

Chapter 1

Algebra, Mathematical Models, and Problem Solving

1.1 Check Points

1. a. $\overbrace{8x}^{\text{eight times a number}} + \overbrace{5}^{\text{five more}} = 8x + 5$

b. $\underbrace{\frac{x}{7}}_{\text{the quotient of a number and seven}} - \underbrace{2x}_{\text{decreased by twice the number}} = \frac{x}{7} - 2x$

2. $\overbrace{23 - 0.12x}^{\text{replace } x \text{ with } 10}$
 $= 23 - 0.12(10)$
 $= 23 - 1.2$
 $= 21.8$

At age 10, the average neurotic level is 21.8.

3. $\overbrace{8 + 6(x - 3)^2}^{\text{replace } x \text{ with } 13}$
 $= 8 + 6(13 - 3)^2$
 $= 8 + 6(10)^2$
 $= 8 + 6(100)$
 $= 8 + 600$
 $= 608$

4. a. 2010 is 3 years after 2007.

$$\overbrace{S = 2.7x^2 + 5.6x + 8}^{\text{replace } x \text{ with } 3}$$

$$\begin{aligned} S &= 2.7(3)^2 + 5.6(3) + 8 \\ &= 2.7(9) + 5.6(3) + 8 \\ &= 24.3 + 16.8 + 8 \\ &= 49.1 \end{aligned}$$

- b. The model value, 49.1, is the same as the actual data value shown in the figure.

5. a. true; Because the number 13 is an element of the set of integers.

- b. true; Because 6 is not an element of $\{7, 8, 9, 10\}$, the statement is true.

6. a. -8 is less than -2 ; true

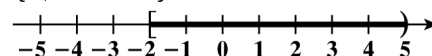
- b. 7 is greater than -3 ; true

- c. -1 is less than or equal to -4 ; false

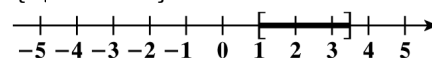
- d. 5 is greater than or equal to 5; true

- e. 2 is greater than or equal to -14 ; true

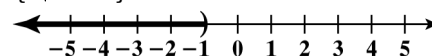
7. a. $\{x | -2 \leq x < 5\}$



b. $\{x | 1 \leq x \leq 3.5\}$



c. $\{x | x < -1\}$



1.1 Concept and Vocabulary Check

1. variable
2. expression
3. b th to the n th power; base; exponent
4. formula; modeling; models
5. natural
6. whole
7. integers
8. rational
9. irrational
10. rational; irrational
11. left
12. 2; 5; 2; 5
13. greater than
14. less than or equal to

1.1 Exercise Set

2. $x + 6$

4. $x - 9$

6. $2x$

8. $5x + 4$

10. $3 - \frac{1}{2}x$

12. $\frac{5}{x} - 3$

14. $\frac{6}{10 - x}$

16. $8 + 6(5) = 8 + 30 = 38$

18. $8(3) - 4 = 24 - 4 = 20$

20. $\left(\frac{1}{2}\right)^2 + 2\left(\frac{1}{2}\right) = \frac{1}{4} + 1 = 1\frac{1}{4}$

22. $8^2 - 7(8) + 4 = 64 - 56 + 4 = 8 + 4 = 12$

$$\begin{aligned}
 24. \quad 6 + 5(8 - 6)^3 &= 6 + 5(2)^3 \\
 &= 6 + 5(8) \\
 &= 6 + 40 = 46
 \end{aligned}$$

26. $8^2 - 4(8 - 3) = 64 - 4(5) = 64 - 20 = 44$

28. $\{1, 2, 3\}$

30. $\{-6, -5, -4, -3\}$

32. $\{10, 11, 12, \dots\}$

34. $\{1, 3, 5, 7\}$

36. true; Nine is an integer.

38. true; Nine is a rational number.

40. false; Nine is not an irrational number.

42. true; Five is not an irrational number.

44. false; $\frac{1}{4}$ is a rational number.

46. true; π is not a rational number.

48. false; π is a real number.

50. -7 is less than -3 ; true

52. 3 is greater than -8 ; true

54. 0 is less than -5 ; false. 0 is greater than -5 .

56. -5 is less than or equal to 1 ; true

58. -3 is less than or equal to -7 ; false. -3 is greater than -7 .

60. -3 is less than or equal to -3 ; true

62. -3 is greater than or equal to -3 ; true

64. 4 is less than or equal to $-\frac{1}{2}$; false. 4 is greater than $-\frac{1}{2}$.

66. $\{x | -2 < x \leq 4\}$

68. $\{x | -4 \leq x < 3\}$

70. $\{x | -2 \leq x \leq 5\}$

72. $\{x | x > 3\}$

74. $\{x | x \geq -5\}$

76. $\{x | x < 2\}$

78. $\{x | x \leq 3.5\}$

80. true

- 82.** false; $\{4\} \not\subset \{1, 2, 3, 4, 5\}$.
- 84.** true
- 86.** false; The value of $\{x \mid x \text{ is an integer between } -4 \text{ and } 0\} = \{-3, -2, -1\}$, not $\{-4, -3, -2, -1, 0\}$.
- 88.** false; Three times the sum of a number and five is represented by $3(x+5)$, not $3x+5$.
- 90.** $R = 4.6 - 0.02x$
 $= 4.6 - 0.02(30)$
 $= 4.0$
 The average resistance to happiness at age 30 is 4.0.
- 92.** $[4.6 - 0.02(20)] - [4.6 - 0.02(70)]$
 $= 4.2 - 3.2$
 $= 1.0$
 The difference between the average resistance to happiness at age 20 and at age 70 is 0.4.
- 94.** $G = 4.6x^2 + 5.5x + 5$
 $= 4.6(3)^2 + 5.5(3) + 5$
 $= 62.9$
 ≈ 63
 According to the formula, 63 new college programs in green studies were created in 2008. The formula underestimated the actual value by 3 programs.
- 96.** $C = \frac{5}{9}(F - 32) = \frac{5}{9}(86 - 32) = \frac{5}{9}(54) = 30$
 30°C is equivalent to 86°F .
- 98.** $h = 4 + 60t - 16t^2$
 $= 4 + 60(3) - 16(3)^2$
 $= 4 + 180 - 16(9)$
 $= 4 + 180 - 144$
 $= 184 - 144 = 40$
 Three seconds after it was kicked, the ball's height was 40 feet.
- 100. – 116.** Answers will vary.
- 118.** does not make sense; Explanations will vary. Sample explanation: Though this value is beyond the capabilities of a calculator, it still exists. This particular expression can be obtained via several software applications.
- 120.** does not make sense; Explanations will vary. Sample explanation: The model can be used to estimate the number in 2000 by letting $x = 0$.
- 122.** false; Changes to make the statement true will vary. A sample change is: Some integers are not whole numbers.
- 124.** true
- 126.** $(2 \cdot 3 + 3) \cdot 5 = 45$
- 128.** 26 is not a perfect square and $\sqrt{26}$ cannot be simplified. Consider the numbers closest to 26, both smaller and larger, which are perfect squares. The first perfect square smaller than 26 is 25. The first perfect square larger than 26 is 36. We know that the square root of 26 will lie between these numbers. We have $-\sqrt{36} < -\sqrt{26} < -\sqrt{25}$. If we simplify, we have $-6 < -\sqrt{26} < -5$. Therefore, $-\sqrt{26}$ lies between -6 and -5 .
- 129.** -5 and 5 are both a distance of five units from zero on a real number line.
- 130.** $\frac{16 + 3(2)^4}{12 - (10 - 6)} = \frac{16 + 3(16)}{12 - (4)} = \frac{16 + 48}{8} = \frac{64}{8} = 8$
- 131.** $2(3x + 5)$
 $= 2(3(4) + 5)$
 $= 2(12 + 5)$
 $= 2(17)$
 $= 34$
 $6x + 10$
 $= 6(4) + 10$
 $= 24 + 10$
 $= 34$

1.2 Check Points

- 1. a.** $|-6| = 6$ because -6 is 6 units from 0.
- b.** $|4.5| = 4.5$ because 4.5 is 4.5 units from 0.
- c.** $|0| = 0$ because 0 is 0 units from 0.
- 2. a.** $-10 + (-18) = -28$

- b.** $-0.2 + 0.9 = 0.7$
- c.** $-\frac{3}{5} + \frac{1}{2} = -\frac{6}{10} + \frac{5}{10} = -\frac{1}{10}$
- 3. a.** If $x = -8$, then $-x = -(-8) = 8$.
- b.** If $x = \frac{1}{3}$, then $-x = -\frac{1}{3}$.
- 4. a.** $7 - 10 = 7 + (-10) = -3$
- b.** $4.3 - (-6.2) = 4.3 + 6.2 = 10.5$
- c.** $-\frac{4}{5} - \left(-\frac{1}{5}\right) = -\frac{4}{5} + \frac{1}{5} = -\frac{3}{5}$
- 5. a.** $(-5)^2 = (-5)(-5) = 25$
- b.** $-5^2 = -(5 \cdot 5) = -25$
- c.** $(-4)^3 = (-4)(-4)(-4) = -64$
- d.** $\left(-\frac{3}{5}\right)^4 = \left(-\frac{3}{5}\right)\left(-\frac{3}{5}\right)\left(-\frac{3}{5}\right)\left(-\frac{3}{5}\right) = \frac{81}{625}$
- 6. a.** $\frac{32}{-4} = -8$
- b.** $-\frac{2}{3} \div \left(-\frac{5}{4}\right) = -\frac{2}{3} \cdot \left(-\frac{4}{5}\right) = \frac{8}{15}$
- 7.** $3 - 5^2 + 12 \div 2(-4)^2$
 $= 3 - 25 + 12 \div 2(16)$
 $= 3 - 25 + 6(16)$
 $= 3 - 25 + 96$
 $= -22 + 96$
 $= 74$
- 8.** $\frac{4 + 3(-2)^3}{2 - (6 - 9)}$
 $= \frac{4 + 3(-8)}{2 - (-3)}$
 $= \frac{4 - 24}{2 + 3}$
 $= \frac{-20}{5}$
 $= -4$
- 9.** Commutative Property of Addition: $4x + 9 = 9 + 4x$
 Commutative Property of Multiplication:
 $4x + 9 = x \cdot 4 + 9$
- 10. a.** $6 + (12 + x) = (6 + 12) + x = 18 + x$
- b.** $-7(4x) = (-7 \cdot 4)x = -28x$
- 11.** $-4(7x + 2) = -28x - 8$
- 12.** $3x + 14x^2 + 11x + x^2$
 $= (14x^2 + x^2) + (3x + 11x)$
 $= (14 + 1)x^2 + (3 + 11)x$
 $= 15x^2 + 14x$
- 13.** $8(2x - 5) - 4x$
 $= 16x - 40 - 4x$
 $= 16x - 4x - 40$
 $= 12x - 40$
- 14.** $6 + 4[7 - (x - 2)]$
 $= 6 + 4[7 - x + 2]$
 $= 6 + 4[9 - x]$
 $= 6 + 36 - 4x$
 $= 42 - 4x$

1.2 Concept and Vocabulary Check

- negative number
- 0
- positive number
- positive number
- positive number
- negative number
- positive number
- divide
- subtract
- absolute value; 0; a
- a ; $-a$
- 0; inverse; 0; identity

13. $b + a$

14. $(ab)c$

15. $ab + ac$

16. simplified

1.2 Exercise Set

2. $|-10| = 10$

4. $|13| = 13$

6. $|-8.3| = 8.3$

8. $\left|\frac{\pi}{3}\right| = \frac{\pi}{3}$

10. $|\sqrt{3}| = \sqrt{3}$

12. $-\left|-\frac{7}{10}\right| = -\frac{7}{10}$

14. $-5 + (-10) = -15$

16. $-15 + 6 = -9$

18. $-7.9 + 2.4 = -5.5$

20.
$$\begin{aligned}\frac{7}{10} + \left(-\frac{4}{5}\right) &= \frac{7}{10} + \left(-\frac{4}{5}\right)\left(\frac{2}{2}\right) \\ &= \frac{7}{10} + \left(-\frac{8}{10}\right) = -\frac{1}{10}\end{aligned}$$

22.
$$\begin{aligned}-\frac{3}{5} - \frac{4}{7} &= -\frac{3}{5} + \left(-\frac{4}{7}\right) \\ &= -\frac{21}{35} + \left(-\frac{20}{35}\right) = -\frac{41}{35}\end{aligned}$$

24. $-6.2 + (-5.9) = -12.1$

26. $0 + (-15.3) = -15.3$

28. $15.3 + (-15.3) = 0$

30. $x = 13$
 $-x = -13$

32. $x = -9$
 $-x = 9$

34. $x = -\sqrt{2}$
 $-x = \sqrt{2}$

36. $4 - 20 = 4 + (-20) = -16$

38. $7 - (-13) = 7 + 13 = 20$

40. $-30 - (-10) = -30 + 10 = -20$

42.
$$\begin{aligned}\frac{1}{10} - \frac{2}{5} &= \frac{1}{10} + \left(-\frac{2}{5}\right) = \frac{1}{10} + \left(-\frac{2}{5}\right)\left(\frac{2}{2}\right) \\ &= \frac{1}{10} + \left(-\frac{4}{10}\right) = -\frac{3}{10}\end{aligned}$$

44. $-4.3 - (-8.7) = -4.3 + 8.7 = 4.4$

46. $0 - (-\sqrt{3}) = 0 + \sqrt{3} = \sqrt{3}$

48. $8(-10) = -80$

50. $(-7)(-11) = 77$

52. $\frac{11}{13}(-1) = -\frac{11}{13}$

54. $-\sqrt{3} \cdot 0 = 0$

56. $(-5)(-3)(-2) = (15)(-2) = -30$

58.
$$\begin{aligned}3(-2)(-1)(-5)(-3) &= -6(-1)(-5)(-3) \\ &= 6(-5)(-3) \\ &= -30(-3) = 90\end{aligned}$$

60. $(-8)^2 = (-8)(-8) = 64$

62. $-8^2 = -(8)(8) = -64$

64. $(-3)^3 = (-3)(-3)(-3) = -27$

66. $(-4)^4 = (-4)(-4)(-4)(-4) = 256$

68. A product with an odd number of negative factors is negative.
 $(-1)^{35} = -1$

$$70. -\left(-\frac{1}{4}\right)^3 = -\left(-\frac{1}{4}\right)\left(-\frac{1}{4}\right)\left(-\frac{1}{4}\right) = \frac{1}{64}$$

$$72. \frac{30}{-5} = -6$$

$$74. \frac{-55}{-5} = 11$$

$$76. \frac{0}{-5.3} = 0$$

$$78. -\frac{5.3}{0} \text{ is undefined.}$$

$$80. -\frac{1}{2} \div \left(-\frac{3}{5}\right) = -\frac{1}{2} \cdot \left(-\frac{5}{3}\right) = \frac{5}{6}$$

$$82. 8 \div \left(-\frac{2}{9}\right) = \frac{8}{1} \cdot \left(-\frac{9}{2}\right) = -\frac{72}{2} = -36$$

$$84. 8(-3) - 5(-6) = -24 - (-30) = -24 + 30 = 6$$

$$86. 5(-3)^2 - 2(-2)^2 = 5(9) - 2(4) = 45 - 8 = 37$$

$$\begin{aligned} 88. \quad & 10^2 - 100 \div 5^2 \cdot 2 - 3 \\ & = 100 - 100 \div 25 \cdot 2 - 3 \\ & = 100 - 4 \cdot 2 - 3 = 100 - 8 - 3 \\ & = 92 - 3 = 89 \end{aligned}$$

$$90. \frac{10 \div 2 + 3 \cdot 4}{(12 - 3 \cdot 2)^2} = \frac{5 + 3 \cdot 4}{(12 - 6)^2} = \frac{5 + 12}{(6)^2} = \frac{17}{36}$$

$$\begin{aligned} 92. \quad & 8 - 3[-2(5 - 7) - 5(4 - 2)] \\ & = 8 - 3[-2(-2) - 5(2)] = 8 - 3[4 - 10] \\ & = 8 - 3[4 + (-10)] = 8 - 3[-6] \\ & = 8 + 18 = 26 \end{aligned}$$

$$94. \frac{6(-4) - 5(-3)}{9 - 10} = \frac{-24 + 15}{-1} = \frac{-9}{-1} = 9$$

$$\begin{aligned} 96. \quad & \frac{12 \div 3 \cdot 5 | 2^2 + 3^2 |}{7 + 3 - 6^2} = \frac{12 \div 3 \cdot 5 | 4 + 9 |}{7 + 3 - 36} \\ & = \frac{12 \div 3 \cdot 5 | 13 |}{10 - 36} \\ & = \frac{12 \div 3 \cdot 5(13)}{-26} = \frac{4 \cdot 5(13)}{-26} \\ & = \frac{20(13)}{-26} = \frac{260}{-26} = -10 \end{aligned}$$

$$\begin{aligned} 98. \quad & 17 - |5 - (-2)| + 12 \div 2 \cdot 3 \\ & = 17 - |7| + 12 \div 2 \cdot 3 = 17 - 7 + 12 \div 2 \cdot 3 \\ & = 17 - 7 + 6 \cdot 3 = 17 - 7 + 18 \\ & = 10 + 18 = 28 \end{aligned}$$

$$\begin{aligned} 100. \quad & 24 \div \sqrt{3 \cdot (5 - 2)} \div [-1 - (-3)]^2 \\ & = 24 \div \sqrt{3(3)} \div [-1 + 3]^2 \\ & = 24 \div \sqrt{9} \div [2]^2 \\ & = 24 \div 3 \div 4 = 8 \div 4 \\ & = 2 \end{aligned}$$

