 $-18 = -18$
 The solution set is $\{-13\}$.

14. $z + 13 = -15$
 $z = -15 - 13$
 $z = -28$
 Check:
 $-28 + 13 = -15$
 $-15 = -15$
 The solution set is $\{-28\}$.

16. $-13 = x + 11$
 $-13 - 11 = x$
 $-24 = x$
 Check:
 $-13 = -24 + 11$
 $-13 = -13$
 The solution set is $\{-24\}$.

18. $-21 = y - 4$
 $-21 + 4 = y$
 $-17 = y$
 Check:
 $-21 = -17 - 4$
 $-21 = -21$
 The solution set is $\{-17\}$.

20. $18 + z = 14$
 $z = 14 - 18$
 $z = -4$
 Check:
 $18 + (-4) = 14$
 $14 = 14$
 The solution set is $\{-4\}$.

22. $-8 + y = -29$
 $y = -29 + 8$
 $y = -21$
 Check:
 $-8 + (-21) = -29$
 $-29 = -29$
 The solution set is $\{-21\}$.

24. $x + \frac{7}{8} = \frac{9}{8}$
 $x = \frac{9}{8} - \frac{7}{8}$
 $x = \frac{2}{8} = \frac{1}{4}$
 Check:
 $\frac{1}{4} + \frac{7}{8} = \frac{9}{8}$
 $\frac{2}{8} + \frac{7}{8} = \frac{9}{8}$
 $\frac{9}{8} = \frac{9}{8}$
 The solution set is $\left\{\frac{1}{4}\right\}$.

$$\begin{aligned}
 26. \quad t + \frac{2}{3} &= -\frac{7}{6} \\
 t &= -\frac{7}{6} - \frac{2}{3} \\
 t &= -\frac{7}{6} - \frac{4}{6} = -\frac{11}{6}
 \end{aligned}$$

Check:

$$\begin{aligned}
 -\frac{11}{6} + \frac{2}{3} &= -\frac{7}{6} \\
 -\frac{11}{6} + \frac{4}{6} &= -\frac{7}{6} \\
 -\frac{7}{6} &= -\frac{7}{6}
 \end{aligned}$$

The solution set is $\left\{-\frac{11}{6}\right\}$.

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

Check:

$$\begin{aligned}
 \frac{13}{10} - \frac{3}{5} &= \frac{7}{10} \\
 \frac{13}{10} - \frac{6}{10} &= \frac{7}{10} \\
 \frac{7}{10} &= \frac{7}{10}
 \end{aligned}$$

The solution set is $\left\{\frac{13}{10}\right\}$.

$$\begin{aligned}
 30. \quad -\frac{1}{8} + y &= -\frac{1}{4} \\
 y &= -\frac{1}{4} + \frac{1}{8} \\
 y &= -\frac{2}{8} + \frac{1}{8} = -\frac{1}{8}
 \end{aligned}$$

Check:

$$\begin{aligned}
 -\frac{1}{8} + \left(-\frac{1}{8}\right) &= -\frac{1}{4} \\
 -\frac{2}{8} &= -\frac{1}{4} \\
 -\frac{1}{4} &= -\frac{1}{4}
 \end{aligned}$$

The solution set is $\left\{-\frac{1}{8}\right\}$.

$$\begin{aligned}
 32. \quad -2.7 + w &= -5.3 \\
 w &= -5.3 + 2.7 \\
 w &= -2.6
 \end{aligned}$$

Check:

$$\begin{aligned}
 -2.7 + (-2.6) &= -5.3 \\
 -5.3 &= -5.3
 \end{aligned}$$

The solution set is $\{-2.6\}$.

$$\begin{aligned}
 34. \quad r + \frac{3}{5} &= -\frac{7}{10} \\
 r &= -\frac{7}{10} - \frac{6}{10} \\
 &= -\frac{13}{10}
 \end{aligned}$$

Check:

$$\begin{aligned}
 -\frac{13}{10} + \frac{3}{5} &= -\frac{7}{10} \\
 -\frac{13}{10} + \frac{6}{10} &= -\frac{7}{10} \\
 -\frac{7}{10} &= -\frac{7}{10}
 \end{aligned}$$

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

$$\begin{aligned}
 36. \quad -11 &= 8 + x \\
 -11 &= 8 + x \\
 -19 &= x
 \end{aligned}$$

Check:

$$\begin{aligned}
 -11 &= 8 + (-19) \\
 -11 &= -11
 \end{aligned}$$

The solution set is $\{-19\}$.

$$38. \quad \frac{7}{3} = -\frac{5}{2} + z$$

$$\frac{7}{3} + \frac{5}{2} = z$$

$$\frac{14+15}{6} = z$$

$$z = \frac{29}{6}$$

Check:

$$\frac{7}{3} = -\frac{5}{2} + \frac{29}{6}$$

$$\frac{14}{6} = -\frac{15}{6} + \frac{29}{6}$$

$$\frac{14}{6} = \frac{14}{6}$$

The solution set is $\left\{\frac{29}{6}\right\}$.

$$40. \quad -90 + t = -35$$

$$t = -35 + 90$$

$$t = 55$$

Check:

$$-90 + 55 = -35$$

$$-35 = -35$$

The solution set is $\{55\}$.

$$42. \quad x + 10.6 = -9$$

$$x = -9 - 10.6$$

$$x = -19.6$$

Check:

$$-19.6 + 10.6 = -9$$

$$-9 = -9$$

The solution set is $\{-19.6\}$.

$$44. \quad y + \frac{7}{11} = \frac{7}{11}$$

$$y = \frac{7}{11} - \frac{7}{11}$$

$$y = 0$$

Check:

$$0 + \frac{7}{11} = \frac{7}{11}$$

$$\frac{7}{11} = \frac{7}{11}$$

The solution set is $\{0\}$.

$$46. \quad -3x - 5 + 4x = 9$$

$$x - 5 = 9$$

$$x = 14$$

Check:

$$-3(14) - 5 + (14) = 9$$

$$-42 - 5 + 56 = 9$$

$$-49 + 56 = 9$$

$$9 = 9$$

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

$$48. \quad 13 - 3r + 2 + 6r - 2r - 1 = 3 + 2 \cdot 9$$

$$(-3r + 6r - 2r) + (13 + 2 - 1) = 3 + 18$$

$$r + 14 = 21$$

$$r + 14 - 14 = 21 - 14$$

$$r = 7$$

Check:

$$13 - 3(7) + 2 + 6(7) - 2(7) - 1 = 3 + 2 \cdot 9$$

$$13 - 21 + 2 + 42 - 14 - 1 = 3 + 18$$

$$21 = 21$$

The solution set is $\{7\}$.

$$50. \quad 4r - 3 = 5 + 3r$$

$$4r - 3 - 3r = 5 + 3r - 3r$$

$$r - 3 = 5$$

$$r - 3 + 3 = 5 + 3$$

$$r = 8$$

Check:

$$4(8) - 3 = 5 + 3(8)$$

$$32 - 3 = 5 + 24$$

$$29 = 29$$

The solution set is $\{8\}$.

$$52. \quad 20 - 7s = 26 - 8s$$

$$20 - 7s + 8s = 26 - 8s + 8s$$

$$20 + s = 26$$

$$20 - 20 + s = 26 - 20$$

$$s = 6$$

Check:

$$20 - 7(6) = 26 - 8(6)$$

$$20 - 42 = 26 - 48$$

$$-22 = -22$$

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

54. $7x + 3 = 6(x - 1) + 9$

$$7x + 3 = 6x - 6 + 9$$

$$7x + 3 = 6x + 3$$

$$x + 3 = 3$$

$$x = 0$$

Check:

$$7(0) + 3 = 6(0 - 1) + 9$$

$$0 + 3 = 6(-1) + 9$$

$$3 = -6 + 9$$

$$3 = 3$$

The solution set is $\{0\}$.

56. $x + \square = \Delta$

$$x + \square - \square = \Delta - \square$$

$$x = \Delta - \square$$

58. $6x - \Delta = 7x - \square$

$$6x - \Delta - 6x = 7x - \square - 6x$$

$$-\Delta = x - \square$$

$$-\Delta + \square = x - \square + \square$$

$$\square - \Delta = x$$

60. $x - 23 = -8$

$$x - 23 + 23 = -8 + 23$$

$$x = 15$$

The number is 15.

62. $3 - \frac{2}{7}x = \frac{5}{7}x$

$$3 - \frac{2}{7}x + \frac{2}{7}x = \frac{5}{7}x + \frac{2}{7}x$$

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

$$3 = x$$

The number is 3.

64. $C = 520, S = 650$

$$C + M = S$$

$$520 + M = 650$$

$$M = 650 - 520$$

$$M = 130$$

The markup is \$130.

66. $d - 257x = 8328$

$$d - 257(7) = 8328$$

$$d - 1799 = 8328$$

$$d - 1799 + 1799 = 8328 + 1799$$

$$d = 10,127$$

According to the formula, the average credit-card debt per U.S. household was \$10,127 in 2007.

This underestimates the value given in the bar graph by \$287.

68. a. According to the line graph, the U.S. diversity index was about 47 in 2000.

b. 2000 is 20 years after 1980.

$$I - 0.6x = 34$$

$$I - 0.6(20) = 34$$

$$I - 12 = 34$$

$$I - 12 + 12 = 34 + 12$$

$$I = 46$$

According to the formula, the U.S. diversity index was 46 in 2000.

This matches the line graph very well.

70. Answers will vary.

72. The adjective linear means that the points lie on a line.

74. makes sense

76. makes sense

78. false; Changes to make the statement true will vary. A sample change is: If $y + 7 = 0$, then $y = -7$.

80. false; Changes to make the statement true will vary. A sample change is: If $3x = 18$, then $x = \frac{18}{3} = 6$.

82. $x - 7.0463 = -9.2714$

$$x = -9.2714 + 7.0463$$

$$x = -2.2251$$

The solution set is $\{-2.2251\}$.

84. $\frac{9}{x} - 4x$

$$\begin{aligned} 85. \quad -16 - 8 \div 4 \cdot (-2) &= -16 - 2 \cdot (-2) \\ &= -16 + (-2)(-2) \\ &= -16 + 4 \\ &= -12 \end{aligned}$$

$$\begin{aligned}
 86. \quad 3[7x - 2(5x - 1)] &= 3[7x - 10x + 2] \\
 &= 3[-3x + 2] \\
 &= -9x + 6 \text{ or } 6 - 9x
 \end{aligned}$$

$$87. \quad 5 \cdot \frac{x}{5} = \frac{5}{1} \cdot \frac{x}{5} = x$$

$$88. \quad \frac{-7y}{-7} = y$$

$$\begin{aligned}
 89. \quad 3x - 14 &= -2x + 6 \\
 3(4) - 14 &= -2(4) + 6 \\
 12 - 14 &= -8 + 6 \\
 -2 &= -2, \text{ true}
 \end{aligned}$$

Yes, 4 is a solution of the equation.