$$\begin{aligned} 102. \quad & \text{Commutative Property of Addition} \\ & 5x + 30 = 30 + 5x \\ & \text{Commutative Property of Multiplication} \\ & 5x + 30 = x \cdot 5 + 30 \end{aligned}$$

$$\begin{aligned} 104. \quad & \text{Commutative Property of Addition} \\ & 3x - 7 = -7 + 3x \\ & \text{Commutative Property of Multiplication} \\ & 3x - 7 = x \cdot 3 - 7 \end{aligned}$$

$$106. 12 + (3 + x) = (12 + 3) + x = 15 + x$$

$$108. -10(5x) = (-10 \cdot 5)x = -50x$$

$$110. -\frac{1}{4}(-4y) = \left(-\frac{1}{4} \cdot -4\right)y = y$$

$$112. 5(4x + 7) = 5 \cdot 4x + 5 \cdot 7 = 20x + 35$$

$$114. -9(3x + 2) = -9 \cdot 3x + (-9)2 = -27x - 18$$

$$116. -(6x - 3) = -1(6x) - (-1)3 = -6x + 3$$

$$118. 8x + 10x = (8 + 10)x = 18x$$

$$120. 9x^2 - x^2 = (9 - 1)x^2 = 8x^2$$

$$122. \quad 9x + 5x^2 + 3x + 4x^2 = (9+3)x + (5+4)x^2 \\ = 12x + 9x^2$$

$$124. \quad 7(4x-5) - 8x \\ = 7 \cdot 4x - 7 \cdot 5 - 8x = 28x - 35 - 8x \\ = (28-8)x - 35 = 20x - 35$$

$$126. \quad 4(5y-3) - (6y+3) \\ = 4 \cdot 5y - 4 \cdot 3 - 1(6y) + (-1)3 \\ = 20y - 12 - 6y - 3 \\ = (20-6)y - 15 \\ = 14y - 15$$

$$128. \quad 6 - 5[8 - (2y - 4)] = 6 - 5[8 - 2y + 4] \\ = 6 - 5[12 - 2y] \\ = 6 - 5 \cdot 12 - (-5)(2y) \\ = 6 - 60 + 10y \\ = 10y - 54$$

$$130. \quad 14x^2 + 5 - [7(x^2 - 2) + 4] \\ = 14x^2 + 5 - [7x^2 - 14 + 4] \\ = 14x^2 + 5 - [7x^2 - 10] \\ = 14x^2 + 5 - 7x^2 + 10 \\ = 14x^2 - 7x^2 + 5 + 10 \\ = (14-7)x^2 + 15 \\ = 7x^2 + 15$$

$$132. \quad x - (8 - x) = x - 8 + x = 2x - 8$$

$$134. \quad 10(-4x) = -40x$$

$$136. \quad 6x - (-2x) = 6x + 2x = 8x$$

$$138. \quad 8 - 3(x+6) = 8 - 3x - 18 = -3x - 10$$

$$140. \quad 4 + (-10) = -6$$

$$142. \quad 4 - (-10) = 4 + 10 \\ = 14$$

$$144. \quad -3 - (-29) = -3 + 29 \\ = 26$$

The approval rating of France exceeds the approval rating of Iran by 26.

$$146. \quad \frac{-29 + (-10) + 21}{3} = \frac{-18}{3} \\ = -6$$

The average approval rating of Iran, China, and the UK is -6.

$$148. \quad D = -0.2x^2 + 5(x+12) \\ = -0.2(3)^2 + 5(3+12) \\ = 73.2$$

According to the model, college students spent \$73.2 billion in 2009.

The model underestimates the actual value displayed in the graph by \$0.8 billion.

$$150. \quad \text{a. } 0.06t + 0.5(50 - t) \\ = 0.06t + 25 - 0.5t \\ = 25 - 0.44t$$

$$\text{b. } 0.06(20) + 0.5(50 - 20) \\ = 0.06(20) + 0.5(30) \\ = 1.2 + 15 = 16.2$$

$$25 - 0.44(20) = 25 - 8.8 = 16.2$$

The total distance will be 16.2 miles.

152. – 166. Answers will vary.

168. makes sense

170. does not make sense; Explanations will vary.
Sample explanation: For terms to be considered like terms they must have the same variables and the same powers.

172. false; Changes to make the statement true will vary.
A sample change is: $16 \div 4 \cdot 2 = 4 \cdot 2 = 8$

174. false; Changes to make the statement true will vary.
A sample change is:
 $5 + 3(x - 4) = 5 + 3x - 12 = 3x - 7$

176. true

$$178. \quad \left(2 \cdot 5 - \frac{1}{2} \cdot 10\right) \cdot 9 = 45$$

180. $\frac{10}{x} - 4x$

181. $10 + 2(x-5)^4 = 10 + 2(7-5)^4$
 $= 10 + 2(2)^4 = 10 + 2(16)$
 $= 10 + 32 = 42$

182. true; $\frac{1}{2}$ is not an irrational number.

183.

x	$y = 4 - x^2$
-3	$y = 4 - (-3)^2 = 4 - 9 = -5$
-2	$y = 4 - (-2)^2 = 4 - 4 = 0$
-1	$y = 4 - (-1)^2 = 4 - 1 = 3$
0	$y = 4 - (0)^2 = 4 - 0 = 4$
1	$y = 4 - (1)^2 = 4 - 1 = 3$
2	$y = 4 - (2)^2 = 4 - 4 = 0$
3	$y = 4 - (3)^2 = 4 - 9 = -5$

184.

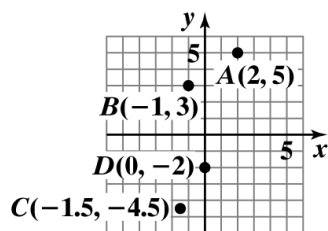
x	$y = 1 - x^2$
-3	$y = 1 - (-3)^2 = 1 - 9 = -8$
-2	$y = 1 - (-2)^2 = 1 - 4 = -3$
-1	$y = 1 - (-1)^2 = 1 - 1 = 0$
0	$y = 1 - (0)^2 = 1 - 0 = 1$
1	$y = 1 - (1)^2 = 1 - 1 = 0$
2	$y = 1 - (2)^2 = 1 - 4 = -3$
3	$y = 1 - (3)^2 = 1 - 9 = -8$

185.

x	$y = x+1 $
-4	$y = -4+1 = -3 = 3$
-3	$y = -3+1 = -2 = 2$
-2	$y = -2+1 = -1 = 1$
-1	$y = -1+1 = 0 = 0$
0	$y = 0+1 = 1 = 1$
1	$y = 1+1 = 2 = 2$
2	$y = 2+1 = 3 = 3$

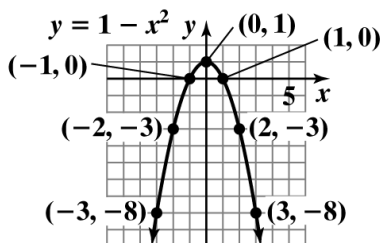
1.3 Check Points

1.



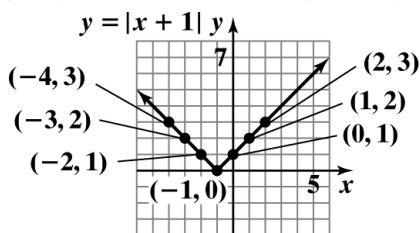
2. Make a table:

x	$y = 1 - x^2$	(x, y)
-3	$y = 1 - (-3)^2 = -8$	$(-3, -8)$
-2	$y = 1 - (-2)^2 = -3$	$(-2, -3)$
-1	$y = 1 - (-1)^2 = 0$	$(-1, 0)$
0	$y = 1 - (0)^2 = 1$	$(0, 1)$
1	$y = 1 - (1)^2 = 0$	$(1, 0)$
2	$y = 1 - (2)^2 = -3$	$(2, -3)$
3	$y = 1 - (3)^2 = -8$	$(3, -8)$

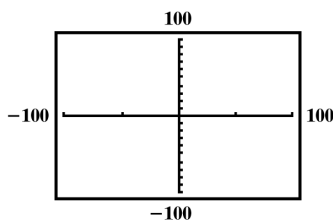


3. Make a table:

x	$y = x+1 $	(x, y)
-4	$y = -4+1 = -3 = 3$	$(-4, 3)$
-3	$y = -3+1 = -2 = 2$	$(-3, 2)$
-2	$y = -2+1 = -1 = 1$	$(-2, 1)$
-1	$y = -1+1 = 0 = 0$	$(-1, 0)$
0	$y = 0+1 = 1 = 1$	$(0, 1)$
1	$y = 1+1 = 2 = 2$	$(1, 2)$
2	$y = 2+1 = 3 = 3$	$(2, 3)$



4. a. The drug concentration is increasing from 0 to 3 hours.
 b. The drug concentration is decreasing from 3 to 13 hours.
 c. The drug's maximum concentration is 0.05 milligram per 100 milliliters, which occurs after 3 hours.
 d. None of the drug is left in the body.
5. The minimum x -value is -100 , the maximum x -value is 100 , and the distance between consecutive tick marks is 50 . The minimum y -value is -100 , the maximum y -value is 100 , and the distance between consecutive tick marks is 10 .

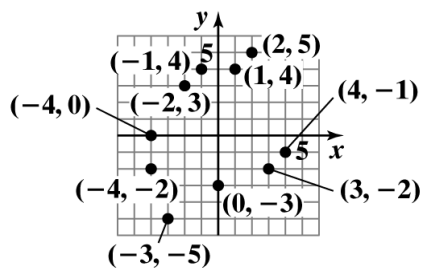


1.3 Concept and Vocabulary Check

- x -axis
- y -axis
- origin
- quadrants; four
- x -coordinate; y -coordinate
- solution; satisfies

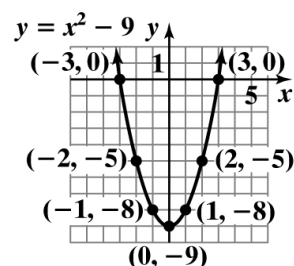
1.3 Exercise Set

2. – 10.



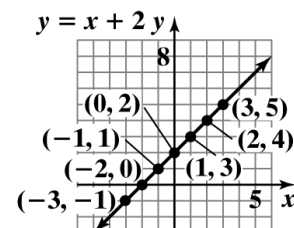
12.

x	(x, y)
-3	$(-3, 0)$
-2	$(-2, -5)$
-1	$(-1, -8)$
0	$(0, -9)$
1	$(1, -8)$
2	$(2, -5)$
3	$(3, 0)$



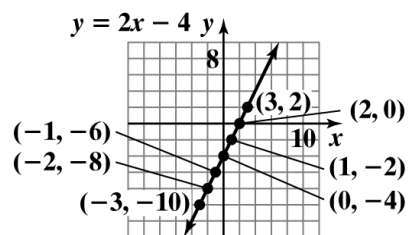
14.

x	(x, y)
-3	$(-3, -1)$
-2	$(-2, 0)$
-1	$(-1, 1)$
0	$(0, 2)$
1	$(1, 3)$
2	$(2, 4)$
3	$(3, 5)$



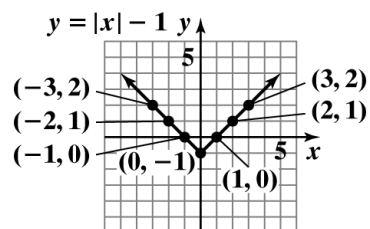
16.

x	(x, y)
-3	$(-3, -10)$
-2	$(-2, -8)$
-1	$(-1, -6)$
0	$(0, -4)$
1	$(1, -2)$
2	$(2, 0)$
3	$(3, 2)$



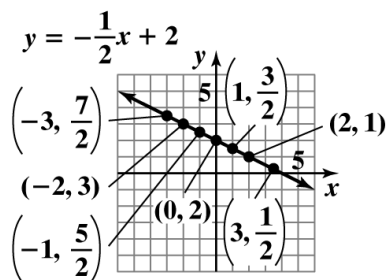
20.

x	(x, y)
-3	$(-3, 2)$
-2	$(-2, 1)$
-1	$(-1, 0)$
0	$(0, -1)$
1	$(1, 0)$
2	$(2, 1)$
3	$(3, 2)$



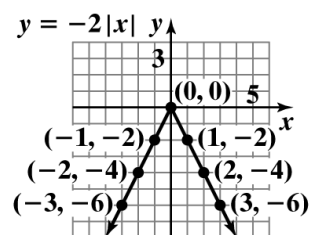
18.

x	(x, y)
-3	$\left(-3, \frac{7}{2}\right)$
-2	$(-2, 3)$
-1	$\left(-1, \frac{5}{2}\right)$
0	$(0, 2)$
1	$\left(1, \frac{3}{2}\right)$
2	$(2, 1)$
3	$\left(3, \frac{1}{2}\right)$



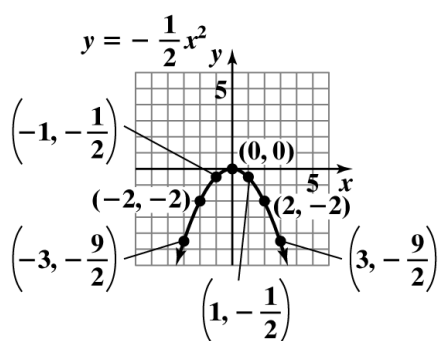
22.

x	(x, y)
-3	$(-3, -6)$
-2	$(-2, -4)$
-1	$(-1, -2)$
0	$(0, 0)$
1	$(1, -2)$
2	$(2, -4)$
3	$(3, -6)$



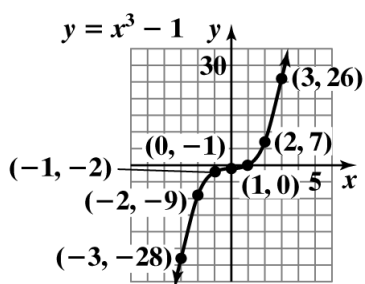
24.

x	(x, y)
-3	$(-3, -\frac{9}{2})$
-2	$(-2, -2)$
-1	$(-1, -\frac{1}{2})$
0	$(0, 0)$
1	$(1, -\frac{1}{2})$
2	$(2, -2)$
3	$(3, -\frac{9}{2})$

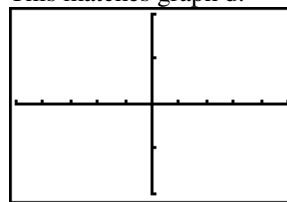


26.

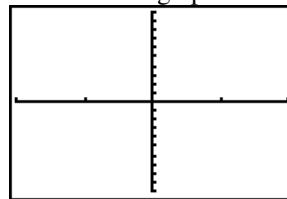
x	(x, y)
-3	$(-3, -28)$
-2	$(-2, -9)$
-1	$(-1, -2)$
0	$(0, -1)$
1	$(1, 0)$
2	$(2, 7)$
3	$(3, 26)$

28. $[-10, 10, 2]$ by $[-4, 4, 2]$

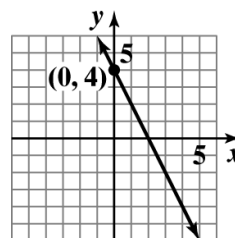
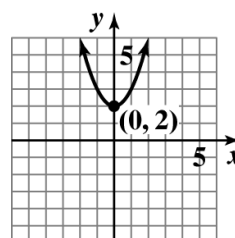
This matches graph d.

30. $[-40, 40, 20]$ by $[-1000, 1000, 100]$

This matches graph a.

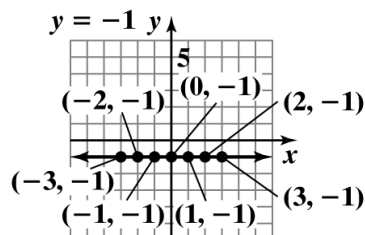
32. The equation that corresponds to Y_1 in the table is

(b), $y_1 = x^2$. We can tell because all of the points $(-3, 9)$, $(-2, 4)$, $(-1, 1)$, $(0, 0)$, $(1, 1)$, $(2, 4)$, and $(3, 9)$ are on the graph $y = x^2$, but all are not on any of the others.

34. Yes. It passes through the point $(0, 0)$.36. $(0, 2)$ 38. The values of Y_1 and Y_2 are the same when $x = -2$ and $x = 1$.40. $y = 4 - 2x$ 42. $y = x^2 + 2$ 

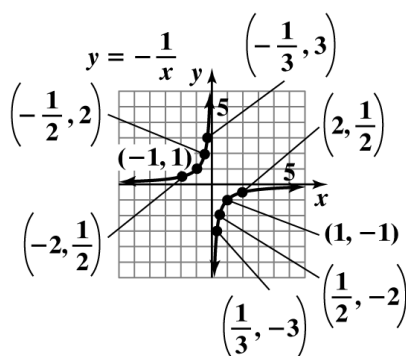
44.

x	(x, y)
-3	$(-3, -1)$
-2	$(-2, -1)$
-1	$(-1, -1)$
0	$(0, -1)$
1	$(1, -1)$
2	$(2, -1)$
3	$(3, -1)$



46.

x	(x, y)
-2	$\left(-2, \frac{1}{2}\right)$
-1	$(-1, 1)$
$-\frac{1}{2}$	$\left(-\frac{1}{2}, 2\right)$
$-\frac{1}{3}$	$\left(-\frac{1}{3}, 3\right)$
$\frac{1}{3}$	$\left(\frac{1}{3}, -3\right)$
$\frac{1}{2}$	$\left(\frac{1}{2}, -2\right)$
1	$(1, -1)$
2	$\left(2, -\frac{1}{2}\right)$



48. The top marginal tax rate in 1925 was 25%.

50. The lowest marginal tax rate occurred in 1990 and was about 28%.

52. During the five-year period from 1930 to 1935, the top marginal tax rate increased about 38%.

54. At age 65, men have the greatest number of awakenings, averaging about 8 awakenings per night.

56. The difference between the number of awakenings for 18-year-old men and women is about 1.1.

58. graph d

60. graph c

62. graph a

64. graph b

66. – 72. Answers will vary.