2.2 Check Points

$$1. \quad \frac{x}{3} = 12$$

$$3 \cdot \frac{x}{3} = 12 \cdot 3$$

$$1x = 36$$

$$x = 36$$

Check:

$$\frac{x}{3} = 12$$

$$\frac{36}{3} = 12$$

$$12 = 12$$

The solution set is $\{36\}$.

$$2. \quad \text{a.} \quad 4x = 84$$

$$\frac{4x}{4} = \frac{84}{4}$$

$$1x = 21$$

$$x = 21$$

The solution set is $\{21\}$.

$$\text{b.} \quad -11y = 44$$

$$\frac{-11y}{-11} = \frac{44}{-11}$$

$$1x = -4$$

$$x = -4$$

The solution set is $\{-4\}$.

$$\text{c.} \quad -15.5 = 5z$$

$$\frac{-15.5}{5} = \frac{5z}{5}$$

$$-3.1 = 1z$$

$$-3.1 = z$$

The solution set is $\{-3.1\}$.

$$3. \quad \text{a.} \quad \frac{2}{3}y = 16$$

$$\frac{3}{2}\left(\frac{2}{3}y\right) = \frac{3}{2} \cdot 16$$

$$1y = 24$$

$$y = 24$$

The solution set is $\{24\}$.

$$\text{b.} \quad 28 = -\frac{7}{4}x$$

$$-\frac{4}{7} \cdot 28 = -\frac{4}{7}\left(-\frac{7}{4}x\right)$$

$$-16 = 1x$$

$$-16 = x$$

The solution set is $\{-16\}$.

$$4. \quad \text{a.} \quad -x = 5$$

$$-1x = 5$$

$$(-1)(-1x) = (-1)5$$

$$1x = -5$$

$$x = -5$$

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

$$\text{b.} \quad -x = -3$$

$$-1x = -3$$

$$(-1)(-1x) = (-1)(-3)$$

$$1x = 3$$

$$x = 3$$

The solution set is $\{3\}$.

$$5. \quad 4x + 3 = 27$$

$$4x + 3 - 3 = 27 - 3$$

$$4x = 24$$

$$\frac{4x}{4} = \frac{24}{4}$$

$$x = 6$$

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

$$\begin{aligned}
 6. \quad & -4y - 15 = 25 \\
 & -4y - 15 + 15 = 25 + 15 \\
 & -4y = 40 \\
 & \frac{-4y}{-4} = \frac{40}{-4} \\
 & y = -10
 \end{aligned}$$

The solution set is $\{-10\}$.

$$\begin{aligned}
 7. \quad & 2x - 15 = -4x + 21 \\
 & 2x + 4x - 15 = -4x + 4x + 21 \\
 & 6x - 15 = 21 \\
 & 6x - 15 + 15 = 21 + 15 \\
 & 6x = 36 \\
 & \frac{6x}{6} = \frac{36}{6} \\
 & x = 6
 \end{aligned}$$

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

8. a. The bar graph indicates that the price of a Westie puppy was \$2000 in 2009. Since 2009 is 69 years after 1940, substitute 69 into the formula for n .
- $$P = 18n + 765$$
- $$P = 18(69) + 765$$
- $$P = 1242 + 765$$
- $$P = 2007$$
- The formula indicates that the price of a Westie puppy was \$2007 in 2009.
The formula overestimates by \$7.

b.

$$P = 18n + 765$$

$$2151 = 18n + 765$$

$$2151 - 765 = 18n + 765 - 765$$

$$1386 = 18n$$

$$\frac{1386}{18} = \frac{18n}{18}$$

$$77 = n$$

The formula estimates that the price will be \$2151 for a Westie puppy 77 years after 1940, or in 2017.

4. dividing; -8
Alternatively, multiplying; $-\frac{1}{8}$

5. multiplying; $\frac{5}{3}$

6. multiplying/dividing; -1

7. subtracting 2; dividing; 5

2.2 Exercise Set

2. $\frac{x}{7} = 4$

$$7 \cdot \frac{x}{7} = 7 \cdot 4$$

$$x = 28$$

Check:

$$\frac{28}{7} = 4$$

$$4 = 4$$

The solution set is $\{28\}$.

4. $\frac{x}{-5} = 8$

$$-5 \cdot \frac{x}{-5} = 8(-5)$$

$$x = -40$$

Check:

$$\frac{-40}{-5} = 8$$

$$8 = 8$$

The solution set is $\{-40\}$.

6. $6y = 42$

$$\frac{6y}{6} = \frac{42}{6}$$

$$y = 7$$

Check:

$$6(7) = 42$$

$$42 = 42$$

The solution set is $\{7\}$.

2.2 Concept and Vocabulary Check

1. bc
2. divide
3. multiplying; 7

8. $-4y = 32$

$$\frac{-4y}{-4} = \frac{32}{-4}$$

$$y = -8$$

Check:

$$-4(-8) = 32$$

$$32 = 32$$

The solution set is $\{-8\}$.

10. $-36 = 8z$

$$\frac{-36}{8} = \frac{8z}{8}$$

$$-\frac{9}{2} = z$$

Check:

$$-36 = 8\left(-\frac{9}{2}\right)$$

$$-36 = -36$$

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

12. $-54 = -9z$

$$\frac{-54}{-9} = \frac{-9z}{-9}$$

$$6 = z$$

Check:

$$-54 = -9(6)$$

$$-54 = -54$$

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

14. $-8x = 4$

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

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

Check:

$$-8\left(-\frac{1}{2}\right) = 4$$

$$4 = 4$$

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

16. $-16y = 0$

$$\frac{-16y}{-16} = \frac{0}{-16}$$

$$y = 0$$

Check:

$$-16(0) = 0$$

$$0 = 0$$

The solution set is $\{0\}$.

18. $\frac{3}{4}y = 15$

$$\frac{4}{3}\left(\frac{3}{4}y\right) = \frac{4}{3}(15)$$

$$1y = \frac{4}{3} \cdot \frac{15}{1} = \frac{60}{3}$$

$$y = 20$$

Check:

$$\frac{3}{4}(20) = 15$$

$$\frac{3}{4} \cdot \frac{20}{1} = 15$$

$$\frac{60}{4} = 15$$

$$15 = 15$$

The solution set is $\{20\}$.

20. $20 = -\frac{5}{8}x$

$$-\frac{8}{5}(20) = -\frac{8}{5}\left(-\frac{5}{8}x\right)$$

$$-\frac{160}{5} = 1x$$

$$-32 = x$$

Check:

$$20 = -\frac{5}{8}(-32)$$

$$20 = \frac{160}{8}$$

$$20 = 20$$

The solution set is $\{-32\}$.

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

Check:

$$\begin{aligned}
 -(-23) &= 23 \\
 23 &= 23
 \end{aligned}$$

The solution set is $\{-23\}$.

$$\begin{aligned}
 24. \quad & -51 = -y \\
 & \frac{-51}{-1} = \frac{-y}{-1} \\
 & 51 = y
 \end{aligned}$$

Check:

$$-51 = -51$$

The solution set is $\{51\}$.

$$\begin{aligned}
 26. \quad & -\frac{x}{5} = -1 \\
 & -5\left(-\frac{x}{5}\right) = -5(-1) \\
 & x = 5
 \end{aligned}$$

Check:

$$\begin{aligned}
 -\frac{5}{5} &= -1 \\
 -1 &= -1
 \end{aligned}$$

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

$$\begin{aligned}
 28. \quad & 8x - 3x = -45 \\
 & 8x + (-3x) = -45 \\
 & 5x = -45 \\
 & \frac{5x}{5} = \frac{-45}{5} \\
 & x = -9
 \end{aligned}$$

Check:

$$\begin{aligned}
 8(-9) - 3(-9) &= -45 \\
 -72 + 27 &= -45 \\
 -45 &= -45
 \end{aligned}$$

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

$$\begin{aligned}
 30. \quad & 2x + 5 = 13 \\
 & 2x + 5 - 5 = 13 - 5 \\
 & 2x = 8 \\
 & \frac{2x}{2} = \frac{8}{2} \\
 & x = 4
 \end{aligned}$$

Check:

$$\begin{aligned}
 2(4) + 5 &= 13 \\
 8 + 5 &= 13 \\
 13 &= 13
 \end{aligned}$$

The solution set is $\{4\}$.

$$\begin{aligned}
 32. \quad & 3x - 2 = 9 \\
 & 3x - 2 + 2 = 9 + 2 \\
 & 3x = 11 \\
 & \frac{3x}{3} = \frac{11}{3} \\
 & x = \frac{11}{3}
 \end{aligned}$$

Check:

$$\begin{aligned}
 3\left(\frac{11}{3}\right) &= 9 \\
 11 - 2 &= 9 \\
 9 &= 9
 \end{aligned}$$

The solution set is $\left\{\frac{11}{3}\right\}$.

$$\begin{aligned}
 34. \quad & -3y + 4 = 13 \\
 & -3y + 4 - 4 = 13 - 4 \\
 & -3y = 9 \\
 & \frac{-3y}{-3} = \frac{9}{-3} \\
 & y = -3
 \end{aligned}$$

Check:

$$\begin{aligned}
 -3(-3) + 4 &= 13 \\
 9 + 4 &= 13 \\
 13 &= 13
 \end{aligned}$$

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

$$\begin{aligned}
 36. \quad & -2y - 5 = 7 \\
 & -2y - 5 + 5 = 7 + 5 \\
 & -2y = 12 \\
 & \frac{-2y}{-2} = \frac{12}{-2} \\
 & y = -6
 \end{aligned}$$

Check:

$$\begin{aligned}
 & -2(-6) - 5 = 7 \\
 & 12 - 5 = 7 \\
 & 7 = 7
 \end{aligned}$$

The solution set is $\{-6\}$.

$$\begin{aligned}
 38. \quad & 14 = 5z - 21 \\
 & 14 + 21 = 5z - 21 + 21 \\
 & 35 = 5z \\
 & \frac{35}{5} = \frac{5z}{5} \\
 & 7 = z
 \end{aligned}$$

Check:

$$\begin{aligned}
 & 14 = 5(7) - 21 \\
 & 14 = 35 - 21 \\
 & 14 = 14
 \end{aligned}$$

The solution set is $\{7\}$.

$$\begin{aligned}
 40. \quad & -x - 5 = 5 \\
 & -x - 5 + 5 = 5 + 5 \\
 & -x = 10 \\
 & x = -10
 \end{aligned}$$

Check:

$$\begin{aligned}
 & -(-10) - 5 = 5 \\
 & 10 - 5 = 5 \\
 & 5 = 5
 \end{aligned}$$

The solution set is $\{-10\}$.

$$\begin{aligned}
 42. \quad & 8y = 3y - 10 \\
 & 8y - 3y = 3y - 10 - 3y \\
 & 5y = -10 \\
 & \frac{5y}{5} = \frac{-10}{5} \\
 & y = -2
 \end{aligned}$$