74. does not make sense; Explanations will vary.
Sample explanation: Most graphing utilities do not display numbers on the axes.76. does not make sense; Explanations will vary.
Sample explanation: There may or may not be a mathematical model that perfectly describes the graph's data.78. false; Changes to make the statement true will vary.
A sample change is: When a point lies on the x -axis, $y = 0$.80. false; Changes to make the statement true will vary.
A sample change is: Substituting the coordinates of $(2, 5)$ into $3y - 2x = -4$ gives $3(5) - 2(2) = -4$ which simplifies to $11 = -4$ which is false.

82. Your car was parked more than six hours, but not exceeding eight hours.

83. $|-14.3| = 14.3$ 84. $[12 - (13 - 17)] - [9 - (6 - 10)]$
 $= [12 - (-4)] - [9 - (-4)]$
 $= [12 + 4] - [9 + 4] = 16 - 13 = 3$ 85. $6x - 5(4x + 3) - 10 = 6x - 20x - 15 - 10$
 $= (6 - 20)x - (15 + 10)$
 $= -14x - 25$

$$\begin{aligned}
 86. \quad & 4x - 3 = 5x + 6 \\
 & 4(-9) - 3 = 5(-9) + 6 \\
 & -36 - 3 = -45 + 6 \\
 & -39 = -39
 \end{aligned}$$

The statement is true for $x = -9$.

$$\begin{aligned}
 87. \quad & 13 - 3(x + 2) \\
 & = 13 - 3x - 6 \\
 & = 7 - 3x
 \end{aligned}$$

$$\begin{aligned}
 88. \quad & 10 \left(\frac{3x + 1}{2} \right) \\
 & = \frac{10}{1} \cdot \frac{3x + 1}{2} \\
 & = 5(3x + 1) \\
 & = 15x + 5
 \end{aligned}$$

1.4 Check Points

$$\begin{aligned}
 1. \quad & 4x + 5 = 29 \\
 & 4x + 5 - 5 = 29 - 5 \\
 & 4x = 24 \\
 & \frac{4x}{4} = \frac{24}{4} \\
 & x = 6
 \end{aligned}$$

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

Check:

$$\begin{aligned}
 & 4x + 5 = 29 \\
 & 4(6) + 5 = 29 \\
 & 24 + 5 = 29 \\
 & 29 = 29
 \end{aligned}$$

$$\begin{aligned}
 2. \quad & 2x - 12 + x = 6x - 4 + 5x \\
 & 3x - 12 = 11x - 4 \\
 & 3x - 11x = -4 + 12 \\
 & -8x = 8 \\
 & \frac{-8x}{-8} = \frac{8}{-8} \\
 & x = -1
 \end{aligned}$$

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

Check:

$$\begin{aligned}
 & 2x - 12 + x = 6x - 4 + 5x \\
 & 2(-1) - 12 + (-1) = 6(-1) - 4 + 5(-1) \\
 & -2 - 12 - 1 = -6 - 4 - 5 \\
 & -15 = -15
 \end{aligned}$$

$$\begin{aligned}
 3. \quad & 2(x - 3) - 17 = 13 - 3(x + 2) \\
 & 2x - 6 - 17 = 13 - 3x - 6 \\
 & 2x - 23 = 7 - 3x \\
 & 2x + 3x = 7 + 23 \\
 & 5x = 30 \\
 & \frac{5x}{5} = \frac{30}{5} \\
 & x = 6
 \end{aligned}$$

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

Check:

$$\begin{aligned}
 & 2(x - 3) - 17 = 13 - 3(x + 2) \\
 & 2(6 - 3) - 17 = 13 - 3(6 + 2) \\
 & 2(3) - 17 = 13 - 3(8) \\
 & 6 - 17 = 13 - 24 \\
 & -11 = -11
 \end{aligned}$$

$$\begin{aligned}
 4. \quad & \frac{x + 5}{7} + \frac{x - 3}{4} = \frac{5}{14} \\
 & 28 \left(\frac{x + 5}{7} + \frac{x - 3}{4} \right) = 28 \left(\frac{5}{14} \right) \\
 & \frac{28}{1} \left(\frac{x + 5}{7} \right) + \frac{28}{1} \left(\frac{x - 3}{4} \right) = \frac{28}{1} \left(\frac{5}{14} \right) \\
 & 4(x + 5) + 7(x - 3) = 2(5) \\
 & 4x + 20 + 7x - 21 = 10 \\
 & 11x - 1 = 10 \\
 & 11x = 10 + 1 \\
 & 11x = 11 \\
 & \frac{11x}{11} = \frac{11}{11} \\
 & x = 1
 \end{aligned}$$

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

Check:

$$\begin{aligned}
 & \frac{x + 5}{7} + \frac{x - 3}{4} = \frac{5}{14} \\
 & \frac{1 + 5}{7} + \frac{1 - 3}{4} = \frac{5}{14} \\
 & \frac{6}{7} + \frac{-2}{4} = \frac{5}{14} \\
 & \frac{24}{28} + \frac{-14}{28} = \frac{10}{28} \\
 & \frac{10}{28} = \frac{10}{28}
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & 4x - 7 = 4(x - 1) + 3 \\
 & 4x - 7 = 4x - 4 + 3 \\
 & 4x - 7 = 4x - 1 \\
 & -7 = -1
 \end{aligned}$$

This equation is an inconsistent equation and thus has no solution.

The solution set is $\{ \}$.

$$\begin{aligned}
 6. \quad 7x + 9 &= 9(x + 1) - 2x \\
 7x + 9 &= 9x + 9 - 2x \\
 7x + 9 &= 7x + 9 \\
 9 &= 9
 \end{aligned}$$

This equation is an identity and all real numbers are solutions.

The solution set is $\{x \mid x \text{ is a real number}\}$ or $(-\infty, \infty)$ or \mathbb{R} .

$$\begin{aligned}
 7. \quad T &= 385x + 3129 \\
 8904 &= 385x + 3129 \\
 8904 - 3129 &= 385x \\
 5775 &= 385x \\
 \frac{5775}{385} &= \frac{385x}{385} \\
 15 &= x
 \end{aligned}$$

The average cost of tuition and fees at public colleges will reach \$8904 in the school year ending 15 years after 2000, or 2015.

1.4 Concept and Vocabulary Check

- linear
- equivalent
- $b + c$
- bc
- apply the distributive property
- least common denominator; 12
- inconsistent; \emptyset
- identity; $(-\infty, \infty)$

1.4 Exercise Set

- $3x + 8 = 50$
 $3x = 42$
 $x = 14$
 The solution set is $\{14\}$.
- $5x - 8 = 72$
 $5x = 80$
 $x = 16$
 The solution set is $\{16\}$.

$$\begin{aligned}
 6. \quad 25 - 6x &= -83 \\
 -6x &= -108 \\
 x &= 18 \\
 \text{The solution set is } \{18\}.
 \end{aligned}$$

$$\begin{aligned}
 8. \quad 5x - (2x - 8) &= 35 \\
 5x - 2x + 8 &= 35 \\
 3x + 8 &= 35 \\
 3x &= 27 \\
 x &= 9 \\
 \text{The solution set is } \{9\}.
 \end{aligned}$$

$$\begin{aligned}
 10. \quad 3x + 5 &= 2x + 13 \\
 x + 5 &= 13 \\
 x &= 8 \\
 \text{The solution set is } \{8\}.
 \end{aligned}$$

$$\begin{aligned}
 12. \quad 8x + 1 &= x + 43 \\
 7x + 1 &= 43 \\
 7x &= 42 \\
 x &= 6 \\
 \text{The solution set is } \{6\}.
 \end{aligned}$$

$$\begin{aligned}
 14. \quad 5y - 2 &= 9y + 2 \\
 -2 &= 4y + 2 \\
 -4 &= 4y \\
 -1 &= y \\
 \text{The solution set is } \{-1\}.
 \end{aligned}$$

$$\begin{aligned}
 16. \quad 2(x - 1) + 3 &= x - 3(x + 1) \\
 2x - 2 + 3 &= x - 3x - 3 \\
 2x + 1 &= -2x - 3 \\
 4x + 1 &= -3 \\
 4x &= -4 \\
 x &= -1 \\
 \text{The solution set is } \{-1\}.
 \end{aligned}$$

$$\begin{aligned}
 18. \quad 2 - (7x + 5) &= 13 - 3x \\
 2 - 7x - 5 &= 13 - 3x \\
 -7x - 3 &= 13 - 3x \\
 -4x - 3 &= 13 \\
 -4x &= 16 \\
 x &= -4 \\
 \text{The solution set is } \{-4\}.
 \end{aligned}$$

$$20. \quad 5x - (2x + 2) = x + (3x - 5)$$

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

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

$$-2 = x - 5$$

$$3 = x$$

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

$$22. \quad 2[3x - (4x - 6)] = 5(x - 6)$$

$$2[3x - 4x + 6] = 5x - 30$$

$$2[-x + 6] = 5x - 30$$

$$-2x + 12 = 5x - 30$$

$$12 = 7x - 30$$

$$42 = 7x$$

$$6 = x$$

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

$$24. \quad \frac{3}{4}(24 - 8z) - 16 = -\frac{2}{3}(6z - 9)$$

$$18 - 6z - 16 = -4z + 6$$

$$2 - 6z = -4z + 6$$

$$2 - 2z = 6$$

$$-2z = 4$$

$$z = -2$$

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

$$26. \quad \frac{x}{5} = \frac{x}{6} + 1$$

$$30\left(\frac{x}{5}\right) = 30\left(\frac{x}{6} + 1\right)$$

$$6x = 5x + 30$$

$$x = 30$$

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

$$28. \quad \frac{x}{5} - \frac{1}{2} = \frac{x}{6}$$

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

$$6x - 15 = 5x$$

$$x - 15 = 0$$

$$x = 15$$

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

$$30. \quad \frac{x}{2} = \frac{3x}{4} + 5$$

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

$$2x = 3x + 20$$

$$-x = 20$$

$$x = -20$$

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

$$32. \quad 2x - \frac{2x}{7} = \frac{x}{2} + \frac{17}{2}$$

$$14\left(2x - \frac{2x}{7}\right) = 14\left(\frac{x}{2} + \frac{17}{2}\right)$$

$$28x - 2(2x) = 7x + 7(17)$$

$$28x - 4x = 7x + 119$$

$$24x = 7x + 119$$

$$17x = 119$$

$$x = 7$$

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

$$34. \quad \frac{x+1}{4} = \frac{1}{6} + \frac{2-x}{3}$$

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

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

$$3x + 3 = 2 + 8 - 4x$$

$$3x + 3 = 10 - 4x$$

$$7x + 3 = 10$$

$$7x = 7$$

$$x = 1$$

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

$$36. \quad 5 + \frac{x-2}{3} = \frac{x+3}{8}$$

$$24\left(5 + \frac{x-2}{3}\right) = 24\left(\frac{x+3}{8}\right)$$

$$120 + 8(x-2) = 3(x+3)$$

$$120 + 8x - 16 = 3x + 9$$

$$104 + 8x = 3x + 9$$

$$104 + 5x = 9$$

$$5x = -95$$

$$x = -19$$

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

$$\begin{aligned}
 38. \quad & \frac{3x}{5} - \frac{x-3}{2} = \frac{x+2}{3} \\
 & 30\left(\frac{3x}{5} - \frac{x-3}{2}\right) = 30\left(\frac{x+2}{3}\right) \\
 & 6(3x) - 15(x-3) = 10(x+2) \\
 & 18x - 15x + 45 = 10x + 20 \\
 & 3x + 45 = 10x + 20 \\
 & 45 = 7x + 20 \\
 & 25 = 7x \\
 & \frac{25}{7} = x
 \end{aligned}$$

The solution set is $\left\{\frac{25}{7}\right\}$.

$$\begin{aligned}
 40. \quad & 4x + 7 = 7(x+1) - 3x \\
 & 4x + 7 = 7x + 7 - 3x \\
 & 4x + 7 = 4x + 7 \\
 & \text{The solution set is } \{x \mid x \text{ is a real number}\} \text{ or } (-\infty, \infty) \text{ or } \mathbb{R}. \text{ The equation is an identity.}
 \end{aligned}$$

$$\begin{aligned}
 42. \quad & 4(y+5) = 21 + 4y \\
 & 4y + 20 = 21 + 4y \\
 & 20 = 21 \\
 & \text{There is no solution. The solution set is } \{ \} \text{ or } \emptyset. \\
 & \text{The equation is inconsistent.}
 \end{aligned}$$

$$\begin{aligned}
 44. \quad & 5x + 7 = 2x + 7 \\
 & 3x + 7 = 7 \\
 & 3x = 0 \\
 & x = 0 \\
 & \text{The solution set is } \{0\}. \text{ The equation is conditional.}
 \end{aligned}$$

$$\begin{aligned}
 46. \quad & \frac{1}{3}(6z+12) = \frac{1}{5}(20z+30) - 8 \\
 & 2z + 4 = 4z + 6 - 8 \\
 & 2z + 4 = 4z - 2 \\
 & -2z = -6 \\
 & z = 3 \\
 & \text{The solution set is } \{3\}. \text{ The equation is conditional.}
 \end{aligned}$$

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

The solution set is $\{x \mid x \text{ is a real number}\}$ or $(-\infty, \infty)$ or \mathbb{R} . The equation is an identity.

$$\begin{aligned}
 50. \quad & 9y - 3(6-5y) = y - 2(3y+9) \\
 & 9y - 18 + 15y = y - 6y - 18 \\
 & 24y - 18 = -5y - 18 \\
 & 29y - 18 = -18 \\
 & 29y = 0 \\
 & y = 0
 \end{aligned}$$

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

$$\begin{aligned}
 52. \quad & 3(2x-5) = 5x+2 \\
 & x = 17
 \end{aligned}$$

$$\begin{aligned}
 54. \quad & 2x - 5 = 4(3x+1) - 2 \\
 & x = -0.7
 \end{aligned}$$

$$\begin{aligned}
 56. \quad & \text{Solve: } 2(x-6) = 3x + 2(2x-1) \\
 & 2x - 12 = 3x + 4x - 2 \\
 & 2x - 12 = 7x - 2 \\
 & -5x - 12 = -2 \\
 & -5x = 10 \\
 & x = -2
 \end{aligned}$$

Now, evaluate $x^2 - x$ for $x = -2$:

$$\begin{aligned}
 x^2 - x &= (-2)^2 - (-2) \\
 &= 4 - (-2) = 4 + 2 = 6
 \end{aligned}$$

$$\begin{aligned}
 58. \quad & \text{Solve for } x: \frac{13x-6}{4} = 5x+2 \\
 & 13x - 6 = 4(5x+2) \\
 & 13x - 6 = 20x + 8 \\
 & -7x - 6 = 8 \\
 & -7x = 14 \\
 & x = -2
 \end{aligned}$$

Solve for y :

$$\begin{aligned}
 5 - y &= 7(y+4) + 1 \\
 5 - y &= 7y + 28 + 1 \\
 5 - y &= 7y + 29 \\
 5 - 8y &= 29 \\
 -8y &= 24 \\
 y &= -3
 \end{aligned}$$

Now, evaluate $x^2 - (xy - y)$ for $x = -2$ and $y = -3$:

$$\begin{aligned}x^2 - (xy - y) &= (-2)^2 - [-2(-3) - (-3)] \\&= (-2)^2 - [6 - (-3)] \\&= 4 - (6 + 3) = 4 - 9 = -5\end{aligned}$$

$$60. \quad 2^3 - [4(5-3)^3] = -8x$$

$$8 - [4(2)^3] = -8x$$

$$8 - 4 \cdot 8 = -8x$$

$$8 - 32 = -8x$$

$$-24 = -8x$$

$$3 = x$$

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

$$62. \quad 2(5x + 58) = 10x + 4(21 + 3.5 - 11)$$

$$10x + 116 = 10x + 4(6 - 11)$$

$$10x + 116 = 10x + 4(-5)$$

$$10x + 116 = 10x - 20$$

$$116 = -20$$

The final statement is a contradiction, so the equation has no solution. The solution set is \emptyset .

$$64. \quad 0.5(x + 2) = 0.1 + 3(0.1x + 0.3)$$

$$0.5x + 1 = 0.1 + 0.3x + 0.9$$

$$0.5x + 1 = 0.3x + 1$$

$$0.2x + 1 = 1$$

$$0.2x = 0$$

$$x = 0$$

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

$$66. \quad -2\{7 - [4 - 2(1 - x) + 3]\} = 10 - [4x - 2(x - 3)]$$

$$-2\{7 - [4 - 2 + 2x + 3]\} = 10 - [4x - 2x + 6]$$

$$-2\{7 - [2x + 5]\} = 10 - [2x + 6]$$

$$-2\{7 - 2x - 5\} = 10 - 2x - 6$$

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

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

$$6x - 4 = 4$$

$$6x = 8$$

$$x = \frac{8}{6} = \frac{4}{3}$$

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

$$68. \quad \text{a. Model 1: } T = 1074x + 15,145$$

$$= 1074(8) + 15,145$$

$$= 23,737$$

$$\text{Model 2: } T = 25.5x^2 + 819x + 15,527$$

$$T = 25.5(8)^2 + 819(8) + 15,527$$

$$= 23,711$$

Model 1 estimates the cost in 2008 to be \$23,737, which means Model 1 overestimates by \$25.