Check:

$$\begin{aligned}
 & 8(-2) = 3(-2) - 10 \\
 & -16 = -6 - 10 \\
 & -16 = -16
 \end{aligned}$$

The solution set is $\{-2\}$.

$$\begin{aligned}
 44. \quad & 2z = -4z + 18 \\
 & 2z + 4z = -4z + 18 + 4z \\
 & 6z = 18 \\
 & \frac{6z}{6} = \frac{18}{6} \\
 & z = 3
 \end{aligned}$$

Check:

$$\begin{aligned}
 & 2(3) = -4(3) + 18 \\
 & 6 = -12 + 18 \\
 & 6 = 6
 \end{aligned}$$

The solution set is $\{3\}$.

$$\begin{aligned}
 46. \quad & -7x = -3x - 8 \\
 & -7x + 3x = -3x - 8 + 3x \\
 & -4x = -8 \\
 & \frac{-4x}{-4} = \frac{-8}{-4} \\
 & x = 2
 \end{aligned}$$

Check:

$$\begin{aligned}
 & -7(2) = -3(2) - 8 \\
 & -14 = -6 - 8 \\
 & -14 = -14
 \end{aligned}$$

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

$$\begin{aligned}
 48. \quad & 5y + 6 = 3y - 6 \\
 & 5y + 6 - 3y = 3y - 6 - 3y \\
 & 2y + 6 = -6 \\
 & 2y + 6 - 6 = -6 - 6 \\
 & 2y = -12 \\
 & \frac{2y}{2} = \frac{-12}{2} \\
 & y = -6
 \end{aligned}$$

Check:

$$\begin{aligned}
 & 5(-6) + 6 = 3(-6) - 6 \\
 & -30 + 6 = -18 - 6 \\
 & -24 = -24
 \end{aligned}$$

The solution set is $\{-6\}$.

$$\begin{aligned}
 50. \quad 6z - 3 &= z + 2 \\
 6z - 3 - z &= z + 2 - z \\
 5z - 3 &= 2 \\
 5z - 3 + 3 &= 2 + 3 \\
 5z &= 5 \\
 \frac{5z}{5} &= \frac{5}{5} \\
 z &= 1
 \end{aligned}$$

Check:

$$\begin{aligned}
 6(1) - 3 &= 1 + 2 \\
 6 - 3 &= 3 \\
 3 &= 3
 \end{aligned}$$

The solution set is $\{1\}$.

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

Check:

$$\begin{aligned}
 9(-2) + 2 &= 6(-2) - 4 \\
 -18 + 2 &= -12 - 4 \\
 -16 &= -16
 \end{aligned}$$

The solution set is $\{-2\}$.

$$\begin{aligned}
 54. \quad -3y - 2 &= -5 - 4y \\
 -3y - 2 + 4y &= -5 - 4y + 4y \\
 y - 2 &= -5 \\
 y - 2 + 2 &= -5 + 2 \\
 y &= -3
 \end{aligned}$$

Check:

$$\begin{aligned}
 -3(-3) - 2 &= -5 - 4(-3) \\
 9 - 2 &= -5 + 12 \\
 7 &= 7
 \end{aligned}$$

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

$$\begin{aligned}
 56. \quad \Delta &= \square x \\
 \frac{\Delta}{\square} &= \frac{\square x}{\square} \\
 \frac{\Delta}{\square} &= x
 \end{aligned}$$

$$\begin{aligned}
 58. \quad \frac{-x}{\square} &= \Delta \\
 -\square \cdot \frac{-x}{\square} &= -\square \cdot \Delta \\
 x &= -\square \cdot \Delta
 \end{aligned}$$

$$\begin{aligned}
 60. \quad -6 \cdot x &= 20 \\
 \frac{-6x}{-6} &= \frac{20}{-6} \\
 x &= -\frac{10}{3} \\
 \text{The number is } &-\frac{10}{3}.
 \end{aligned}$$

$$\begin{aligned}
 62. \quad \frac{x}{-7} &= 8 \\
 -7 \cdot \frac{x}{-7} &= -7 \cdot 8 \\
 x &= -56 \\
 \text{The number is } &-56.
 \end{aligned}$$

$$\begin{aligned}
 64. \quad 3x - 10 &= 23 \\
 3x - 10 + 10 &= 23 + 10 \\
 3x &= 33 \\
 \frac{3x}{3} &= \frac{33}{3} \\
 x &= 11 \\
 \text{The number is } &11.
 \end{aligned}$$

$$\begin{aligned}
 66. \quad -5x + 11 &= -29 \\
 -5x + 11 - 11 &= -29 - 11 \\
 -5x &= -40 \\
 \frac{-5x}{-5} &= \frac{-40}{-5} \\
 x &= 8 \\
 \text{The number is } &8.
 \end{aligned}$$

$$\begin{aligned}
 68. \quad M &= \frac{n}{5} \\
 3 &= \frac{n}{5} \\
 5(3) &= 5\left(\frac{n}{5}\right)
 \end{aligned}$$

$$15 = n$$

If you are 3 miles away from the lightning flash, it will take 15 seconds for the sound of thunder to reach you.

$$70. \quad M = \frac{A}{740}$$

$$3.3 = \frac{A}{740}$$

$$740(3.3) = 740 \cdot \frac{A}{740}$$

$$2442 = A$$

The speed of the SR-71 Blackbird is 2442 miles per hour.

72. a. The bar graph indicates that the average nightly hotel room rate was \$98.

Since 2009 is 106 years after 1903, substitute 106 into the formula for n .

$$H = 0.5n + 50$$

$$H = 0.5(106) + 50$$

$$H = 53 + 50$$

$$H = 103$$

The formula indicates that the average nightly hotel room rate was \$103 in 2009.

The formula overestimates by \$5.

b. $H = 0.5n + 50$

$$110 = 0.5n + 50$$

$$110 - 50 = 0.5n + 50 - 50$$

$$60 = 0.5n$$

$$60 = 0.5n$$

$$\frac{60}{0.5} = \frac{0.5n}{0.5}$$

$$120 = n$$

The formula estimates that \$110 will be the cost of the average nightly hotel room rate 120 years after 1903, or 2023.

74. Answers will vary.

76. does not make sense; Explanations will vary.
Sample explanation: The addition property of equality is not necessary for this equation.

78. makes sense

80. false; Changes to make the statement true will vary.

A sample change is: If $7x = 21$, then $\frac{7x}{7} = \frac{21}{7} = 3$.

82. false; Changes to make the statement true will vary.

A sample change is: If $3x + 7 = 0$, then

$$3x = -7 \text{ and } x = \frac{-7}{3}.$$

84. Answers will vary. Start by selecting the integer answer and set x equal to this value. Then, multiply both sides of this equation by -60 (since we will divide both sides of the equation by -60 to solve). For example, suppose we want the solution to be 3. We set x equal to this value and write $x = 3$.

Now multiply both sides of the equation by -60 .

$$x = 3$$

$$-60 \cdot x = -60 \cdot 3$$

$$-60x = -180$$

So, our equation is $-60x = -180$ and the solution is 3 (an integer).

86. $3.7x - 19.46 = -9.988$

$$3.7x = -9.988 + 19.46$$

$$3.7x = 9.472$$

$$\frac{3.7x}{3.7} = \frac{9.472}{3.7}$$

$$x = 2.56$$

The solution set is $\{2.56\}$.

88. $(-10)^2 = (-10)(-10) = 100$

89. $-10^2 = -1 \cdot 10^2 = -1(10)(10) = -100$

90. $x^3 - 4x = (-1)^3 - 4(-1)$
 $= -1 + 4$
 $= 3$

91. $13 - 3(x + 2) = 13 - 3x - 6$
 $= -3x + 7$

92. $2(x - 3) - 17 = 13 - 3(x + 2)$
 $2(6 - 3) - 17 = 13 - 3(6 + 2)$
 $2(3) - 17 = 13 - 3(8)$
 $6 - 17 = 13 - 24$
 $-11 = -11, \text{ true}$

Yes, 6 is a solution of the equation.

93. $10\left(\frac{x}{5} - \frac{39}{5}\right) = 10 \cdot \frac{x}{5} - 10 \cdot \frac{39}{5}$
 $= 2x - 78$

2.3 Check Points

1. Simplify the algebraic expression on each side.

$$-7x + 25 + 3x = 16 - 2x - 3$$

$$-4x + 25 = 13 - 2x$$

Collect variable terms on one side and constant terms on the other side.

$$-4x + 25 = 13 - 2x$$

$$-4x + 25 + 2x = 13 - 2x + 2x$$

$$-2x + 25 = 13$$

$$-2x + 25 - 25 = 13 - 25$$

$$-2x = -12$$

Isolate the variable and solve.

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

$$x = 6$$

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

2. Simplify the algebraic expression on each side.

$$8x = 2(x + 6)$$

$$8x = 2x + 12$$

Collect variable terms on one side and constant terms on the other side.

$$8x - 2x = 2x - 2x + 12$$

$$6x = 12$$

Isolate the variable and solve.

$$\frac{6x}{6} = \frac{12}{6}$$

$$x = 2$$

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

3. Simplify the algebraic expression on each side.

$$4(2x + 1) - 29 = 3(2x - 5)$$

$$8x + 4 - 29 = 6x - 15$$

$$8x - 25 = 6x - 15$$

Collect variable terms on one side and constant terms on the other side.

$$8x - 6x - 25 = 6x - 6x - 15$$

$$2x - 25 = -15$$

$$2x - 25 + 25 = -15 + 25$$

$$2x = 10$$

Isolate the variable and solve.

$$\frac{2x}{2} = \frac{10}{2}$$

$$x = 5$$

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

4. Begin by multiplying both sides of the equation by 12, the least common denominator.

$$\frac{x}{4} = \frac{2x}{3} + \frac{5}{6}$$

$$12 \cdot \frac{x}{4} = 12 \left(\frac{2x}{3} + \frac{5}{6} \right)$$

$$12 \cdot \frac{x}{4} = 12 \cdot \frac{2x}{3} + 12 \cdot \frac{5}{6}$$

$$3x = 8x + 10$$

$$3x - 8x = 8x - 8x + 10$$

$$-5x = 10$$

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

$$x = -2$$

The solution set is $\{-2\}$.

5. First apply the distributive property to remove the parentheses, and then multiply both sides by 100 to clear the decimals.

$$0.48x + 3 = 0.2(x - 6)$$

$$0.48x + 3 = 0.2x - 1.2$$

$$100(0.48x + 3) = 100(0.2x - 1.2)$$

$$48x + 300 = 20x - 120$$

$$48x + 300 - 300 = 20x - 120 - 300$$

$$48x = 20x - 420$$

$$48x - 20x = 20x - 20x - 420$$

$$28x = -420$$

$$\frac{28x}{28} = \frac{-420}{28}$$

$$x = -15$$

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

- 6.
- $3x + 7 = 3(x + 1)$

$$3x + 7 = 3x + 3$$

$$3x - 3x + 7 = 3x - 3x + 3$$

$$7 = 3$$

The original equation is equivalent to the false statement $7 = 3$.

The equation has no solution. The solution set is $\{ \}$.

7. $3(x-1)+9=8x+6-5x$

$$3x-3+9=3x+6$$

$$3x+6=3x+6$$

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

$$6=6$$

The original equation is equivalent to $6=6$, which is true for every value of x .

The equation's solution is all real numbers or $\{x \mid x \text{ is a real number}\}$.

8. $D = \frac{10}{9}x + \frac{53}{9}$

$$10 = \frac{10}{9}x + \frac{53}{9}$$

$$9 \cdot 10 = 9 \left(\frac{10}{9}x + \frac{53}{9} \right)$$

$$90 = 10x + 53$$

$$90 - 53 = 10x + 53 - 53$$

$$37 = 10x$$

$$\frac{37}{10} = \frac{10x}{10}$$

$$3.7 = x$$

$$x = 3.7$$

The formula indicates that if the low-humor group averages a level of depression of 10 in response to a negative life event, the intensity of that event is 3.7. This is shown as the point whose corresponding value on the vertical axis is 10 and whose value on the horizontal axis is 3.7.

2.3 Concept and Vocabulary Check

1. simplify each side; combine like terms
2. 30
3. 100
4. inconsistent
5. identity
6. inconsistent
7. identity

2.3 Exercise Set

2. $4x+8x-2x=20-15$

$$10x=5$$

$$x = \frac{5}{10} = \frac{1}{2}$$

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

4. $3x+2x+64=40-7x$

$$5x+64=40-7x$$

$$12x+64=40$$

$$12x=-24$$

$$x=-2$$

The solution set is $\{-2\}$.

6. $3x+2-x=6+3x-8$

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

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

$$-x+2=-2$$

$$-x+2-2=-2-2$$

$$-x=-4$$

$$x=4$$

The solution set is $\{4\}$.

8. $3(x-2)=-6$

$$3x-6=-6$$

$$3x=0$$

$$x=0$$

The solution set is $\{0\}$.

10. $4(2x-3)=32$

$$8x-12=32$$

$$8x=44$$

$$x = \frac{44}{8} = \frac{11}{2}$$

The solution set is $\left\{\frac{11}{2}\right\}$.

$$12. \quad 20 = 44 - 8(2 - x)$$

$$20 = 44 - 16 + 8x$$

$$20 = 28 + 8x$$

$$-8 = 8x$$

$$-1 = x$$

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

$$14. \quad 3(3z + 5) - 7 = 89$$

$$9z + 15 - 7 = 89$$

$$9z + 8 = 89$$

$$9z = 81$$

$$z = 9$$

The solution set is $\{9\}$.

$$16. \quad 5x - (2x + 14) = 10$$

$$5x - 2x - 14 = 10$$

$$3x - 14 = 10$$

$$3x = 24$$

$$x = 8$$

The solution set is $\{8\}$.

$$18. \quad 3(x + 2) = x + 30$$

$$3x + 6 = x + 30$$

$$2x + 6 = 30$$

$$2x = 24$$

$$x = 12$$

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

$$20. \quad 3(3x - 1) = 4(3 + 3x)$$

$$9x - 3 = 12 + 12x$$

$$-3 - 3 = 12$$

$$-3x = 15$$

$$x = -5$$

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

$$22. \quad 8(y + 3) = 3(2y + 12)$$

$$8y + 24 = 6y + 36$$

$$2y + 24 = 36$$

$$2y = 12$$

$$y = 6$$

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

$$24. \quad 5x - 4(x + 9) = 2x - 3$$

$$5x - 4x - 36 = 2x - 3$$

$$x - 36 = 2x - 3$$

$$x = 2x + 33$$

$$-x = 33$$

$$x = -33$$

The solution set is $\{-33\}$.

$$26. \quad 7(3x - 2) + 5 = 6(2x - 1) + 24$$

$$21x - 14 + 5 = 12x - 6 + 24$$

$$21x - 9 = 12x + 18$$

$$21x = 12x + 27$$

$$9x = 27$$

$$x = 3$$

The solution set is $\{3\}$.

$$28. \quad 100 = -(x - 1) + 4(x - 6)$$

$$100 = -x + 1 + 4x - 24$$

$$100 = 3x - 23$$

$$123 = 3x$$

$$41 = x$$

The solution set is $\{41\}$.

$$30. \quad -2(z - 4) - (3z - 2) = -2 - (6z - 2)$$

$$-2z + 8 - 3z + 2 = -2 - 6z + 2$$

$$-5z + 10 = -6z$$

$$z + 10 = 0$$

$$z = -10$$

The solution set is $\{-10\}$.

$$32. \quad \frac{x}{2} + 13 = -22$$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 2.

$$\frac{x}{2} + 13 = -22$$

$$2\left(\frac{x}{2} + 13\right) = 2(-22)$$

$$2 \cdot \frac{x}{2} + 2 \cdot 13 = -44$$

$$x + 26 = -44$$

$$x + 26 - 26 = -44 - 26$$

$$x = -70$$

The solution set is $\{-70\}$.

34. $\frac{3x}{4} - 9 = -6$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 4.

$$4\left(\frac{3x}{4} - 9\right) = 4(-6)$$

$$4 \cdot \frac{3x}{4} - 4 \cdot 9 = -24$$

$$3x - 36 = -24$$

$$3x = 12$$

$$x = 4$$

The solution set is $\{4\}$.

36. $\frac{3y}{4} - \frac{2}{3} = \frac{7}{12}$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 12.

$$12\left(\frac{3y}{4} - \frac{2}{3}\right) = 12\left(\frac{7}{12}\right)$$

$$12\left(\frac{3y}{4}\right) - 12\left(\frac{2}{3}\right) = 7$$

$$9y - 8 = 7$$

$$9y = 15$$

$$y = \frac{15}{9} = \frac{5}{3}$$

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

38. $\frac{x}{4} - \frac{x}{5} = 1$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 20.

$$20\left(\frac{x}{4} - \frac{x}{5}\right) = 20(1)$$

$$5x - 4x = 20$$

$$x = 20$$

The solution set is $\{20\}$.

40. $\frac{z}{5} - \frac{1}{2} = \frac{z}{6}$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 30.

$$30\left(\frac{z}{5} - \frac{1}{2}\right) = 30\left(\frac{z}{6}\right)$$

$$6z - 15 = 5z$$

$$z - 15 = 0$$

$$z = 15$$

The solution set is $\{15\}$.

42. $\frac{y}{12} + \frac{1}{6} = \frac{y}{2} - \frac{1}{4}$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 12.

$$12\left(\frac{y}{12} + \frac{1}{6}\right) = 12\left(\frac{y}{2} - \frac{1}{4}\right)$$

$$y + 2 = 6y - 3$$

$$-5y + 2 = -3$$

$$-5y = -5$$

$$y = 1$$

The solution set is $\{1\}$.

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

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 15.

$$15\left(\frac{3x}{5} - \frac{2}{5}\right) = 15\left(\frac{x}{3} + \frac{2}{5}\right)$$

$$9x - 6 = 5x + 6$$

$$4x - 6 = 6$$

$$4x = 12$$

$$x = 3$$

The solution set is $\{3\}$.

46. $\frac{x-2}{3} - 4 = \frac{x+1}{4}$

To clear the equation of fractions, multiply both sides by the least common denominator (LCD), which is 12.

$$\begin{aligned} 12\left(\frac{x-2}{3}\right) - 12(4) &= 12\left(\frac{x+1}{4}\right) \\ 4(x-2) - 48 &= 3(x+1) \\ 4x - 8 - 48 &= 3x + 3 \\ 4x - 56 &= 3x + 3 \\ x - 56 &= 3 \\ x &= 59 \end{aligned}$$

The solution set is $\{59\}$.

48. $1.2x - 3.6 = 2.4 - 0.3x$

To clear the equation of decimals, multiply both sides by 10.

$$\begin{aligned} 10(1.2x - 3.6) &= 10(2.4 - 0.3x) \\ 12x - 36 &= 24 - 3x \\ 12x &= 60 - 3x \\ 15x &= 60 \\ x &= 4 \end{aligned}$$

The solution set is $\{4\}$.

50. $0.15y - 0.1 = 2.5y - 1.04$

To clear the equation of decimals, multiply both sides by 100.

$$\begin{aligned} 100(0.15y - 0.1) &= 100(2.5y - 1.04) \\ 15y - 10 &= 250y - 104 \\ 15y &= 250y - 94 \\ -235y &= -94 \\ y &= 0.4 \end{aligned}$$

The solution set is $\{0.4\}$.

52. $0.1(x + 80) = 14 - 0.2x$

$$0.1x + 8 = 14 - 0.2x$$

To clear the equation of decimals, multiply both sides by 10.

$$\begin{aligned} 10(0.1x + 8) &= 10(14 - 0.2x) \\ x + 80 &= 140 - 2x \\ x &= 60 - 2x \\ 3x &= 60 \\ x &= 20 \end{aligned}$$

The solution set is $\{20\}$.

54. $1.4(z - 5) - 0.2 = 0.5(6z - 8)$

$$1.4z - 7 - 0.2 = 3z - 4$$

$$1.4z - 7.2 = 3z - 4$$

To clear the equation of decimals, multiply both sides by 10.

$$\begin{aligned} 10(1.4z - 7.2) &= 10(3z - 4) \\ 14z - 72 &= 30z - 40 \\ 14z &= 30z + 32 \\ -16z &= 32 \\ z &= -2 \end{aligned}$$

The solution set is $\{-2\}$.

56. $0.02(x - 2) = 0.06 - 0.01(x + 1)$

$$0.02x - 0.04 = 0.06 - 0.01x - 0.01$$

$$0.02x - 0.04 = -0.01x + 0.05$$

To clear the equation of decimals, multiply both sides by 100.

$$\begin{aligned} 100(0.02x - 0.04) &= 100(-0.01x + 0.05) \\ 2x - 4 &= -x + 5 \\ 2x &= -x + 9 \\ 3x &= 9 \\ x &= 3 \end{aligned}$$

The solution set is $\{3\}$.

58. $0.05(7x + 36) = 0.4x + 1.2$

$$0.35x + 1.8 = 0.4x + 1.2$$

To clear the equation of decimals, multiply both sides by 100.

$$\begin{aligned} 100(0.35x + 1.8) &= 100(0.4x + 1.2) \\ 35x + 180 &= 40x + 120 \\ 35x &= 40x - 60 \\ -5x &= -60 \\ x &= 12 \end{aligned}$$

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

60. $2(x - 5) = 2x + 10$

$$2x - 10 = 2x + 10$$

$$2x - 10 - 2x = 2x + 10 - 2x$$

$$-10 = 10$$

The original equation is equivalent to the false statement $-10 = 10$, so the equation is inconsistent and has no solution.