Model 2 estimates the cost in 2008 to be \$23,711, which means Model 2 underestimates by \$1.

$$\text{b. } T = 1074x + 15,145$$

$$32,329 = 1074x + 15,145$$

$$17,184 = 1074x$$

$$\frac{17,184}{1074} = \frac{1074x}{1074}$$

$$16 = x$$

Tuition and fees will average \$32,329 at private four-year colleges in the school year ending 16 years after 2000, or 2016.

$$70. \quad \text{a. } \$39,000$$

$$\text{b. } C = 1388x + 24,963$$

$$= 1388(10) + 24,963$$

$$= \$38,843$$

It describes the estimate from part (a) reasonably well.

$$\text{c. } C = 3x^2 + 1308x + 25,268$$

$$= 3(10)^2 + 1308(10) + 25,268$$

$$= \$38,648$$

It describes the estimate from part (a) reasonably well.

$$72. \quad \text{Model 1:}$$

$$C = 1388x + 24,963$$

$$= 1388(28) + 24,963$$

$$= \$63,827$$

$$\text{Model 2:}$$

$$C = 3x^2 + 1308x + 25,268$$

$$= 3(28)^2 + 1308(28) + 25,268$$

$$= \$64,244$$

According to the graph, the cost in 2008 was \$64,500. Thus, Model 2 is the better model.

74. $C = 1388x + 24,963$

$$80,483 = 1388x + 24,963$$

$$55,520 = 1388x$$

$$\frac{55,520}{1388} = \frac{1388x}{1388}$$

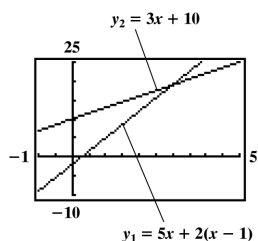
$$40 = x$$

Model 1 predicts the cost will be \$80,483 40 years after 1980, or 2020.

76. – 84. Answers will vary.

86. $5x + 2(x - 1) = 3x + 10$

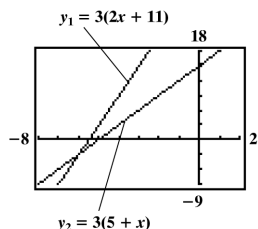
Let $y_1 = 5x + 2(x - 1)$ and let $y_2 = 3x + 10$.



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

88. $3(2x + 11) = 3(5 + x)$

Let $y_1 = 3(2x + 11)$ and let $y_2 = 3(5 + x)$.



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

90. makes sense

92. does not make sense; Explanations will vary.
Sample explanation: The solution set is all real numbers.

94. false; Changes to make the statement true will vary.
A sample change is: The equation has a solution set of $\{0\}$.

$$-7x = x$$

$$-7x - x = x - x$$

$$-8x = 0$$

$$x = 0$$

96. true

98. $ax + b = c$

$$ax + b - b = c - b$$

$$ax = c - b$$

$$x = \frac{c - b}{a}$$

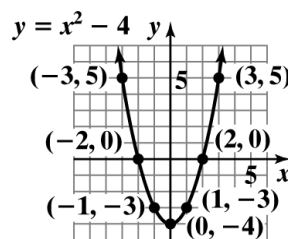
100. Answers will vary.

102. $-\frac{1}{5} - \left(-\frac{1}{2}\right) = -\frac{1}{5} + \frac{1}{2} = -\frac{1}{5} \cdot \frac{2}{2} + \frac{1}{2} \cdot \frac{5}{5}$
 $= -\frac{2}{10} + \frac{5}{10} = \frac{3}{10}$

103. $4(-3)(-1)(-5) = (-12)(5) = -60$

104.

x	(x, y)
-3	$(-3, 5)$
-2	$(-2, 0)$
-1	$(-1, -3)$
0	$(0, -4)$
1	$(1, -3)$
2	$(2, 0)$
3	$(3, 5)$



105. a. $3x - 4 = 32$

b. $3x - 4 = 32$

$$3x = 36$$

$$x = 12$$

The number is 12.

106. $x + 44$

107. $20,000 - 2500x$

Mid-Chapter Check Point – Chapter 1

$$\begin{aligned} 1. \quad -5 + 3(x+5) &= -5 + 3x + 15 \\ &= 3x + 10 \end{aligned}$$

$$\begin{aligned} 2. \quad -5 + 3(x+5) &= 2(3x-4) \\ -5 + 3x + 15 &= 6x - 8 \\ 3x + 10 &= 6x - 8 \\ -3x + 10 &= -8 \\ -3x &= -18 \\ x &= 6 \end{aligned}$$

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

$$\begin{aligned} 3. \quad 3[7-4(5-2)] &= 3[7-4(3)] \\ &= 3[7-12] \\ &= 3(-5) \\ &= -15 \end{aligned}$$

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

$$\begin{aligned} 4. \quad \frac{x-3}{5} - 1 &= \frac{x-5}{4} \\ 20\left(\frac{x-3}{5} - 1\right) &= 20\left(\frac{x-5}{4}\right) \\ 4(x-3) - 20 &= 5(x-5) \\ 4x - 12 - 20 &= 5x - 25 \\ 4x - 32 &= 5x - 25 \\ -x - 32 &= -25 \\ -x &= 7 \\ x &= -7 \end{aligned}$$

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

$$5. \quad \frac{-2^4 + (-2)^2}{-4 - (2-2)} = \frac{-16 + 4}{-4 - 0} = \frac{-12}{-4} = 3$$

$$\begin{aligned} 6. \quad 7x - [8 - 3(2x-5)] \\ &= 7x - [8 - 6x + 15] \\ &= 7x - [-6x + 23] \\ &= 7x + 6x - 23 \\ &= 13x - 23 \end{aligned}$$

$$\begin{aligned} 7. \quad 3(2x-5) - 2(4x+1) &= -5(x+3) - 2 \\ 6x - 15 - 8x - 2 &= -5x - 15 - 2 \\ -2x - 17 &= -5x - 17 \\ 3x - 17 &= -17 \end{aligned}$$

$$3x = 0$$

$$x = 0$$

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

$$\begin{aligned} 8. \quad 3(2x-5) - 2(4x+1) - 5(x+3) - 2 \\ &= 6x - 15 - 8x - 2 - 5x - 15 - 2 \\ &= (6x - 8x - 5x) + (-15 - 2 - 15 - 2) \\ &= -7x - 34 \end{aligned}$$

$$\begin{aligned} 9. \quad -4^2 \div 2 + (-3)(-5) &= -16 \div 2 + (-3)(-5) \\ &= -8 + 15 \\ &= 7 \end{aligned}$$

$$\begin{aligned} 10. \quad 3x + 1 - (x-5) &= 2x - 4 \\ 3x + 1 - x + 5 &= 2x - 4 \\ 2x + 6 &= 2x - 4 \\ 6 &= -4 \end{aligned}$$

This is a contradiction, so the equation has no solution. The solution set is \emptyset .

$$\begin{aligned} 11. \quad \frac{3x}{4} - \frac{x}{3} + 1 &= \frac{4x}{5} - \frac{3}{20} \\ 60\left(\frac{3x}{4} - \frac{x}{3} + 1\right) &= 60\left(\frac{4x}{5} - \frac{3}{20}\right) \\ 45x - 20x + 60 &= 48x - 9 \\ 25x + 60 &= 48x - 9 \\ -23x + 60 &= -9 \\ -23x &= -69 \\ x &= 3 \end{aligned}$$

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

$$\begin{aligned} 12. \quad (6-9)(8-12) \div \frac{5^2 + 4 \div 2}{8^2 - 9^2 + 8} \\ &= (-3)(-4) \div \frac{25 + 2}{64 - 81 + 8} \\ &= (-3)(-4) \div \frac{27}{-9} \\ &= (-3)(-4) \div (-3) \\ &= 12 \div (-3) \\ &= -4 \end{aligned}$$

13. $4x - 2(1 - x) = 3(2x + 1) - 5$

$$4x - 2 + 2x = 6x + 3 - 5$$

$$6x - 2 = 6x - 2$$

The equation is an identity. The solution set is $\{x \mid x \text{ is a real number}\}$ or \mathbb{R} .

14.
$$\frac{3[4 - 3(-2)^2]}{2^2 - 2^4} = \frac{3(4 - 3 \cdot 4)}{4 - 16}$$

$$= \frac{3(4 - 12)}{-12}$$

$$= \frac{3(-8)}{-12}$$

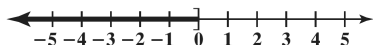
$$= \frac{-24}{-12}$$

$$= 2$$

15. $\{x \mid -2 \leq x < 0\}$

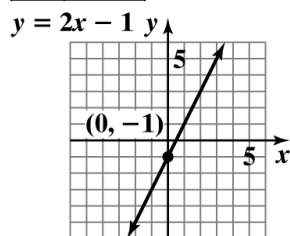


16. $\{x \mid x \leq 0\}$



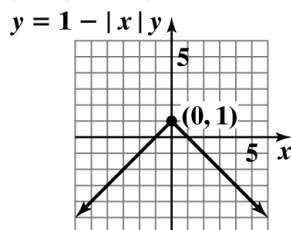
17.

x	(x, y)
-2	-5
-1	-3
0	-1
1	1
2	3



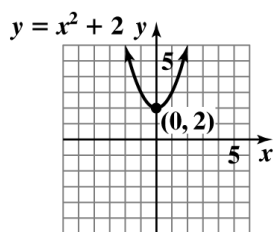
18.

x	(x, y)
-3	-2
-2	-1
-1	0
0	1
1	0
2	-1
3	-2



19.

x	(x, y)
-2	6
-1	3
0	2
1	3
2	6



20. true

21. false; $\{x \mid x \text{ is a negative greater than } -4\}$
 $= \{-3, -2, -1\}$, not $\{-4, -3, -2, -1\}$.

22. false; -17 does belong to the set of rational numbers.

23. true; $-128 \div (2 \cdot 4) > (-128 \div 2) \cdot 4$

$$-128 \div 8 > -64 \cdot 4$$

$$-16 > -256$$

which is true because -16 is to the right of -256 on the number line.

1.5 Check Points

1. Let x = the average yearly salary, in thousands, of women with some college.
 Let $x + 4$ = the average yearly salary, in thousands, of women with an associate's degree.
 Let $x + 21$ = the average yearly salary, in thousands, of women with a bachelor's degree or more.

$$x + (x + 4) + (x + 21) = 136$$

$$x + x + 4 + x + 21 = 136$$

$$3x + 25 = 136$$

$$3x = 111$$

$$x = 37$$

$$x = 37, \text{ some college: } \$37,000$$

$$x + 4 = 41, \text{ associate's degree: } \$41,000$$

$$x + 21 = 58, \text{ bachelor's degree: } \$58,000$$

2. Let x = the number of years since 1969.

$$85 - 0.9x = 25$$

$$-0.9x = 25 - 85$$

$$-0.9x = -60$$

$$x = \frac{-60}{-0.9}$$

$$x \approx 67$$

25% of freshmen will respond this way 67 years after 1969, or 2036.

3. Let x = the number of text messages for which the two plans cost the same.

$$15 + 0.08x = 3 + 0.12x$$

$$0.08x - 0.12x = 3 - 15$$

$$-0.04x = -12$$

$$\frac{-0.04x}{-0.04} = \frac{-12}{-0.04}$$

$$x = 300$$

The two plans cost the same for 300 text messages.

4. Let x = the original price of the new computer.

$$x - 0.30x = 840$$

$$0.70x = 840$$

$$\frac{0.70x}{0.70} = \frac{840}{0.70}$$

$$x = 1200$$

The original price of the new computer was \$1200.

5. Let x = the width of the basketball court.

Let $x + 44$ = length of the basketball court.

$$P = 2l + 2w$$

$$288 = 2(x + 44) + 2x$$

$$288 = 2x + 88 + 2x$$

$$288 = 4x + 88$$

$$-4x = -200$$

$$x = 50$$

$$x + 44 = 94$$

The dimensions of the basketball court are 50 feet by 94 feet.

6. $2l + 2w = P$

$$2w = P - 2l$$

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

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

7. $V = lwh$

$$\frac{V}{lw} = \frac{lwh}{lw}$$

$$\frac{V}{lw} = h$$

$$h = \frac{V}{lw}$$

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

$$\frac{W}{2} = 53 + 3H$$

$$2\left(\frac{W}{2}\right) = 2(53 + 3H)$$

$$W = 106 + 6H$$

9. $P = C + MC$

$$P = C(1 + M)$$

$$\frac{P}{1 + M} = \frac{C(1 + M)}{1 + M}$$

$$\frac{P}{1 + M} = C$$

$$C = \frac{P}{1 + M}$$

1.5 Concept and Vocabulary Check

1. $x + 658.6$

2. $31 + 2.4x$

3. $4 + 0.15x$

4. $x - 0.15x$ or $0.85x$
5. isolated on one side
6. distributive

1.5 Exercise Set

2. Let x = a number.
 $2x - 3 = 11$
 $2x = 14$
 $x = 7$
 The number is 7.

4. Let x = a number.
 $x - 0.30x = 28$
 $0.70x = 28$
 $x = 40$
 The number is 40.

6. Let x = a number.
 $0.80x + x = 252$
 $1.8x = 252$
 $x = 140$
 The number is 140.

8. Let x = a number.
 $0.70x = 252$
 $x = 360$
 The number is 360.

10. Let x = a number.
 Let $x + 24$ = the other number.
 $x + (x + 24) = 58$
 $x + x + 24 = 58$
 $2x + 24 = 58$
 $2x = 34$
 $x = 17$
 If $x = 17$, then $x + 24 = 41$.
 The numbers are 17 and 41.

12. $y_1 - y_2 = 3$
 $(10x + 6) - (12x - 7) = 3$
 $10x + 6 - 12x + 7 = 3$
 $-2x + 13 = 3$
 $-2x = -10$
 $x = 5$

14. $y_1 = 12y_2 - 51$
 $9(3x - 5) = 12(3x - 1) - 51$
 $27x - 45 = 36x - 12 - 51$
 $27x - 45 = 36x - 63$
 $27x - 36x = 45 - 63$
 $-9x = -18$
 $x = 2$

16. $2y_1 - 3y_2 = 4y_3 - 8$
 $2(2.5) - 3(2x + 1) = 4(x) - 8$
 $5 - 6x - 3 = 4x - 8$
 $-6x + 2 = 4x - 8$
 $-6x - 4x = -8 - 2$
 $-10x = -10$
 $x = 1$

18. Let x = the number of words, in thousands, in Japanese.
 Let $x + 767$ = the number of words, in thousands, in English.
 Let $x + 268$ = the number of words, in thousands, in Chinese.
 $x + (x + 767) + (x + 268) = 1731$
 $x + x + 767 + x + 268 = 1731$
 $3x + 1035 = 1731$
 $3x = 696$
 $x = 232$
 $x + 767 = 999$
 $x + 268 = 500$
 The number of words, in thousands, in Japanese, English, and Chinese are 232, 999, and 500, respectively.

20. Let x = the measure of the second angle.
 Let $3x$ = the measure of the first angle.
 Let $x - 35$ = the measure of the third angle.
 $x + 3x + (x - 35) = 180$
 $x + 3x + x - 35 = 180$
 $5x - 35 = 180$
 $5x = 215$
 $x = 43$
 If $x = 43$, $3x = 3(43) = 129$ and
 $x - 35 = 43 - 35 = 8$.
 The measure of the first angle is 129° .
 The measure of the second angle is 43° .
 The measure of the third angle is 8° .