The solution set is $\{\}$.

$$62. \quad 3(x-1) = 8x+6-5x-9$$

$$3x-3 = 3x-3$$

$$3x-3-3x = 3x-3-3x$$

$$-3 = -3$$

The original equation is equivalent to the true statement $-3 = -3$, so the equation is an identity and the solution set is all real numbers $\{x|x \text{ is a real number}\}$.

$$64. \quad 2+3(2x-7) = 9-4(3x+1)$$

$$2+6x-21 = 9-12x-4$$

$$6x-19 = -12x+5$$

$$18x-19 = 5$$

$$18x = 24$$

$$x = \frac{24}{18} = \frac{4}{3}$$

The solution set is $\left\{\frac{4}{3}\right\}$.

$$66. \quad 5x-5 = 3x-7+2(x+1)$$

$$5x-5 = 3x-7+2x+2$$

$$5x-5 = 5x-5$$

$$5x-5-5x = 5x-5-5x$$

$$-5 = -5$$

The original equation is equivalent to the true statement $-5 = -5$, so the equation is an identity and the solution set is all real numbers $\{x|x \text{ is a real number}\}$.

$$68. \quad 5x-3(x+1) = 2(x+3)-5$$

$$5x-3x-3 = 2x+6-5$$

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

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

$$-3 = 1$$

Since $-3 = 1$ is a false statement, the original equation is inconsistent and has no solution. The solution set is $\{\}$.

$$70. \quad 5-x = 4x+5$$

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

$$-5x+5 = 5$$

$$-5x = 0$$

$$\frac{-5x}{-5} = \frac{0}{-5}$$

$$x = 0$$

The solution set is $\{0\}$.

$$72. \quad \frac{x}{4} + 3 = \frac{x}{4}$$

Multiply by the LCD, which is 4.

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

$$x+12 = x$$

$$x+12-x = x-x$$

$$12 = 0$$

Since $12 = 0$ is a false statement, the original equation has no solution. The solution set is $\{\}$.

$$74. \quad \frac{x}{2} + \frac{2x}{3} + 3 = x+3$$

Multiply both sides by the LCD which is 6.

$$6\left(\frac{x}{2} + \frac{2x}{3} + 3\right) = 6(x+3)$$

$$3x+4x+18 = 6x+18$$

$$7x+18 = 6x+18$$

$$x+18 = 18$$

$$x = 0$$

The solution set is $\{0\}$.

$$76. \quad \frac{2}{3}x = \frac{1}{4}x - 8$$

Multiply both sides by the LCD which is 12.

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

$$8x = 3x - 96$$

$$5x = -96$$

$$x = -\frac{96}{5}$$

The solution set is $\left\{-\frac{96}{5}\right\}$.

78. $0.04(x - 2) = 0.02(6x - 3) - 0.02$

$$0.04x - 0.08 = 0.12x - 0.06 - 0.02$$

$$0.04x - 0.08 = 0.12x - 0.08$$

To clear the equation of decimals, multiply both sides by 100.

$$100(0.04x - 0.08) = 100(0.12x - 0.08)$$

$$4x - 8 = 12x - 8$$

$$4x = 12x$$

$$-8x = 0$$

$$x = 0$$

The solution set is $\{0\}$.

80. $\frac{x}{\square} - \Delta = -\$$

$$\frac{x}{\square} - \Delta + \Delta = -\$ + \Delta$$

$$\frac{x}{\square} = -\$ + \Delta$$

$$\square \cdot \frac{x}{\square} = \square \cdot (-\$ + \Delta)$$

$$x = \square \cdot (-\$ + \Delta)$$

$$x = -\square\$ + \square\Delta$$

$$x = \square\Delta - \square\$$$

82. First solve the equation for x .

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

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

$$6x + 3x = x - 16$$

$$9x = x - 16$$

$$8x = -16$$

$$x = -2$$

Now evaluate the expression $x^2 - x$ for $x = -2$.

$$x^2 - x = (-2)^2 - (-2)$$

$$= 4 + 2$$

$$= 6$$

84. $\frac{2}{5}x + \frac{1}{4}x = 13$

$$20\left(\frac{2}{5}x + \frac{1}{4}x\right) = 20(13)$$

$$8x + 5x = 260$$

$$13x = 260$$

$$\frac{13x}{13} = \frac{260}{13}$$

$$x = 20$$

The number is 20.

86. $\frac{7}{8}x - 30 = \frac{1}{2}x$

$$8\left(\frac{7}{8}x - 30\right) = 8\left(\frac{1}{2}x\right)$$

$$7x - 240 = 4x$$

$$-240 = -3x$$

$$\frac{-240}{-3} = \frac{-3x}{-3}$$

$$80 = x$$

The number is 80.

88. $F = 10(x - 65) + 50$

$$400 = 10x - 650 + 50$$

$$400 = 10x - 600$$

$$1000 = 10x$$

$$100 = x$$

A person receiving a \$400 fine was driving 100 miles per hour.

90. $\frac{W}{2} - 3H = 53$

$$\frac{W}{2} - 3(12) = 53$$

$$\frac{W}{2} - 36 = 53$$

$$\frac{W}{2} - 36 + 36 = 53 + 36$$

$$\frac{W}{2} = 89$$

$$2 \cdot \frac{W}{2} = 2 \cdot 89$$

$$W = 178$$

According to the formula, the healthy weight of a person of height 6' is 178 pounds. This is 6 pounds below the upper end of the range shown in the bar graph.

$$92. \quad p = 15 + \frac{5d}{11}$$

$$20 = 15 + \frac{5d}{11}$$

$$5 = \frac{5d}{11}$$

$$11(5) = 11\left(\frac{5d}{11}\right)$$

$$55 = 5d$$

$$11 = d$$

The pressure is 20 pounds per square foot at a depth of 11 feet.

94. – 96. Answers will vary.

98. makes sense

100. does not make sense; Explanations will vary.
Sample explanation: Though 5 is a solution, the complete solution is all real numbers.

102. false; Changes to make the statement true will vary.
A sample change is: The solution of the equation is all real numbers.

104. true

$$106. \quad f = 0.432h - 10.44$$

$$16 = 0.432h - 10.44$$

$$16 + 10.44 = 0.432h - 10.44 + 10.44$$

$$26.44 = 0.432h$$

$$\frac{26.44}{0.432} = \frac{0.432h}{0.432}$$

$$61.2 \approx h$$

The woman's height was about 61 inches or 5 feet 1 inch, so the partial skeleton could be that of the missing woman.

$$108. \quad 2(3x + 4) = 3x + 2[3(x - 1) + 2]$$

$$6x + 8 = 3x + 2(3x - 3 + 2)$$

$$6x + 8 = 3x + 2(3x - 1)$$

$$6x + 8 = 3x + 6x - 2$$

$$6x + 8 = 9x - 2$$

$$6x + 8 - 9x = 9x - 2 - 9x$$

$$-3x + 8 = -2$$

$$-3x + 8 - 8 = -2 - 8$$

$$-3x = -10$$

$$\frac{-3x}{-3} = \frac{-10}{3}$$

$$x = \frac{10}{3}$$

The solution set is $\left\{\frac{10}{3}\right\}$.

109. $-24 < -20$ because -24 lies further to the left on a number line.

110. $-\frac{1}{3} < -\frac{1}{5}$ because $-\frac{1}{3}$ lies further to the left on a number line.

$$\begin{aligned} 111. \quad -9 - 11 + 7 - (-3) &= -9 - 11 + 7 + 3 \\ &= -20 + 10 \\ &= -10 \end{aligned}$$

$$\begin{aligned} 112. \quad \text{a.} \quad T &= D + pm \\ T - D &= pm \end{aligned}$$

$$\text{b.} \quad T - D = pm$$

$$\frac{T - D}{p} = \frac{pm}{p}$$

$$\frac{T - D}{p} = m$$

$$113. \quad 4 = 0.25B$$

$$\frac{4}{0.25} = \frac{0.25B}{0.25}$$

$$16 = B$$

The solution set is $\{16\}$.

114. $1.3 = P \cdot 26$

$$\frac{1.3}{26} = \frac{P \cdot 26}{26}$$

$$0.05 = P$$

The solution set is $\{0.05\}$.

2.4 Check Points

1. $A = lw$

$$\frac{A}{w} = \frac{lw}{w}$$

$$\frac{A}{w} = l$$

2. $2l + 2w = P$

$$2l + 2w - 2w = P - 2w$$

$$2l = P - 2w$$

$$\frac{2l}{2} = \frac{P - 2w}{2}$$

$$l = \frac{P - 2w}{2}$$

3. $T = D + pm$

$$T - D = pm$$

$$\frac{T - D}{p} = \frac{pm}{p}$$

$$\frac{T - D}{p} = m$$

$$m = \frac{T - D}{p}$$

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

$$3\left(\frac{x}{3} - 4y\right) = 3 \cdot 5$$

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

$$x - 12y = 15$$

$$x - 12y + 12y = 15 + 12y$$

$$x = 15 + 12y$$

5. Use the formula $A = PB$: A is P percent of B .

$$\begin{array}{|c|c|c|c|c|} \hline \text{What} & \text{is} & 9\% & \text{of} & 50? \\ \hline \widehat{A} & = & 0.09 & \cdot & \widehat{B} \\ \hline A & = & 4.5 & & \end{array}$$

6. Use the formula $A = PB$: A is P percent of B .

$$\begin{array}{|c|c|c|c|c|} \hline 9 & \text{is} & 60\% & \text{of} & \text{what?} \\ \hline \widehat{9} & = & 0.60 & \cdot & \widehat{B} \\ \hline \end{array}$$

$$\frac{9}{0.60} = \frac{0.60B}{0.60}$$

$$15 = B$$

7. Use the formula $A = PB$: A is P percent of B .

$$\begin{array}{|c|c|c|c|c|} \hline 18 & \text{is} & \text{what percent} & \text{of} & 50? \\ \hline \widehat{18} & = & \widehat{P} & \cdot & \widehat{50} \\ \hline \end{array}$$

$$18 = P \cdot 50$$

$$\frac{18}{50} = \frac{50P}{50}$$

$$0.36 = P$$

To change 0.36 to a percent, move the decimal point two places to the right and add a percent sign.

$$0.36 = 36\%$$

8. Use the formula $A = PB$: A is P percent of B .

Find the price decrease: $\$940 - \$611 = \$329$

$$\begin{array}{|c|c|c|c|c|} \hline \text{The price} & \text{is} & \text{what} & \text{of} & \text{the original} \\ \text{decrease} & & \text{percent} & & \text{price?} \\ \hline \widehat{329} & = & \widehat{P} & \cdot & \widehat{940} \\ \hline \end{array}$$

$$329 = P \cdot 940$$

$$\frac{329}{940} = \frac{940P}{940}$$

$$0.35 = P$$

To change 0.35 to a percent, move the decimal point two places to the right and add a percent sign.

$$0.35 = 35\%$$

9. a.

Year	Tax Paid the Year Before	increase/decrease	Taxes Paid This Year
1	\$1200	<u>20% decrease</u> : $0.20 \cdot \$1200 = \240	$\$1200 - \$240 = \$960$
2	\$960	<u>20% increase</u> : $0.20 \cdot \$960 = \192	$\$960 + \$192 = \$1152$

The taxes for year 2 will be \$1152.

- b. The taxes for year 2 are less than those originally paid.

Find the tax decrease: $\$1200 - \$1152 = \$48$

The tax decrease is what percent of the original tax?

$$\underbrace{48}_{\text{decrease}} = \underbrace{P}_{\text{percent}} \cdot \underbrace{1200}_{\text{original tax?}}$$

$$48 = P \cdot 1200$$

$$\frac{48}{1200} = \frac{1200P}{1200}$$

$$0.04 = P$$

To change 0.04 to a percent, move the decimal point two places to the right and add a percent sign.

$$0.04 = 4\%$$

The overall tax decrease is 4%.

2.4 Concept and Vocabulary Check

- isolated on one side
- $A = lw$
- $P = 2l \times 2w$
- $A = PB$
- subtract b ; divide by m

2.4 Exercise Set

2. $d = rt$ for t

$$\frac{d}{r} = \frac{rt}{r}$$

$$\frac{d}{r} = t \text{ or } t = \frac{d}{r}$$

This is the motion formula:

distance = rate \cdot time.

4. $I = Prt$ for r

$$\frac{I}{Pt} = \frac{Prt}{Pt}$$

$$\frac{I}{Pt} = r \text{ or } r = \frac{I}{Pt}$$

This is the formula for simple interest:

interest = principal \cdot rate \cdot time.

6. $C = \pi d$ for d

$$\frac{C}{\pi} = \frac{\pi d}{\pi}$$

$$\frac{C}{\pi} = d \text{ or } d = \frac{C}{\pi}$$

This is the formula for finding the circumference of a circle if you know its diameter.

8. $V = \pi r^2 h$ for h

$$\frac{V}{\pi r^2} = \frac{\pi r^2 h}{\pi r^2}$$

$$\frac{V}{\pi r^2} = h \text{ or } h = \frac{V}{\pi r^2}$$

This is the volume of a cylinder.

10. $y = mx + b$ for x

$$y - b = mx$$

$$\frac{y - b}{m} = \frac{mx}{m}$$

$$\frac{y - b}{m} = x \text{ or } x = \frac{y - b}{m}$$

This is the slope-intercept formula for the equation of a line.

12. $P = C + MC$ for M

$$P - C = C + MC - C$$

$$P - C = MC$$

$$\frac{P - C}{C} = \frac{MC}{C}$$

$$\frac{P - C}{C} = M \text{ or } M = \frac{P - C}{C}$$

This is the business math formula for mark-up based on cost.

14. $A = \frac{1}{2}bh$ for h

$$2A = 2\left(\frac{1}{2}bh\right)$$

$$2A = bh$$

$$\frac{2A}{b} = \frac{bh}{b}$$

$$\frac{2A}{b} = h \text{ or } h = \frac{2A}{b}$$

This is the formula for the area of a triangle: area =

$$\frac{1}{2} \cdot \text{base} \cdot \text{height}.$$

16. $M = \frac{A}{740}$ for A

$$740M = 740\left(\frac{A}{740}\right)$$

$$740M = A \text{ or } A = 740M$$

18. $p = 15 + \frac{5d}{11}$ for d

$$11p = 11\left(15 + \frac{5d}{11}\right)$$

$$11p = 165 + 5d$$

$$11p - 165 = 5d$$

$$\frac{11p - 165}{5} = d \text{ or } d = \frac{11p - 165}{5}$$

20. $A = \frac{1}{2}(a + b)$ for b

$$2A = 2\left[\frac{1}{2}(a + b)\right]$$

$$2A = a + b$$

$$2A - a = b \text{ or } b = 2A - a$$

This is the formula for finding the average of two numbers.

22. $S = P + Prt$ for t

$$S - P = Prt$$

$$\frac{S - P}{Pr} = \frac{Prt}{Pr}$$

$$\frac{S - P}{Pr} = t \text{ or } t = \frac{S - P}{Pr}$$

This is the formula for finding the sum of principle and interest for simple interest problems.

24. $A = \frac{1}{2}h(a + b)$ for a

$$2A = 2\left[\frac{1}{2}h(a + b)\right]$$

$$2A = h(a + b)$$

$$\frac{2A}{h} = \frac{h(a + b)}{h}$$

$$\frac{2A}{h} = a + b$$

$$\frac{2A}{h} - b = a + b - b$$

$$\frac{2A}{h} - b = a \text{ or } a = \frac{2A}{h} - b$$

This is the formula for finding the area of a trapezoid.

26. $Ax + By = C$ for y

$$Ax + By - Ax = C - Ax$$

$$By = C - Ax$$

$$\frac{By}{B} = \frac{C - Ax}{B}$$

$$y = \frac{C - Ax}{B}$$

This is the standard form of the equation of a line.

28. $A = PB$; $P = 8\% = 0.08$, $B = 300$

$$A = PB$$

$$A = 0.08(300) = 24$$

30. $A = PB$; $P = 16\% = 0.16$, $B = 90$

$$A = PB$$

$$A = 0.16(90) = 14.4$$

16% of 90 is 14.4

32. $A = PB$; $A = 8$, $P = 40\% = 0.4$

$$A = PB$$

$$8 = 0.4 \cdot B$$

$$\frac{8}{0.4} = \frac{0.4B}{0.4}$$

$$20 = B$$

8 is 40% of 20.

34. $A = PB$; $A = 51.2$, $P = 32\% = 0.32$

$$A = PB$$

$$51.2 = 0.32 \cdot B$$

$$\frac{51.2}{0.32} = \frac{0.32B}{0.32}$$

$$160 = B$$

51.2 is 32% of 160.

36. $A = PB$; $A = 18$; $B = 90$

$$A = PB$$

$$18 = P \cdot 90$$

$$\frac{18}{90} = \frac{P \cdot 90}{90}$$

$$0.2 = P$$

$$0.2 = 20\%$$

18 is 20% of 90.

38. $A = PB$; $A = 0.6$, $B = 7.5$

$$A = PB$$

$$0.6 = P \cdot 7.5$$

$$\frac{0.6}{7.5} = \frac{P \cdot 7.5}{7.5}$$

$$0.08 = P$$

$$0.08 = 8\%$$

0.6 is 8% of 7.5.

40. The increase is $9 - 5 = 4$.

$$A = PB$$

$$4 = P \cdot 5$$

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

$$0.80 = P$$

This is an 80% increase.

42. The decrease is $8 - 6 = 2$.

$$A = PB$$

$$2 = P \cdot 8$$

$$\frac{2}{8} = \frac{8P}{8}$$

$$0.25 = P$$

This is a 25% decrease.

44. $y = (a - b)x$

$$\frac{y}{(a - b)} = \frac{(a - b)x}{(a - b)}$$

$$\frac{y}{a - b} = x \quad \text{or} \quad x = \frac{y}{a - b}$$

46. $y = (a + b)x - 8$

$$y + 8 = (a + b)x - 8 + 8$$

$$y + 8 = (a + b)x$$

$$\frac{y + 8}{(a + b)} = \frac{(a + b)x}{(a + b)}$$

$$\frac{y + 8}{a + b} = x \quad \text{or} \quad x = \frac{y + 8}{a + b}$$

48. $y = cx - dx$

$$y = (c - d)x$$

$$\frac{y}{(c - d)} = \frac{(c - d)x}{(c - d)}$$

$$\frac{y}{c - d} = x \quad \text{or} \quad x = \frac{y}{c - d}$$

50. $y = Ax + Bx + C$

$$y - C = Ax + Bx + C - C$$

$$y - C = Ax + Bx$$

$$y - C = (A + B)x$$

$$\frac{y - C}{(A + B)} = \frac{(A + B)x}{(A + B)}$$

$$\frac{y - C}{A + B} = x \quad \text{or} \quad x = \frac{y - C}{A + B}$$

52. a. $A = \frac{x + y + z + w}{4}$ for w

$$4A = 4\left(\frac{x + y + z + w}{4}\right)$$

$$4A = x + y + z + w$$

$$4A - x - y - z = x + y + z + w - x - y - z$$

$$4A - x - y - z = w$$

b. $w = 4A - xy - z; x = 76, y = 78, z = 79$

$$w = 4A - x - y - z$$

$$w = 4(80) - 76 - 78 - 79$$

$$w = 87$$

You need to get 87% on the fourth exam to have an average of 80%.

54. a. $F = \frac{9}{5}C + 32$ for C

$$5F = 5\left(\frac{9}{5}C + 32\right)$$

$$5F = 9C + 160$$

$$5F - 160 = 9C$$

$$\frac{5F - 160}{9} = \frac{9C}{9}$$

$$\frac{5F - 160}{9} = C$$

b. $C = \frac{5F - 160}{9}; F = 59$

$$C = \frac{5F - 160}{9}$$

$$C = \frac{5(59) - 160}{9}$$

$$C = \frac{295 - 160}{9}$$

$$C = \frac{135}{9} = 15$$

$$59^\circ\text{F} = 15^\circ\text{C}$$

56. $0.14 \cdot 1800 = 252$

252 workers stated that politics is the most taboo topic to discuss at work.

58. This is the equivalent of asking: 55 is 11% of what?

$$A = P \cdot B$$

$$55 = 0.11 \cdot B$$

$$\frac{55}{0.11} = \frac{0.11B}{0.11}$$

$$500 = B$$

Americans throw away 500 billion pounds of trash each year.

60. a. The total number of countries in 1974 was

$$41 + 48 + 63 = 152.$$

$$A = P \cdot B$$

$$63 = P \cdot 152$$

$$\frac{63}{152} = \frac{152B}{152}$$

$$0.41 \approx B$$

About 41% of countries were not free in 1974.

b. The total number of countries in 2009 was

$$89 + 62 + 42 = 193.$$

$$A = P \cdot B$$

$$42 = P \cdot 193$$

$$\frac{42}{193} = \frac{193B}{193}$$

$$0.22 \approx B$$

About 22% of countries were not free in 2009.

c. The decrease is $63 - 42 = 21$.

$$A = P \cdot B$$

$$21 = P \cdot 63$$

$$\frac{21}{63} = \frac{63B}{63}$$

$$0.33 \approx B$$

There was approximately a 33% decrease in the number of not free countries from 1974 to 2009.

62. This question is equivalent to, "225,000 is what percent of \$500,000?"

$$A = PB$$

$$225,000 = P \cdot 500,000$$

$$\frac{225,000}{500,000} = \frac{P \cdot 500,000}{500,000} \quad 0.45 = P$$

The charity has raised 45% of the goal.