- 22.** Let x = the measure of the first angle.
 Let $x + 2$ = the measure of the second angle.
 Let $x + 4$ = the measure of the third angle.
 $x + (x + 2) + (x + 4) = 180$
 $3x + 6 = 180$
 $3x = 174$
 $x = 58$
 If $x = 58$, $x + 2 = 58 + 2 = 60$, and
 $x + 4 = 58 + 4 = 62$.
 The measure of the first angle is 58° .
 The measure of the second angle is 60° .
 The measure of the third angle is 62° .
- 24.** Let x = the number of years since 2000.
 $45 - 1.7x = 11$
 $-1.7x = 11 - 45$
 $-1.7x = -34$
 $x = \frac{-34}{-1.7}$
 $x = 20$
 11% of American adults will believe that most qualified students get to attend college 20 years after 2000, or 2020.
- 26.** Let x = the number of years since 1960.
 $23 - 0.28x = 5$
 $-0.28x = -18$
 $\frac{-0.28x}{-0.28} = \frac{-18}{-0.28}$
 $x \approx 64$
 If this trend continues, 5% of federal tax receipts will come from corporations 64 years after 1960, or 2024.
- 28. a.** Let x = the number of deaths, in thousands, per day.
 Let $2x + 61$ = the number of births, in thousands, per day.
 $(2x + 61) - x = 214$
 $2x + 61 - x = 214$
 $x + 61 = 214$
 $x = 153$
 $2x + 61 = 367$
 births: 367,000
 deaths: 153,000
- b.** $214,000 \cdot 365 = 78,110,000$
 ≈ 78 million
- c.** $\frac{306 \text{ million}}{78 \text{ million}} \approx 4$
 It will take about 4 years.
- 30.** Let g = the number of video games rented.
 $9g = 4g + 50$
 $5g = 50$
 $g = 10$
 The total amount spent at each store will be the same after 10 rentals.
 $9g = 9(10) = 90$
 The total amount spent will be \$90.
- 32.** Let x = the number of crossings.
 Cost without discount pass: $\$5x$
 Cost with discount pass: $\$30 + \$3.50x$
 $5x = 30 + 3.50x$
 $1.50x = 30$
 $x = 20$
 The bridge must be used 20 times in a month for the costs to be equal.
- 34.** Let x = the number of years after 2000.
 $10,600,000 - 28,000x = 10,200,000 - 12,000x$
 $-16,000x = -400,000$
 $x = 25$
 The countries will have the same population 25 years after the year 2000, or the year 2025.
 $10,200,000 - 12,000x = 10,200,000 - 12,000(25)$
 $= 10,200,000 - 300,000$
 $= 9,900,000$
 The population in the year 2025 will be 9,900,000.
- 36.** Let x = the cost of the dictionary.
 $x - 0.30x = 30.80$
 $0.70x = 30.80$
 $x = 44$
 The dictionary's price before the reduction was \$44.
- 38.** Let x = the nightly cost.
 $x + 0.05x = 252$
 $1.05x = 252$
 $x = 240$
 The nightly cost is \$240.
- 40.** Let c = the dealer's cost.
 $15 = c + 0.25c$
 $15 = 1.25c$
 $12 = c$
 The dealer's cost is \$12.

- 42.** Let w = the width of the swimming pool.
Let $3w$ = the length of the swimming pool.

$$P = 2(\text{length}) + 2(\text{width})$$

$$320 = 2(3w) + 2(w)$$

$$320 = 6w + 2w$$

$$320 = 8w$$

$$40 = w$$

$$\text{If } w = 40, 3w = 3(40) = 120.$$

The dimensions are 40 feet by 120 feet.

- 44.** Let w = the width of the pool.
Let $2w - 6$ = the length of the pool.

$$P = 2(\text{length}) + 2(\text{width})$$

$$126 = 2(2w - 6) + 2(w)$$

$$126 = 4w - 12 + 2w$$

$$126 = 6w - 12$$

$$138 = 6w$$

$$23 = w$$

Find the length.

$$2w - 6 = 2(23) - 6 = 46 - 6 = 40$$

The dimensions are 23 meters by 40 meters.

- 46.** Let w = the width of the path.
Let $40 + 2w$ = the width of the pool and path.
Let $60 + 2w$ = the length of the pool and path.

$$2(40 + 2w) + 2(60 + 2w) = 248$$

$$80 + 4w + 120 + 4w = 248$$

$$200 + 8w = 248$$

$$8w = 48$$

$$w = 6$$

The width of the path is 6 feet.

- 48.** Let g = the gross amount of the paycheck.
Yearly Salary = $2(12)g + 750$

$$33150 = 24g + 750$$

$$32400 = 24g$$

$$1350 = g$$

The gross amount of each paycheck is \$1350.

- 50.** (from geometry)

$$A = lw$$

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

- 52.** (from geometry)

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

$$2A = bh$$

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

- 54.** (from finance)

$$I = Prt$$

$$t = \frac{I}{Pr}$$

- 56.** (from finance)

$$P = C + MC$$

$$P - C = MC$$

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

- 58.** (from geometry)

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

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

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

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

- 60.** (from geometry)

$$V = \frac{1}{3}\pi r^2 h$$

$$3V = \pi r^2 h$$

$$r^2 = \frac{3V}{\pi h}$$

- 62.** (from algebra)

$$y_2 - y_1 = m(x_2 - x_1)$$

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

- 64.** (from statistics)

$$z = \frac{x - u}{s}$$

$$zs = x - u$$

$$x = zs + u$$

66. (from algebra)

$$Ax + By = C$$

$$By = C - Ax$$

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

68. (from physics)

$$s = \frac{1}{2}at^2 + vt$$

$$s - vt = \frac{1}{2}at^2$$

$$2s - 2vt = at^2$$

$$a = \frac{2s - 2vt}{t^2}$$

70. (from algebra)

$$L = a + (n-1)d$$

$$L - a = (n-1)d$$

$$d = \frac{L - a}{n - 1}$$

72. (from geometry)

$$A = 2lw + 2lh + 2wh$$

$$A - 2lw = 2lh + 2wh$$

$$A - 2lw = h(2l + 2w)$$

$$h = \frac{A - 2lw}{2l + 2w}$$

74. (from statistics)

$$A = \frac{x_1 + x_2 + x_3}{n}$$

$$nA = x_1 + x_2 + x_3$$

$$n = \frac{x_1 + x_2 + x_3}{A}$$

76. – 80. Answers will vary.

82. a. Let
- x
- = the number of years after 1960.

$$y = 23 - 0.28x$$

- b. The table and graph of
- y_1
- verify the results.

84. makes sense

86. does not make sense; Explanations will vary.

Sample explanation: When traveling in Europe, the temperature is typically reported in Celsius. Thus, the most useful temperature conversion formula will be from Celsius to Fahrenheit.

88. true

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

A sample change is: It is modeled by $x - \frac{1}{3}x$.

92. Let
- x
- = the number of problems solved correctly.

Let $26 - x$ = the number of problems solved incorrectly.

$$0.08x = 0.05(26 - x)$$

$$0.08x = 1.3 - 0.05x$$

$$0.13x = 1.3$$

$$x = 10$$

10 problems were solved correctly.

94. Let
- x
- = the number of plants originally stolen.

After passing the first security guard, the thief has:

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

After passing the second security guard, the thief has:

$$\begin{aligned} & \frac{1}{2}x - 2 - \left(\frac{1}{2}\left(\frac{1}{2}x - 2\right) + 2\right) \\ &= \frac{1}{2}x - 2 - \left(\frac{1}{4}x - 1 + 2\right) = \frac{1}{2}x - 2 - \left(\frac{1}{4}x + 1\right) \\ &= \frac{1}{2}x - 2 - \frac{1}{4}x - 1 = \frac{1}{4}x - 3. \end{aligned}$$

After passing the third security guard, the thief has:

$$\begin{aligned} & \frac{1}{4}x - 3 - \left(\frac{1}{2}\left(\frac{1}{4}x - 3\right) + 2\right) \\ &= \frac{1}{4}x - 3 - \left(\frac{1}{8}x - \frac{3}{2} + 2\right) = \frac{1}{4}x - 3 - \left(\frac{1}{8}x + \frac{1}{2}\right) \\ &= \frac{1}{4}x - 3 - \frac{1}{8}x - \frac{1}{2} = \frac{1}{8}x - \frac{7}{2}. \end{aligned}$$

Since the thief has 1 plant after passing the third security guard, we can set the expression equal to 1 and solve for x .

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

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

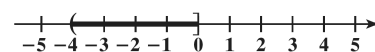
$$x - 4(7) = 8$$

$$x - 28 = 8$$

$$x = 36$$

The thief stole 36 plants.

- 96.
- $\{x | -4 < x \leq 0\}$



$$97. \frac{(2+4)^2 + (-1)^5}{12 \div 2 \cdot 3 - 3} = \frac{(6)^2 + (-1)}{6 \cdot 3 - 3} = \frac{36 + (-1)}{18 - 3} \\ = \frac{35}{15} = \frac{7}{3}$$

$$98. \frac{2x}{3} - \frac{8}{3} = x \\ 3\left(\frac{2x}{3} - \frac{8}{3}\right) = 3(x) \\ 2x - 8 = 3x \\ -8 = x$$

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

$$99. \text{ a. } b^4 \cdot b^3 = (b \cdot b \cdot b \cdot b)(b \cdot b \cdot b) = b^7$$

$$\text{ b. } b^5 \cdot b^5 = (b \cdot b \cdot b \cdot b \cdot b)(b \cdot b \cdot b \cdot b \cdot b) = b^{10}$$

c. When multiplying exponential expressions with the same base, add the exponents.

$$100. \text{ a. } \frac{b^7}{b^3} = \frac{\cancel{b} \cdot \cancel{b} \cdot \cancel{b} \cdot b \cdot b \cdot b \cdot b}{\cancel{b} \cdot \cancel{b} \cdot \cancel{b}} = b^4$$

$$\text{ b. } \frac{b^8}{b^2} = \frac{\cancel{b} \cdot \cancel{b} \cdot b \cdot b \cdot b \cdot b \cdot b \cdot b}{\cancel{b} \cdot \cancel{b}} = b^6$$

c. When dividing exponential expressions with the same base, subtract the exponents.

$$101. \frac{1}{\left(-\frac{1}{2}\right)^3} = \frac{1}{\left(-\frac{2}{1}\right)^{-3}} \\ = \frac{1}{(-2)^{-3}} \\ = (-2)^3 \\ = -8$$

1.6 Check Points

$$1. \text{ a. } b^6 \cdot b^5 = b^{6+5} = b^{11}$$

$$\text{ b. } (4x^3y^4)(10x^2y^6) = 4 \cdot 10 \cdot x^3 \cdot x^2 \cdot y^4 \cdot y^6 \\ = 40x^{3+2}y^{4+6} \\ = 40x^5y^{10}$$

$$2. \text{ a. } \frac{(-3)^6}{(-3)^3} = (-3)^{6-3} = (-3)^3 = -27$$

$$\text{ b. } \frac{27x^{14}y^8}{3x^3y^5} = \frac{27}{3}x^{14-3}y^{8-5} = 9x^{11}y^3$$

$$3. \text{ a. } 7^0 = 1$$

$$\text{ b. } (-5)^0 = 1$$

$$\text{ c. } -5^0 = -(5^0) = -1$$

$$\text{ d. } 10x^0 = 10 \cdot 1 = 10$$

$$\text{ e. } (10x)^0 = 1$$

$$4. \text{ a. } 5^{-2} = \frac{1}{5^2} = \frac{1}{25}$$

$$\text{ b. } (-3)^{-3} = \frac{1}{(-3)^3} = \frac{1}{-27} = -\frac{1}{27}$$

$$\text{ c. } \frac{1}{4^{-2}} = 4^2 = 16$$

$$\text{ d. } 3x^{-6}y^4 = 3 \cdot \frac{1}{x^6} \cdot y^4 = \frac{3y^4}{x^6}$$

$$5. \text{ a. } \frac{7^{-2}}{4^{-3}} = \frac{4^3}{7^2} = \frac{64}{49}$$

$$\text{ b. } \frac{1}{5x^{-2}} = \frac{x^2}{5}$$

$$6. \text{ a. } (x^5)^3 = x^{5 \cdot 3} = x^{15}$$

$$\text{ b. } (y^7)^{-2} = y^{(7)(-2)} = y^{-14} = \frac{1}{y^{14}}$$

$$\text{ c. } (b^{-3})^{-4} = b^{(-3)(-4)} = b^{12}$$

$$7. \text{ a. } (2x)^4 = (2)^4(x)^4 = 16x^4$$

$$\text{ b. } (-3y^2)^3 = (-3)^3(y^2)^3 = -27y^6$$

$$\begin{aligned}\text{c. } (-4x^5y^{-1})^{-2} &= (-4)^{-2}(x^5)^{-2}(y^{-1})^{-2} \\ &= \frac{1}{(-4)^2} \cdot \frac{1}{(x^5)^2} \cdot y^2 \\ &= \frac{y^2}{16x^{10}}\end{aligned}$$

$$8. \text{ a. } \left(\frac{x^5}{4}\right)^3 = \frac{x^{5 \cdot 3}}{4^3} = \frac{x^{15}}{64}$$

$$\text{b. } \left(\frac{2x^{-3}}{y^2}\right)^4 = \frac{2^4 x^{(-3)(4)}}{y^{(2)(4)}} = \frac{16x^{-12}}{y^8} = \frac{16}{x^{12}y^8}$$

$$\text{c. } \left(\frac{x^{-3}}{y^4}\right)^{-5} = \frac{x^{(-3)(-5)}}{y^{(4)(-5)}} = \frac{x^{15}}{y^{-20}} = x^{15}y^{20}$$

$$\begin{aligned}9. \text{ a. } &(-3x^{-6}y)(-2x^3y^4)^2 \\ &= (-3x^{-6}y)(-2)^2(x^3)^2(y^4)^2 \\ &= -3 \cdot x^{-6} \cdot y \cdot 4 \cdot x^6 \cdot y^8 \\ &= -12 \cdot x^{-6+6} \cdot y^{1+8} \\ &= -12x^0y^9 \\ &= -12y^9\end{aligned}$$

$$\begin{aligned}\text{b. } &\left(\frac{10x^3y^5}{5x^6y^{-2}}\right)^2 = (2x^{3-6}y^{5+2})^2 \\ &= (2x^{-3}y^7)^2 = 4x^{-6}y^{14} = \frac{4y^{14}}{x^6}\end{aligned}$$

$$\begin{aligned}\text{c. } &\left(\frac{x^3y^5}{4}\right)^{-3} = \frac{x^{(3)(-3)}y^{(5)(-3)}}{4^{-3}} \\ &= \frac{x^{-9}y^{-15}}{4^{-3}} = \frac{4^3}{x^9y^{15}} = \frac{64}{x^9y^{15}}\end{aligned}$$

$$3. 1$$

$$4. \frac{1}{b^n}$$

$$5. \text{ false}$$

$$6. b^n$$

$$7. \text{ true}$$

1.6 Exercise Set

$$2. b^5 \cdot b^9 = b^{5+9} = b^{14}$$

$$4. x \cdot x^4 = x^{1+4} = x^5$$

$$8. 5x^3 \cdot 3x^2 = 15x^{3+2} = 15x^5$$

$$10. (-4y^8)(-8y^4) = 32y^{8+4} = 32y^{12}$$

$$12. (4x^5y^6)(20x^7y^4) = 80x^{5+7}y^{6+4} = 80x^{12}y^{10}$$

$$\begin{aligned}14. (-9x^3yz^4)(-5xy^0z^2) &= -9(-5)x^{3+1}y^{1+0}z^{4+2} \\ &= 45x^4yz^6\end{aligned}$$

$$16. \frac{b^{25}}{b^5} = b^{25-5} = b^{20}$$

$$18. \frac{18x^{11}}{3x^4} = 6x^{11-4} = 6x^7$$

$$20. \frac{x^9y^{12}}{x^2y^6} = x^{9-2}y^{12-6} = x^7y^6$$

$$22. \frac{36x^{12}y^4}{4xy^2} = 9x^{12-1}y^{4-2} = 9x^{11}y^2$$

$$24. \frac{-66a^9b^7c^6}{6a^3bc^2} = -11a^6b^6c^4$$

$$26. 9^0 = 1$$

$$28. (-2)^0 = 1$$

1.6 Concept and Vocabulary Check

$$1. b^{m+n}; \text{ add}$$

$$2. b^{m-n}; \text{ subtract}$$

$$30. -2^0 = -1$$

$$32. 17y^0 = 17(1) = 17$$

$$34. (17y)^0 = 1$$

$$36. 4^{-2} = \frac{1}{4^2} = \frac{1}{16}$$

$$38. (-7)^{-2} = \frac{1}{(-7)^2} = \frac{1}{49}$$

$$40. -7^{-2} = -\left(7^{-2}\right) = -\frac{1}{7^2} = -\frac{1}{49}$$

$$42. x^3y^{-4} = \frac{x^3}{y^4}$$

$$44. 9x^{-8}y^4 = \frac{9y^4}{x^8}$$

$$46. \frac{1}{2^{-5}} = 2^5 = 32$$

$$48. \frac{1}{(-2)^{-4}} = (-2)^4 = 16$$

$$50. \frac{x^{-3}}{y^{-7}} = \frac{y^7}{x^3}$$

$$52. \frac{a^{-3}b^8}{c^{-2}} = \frac{b^8c^2}{a^3}$$

$$54. (x^3)^2 = x^{(3 \cdot 2)} = x^6$$

$$56. (b^8)^{-3} = \frac{1}{(b^8)^3} = \frac{1}{b^{(8 \cdot 3)}} = \frac{1}{b^{24}}$$

$$58. (9^{-4})^{-5} = 9^{-4 \cdot (-5)} = 9^{20}$$

$$60. (2x)^5 = 2^5x^5 = 32x^5$$

$$62. (-4x^9)^2 = (-4)^2x^{9 \cdot 2} = 16x^{18}$$

$$64. (3x^2y)^4 = 3^4x^{(2 \cdot 4)}y^4 = 81x^8y^4$$

$$66. (-3x^4y^6)^2 = (-3)^2x^{(4 \cdot 2)}y^{(6 \cdot 2)} = 9x^8y^{12}$$

$$68. (-2x^{-4})^{-3} = (-2)^{-3}(x^{-4})^{-3} = \frac{x^{12}}{(-2)^3} = -\frac{x^{12}}{8}$$

$$70. (7x^2y^{-5})^{-2} = 7^{-2}x^{-4}y^{10} = \frac{y^{10}}{7^2x^4} = \frac{y^{10}}{49x^4}$$

$$72. (-2x^{-4}y^5z^3)^{-4} = (-2)^{-4}x^{16}y^{-20}z^{-12} \\ = \frac{x^{16}}{(-2)^4y^{20}z^{12}} = \frac{x^{16}}{16y^{20}z^{12}}$$