64. $\$3502 + 0.28(35,000 - \$23,000)$

$$= \$3502 + 0.28(\$12,000)$$

$$= \$3502 + \$3360$$

$$= \$6862$$

The income tax on a taxable income of \$35,000 is \$6862.

66. a. The sales tax is 7% of \$96.

$$0.07(96) = 6.72$$

The sales tax due on the graphing calculator is \$6.72.

b. The total cost is the sum of the price of the calculator and the sales tax.

$$\$96 + \$6.72 = \$102.72$$

The calculator's total cost is \$102.72.

68. a. The discount amount is 40% of \$16.50.

$$0.4(16.50) = 6.60$$

The discount amount is \$6.60.

b. The sale price is the regular price minus the discount amount.

$$\$16.50 - \$6.60 = \$9.90$$

The sale price is \$9.90.

70. The decrease is $\$380 - \$266 = \$114$.

$$A = P \cdot B$$

$$114 = P \cdot 380$$

$$\frac{114}{380} = \frac{P \cdot 380}{380}$$

$$0.30 = P$$

This is a $0.30 = 30\%$ decrease.

72. No; the first sale price is 70% of the original amount and the second sale price is 80% of the *first sale price*. The second sale price would be obtained by the following computation:

$$A = P_2(P_1(B))$$

$$= 0.80(0.70B)$$

$$= 0.56B$$

The second sale price is 56% of the original price, so there is 44% reduction overall.

74. Answers will vary.

76. does not make sense; Explanations will vary.

Sample explanation: Sometimes you will solve for one variable in terms of other variables.

78. does not make sense; Explanations will vary.

Sample explanation: Since the sale price cannot be negative, the percent decrease cannot be more than 100%.

80. false; Changes to make the statement true will vary.

A sample change is: If $A = lw$, then $w = \frac{A}{l}$.

82. true

84. $5x + 20 = 8x - 16$

$$5x + 20 - 8x = 8x - 16 - 8x$$

$$-3x + 20 = -16$$

$$-3x + 20 - 20 = -16 - 20$$

$$-3x = -36$$

$$\frac{-3x}{-3} = \frac{-36}{-3}$$

$$x = 12$$

Check:

$$5(12) + 20 = 8(12) - 16$$

$$60 + 20 = 96 - 16$$

$$80 = 80$$

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

85. $5(2y - 3) - 1 = 4(6 + 2y)$

$$10y - 15 - 1 = 24 + 8y$$

$$10y - 16 = 24 + 8y$$

$$10y - 16 - 8y = 24 + 8y - 8y$$

$$2y - 16 = 24$$

$$2y - 16 + 16 = 24 + 16$$

$$2y = 40$$

$$\frac{2y}{2} = \frac{40}{2}$$

$$y = 20$$

Check:

$$5(2 \cdot 20 - 3) - 1 = 4(6 + 2 \cdot 20)$$

$$5(40 - 3) - 1 = 4(6 + 40)$$

$$5(37) - 1 = 4(46)$$

$$185 - 1 = 184$$

$$184 = 184$$

The solution set is $\{20\}$.

86. $x - 0.3x = 1x - 0.3x = (1 - 0.3)x = 0.7x$

87. $\frac{13}{x} - 7x$

88. $8(x + 14)$

89. $9(x - 5)$

Mid-Chapter Check Point

1. Begin by multiplying both sides of the equation by 4, the least common denominator.

$$\begin{aligned}\frac{x}{2} &= 12 - \frac{x}{4} \\ 4\left(\frac{x}{2}\right) &= 4(12) - 4\left(\frac{x}{4}\right) \\ 2x &= 48 - x \\ 2x + x &= 48 - x + x \\ 3x &= 48 \\ \frac{3x}{3} &= \frac{48}{3} \\ x &= 16\end{aligned}$$

The solution set is $\{16\}$.

2. $5x - 42 = -57$

$$\begin{aligned}5x - 42 + 42 &= -57 + 42 \\ 5x &= -15 \\ \frac{5x}{5} &= \frac{-15}{5} \\ x &= -3\end{aligned}$$

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

3. $H = \frac{EC}{825}$

$$\begin{aligned}H \cdot 825 &= \frac{EC}{825} \cdot 825 \\ 825H &= EC \\ \frac{825H}{E} &= \frac{EC}{E} \\ \frac{825H}{E} &= C\end{aligned}$$

4. $A = P \cdot B$

$$\begin{aligned}A &= 0.06 \cdot 140 \\ A &= 8.4 \\ 8.4 &\text{ is } 6\% \text{ of } 140.\end{aligned}$$

5. $\frac{-x}{10} = -3$

$$\begin{aligned}10\left(\frac{-x}{10}\right) &= 10(-3) \\ -x &= -30 \\ -1(-x) &= -1(-30) \\ x &= 30\end{aligned}$$

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

6. $1 - 3(y - 5) = 4(2 - 3y)$

$$\begin{aligned}1 - 3y + 15 &= 8 - 12y \\ -3y + 16 &= 8 - 12y \\ -3y + 12y + 16 &= 8 - 12y + 12y \\ 9y + 16 &= 8 \\ 9y + 16 - 16 &= 8 - 16 \\ 9y &= -8 \\ \frac{9y}{9} &= \frac{-8}{9} \\ y &= -\frac{8}{9}\end{aligned}$$

The solution set is $\left\{-\frac{8}{9}\right\}$.

7. $S = 2\pi rh$

$$\begin{aligned}\frac{S}{2\pi h} &= \frac{2\pi rh}{2\pi h} \\ \frac{S}{2\pi h} &= r\end{aligned}$$

8. $A = P \cdot B$

$$\begin{aligned}12 &= 0.30 \cdot B \\ \frac{12}{0.30} &= \frac{0.30 \cdot B}{0.30} \\ 40 &= B \\ 12 &\text{ is } 30\% \text{ of } 40.\end{aligned}$$

$$9. \quad \frac{3y}{5} + \frac{y}{2} = \frac{5y}{4} - 3$$

To clear fractions, multiply both sides by the LCD, 20.

$$20\left(\frac{3y}{5}\right) + 20\left(\frac{y}{2}\right) = 20\left(\frac{5y}{4}\right) - 20(3)$$

$$4(3y) + 10y = 5(5y) - 60$$

$$12y + 10y = 25y - 60$$

$$22y = 25y - 60$$

$$22y - 25y = 25y - 25y - 60$$

$$-3y = -60$$

$$\frac{-3y}{-3} = \frac{-60}{-3}$$

$$y = 20$$

The solution set is $\{20\}$.

$$10. \quad 2.4x + 6 = 1.4x + 0.5(6x - 9)$$

$$2.4x + 6 = 1.4x + 3x - 4.5$$

$$2.4x + 6 = 4.4x - 4.5$$

To clear decimals, multiply both sides by 10.

$$10(2.4x + 6) = 10(4.4x - 4.5)$$

$$24x + 60 = 44x - 45$$

$$24x = 44x - 105$$

$$-20x = -105$$

$$\frac{-20x}{-20} = \frac{-105}{-20}$$

$$x = 5.25$$

The solution set is $\{5.25\}$.

$$11. \quad 5z + 7 = 6(z - 2) - 4(2z - 3)$$

$$5z + 7 = 6z - 12 - 8z + 12$$

$$5z + 7 = -2z$$

$$5z - 5z + 7 = -2z - 5z$$

$$7 = -7z$$

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

$$-1 = z$$

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

$$12. \quad Ax - By = C$$

$$Ax - By + By = C + By$$

$$Ax = C + By$$

$$\frac{Ax}{A} = \frac{C + By}{A}$$

$$x = \frac{C + By}{A} \text{ or } \frac{By + C}{A}$$

$$13. \quad 6y + 7 + 3y = 3(3y - 1)$$

$$9y + 7 = 9y - 3$$

$$9y - 9y + 7 = 9y - 9y - 3$$

$$7 = -3$$

Since this is a false statement, there is no solution or $\{\}$.

$$14. \quad 10\left(\frac{1}{2}x + 3\right) = 10\left(\frac{3}{5}x - 1\right)$$

$$10\left(\frac{1}{2}x\right) + 10(3) = 10\left(\frac{3}{5}x\right) - 10(1)$$

$$5x + 30 = 6x - 10$$

$$5x - 5x + 30 = 6x - 5x - 10$$

$$30 = x - 10$$

$$30 + 10 = x - 10 + 10$$

$$40 = x$$

The solution set is $\{40\}$.

$$15. \quad A = P \cdot B$$

$$50 = P \cdot 400$$

$$\frac{50}{400} = \frac{P \cdot 400}{400}$$

$$0.125 = P$$

50 is 0.125 = 12.5% of 400.

$$16. \quad \frac{3(m+2)}{4} = 2m+3$$

$$4 \cdot \frac{3(m+2)}{4} = 4(2m+3)$$

$$3(m+2) = 4(2m+3)$$

$$3m+6 = 8m+12$$

$$3m-3m+6 = 8m-3m+12$$

$$6 = 5m+12$$

$$6-12 = 5m+12-12$$

$$-6 = 5m$$

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

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

The solution set is $\left\{-\frac{6}{5}\right\}$.

17. The increase is $50 - 40 = 10$.

$$A = P \cdot B$$

$$10 = P \cdot 40$$

$$\frac{10}{40} = \frac{P \cdot 40}{40}$$

$$0.25 = P$$

This is a $0.25 = 25\%$ increase.

18. $12w-4+8w-4 = 4(5w-2)$

$$20w-8 = 20w-8$$

$$20w-20w-8 = 20w-20w-8$$

$$-8 = -8$$

Since $-8 = -8$ is a true statement, the solution is all real numbers or $\{x | x \text{ is a real number}\}$.

19. a. $B = -\frac{5}{2}a + 82$

$$B = -\frac{5}{2}(14) + 82$$

$$= -35 + 82$$

$$= 47$$

According to the formula, 47% of 14-year-olds believe that reading books is important.

This underestimates the actual percentage shown in the bar graph by 2%

b. $B = -\frac{5}{2}a + 82$

$$22 = -\frac{5}{2}a + 82$$

$$2(22) = 2\left(-\frac{5}{2}a + 82\right)$$

$$44 = -5a + 164$$

$$-120 = -5a$$

$$24 = a$$

According to the formula, 22% of 24-year-olds will believe that reading books is important.

2.5 Check Points

1. Let x = the number.

$$6x - 4 = 68$$

$$6x - 4 + 4 = 68 + 4$$

$$6x = 72$$

$$x = 12$$

The number is 12.

2. Let x = the median starting salary, in thousands of dollars, for English majors.

Let $x + 18$ = the median starting salary, in

thousands of dollars, for computer science majors.

$$x + (x + 18) = 94$$

$$x + x + 18 = 94$$

$$2x + 18 = 94$$

$$2x = 76$$

$$x = 38$$

$$x + 18 = 56$$

The average salary for English majors is \$18 thousand and the average salary for computer science majors is $\$38 + \$18 = \$56$.