$$74. \left(\frac{y}{2}\right)^5 = \frac{y^5}{2^5} = \frac{y^5}{32}$$

$$76. \left(\frac{x^4}{6}\right)^2 = \frac{x^{(4 \cdot 2)}}{6^2} = \frac{x^8}{36}$$

$$78. \left(-\frac{2x}{y}\right)^5 = -\frac{2^5x^5}{y^5} = -\frac{32x^5}{y^5}$$

$$80. \left(\frac{x^5}{y^3}\right)^6 = \frac{x^{(5 \cdot 6)}}{y^{(3 \cdot 6)}} = \frac{x^{30}}{y^{18}}$$

$$82. \left(\frac{x^4}{y^{-2}}\right)^3 = \frac{x^{(4 \cdot 3)}}{y^{(-2 \cdot 3)}} = \frac{x^{12}}{y^{-6}} = x^{12}y^6$$

$$84. \left(\frac{a^{-3}}{b^5}\right)^{-4} = \frac{a^{-3(-4)}}{b^{5(-4)}} = \frac{a^{12}}{b^{-20}} = a^{12}b^{20}$$

$$86. \frac{x^6}{x^{10}} = x^{6-10} = x^{-4} = \frac{1}{x^4}$$

$$88. \frac{10x^5}{-2x^6} = -5x^{5-6} = -5x^{-1} = -\frac{5}{x}$$

$$90. \frac{15x^2}{3x^{11}} = 5x^{2-11} = 5x^{-9} = \frac{5}{x^9}$$

$$92. \frac{72a^5b^{11}}{9ab^{17}} = 8a^{5-1}b^{11-17} = 8a^4b^{-6} = \frac{8a^4}{b^6}$$

$$94. x^4 \cdot x^{-12} = x^{4+(-12)} = x^{-8} = \frac{1}{x^8}$$

$$96. (4a^2)(-2a^{-5}) = -8a^{-3} = -\frac{8}{a^3}$$

$$\begin{aligned} 98. & \left(-\frac{1}{3}x^{-5}y^4z^6\right)\left(-18x^{-2}y^{-1}z^{-7}\right) \\ &= 6x^{-5+(-2)}y^{4+(-1)}z^{6+(-7)} \\ &= 6x^{-7}y^3z^{-1} = \frac{6y^3}{x^7z} \end{aligned}$$

$$100. \frac{12x^5}{3x^{-10}} = 4x^{5-(-10)} = 4x^{15}$$

$$102. \frac{x^{-10}}{x^4} = x^{-10-4} = x^{-14} = \frac{1}{x^{14}}$$

$$\begin{aligned} 104. \frac{24x^2y^{13}}{-2x^5y^{-2}} &= -12x^{2-5}y^{13-(-2)} \\ &= -12x^{-3}y^{15} = -\frac{12y^{15}}{x^3} \end{aligned}$$

$$\begin{aligned} 106. \frac{-24a^2b^{-2}c^8}{-8a^{-5}b^{-1}c^{-3}} &= 3a^{2-(-5)}b^{-2-(-1)}c^{8-(-3)} \\ &= 3a^7b^{-1}c^{11} \\ &= \frac{3a^7c^{11}}{b} \end{aligned}$$

$$108. \left(\frac{x^4}{x^{-11}}\right)^3 = (x^{4-(-11)})^3 = (x^{15})^3 = x^{45}$$

$$\begin{aligned} 110. \left(\frac{-30a^{14}b^8}{10a^{17}b^{-2}}\right)^3 &= (-3a^{14-17}b^{8-(-2)})^3 \\ &= (-3a^{-3}b^{10})^3 \\ &= -27a^{-9}b^{30} = -\frac{27b^{30}}{a^9} \end{aligned}$$

$$112. \left(\frac{4a^{-5}b^3}{12a^3b^{-5}}\right)^0 = 1$$

$$114. \left(\frac{x^6y^{-7}}{2}\right)^{-3} = \frac{x^{-18}y^{21}}{2^{-3}} = \frac{8y^{21}}{x^{18}}$$

$$\begin{aligned} 116. \left(\frac{-2a^{-4}b^3c^{-1}}{3a^{-2}b^{-5}c^{-2}}\right)^{-4} &= \left(\frac{-2a^{-4-(-2)}b^{3-(-5)}c^{-1-(-2)}}{3}\right)^{-4} \\ &= \left(\frac{-2a^{-2}b^8c}{3}\right)^{-4} \\ &= \frac{(-2)^{-4}a^8b^{-32}c^{-4}}{3^{-4}} \\ &= \frac{3^4a^8}{(-2)^4b^{32}c^4} \\ &= \frac{81a^8}{16b^{32}c^4} \end{aligned}$$

$$\begin{aligned} 118. \frac{7x^3}{y^{-9}} + \left(\frac{x^{-1}}{y^3}\right)^{-3} &= 7x^3y^9 + \frac{x^{(-1)(-3)}}{y^{3(-3)}} \\ &= 7x^3y^9 + \frac{x^3}{y^{-9}} \\ &= 7x^3y^9 + x^3y^9 \\ &= 8x^3y^9 \end{aligned}$$

$$\begin{aligned} 120. \left(\frac{2^{-1}x^{-2}y}{x^4y^{-1}}\right)^{-2} \left(\frac{xy^{-3}}{x^{-3}y}\right)^3 &= \frac{2^{(-1)(-2)}x^{(-2)(-2)}y^{1(-2)}}{x^{4(-2)}y^{(-1)(-2)}} \cdot \frac{x^{1 \cdot 3}y^{-3 \cdot 3}}{x^{-3 \cdot 3}y^{1 \cdot 3}} \\ &= \frac{2^2x^4y^{-2}}{x^{-8}y^2} \cdot \frac{x^3y^{-9}}{x^{-9}y^3} \\ &= 4x^{4-(-8)}y^{-2-2} \cdot x^{3-(-9)}y^{-9-3} \\ &= 4x^{12}y^{-4} \cdot x^{12}y^{-12} \\ &= 4x^{12+12}y^{-4+(-12)} \\ &= 4x^{24}y^{-16} \\ &= \frac{4x^{24}}{y^{16}} \end{aligned}$$

$$\begin{aligned}
 122. \quad (-4x^{-4}y^5)^{-2}(-2x^5y^{-6}) &= \frac{-2x^5y^{-6}}{(-4x^{-4}y^5)^2} \\
 &= \frac{-2x^5y^{-6}}{(-4)^2x^{-4 \cdot 2}y^{5 \cdot 2}} \\
 &= -\frac{2x^5y^{-6}}{16x^{-8}y^{10}} \\
 &= -\frac{x^{5-(-8)}}{8y^{10-(-6)}} \\
 &= -\frac{x^{13}}{8y^{16}}
 \end{aligned}$$

$$\begin{aligned}
 124. \quad \frac{(3x^3y^2)^{-1}(2x^2y)^{-2}}{(xy^2)^{-5}(x^2y^3)^3} \\
 &= \frac{(xy^2)^5}{(3x^3y^2)^1(2x^2y)^2(x^2y^3)^3} \\
 &= \frac{x^{1 \cdot 5}y^{2 \cdot 5}}{(3x^3y^2)(2^2x^{2 \cdot 2}y^2)(x^{2 \cdot 3}y^{3 \cdot 3})} \\
 &= \frac{x^5y^{10}}{(3x^3y^2)(4x^4y^2)(x^6y^9)} \\
 &= \frac{x^5y^{10}}{12x^{3+4+6}y^{2+2+9}} \\
 &= \frac{x^5y^{10}}{12x^{13}y^{13}} = \frac{1}{12x^{13-5}y^{13-10}} = \frac{1}{12x^8y^3}
 \end{aligned}$$

126. a. $A = 1000 \cdot 2^t = 1000 \cdot 2^0 = 1000 \cdot 1 = 1000$
The present aphid population is 1000.
- b. $A = 1000 \cdot 2^t = 1000 \cdot 2^3 = 1000 \cdot 8 = 8,000$
In three weeks the aphid population will be 8000.
- c. $A = 1000 \cdot 2^t = 1000 \cdot 2^{-2}$

$$= 1000 \cdot \frac{1}{2^2} = 1000 \cdot \frac{1}{4} = 250$$
Two weeks ago the aphid population was 250.

$$128. \text{ a. } N = \frac{25}{1 + 24 \cdot 2^{-t}} = \frac{25}{1 + 24 \cdot 2^{-0}} = \frac{25}{1 + 24 \cdot 1} = \frac{25}{25} = 1$$

One person started the rumor.

$$\begin{aligned}
 \text{b. } N &= \frac{25}{1 + 24 \cdot 2^{-t}} = \frac{25}{1 + 24 \cdot 2^{-4}} \\
 &= \frac{25}{1 + \frac{24}{2^4}} = \frac{25}{1 + \frac{24}{16}} = \frac{25}{1 + 0.375} = \frac{25}{1.375} \approx 18
 \end{aligned}$$

After 6 minutes, about 18 people in the class had heard the rumor.

130. a. At time zero, one person started the rumor. This is represented by the point (0,1).
- b. After 6 minutes, about 18 people in the class had heard the rumor. This is represented by the point (6,18).

132. 25 people in the class eventually heard the rumor.

$$\begin{aligned}
 134. \text{ If } n = 2, \\
 d &= \frac{3(2^{n-2}) + 4}{10} = \frac{3(2^{2-2}) + 4}{10} = \frac{3(2^0) + 4}{10} \\
 &= \frac{3(1) + 4}{10} = \frac{3 + 4}{10} = \frac{7}{10} = 0.7
 \end{aligned}$$

Venus is 0.7 astronomical units from the Sun.

$$\begin{aligned}
 136. \text{ If } n = 7, \\
 d &= \frac{3(2^{n-2}) + 4}{10} = \frac{3(2^{7-2}) + 4}{10} = \frac{3(2^5) + 4}{10} \\
 &= \frac{3(32) + 4}{10} = \frac{96 + 4}{10} = \frac{100}{10} = 10
 \end{aligned}$$

Uranus is 10 astronomical units from the Sun. Thus, Uranus is 9 astronomical units farther from the Sun than Earth.

138. – 144. Answers will vary.

146. makes sense

148. does not make sense; Explanations will vary.

Sample explanation: $25(x^3)^9 = 25x^{27}$, not $25x^{12}$.

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

A sample change is: $2^2 \cdot 2^4 = 2^{2+4} = 2^6$

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

A sample change is: $6^5 = (2 \cdot 3)^5 = 2^5 \cdot 3^5$

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

A sample change is: $\frac{2^8}{2^{-3}} = 2^{8-(-3)} = 2^{11}$, not 2^5 .

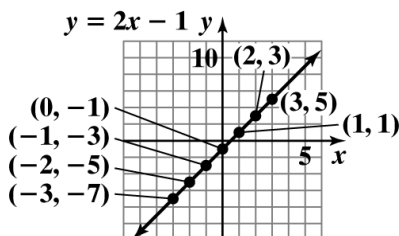
156. true

158. $x^{n-1} \cdot x^{3n+4} = x^{n-1+3n+4} = x^{4n+3}$

160. $\left(\frac{x^{3-n}}{x^{6-n}}\right)^{-2} = (x^{3-n-(6-n)})^{-2} = (x^{3-n-6+n})^{-2}$
 $= (x^{-3})^{-2} = x^6$

162.

x	(x, y)
-3	$(-3, -7)$
-2	$(-2, -5)$
-1	$(-1, 0)$
0	$(0, -1)$
1	$(1, 1)$
2	$(2, 3)$
3	$(3, 5)$



163. $Ax + By = C$

$$By = C - Ax$$

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

164. Let w = the width of the playing field.

Let $2w - 5$ = the length of the playing field.

$$P = 2(\text{length}) + 2(\text{width})$$

$$230 = 2(2w - 5) + 2w$$

$$230 = 4w - 10 + 2w$$

$$230 = 6w - 10$$

$$240 = 6w$$

$$40 = w$$

Find the length. $2w - 5 = 2(40) - 5 = 80 - 5 = 75$

The playing field is 40 meters by 75 meters.

165. It moves the decimal point 3 places to the right.

166. It moves the decimal point 2 places to the left.

167. a. $10^9 \times 10^{-4} = 10^{9-4} = 10^5 = 100,000$

b. $\frac{10^4}{10^{-2}} = 10^4 \times 10^2 = 10^{4+2} = 10^6 = 1,000,000$

1.7 Check Points

1. a. Move the decimal point 7 places to the right.
 $-2.6 \times 10^9 = -2,600,000,000$

b. Move the decimal point 6 places to the left.
 $3.017 \times 10^{-6} = 0.000003017$

2. a. The decimal point must be moved 9 places to the left to get a number whose absolute value is between 1 and 10. Thus the exponent on 10 is 9.
 $5,210,000,000 = 5.21 \times 10^9$

b. The decimal point must be moved 8 places to the right to get a number whose absolute value is between 1 and 10. Thus the exponent on 10 is -8.
 $-0.00000006893 = -6.893 \times 10^{-8}$

3. 18 million = 18,000,000 = 1.8×10^7

4. a. $(7.1 \times 10^5)(5 \times 10^{-7}) = (7.1 \times 5) \times (10^5 \times 10^{-7})$
 $= 35.5 \times 10^{-2} = 3.55 \times 10^{-1}$

b. $\frac{1.2 \times 10^6}{3 \times 10^{-3}} = \left(\frac{1.2}{3}\right) \times \left(\frac{10^6}{10^{-3}}\right)$
 $= 0.4 \times 10^{6-(-3)} = 0.4 \times 10^9 = 4 \times 10^8$

5. $\frac{2.75 \times 10^{12}}{3.06 \times 10^8} = \left(\frac{2.75}{3.06}\right) \times \left(\frac{10^{12}}{10^8}\right)$
 $\approx 0.8987 \times 10^{12-8}$
 $= 0.8987 \times 10^4 = 8987$
 The per capita tax was about \$8987 in 2008.

6. $d = rt$

$$d = (1.55 \times 10^3)(20,000)$$

$$d = (1.55 \times 10^3)(2 \times 10^4)$$

$$d = (1.55 \times 2) \times (10^3 \times 10^4)$$

$$d = 3.1 \times 10^7$$

The distance from Venus to Mercury is 3.1×10^7 ,
or 31 million miles.

1.7 Concept and Vocabulary Check

1. a number greater than or equal to 1 and less than 10; integer
2. true
3. false

1.7 Exercise Set

2. $9.2 \times 10^2 = 920$

4. $7 \times 10^{-5} = 0.00007$

6. $-8.17 \times 10^6 = -8,170,000$

8. $2.4 \times 10^0 = 2.4 \times 1 = 2.4$

10. $6.8 \times 10^{-1} = 0.68$

12. $-3.14 \times 10^{-3} = -0.00314$

14. $-7.00001 \times 10^{10} = -70,000,100,000$

16. $64,000 = 6.4 \times 10^4$

18. $579,000,000,000,000,000 = 5.79 \times 10^{17}$

20. $-326 = -3.26 \times 10^2$

22. $-3829 = -3.829 \times 10^3$

24. $0.0083 = 8.3 \times 10^{-3}$

26. $-0.00000000405 = -4.05 \times 10^{-9}$

28. $0.005 = 5 \times 10^{-3}$

30. $2.71828 = 2.71828 \times 10^0$

32. $(2 \times 10^4)(4.1 \times 10^3) = 8.2 \times 10^7$

34. $(1.4 \times 10^{15})(3 \times 10^{-11}) = 4.2 \times 10^4$

36. $(5.1 \times 10^{-8})(3 \times 10^{-4}) = 15.3 \times 10^{-12}$
 $= 1.53 \times 10^{-11}$

38. $(8.2 \times 10^8)(4.6 \times 10^4)$
 $= 37.72 \times 10^{8+4} = 37.72 \times 10^{12}$
 $= 3.772 \times 10^{13} \approx 3.77 \times 10^{13}$

40. $\frac{6.9 \times 10^8}{3 \times 10^5} = 2.3 \times 10^{8-5} = 2.3 \times 10^3$

42. $\frac{1.2 \times 10^4}{2 \times 10^{-2}} = 0.6 \times 10^{4-(-2)} = 0.6 \times 10^6$
 $= (6 \times 10^{-1}) \times 10^6 = 6 \times 10^5$

44. $\frac{7.5 \times 10^{-2}}{2.5 \times 10^6} = 3 \times 10^{-2-6} = 3 \times 10^{-8}$

46. $\frac{1.5 \times 10^{-2}}{5 \times 10^{-6}} = 0.5 \times 10^{-2-(-6)}$
 $= 0.5 \times 10^4 = 5 \times 10^3$

48. $\frac{282,000,000,000}{0.00141} = \frac{2.82 \times 10^{11}}{1.41 \times 10^{-3}}$
 $= 2 \times 10^{11-(-3)}$
 $= 2 \times 10^{14}$

50. $\frac{66000 \times 0.001}{0.003 \times 0.002} = \frac{(6.6 \times 10^4)(1 \times 10^{-3})}{(3 \times 10^{-3})(2 \times 10^{-3})}$
 $= \frac{6.6 \times 10^1}{6 \times 10^{-6}}$
 $= 1.1 \times 10^{1-(-6)}$
 $= 1.1 \times 10^7$

$$52. (3 \times 10^{-2})x = 1.2 \times 10^4$$

$$\begin{aligned} x &= \frac{1.2 \times 10^4}{3 \times 10^{-2}} \\ &= \frac{1.2}{3} \times \frac{10^4}{10^{-2}} \\ &= 0.4 \times 10^{4-(-2)} \\ &= 0.4 \times 10^6 = 4 \times 10^5 \end{aligned}$$

$$54. \frac{x}{5 \times 10^{11}} = -2.9 \times 10^{-3}$$

$$\begin{aligned} x &= (5 \times 10^{11})(-2.9 \times 10^{-3}) \\ &= [5(-2.9)] \times (10^{11} \cdot 10^{-3}) \\ &= -14.5 \times 10^{11+(-3)} \\ &= -14.5 \times 10^8 = -1.45 \times 10^9 \end{aligned}$$

$$56. x - (5.3 \times 10^{-16}) = 8.4 \times 10^{-16}$$

$$\begin{aligned} x &= (8.4 \times 10^{-16}) + (5.3 \times 10^{-16}) \\ &= (8.4 + 5.3) \times 10^{-16} \\ &= 13.7 \times 10^{-16} \\ &= 1.37 \times 10^{-15} \end{aligned}$$

$$58. (-7.8 \times 10^{-4})x = (3.9 \times 10^{-7})(6.8 \times 10^5)$$

$$\begin{aligned} x &= \frac{(3.9 \times 10^{-7})(6.8 \times 10^5)}{-7.8 \times 10^{-4}} \\ &= \frac{3.9 \cdot 6.8}{-7.8} \times \frac{10^{-7} \cdot 10^5}{10^{-4}} \\ &= \frac{6.8}{-2} \times 10^{-7+5-(-4)} \\ &= -3.4 \times 10^2 \end{aligned}$$

$$60. 50.0 \text{ billion} = 50,000,000,000 = 5.0 \times 10^{10}$$

Warren Buffett is worth $\$5 \times 10^{10}$.

$$\begin{aligned} 62. 39.5 \times 10^9 - 23.3 \times 10^9 &= (39.5 - 23.3) \times 10^9 \\ &= 16.2 \times 10^9 \\ &= 1.62 \times 10^{10} \end{aligned}$$

Larry Ellison's worth exceeds Sheldon Adelson's worth by $\$1.62 \times 10^{10}$.

$$64. \frac{6 \times 10^8}{3 \times 10^8} = 2 \times 10^{8-8} = 2 \times 10^0 = 2 \times 1 = 2$$

Approximately 2 Big Macs per person would be consumed by each American in a year.

$$66. 127 \times 3.2 \times 10^7 = 406.4 \times 10^7 = 4.064 \times 10^9$$

4.064×10^9 chickens are eaten per year in the U.S.

$$68. \text{ a. } \frac{33 \times 10^9}{25.7 \times 10^6} \approx 1.284 \times 10^3$$

$$= \$1284$$

$$\text{ b. } \frac{\$1284}{12} \approx \$107$$

$$70. \frac{7.2 \times 10^6}{3.66 \times 10^8} \approx 1.97 \times 10^{-2} = 0.0197 \approx 0.02$$

The U.S. paid Russia approximately \$0.02 per acre.

$$72. 80,000(1.67 \times 10^{-24})$$

$$= (8 \times 10^4)(1.67 \times 10^{-24}) = 13.36 \times 10^{4-24}$$

$$= (1.336 \times 10) \times 10^{-20} = 1.336 \times 10^{-19}$$

The mass of 80,000 hydrogen atoms is 1.336×10^{-19} grams.

74. – 80. Answers will vary.

82. makes sense

84. does not make sense; Explanations will vary.
Sample explanation: 58 million
 $= 58,000,000 = 5.8 \times 10^7$. 58 millionths
 $= 0.000058 = 5.8 \times 10^{-5}$. 7 and -5 do not have the same absolute value.

86. false; Changes to make the statement true will vary.
A sample change is:

$$\frac{8 \times 10^{30}}{4 \times 10^{-5}} = 2 \times 10^{30-(-5)} = 2 \times 10^{35}, \text{ not } 2 \times 10^{25}.$$

88. true

$$90. 5.6 \times 10^{13} + 3.1 \times 10^{13} = (5.6 + 3.1) \times 10^{13} = 8.7 \times 10^{13}$$

$$\begin{aligned}
 92. \quad & \frac{70 \text{ bts}}{\cancel{\text{min}}} \cdot \frac{60 \cancel{\text{min}}}{\cancel{\text{hr}}} \cdot \frac{24 \cancel{\text{hrs}}}{\cancel{\text{day}}} \cdot \frac{365 \cancel{\text{days}}}{\cancel{\text{yr}}} \cdot 80 \cancel{\text{yrs}} \\
 &= 70 \cdot 60 \cdot 24 \cdot 365 \cdot 80 \text{ beats} \\
 &= 2943360000 \text{ beats} \\
 &= 2.94336 \times 10^9 \text{ beats} \\
 &\approx 2.94 \times 10^9 \text{ beats} \\
 &\text{The heart beats approximately } 2.94 \times 10^9 \text{ times} \\
 &\text{over a lifetime of 80 years.}
 \end{aligned}$$

$$\begin{aligned}
 94. \quad & 9(10x - 4) - (5x - 10) = 90x - 36 - 5x + 10 \\
 &= 90x - 5x - 36 + 10 \\
 &= 85x - 26
 \end{aligned}$$

$$\begin{aligned}
 95. \quad & \frac{4x-1}{10} = \frac{5x+2}{4} - 4 \\
 & 20\left(\frac{4x-1}{10}\right) = 20\left(\frac{5x+2}{4} - 4\right) \\
 & 2(4x-1) = 5(5x+2) - 80 \\
 & 8x-2 = 25x+10-80 \\
 & 8x-2 = 25x-70 \\
 & -2 = 17x-70 \\
 & 68 = 17x \\
 & 4 = x
 \end{aligned}$$

$$\begin{aligned}
 96. \quad & (8x^4y^{-3})^{-2} = 8^{-2}(x^4)^{-2}(y^{-3})^{-2} \\
 &= 8^{-2}x^{-8}y^6 = \frac{y^6}{64x^8}
 \end{aligned}$$

97. In set 1, each x -coordinate is paired with one and only one y -coordinate.

$$\begin{aligned}
 98. \quad & r^3 - 2r^2 + 5 \\
 &= (-5)^3 - 2(-5)^2 + 5 \\
 &= -125 - 2(25) + 5 \\
 &= -125 - 50 + 5 \\
 &= -170
 \end{aligned}$$

$$\begin{aligned}
 99. \quad & 5x + 7 = 5(a + h) + 7 \\
 &= 5a + 5h + 7
 \end{aligned}$$

Chapter 1 Review

1. $2x - 10$

2. $4 + 6x = 6x + 4$

3. $\frac{9}{x} + \frac{1}{2}x$

$$\begin{aligned}
 4. \quad & x^2 - 7x + 4 = (10)^2 - 7(10) + 4 \\
 &= 100 - 70 + 4 \\
 &= 34
 \end{aligned}$$

$$\begin{aligned}
 5. \quad & 6 + 2(x - 8)^3 = 6 + 2(11 - 8)^3 \\
 &= 6 + 2(3)^3 \\
 &= 60
 \end{aligned}$$

6. $x^4 - (x - y) = (2)^4 - (2 - 1) = 15$

7. $\{1, 2\}$

8. $\{-3, -2, -1, 0, 1\}$

9. false; Zero is not a natural number.

10. true; -2 is a rational number.

11. true; $\frac{1}{3}$ is not an irrational number.

12. Negative five is less than two. True.

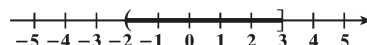
13. Negative seven is greater than or equal to negative three. False.

14. Negative seven is less than or equal to negative seven. True.

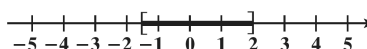
$$\begin{aligned}
 15. \quad & F = 28 + 6x - 0.6x^2 \\
 & F = 28 + 6(4) - 0.6(4)^2 \\
 &= 42.4
 \end{aligned}$$

The model overestimates the actual value by 0.4.

16. $\{x | -2 < x \leq 3\}$



17. $\{x | -1.5 \leq x \leq 2\}$



18. $\{x|x > -1\}$



19. $|-9.7| = 9.7$

20. $|5.003| = 5.003$

21. $|0| = 0$

22. $-2.4 + (-5.2) = -7.6$

23. $-6.8 + 2.4 = -4.4$

24. $-7 - (-20) = -7 + 20 = 13$

25. $(-3)(-20) = 60$

$$\begin{aligned}
 26. \quad -\frac{3}{5} - \left(-\frac{1}{2}\right) &= -\frac{3}{5} + \frac{1}{2} \\
 &= -\frac{3}{5} \cdot \frac{2}{2} + \frac{1}{2} \cdot \frac{5}{5} \\
 &= -\frac{6}{10} + \frac{5}{10} \\
 &= -\frac{1}{10}
 \end{aligned}$$

27. $\left(\frac{2}{7}\right)\left(-\frac{3}{10}\right) = -\frac{6}{70} = -\frac{3}{35}$

28. $4(-3)(-2)(-10) = -12(-2)(-10)$
 $= -240$

29. $(-2)^4 = 16$

30. $-2^5 = -32$

31. $-\frac{2}{3} \div \frac{8}{5} = -\frac{2}{3} \cdot \frac{5}{8} = -\frac{5}{12}$

32. $\frac{-35}{-5} = 7$

33. $\frac{54.6}{-6} = -9.1$

34. $x = -7$

$-1(x) = -1(-7)$

$-x = 7$

35. $-11 - [-17 + (-3)] = -11 - [-20] = 9$

36. $\left(-\frac{1}{2}\right)^3 \cdot 2^4 = -\frac{1}{8} \cdot 16 = -2$

37. $-3[4 - (6 - 8)] = -3[4 - (-2)]$
 $= -3[6] = -18$

$$\begin{aligned}
 38. \quad 8^2 - 36 \div 3^2 \cdot 4 - (-7) \\
 &= 64 - 36 \div 9 \cdot 4 + 7 \\
 &= 64 - 4 \cdot 4 + 7 = 64 - 16 + 7 \\
 &= 48 + 7 = 55
 \end{aligned}$$

39. $\frac{(-2)^4 + (-3)^2}{2^2 - (-21)} = \frac{16 + 9}{4 - (-21)} = \frac{25}{25} = 1$

$$\begin{aligned}
 40. \quad \frac{(7-9)^3 - (-4)^2}{2 + 2(8) \div 4} &= \frac{(-2)^3 - 16}{2 + 16 \div 4} = \frac{-8 - 16}{2 + 4} \\
 &= \frac{-24}{6} = -4
 \end{aligned}$$

$$\begin{aligned}
 41. \quad 4 - (3-8)^2 + 3 \div 6 \cdot 4^2 &= 4 - (-5)^2 + 3 \div 6 \cdot 16 \\
 &= 4 - 25 + 3 \div 6 \cdot 16 \\
 &= 4 - 25 + \frac{1}{2} \cdot 16 \\
 &= 4 - 25 + 8 = -13
 \end{aligned}$$

42. $5(2x-3) + 7x = 10x - 15 + 7x$
 $= 17x - 15$

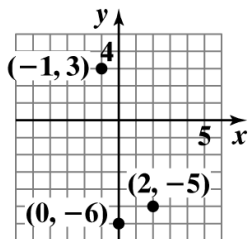
43. $5x + 7x^2 - 4x + 2x^2 = x + 9x^2 = 9x^2 + x$

44. $3(4y-5) - (7y+2) = 12y - 15 - 7y - 2$
 $= 5y - 17$

45. $8 - 2[3 - (5x-1)] = 8 - 2[3 - 5x + 1]$
 $= 8 - 6 + 10x - 2 = 10x$

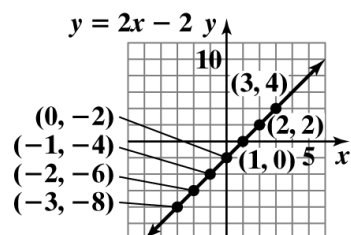
46. $6(2x-3) - 5(3x-2) = 12x - 18 - 15x + 10$
 $= -3x - 8$

47. – 49.



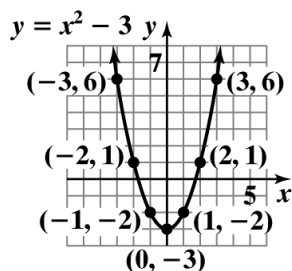
50.

x	(x, y)
-3	$(-3, -8)$
-2	$(-2, -6)$
-1	$(-1, -4)$
0	$(0, -2)$
1	$(1, 0)$
2	$(2, 2)$
3	$(3, 4)$



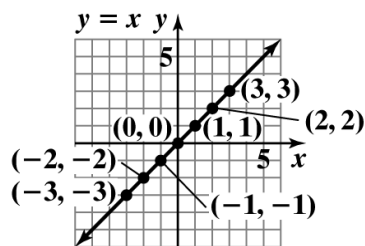
51.

x	(x, y)
-3	$(-3, 6)$
-2	$(-2, 1)$
-1	$(-1, -2)$
0	$(0, -3)$
1	$(1, -2)$
2	$(2, 1)$
3	$(3, 6)$



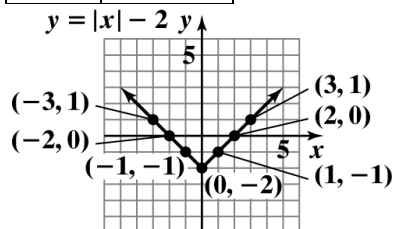
52.

x	(x, y)
-3	$(-3, -3)$
-2	$(-2, -2)$
-1	$(-1, -1)$
0	$(0, 0)$
1	$(1, 1)$
2	$(2, 2)$
3	$(3, 3)$

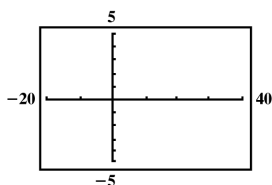


53.

x	(x, y)
-3	$(-3, 1)$
-2	$(-2, 0)$
-1	$(-1, -1)$
0	$(0, -2)$
1	$(1, -1)$
2	$(2, 0)$
3	$(3, 1)$



54. The minimum x -value is -20 and the maximum x -value is 40 . The distance between tick marks is 10 . The minimum y -value is -5 and the maximum y -value is 5 . The distance between tick marks is 1 .



55. 20% of 75-year-old Americans have Alzheimer's.
 56. Age 85 represents a 50% prevalence.
 57. Answers will vary.
 58. Graph c illustrates the description.

59. $2x - 5 = 7$
 $2x = 12$
 $x = 6$
 The solution set is $\{6\}$.

60. $5x + 20 = 3x$
 $2x + 20 = 0$
 $2x = -20$
 $x = -10$
 The solution set is $\{-10\}$.

61. $7(x - 4) = x + 2$
 $7x - 28 = x + 2$
 $6x - 28 = 2$
 $6x = 30$
 $x = 5$
 The solution set is $\{5\}$.

62. $1 - 2(6 - x) = 3x + 2$
 $1 - 12 + 2x = 3x + 2$
 $-11 + 2x = 3x + 2$
 $-11 = x + 2$
 $-13 = x$
 The solution set is $\{-13\}$.

63. $2(x - 4) + 3(x + 5) = 2x - 2$
 $2x - 8 + 3x + 15 = 2x - 2$
 $5x + 7 = 2x - 2$
 $3x + 7 = -2$
 $3x = -9$
 $x = -3$
 The solution set is $\{-3\}$.

64. $2x - 4(5x + 1) = 3x + 17$
 $2x - 20x - 4 = 3x + 17$
 $-18x - 4 = 3x + 17$
 $-4 = 21x + 17$
 $-21 = 21x$
 $-1 = x$
 The solution set is $\{-1\}$.

65. $\frac{2x}{3} = \frac{x}{6} + 1$
 $6\left(\frac{2x}{3}\right) = 6\left(\frac{x}{6} + 1\right)$
 $4x = x + 6$
 $3x = 6$
 $x = 2$
 The solution set is $\{2\}$.

66. $\frac{x}{2} - \frac{1}{10} = \frac{x}{5} + \frac{1}{2}$
 $10\left(\frac{x}{2} - \frac{1}{10}\right) = 10\left(\frac{x}{5} + \frac{1}{2}\right)$
 $5x - 1 = 2x + 5$
 $3x - 1 = 5$
 $3x = 6$
 $x = 2$
 The solution set is $\{2\}$.