3. Let x = the page number of the first facing page.

Let $x + 1$ = the page number of the second facing page.

$$x + (x + 1) = 145$$

$$x + x + 1 = 145$$

$$2x + 1 = 145$$

$$2x + 1 - 1 = 145 - 1$$

$$2x = 144$$

$$x = 72$$

$$x + 1 = 73$$

The page numbers are 72 and 73.

4. Let
- x
- = the number of eighths of a mile traveled.

$$2 + 0.25x = 10$$

$$2 - 2 + 0.25x = 10 - 2$$

$$0.25x = 8$$

$$\frac{0.25x}{0.25} = \frac{8}{0.25}$$

$$x = 32$$

You can go 32 eighths of a mile. That is equivalent

to $\frac{32}{8} = 4$ miles.

5. Let
- x
- = the width of the swimming pool.

Let $3x$ = the length of the swimming pool.

$$P = 2l + 2w$$

$$320 = 2 \cdot 3x + 2 \cdot x$$

$$320 = 6x + 2x$$

$$320 = 8x$$

$$\frac{320}{8} = \frac{8x}{8}$$

$$40 = x$$

$$x = 40$$

$$3x = 120$$

The pool is 40 feet wide and 120 feet long.

6. Let
- x
- = the original price.

Original price	minus	the reduction (40% of original price)	is	the reduced price, \$564
x	$-$	$0.4x$	$=$	564

$$x - 0.4x = 564$$

$$0.6x = 564$$

$$\frac{0.6x}{0.6} = \frac{564}{0.6}$$

$$x = 940$$

The original price was \$940.

2.5 Concept and Vocabulary Check

1. $4x - 6$
2. $x + 215$
3. $x + 1$
4. $125 + 0.15x$
5. $2 \cdot 4x + 2x$ or $2x + 2 \cdot 4x$
6. $x - 0.35x$ or $0.65x$

2.5 Exercise Set

2. $x + 43 = 107$

$$x + 43 - 43 = 107 - 43$$

$$x = 64$$

The number is 64.

4. $x - 17 = 96$

$$x - 17 + 17 = 96 + 17$$

$$x = 113$$

The number is 113.

6. $8x = 272$

$$\frac{8x}{8} = \frac{272}{8}$$

$$x = 34$$

The number is 34.

8. $\frac{x}{14} = 8$

$$14 \left(\frac{x}{14} \right) = 14(8)$$

$$x = 112$$

The number is 112.

10. $5 + 3x = 59$

$$3x = 54$$

$$x = 18$$

The number is 18.

12. $6x - 8 = 298$

$$6x = 306$$

$$x = 51$$

The number is 51.

14. $x + 12 = 4x$

$$12 = 3x$$

$$4 = x$$

The number is 4.

16. $3(5 + x) = 48$

$$15 + 3x = 48$$

$$3x = 33$$

$$x = 11$$

The number is 11.

18. $5 + 4x = x + 35$

$5 + 3x = 35$

$3x = 30$

$x = 10$

The number is 10.

20. $\frac{3x}{4} - 3 = 9$

$\frac{3x}{4} = 12$

$3x = 48$

$x = 16$

The number is 16.

22. Let x = the number of years spent eating.

Let $x + 24$ = the number of years spent sleeping.

$x + (x + 24) = 32$

$x + x + 24 = 32$

$2x + 24 = 32$

$2x = 8$

$x = 4$

$x + 24 = 28$

Americans will spend 4 years eating and 28 years sleeping.

24. Let x = the average salary, in thousands, for an

American whose final degree is a bachelor's.

Let $2x - 39$ = the average salary, in thousands, for an American whose final degree is a doctorate.

$x + (2x - 39) = 126$

$x + 2x - 39 = 126$

$3x - 39 = 126$

$3x = 165$

$x = 55$

$2x - 39 = 71$

The average salary for an American whose final degree is a bachelor's is \$55 thousand and for an American whose final degree is a doctorate is \$71 thousand.

26. Let x = the number of the left-hand page.

Let $x + 1$ = the number of the right-hand page.

$x + (x + 1) = 525$

$2x + 1 = 525$

$2x = 524$

$x = 262$

The smaller page number is 262. The larger page number is $262 + 1 = 263$.

28. Let x = the first consecutive even integer (Hank Greenberg).

Let $x + 2$ = the second consecutive even integer (Babe Ruth).

$x + (x + 2) = 118$

$x + x + 2 = 118$

$2x + 2 = 118$

$2x = 116$

$x = 58$

$x + 2 = 60$

Hank Greenberg had 58 home runs and Babe Ruth had 60.

30. Let x = the number of miles you can travel in one week for \$395.

$180 + 0.25x = 395$

$180 + 0.25x - 180 = 395 - 180$

$0.25x = 215$

$\frac{0.25x}{0.25} = \frac{215}{0.25}$

$x = 860$

You can travel 860 miles in one week for \$395.

32. Let x = the number of years after 2004.

$824 + 7x = 929$

$7x = 105$

$\frac{7x}{7} = \frac{105}{7}$

$x = 15$

Rent payments will average \$929 fifteen years after 2008, or 2023.

34. Let x = the width of the field.

Let $5x$ = the length of the field.

$P = 2l + 2w$

$288 = 2 \cdot 5x + 2 \cdot x$

$288 = 10x + 2x$

$288 = 12x$

$\frac{288}{12} = \frac{12x}{12}$

$24 = x$

$x = 24$

$5x = 120$

The field is 24 yards wide and 120 yards long.

36. Let x = the width of a basketball court.

Let $x + 13$ = the length of a basketball court.

$$P = 2l + 2w$$

$$86 = 2(x + 13) + 2 \cdot x$$

$$86 = 2x + 26 + 2x$$

$$86 = 4x + 26$$

$$60 = 4x$$

$$15 = x$$

$$x = 15$$

$$x + 13 = 28$$

A basketball court is 15 meters wide and 28 meters long.

38. As shown in the diagram,

let x = the length of a shelf and $x + 3$ = the height of the bookcase,

4 shelves and 2 heights are needed.

Since 18 feet of lumber is available,

$$4x + 2(x + 3) = 18.$$

$$4x + 2x + 6 = 18$$

$$6x + 6 = 18$$

$$6x = 12$$

$$x = 2$$

$$x + 3 = 5$$

The length of each shelf is 2 feet and the height of the unit is 5 feet.

40. Let x = the price before the reduction.

$$x - 0.30x = 98$$

$$0.70x = 98$$

$$\frac{0.70x}{0.70} = \frac{98}{0.70}$$

$$x = 140$$

The DVD player's price before the reduction was \$140.

42. Let x = the last year's salary.

$$x + 0.09x = 42,074$$

$$1.09x = 42,074$$

$$\frac{1.09x}{1.09} = \frac{42,074}{1.09}$$

$$x = 38,600$$

Last year's salary was \$38,600.

44. Let x = the nightly cost without tax.

$$x + 0.08x = 172.80$$

$$1.08x = 172.80$$

$$\frac{1.08x}{1.08} = \frac{172.80}{1.08}$$

$$x = 160$$

The nightly cost without tax is \$160.

46. Let x = the number of hours of labor.

$$532 + 63x = 1603$$

$$532 + 63x - 532 = 1603 - 532$$

$$63x = 1071$$

$$\frac{63x}{63} = \frac{1071}{63}$$

$$x = 17$$

It took 17 hours of labor to repair the sailboat.

48. – 50. Answers will vary.

52. makes sense

54. does not make sense; Explanations will vary.

Sample explanation: It is correct to use $x + 2$ for the second consecutive odd integer because any odd integer is 2 more than the previous odd integer. In other words, adding 2 to the first odd integer will skip over the even integer and take you to the next odd integer.

56. false; Changes to make the statement true will vary.

A sample change is: This should be modeled by $x - 0.35x = 780$.

58. true

60. Let x = the number of minutes.

Note that \$0.55 is the cost of the first minute and \$0.40($x - 1$) is the cost of the remaining minutes.

$$0.55 + 0.40(x - 1) = 6.95$$

$$0.55 + 0.4x - 0.40 = 6.95$$

$$0.4x + 0.15 = 6.95$$

$$0.4x + 0.15 - 0.15 = 6.95 - 0.15$$

$$0.4x = 6.80$$

$$\frac{0.4x}{0.4} = \frac{6.80}{0.4}$$

$$x = 17$$

The phone call lasted 17 minutes.

62. Let x = weight of unpeeled bananas.

Let $\frac{1}{8}x$ = the weight of banana peel and $\frac{7}{8}x$ = the weight of peeled banana.

The information in the cartoon translates into the equation.

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

To solve this equation, first eliminate fractions by multiplying both sides by the LCD, which is 8.

$$8x = 8\left(\frac{7}{8}x + \frac{7}{8}\right)$$

$$8x = 8\left(\frac{7}{8}x\right) + 8\left(\frac{7}{8}\right)$$

$$8x = 7x + 7$$

$$8x - 7x = 7x + 7 - 7x$$

$$x = 7$$

The unpeeled banana weighs 7 ounces.

63. $\frac{4}{5}x = -16$

$$\frac{5}{4}\left(\frac{4}{5}x\right) = \frac{5}{4}(-16)$$

$$x = -20$$

Check:

$$\frac{4}{5}(-20) = -16$$

$$\frac{4}{5} \cdot \frac{-20}{1} = -16$$

$$\frac{-80}{5} = -16$$

$$-16 = -16$$

The solution set is $\{-20\}$.

64. $6(y-1) + 7 = 9y - y + 1$

$$6y - 6 + 7 = 9y - y + 1$$

$$6y + 1 = 8y + 1$$

$$6y + 1 - 1 = 8y + 1 - 1$$

$$6y = 8y$$

$$6y - 8y = 8y - 8y$$

$$-2y = 0$$

$$y = 0$$

Check:

$$6(0-1) + 7 = 9(0) - 0 + 1$$

$$6 - 10 + 7 = 0 - 0 + 1$$

$$1 = 1$$

The solution set is $\{0\}$.

65. $V = \frac{1}{3}lwh$ for w

$$V = \frac{1}{3}lwh$$

$$3V = 3\left(\frac{1}{3}lwh\right)$$

$$3V = lwh$$

$$\frac{3V}{lh} = \frac{lwh}{lh}$$

$$\frac{3V}{lh} = w \quad \text{or} \quad w = \frac{3V}{lh}$$

66. $A = \frac{1}{2}bh$

$$30 = \frac{1}{2} \cdot 12h$$

$$30 = 6h$$

$$\frac{30}{6} = \frac{6h}{6}$$

$$5 = h$$

67. $A = \frac{1}{2}h(a+b)$

$$A = \frac{1}{2}(7)(10+16)$$

$$A = \frac{1}{2}(7)(26)$$

$$A = 91$$

68. $x = 4(90-x) - 40$

$$x = 360 - 4x - 40$$

$$x = 320 - 4x$$

$$5x = 320$$

$$x = 64$$

The solution set is $\{64\}$.