67. $\frac{2x}{3} = 6 - \frac{x}{4}$
 $12\left(\frac{2x}{3}\right) = 12\left(6 - \frac{x}{4}\right)$
 $8x = 72 - 3x$
 $11x = 72$
 $x = \frac{72}{11}$
 The solution set is $\left\{\frac{72}{11}\right\}$.

$$68. \quad \frac{x}{4} = 2 + \frac{x-3}{3}$$

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

$$3x = 24 + 4(x-3)$$

$$3x = 24 + 4x - 12$$

$$3x = 12 + 4x$$

$$-x = 12$$

$$x = -12$$

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

$$69. \quad \frac{3x+1}{3} - \frac{13}{2} = \frac{1-x}{4}$$

$$12\left(\frac{3x+1}{3} - \frac{13}{2}\right) = 12\left(\frac{1-x}{4}\right)$$

$$4(3x+1) - 6(13) = 3(1-x)$$

$$12x + 4 - 78 = 3 - 3x$$

$$12x - 74 = 3 - 3x$$

$$15x - 74 = 3$$

$$15x = 77$$

$$x = \frac{77}{15}$$

The solution set is $\left\{\frac{77}{15}\right\}$.

$$70. \quad 7x + 5 = 5(x + 3) + 2x$$

$$7x + 5 = 5x + 15 + 2x$$

$$7x + 5 = 7x + 15$$

$$5 = 15$$

There is no solution. The solution set is \emptyset . The equation is inconsistent.

$$71. \quad 7x + 13 = 4x - 10 + 3x + 23$$

$$7x + 13 = 7x + 13$$

The solution set is $(-\infty, \infty)$. The equation is an identity.

$$72. \quad 7x + 13 = 3x - 10 + 2x + 23$$

$$7x + 13 = 5x - 10 + 23$$

$$7x + 13 = 5x + 13$$

$$2x + 13 = 13$$

$$2x = 0$$

$$x = 0$$

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

$$73. \quad 4(x-3) + 5 = x + 5(x-2)$$

$$4x - 12 + 5 = x + 5x - 10$$

$$4x - 7 = 6x - 10$$

$$-2x - 7 = -10$$

$$-2x = -3$$

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

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

$$74. \quad (2x-3)2 - 3(x+1) = (x-2)4 - 3(x+5)$$

$$4x - 6 - 3x - 3 = 4x - 8 - 3x - 15$$

$$x - 9 = x - 23$$

$$-9 = -23$$

There is no solution. The solution set is \emptyset . The equation is inconsistent.

$$75. \text{ a. } T = 1.4x + 20$$

$$T = 1.4(20) + 20$$

$$= 48$$

According to the model, 48% of households had three or more TVs in 2005. This overestimates the actual value shown in the graph by 2%.

$$\text{b. } T = 1.4x + 20$$

$$62 = 1.4x + 20$$

$$42 = 1.4x$$

$$\frac{42}{1.4} = \frac{1.4x}{1.4}$$

$$30 = x$$

According to the model, 62% of households will have three or more TVs 30 years after 1985, or 2015.

76. Let x = the average yearly earnings, in thousands, of marketing majors.

Let $x + 19$ = the average yearly earnings, in thousands, of engineering majors.

Let $x + 6$ = the average yearly earnings, in thousands, of accounting majors.

$$x + (x + 19) + (x + 6) = 196$$

$$x + x + 19 + x + 6 = 196$$

$$3x + 25 = 196$$

$$3x = 171$$

$$x = 57$$

$$x + 19 = 76$$

$$x + 6 = 63$$

The average yearly earnings for marketing majors, engineering majors, and accounting majors were \$57 thousand, \$76 thousand, and \$63 thousand, respectively.

77. Let x = the measure of the second angle.

$x + 10$ = the measure of the first angle.

$2[x + (x + 10)]$ = the measure of the 3rd angle.

$$x + (x + 10) + 2[x + (x + 10)] = 180$$

$$x + x + 10 + 2x + 2x + 20 = 180$$

$$6x + 30 = 180$$

$$6x = 150$$

$$x = 25$$

$$x + 10 = 25 + 10 = 35$$

$$2[x + (x + 10)] = 2[25 + 35]$$

$$= 2(60) = 120$$

The angles measure 25° , 35° , and 120°

78. a. Let x = the number of years after 2004.

$$575 + 43x = 1177$$

$$43x = 602$$

$$x = 14$$

The system's income will be \$1177 billion 14 years after 2004, or 2018.

- b. 2018 is 14 years after 2004.

$$B = 0.07x^2 + 47.4x + 500$$

$$= 0.07(14)^2 + 47.4(14) + 500$$

$$\approx 1177$$

The amount paid in benefits for 2018 will be \$1177 billion.

- c. In 2018 the \$1177 billion paid in benefits is represented by the point (2018, 1177).

79. Let x = the number of text messages.

Plan A: $C = 15 + 0.05x$

Plan B: $C = 5 + 0.07x$

Set the costs equal to each other.

$$15 + 0.05x = 5 + 0.07x$$

$$15 = 5 + 0.02x$$

$$10 = 0.02x$$

$$500 = x$$

The cost will be the same for 500 text messages.

80. Let x = the original price of the phone.

$$48 = x - 0.20x$$

$$48 = 0.80x$$

$$60 = x$$

The original price is \$60.

81. Let x = the amount sold to earn \$800 in one week.

$$800 = 300 + 0.05x$$

$$500 = 0.05x$$

$$10,000 = x$$

Sales must be \$10,000 in one week to earn \$800.

82. Let w = the width of the playing field.

Let $3w - 6$ = the length of the playing field.

$$P = 2(\text{length}) + 2(\text{width})$$

$$340 = 2(3w - 6) + 2w$$

$$340 = 6w - 12 + 2w$$

$$340 = 8w - 12$$

$$352 = 8w$$

$$44 = w$$

The dimensions are 44 yards by 126 yards.

83. a. Let x = the number of years (after 2005).

College A's enrollment: $14,100 + 1500x$

College B's enrollment: $41,700 - 800x$

$$14,100 + 1500x = 41,700 - 800x$$

- b. Check points to determine that

$$y_1 = 14,100 + 1500x \text{ and } y_2 = 41,700 - 800x.$$

Since $y_1 = y_2 = 32,100$ when $x = 12$, the two colleges will have the same enrollment in the year $2005 + 12 = 2017$. That year the enrollments will be 32,100 students.

84. $V = \frac{1}{3}Bh$

$$3V = Bh$$

$$h = \frac{3V}{B}$$

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

$$\frac{y - y_1}{m} = x - x_1$$

$$x = \frac{y - y_1}{m} + x_1$$

or

$$x = \frac{y - y_1 + mx_1}{m}$$

$$86. E = I(R + r)$$

$$\frac{E}{I} = R + r$$

$$R = \frac{E}{I} - r \quad \text{or} \quad R = \frac{E - Ir}{I}$$

$$87. C = \frac{5F - 160}{9}$$

$$9C = 5F - 160$$

$$9C + 160 = 5F$$

$$F = \frac{9C + 160}{5} \quad \text{or} \quad F = \frac{9}{5}C + 32$$

$$88. s = vt + gt^2$$

$$s - vt = gt^2$$

$$g = \frac{s - vt}{t^2}$$

$$89. T = gr + gvt$$

$$T = g(r + vt)$$

$$g = \frac{T}{r + vt}$$

$$90. (-3x^7)(-5x^6) = 15x^{7+6} = 15x^{13}$$

$$91. x^2y^{-5} = \frac{x^2}{y^5}$$

$$92. \frac{3^{-2}x^4}{y^{-7}} = \frac{x^4y^7}{3^2} = \frac{x^4y^7}{9}$$

$$93. (x^3)^{-6} = x^{3(-6)} = x^{-18} = \frac{1}{x^{18}}$$

$$94. (7x^3y)^2 = 7^2x^{3 \cdot 2}y^{1 \cdot 2} = 49x^6y^2$$

$$95. \frac{16y^3}{-2y^{10}} = -8y^{3-10} = -8y^{-7} = -\frac{8}{y^7}$$

$$96. (-3x^4)(4x^{-11}) = -12x^{-7} = -\frac{12}{x^7}$$

$$97. \frac{12x^7}{4x^{-3}} = 3x^{7-(-3)} = 3x^{10}$$

$$98. \frac{-10a^5b^6}{20a^{-3}b^{11}} = \frac{-1}{2}a^{5-(-3)}b^{6-11}$$

$$= \frac{-1}{2}a^8b^{-5} = -\frac{a^8}{2b^5}$$

$$99. (-3xy^4)(2x^2)^3 = (-3xy^4)(8x^6)$$

$$= -24x^{1+6}y^4 = -24x^7y^4$$

$$100. 2^{-2} + \frac{1}{2}x^0 = \frac{1}{2^2} + \frac{1}{2} \cdot 1 = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$$

$$101. (5x^2y^{-4})^{-3} = \left(\frac{5x^2}{y^4}\right)^{-3} = \left(\frac{y^4}{5x^2}\right)^3 = \frac{y^{12}}{125x^6}$$

$$102. (3x^4y^{-2})(-2x^5y^{-3}) = \left(\frac{3x^4}{y^2}\right)\left(\frac{-2x^5}{y^3}\right) = -\frac{6x^9}{y^5}$$

$$103. \left(\frac{3xy^3}{5x^{-3}y^{-4}}\right)^2 = \left(\frac{3x^{1-(-3)}y^{3-(-4)}}{5}\right)^2$$

$$= \left(\frac{3x^4y^7}{5}\right)^2$$

$$= \frac{3^2x^{4 \cdot 2}y^{7 \cdot 2}}{5^2} = \frac{9x^8y^{14}}{25}$$

$$104. \left(\frac{-20x^{-2}y^3}{10x^5y^{-6}}\right)^{-3} = (-2x^{-2-5}y^{3-(-6)})^{-3}$$

$$= (-2x^{-7}y^9)^{-3}$$

$$= (-2)^{-3}x^{(-7)(-3)}y^{9(-3)}$$

$$= \frac{x^{21}y^{-27}}{(-2)^3}$$

$$= \frac{x^{21}}{-8y^{27}} = -\frac{x^{21}}{8y^{27}}$$

$$105. 7.16 \times 10^6 = 7,160,000$$

$$106. 1.07 \times 10^{-4} = 0.000107$$

$$107. -41,000,000,000,000 = -4.1 \times 10^{13}$$

$$108. 0.00809 = 8.09 \times 10^{-3}$$

$$\begin{aligned}
 109. \quad (4.2 \times 10^{13})(3 \times 10^{-6}) &= 12.6 \times 10^{13+(-6)} \\
 &= 12.6 \times 10^7 \\
 &= 1.26 \times 10^8
 \end{aligned}$$

$$\begin{aligned}
 110. \quad \frac{5 \times 10^{-6}}{20 \times 10^{-8}} &= 0.25 \times 10^{-6-(-8)} \\
 &= 0.25 \times 10^2 = 2.5 \times 10^1
 \end{aligned}$$

$$\begin{aligned}
 111. \quad 180(3.2 \times 10^4)(5 \times 10^6) \\
 &= (180 \times 3.2 \times 5) \times (10^4 \times 10^6) \\
 &= 2880 \times 10^{10} \\
 &= 2.880 \times 10^3 \times 10^{10} \\
 &= 2.88 \times 10^{13}
 \end{aligned}$$

The approximate number of red blood cells in the human body of a 180-pound person is 2.88×10^{13} .

Chapter 1 Test

1. $4x - 5$

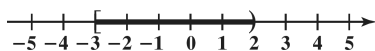
$$\begin{aligned}
 2. \quad 8 + 2(x - 7)^4 &= 8 + 2(10 - 7)^4 \\
 &= 8 + 2(3)^4 \\
 &= 8 + 2(81) \\
 &= 8 + 162 \\
 &= 170
 \end{aligned}$$

3. $\{-4, -3, -2, -1\}$

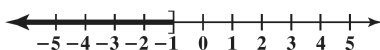
4. true; $\frac{1}{4}$ is not a natural number.

5. Negative three is greater than negative one: false

6. $\{x | -3 \leq x < 2\}$



7. $\{x | x \leq -1\}$



$$\begin{aligned}
 8. \quad P &= -0.5x^2 + 0.1x + 26.9 \\
 P &= -0.5(2)^2 + 0.1(2) + 26.9 \\
 &= 25.1
 \end{aligned}$$

The model estimates that 25.1% of Americans in Group 2 had contact with a police officer. This underestimates the actual number shown in the bar graph by 1.9.

9. $|-17.9| = 17.9$

10. $-10.8 + 3.2 = -7.6$

11. $-\frac{1}{4} - \left(-\frac{1}{2}\right) = -\frac{1}{4} + \frac{1}{2} = -\frac{1}{4} + \frac{2}{4} = \frac{1}{4}$

12. $2(-3)(-1)(-10) = -60$

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

14. $\frac{-27.9}{-9} = 3.1$

15. $24 - 36 \div 4 \cdot 3 = 24 - 9 \cdot 3 = 24 - 27 = -3$

$$\begin{aligned}
 16. \quad (5^2 - 2^4) + [9 \div (-3)] &= (25 - 16) + [-3] \\
 &= (9) + [-3] = 6
 \end{aligned}$$

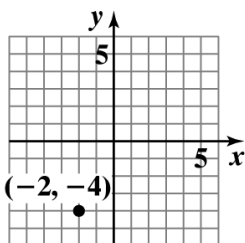
$$\begin{aligned}
 17. \quad \frac{(8-10)^3 - (-4)^2}{2+8(2) \div 4} &= \frac{(-2)^3 - 16}{2+16 \div 4} \\
 &= \frac{-8-16}{2+4} = \frac{-24}{6} = -4
 \end{aligned}$$

$$\begin{aligned}
 18. \quad 7x - 4(3x + 2) - 10 &= 7x - 12x - 8 - 10 \\
 &= -5x - 18
 \end{aligned}$$

$$\begin{aligned}
 19. \quad 5(2y - 6) - (4y - 3) &= 10y - 30 - 4y + 3 \\
 &= 6y - 27
 \end{aligned}$$

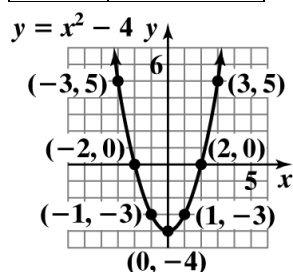
$$\begin{aligned}
 20. \quad 9x - [10 - 4(2x - 3)] \\
 &= 9x - [10 - 8x + 12] \\
 &= 9x - 10 + 8x - 12 = 17x - 22
 \end{aligned}$$

21.



22.

x	(x, y)
-3	$(-3, 5)$
-2	$(-2, 0)$
-1	$(-1, -3)$
0	$(0, -4)$
1	$(1, -3)$
2	$(2, 0)$
3	$(3, 5)$



23. $3(2x - 4) = 9 - 3(x + 1)$

$$6x - 12 = 9 - 3x - 3$$

$$6x - 12 = 6 - 3x$$

$$9x - 12 = 6$$

$$9x = 18$$

$$x = 2$$

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

24.

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

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

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

$$2x-3 = 2x-8-x-1$$

$$2x-3 = x-9$$

$$x-3 = -9$$

$$x = -6$$

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

25. $3(x-4) + x = 2(6+2x)$

$$3x - 12 + x = 12 + 4x$$

$$4x - 12 = 12 + 4x$$

$$-12 = 12$$

There is no solution. The solution set is $\{ \}$ or \emptyset .

The equation is inconsistent.

26. Let x = the first number.

Let $2x + 3$ = the second number.

$$x + 2x + 3 = 72$$

$$3x + 3 = 72$$

$$3x = 69$$

$$x = 23$$

Find the second number.

$$2x + 3 = 2(23) + 3 = 46 + 3 = 49$$

The first number is 23 and the second number is 49.

27. Let x = the number of years since the car was purchased.

$$\text{Value} = \$13,805 - \$1820x$$

$$4705 = 13,805 - 1820x$$

$$-9100 = -1820x$$

$$5 = x$$

The car will have a value of \$4705 in 5 years.

28. Let x = the number of prints.

$$\text{Photo Shop A: } 0.11x + 1.60$$

$$\text{Photo Shop B: } 0.13x + 1.20$$

$$0.13x + 1.20 = 0.11x + 1.60$$

$$0.02x + 1.20 = 1.60$$

$$0.02x = 0.40$$

$$x = 20$$

The cost will be the same for 20 prints. That common price is $0.11(20) + 1.60 = 0.13(20) + 1.20 = \3.80

29. Let x = the original selling price.

$$20 = x - 0.60x$$

$$20 = 0.40x$$

$$50 = x$$

The original price is \$50.

- 30.** Let x = the width of the playing field.
 Let $x + 260$ = the length of the playing field.
 $P = 2(\text{length}) + 2(\text{width})$
 $1000 = 2(x + 260) + 2x$
 $1000 = 2x + 520 + 2x$
 $1000 = 4x + 520$
 $480 = 4x$
 $x = 120$
 The dimensions of the playing field are 120 yards by 380 yards.

31. $V = \frac{1}{3}lwh$

$$3V = lwh$$

$$h = \frac{3V}{lw}$$

32. $Ax + By = C$

$$By = C - Ax$$

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

33. $(-2x^5)(7x^{-10}) = -14x^{5+(-10)} = -14x^{-5} = -\frac{14}{x^5}$

34. $(-8x^{-5}y^{-3})(-5x^2y^{-5}) = 40x^{-5+2}y^{-3+(-5)}$
 $= 40x^{-3}y^{-8}$
 $= \frac{40}{x^3y^8}$

35. $\frac{-10x^4y^3}{-40x^{-2}y^6} = \frac{1}{4}x^{4-(-2)}y^{3-6} = \frac{1}{4}x^6y^{-3} = \frac{x^6}{4y^3}$

36. $(4x^{-5}y^2)^{-3} = \left(\frac{4y^2}{x^5}\right)^{-3} = \left(\frac{x^5}{4y^2}\right)^3 = \frac{x^{15}}{64y^6}$

37. $\left(\frac{-6x^{-5}y}{2x^3y^{-4}}\right)^{-2} = (-3x^{-5-3}y^{1-(-4)})^{-2}$
 $= (-3x^{-8}y^5)^{-2}$
 $= (-3)^{-2}x^{(-8)(-2)}y^{5(-2)}$
 $= \frac{x^{16}y^{-10}}{(-3)^2}$
 $= \frac{x^{16}}{9y^{10}}$

38. $3.8 \times 10^{-6} = 0.0000038$

39. $407,000,000,000 = 4.07 \times 10^{11}$

40. $\frac{4 \times 10^{-3}}{8 \times 10^{-7}} = 0.5 \times 10^{-3-(-7)} = 0.5 \times 10^4 = 5 \times 10^3$

41. $2(6.9 \times 10^9) = 13.8 \times 10^9 = 1.38 \times 10^{10}$

The population will be 1.38×10^{10} .