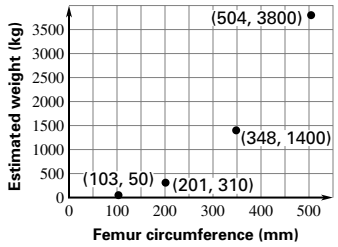
CHAPTER 7

Think & Discuss *(p. 399)*

1. 

because the graph is curved and not a straight line

2. about 2200 kg; locate 400 mm on the graph and read the curve at the point directly above 400 mm.

Skill Review *(p. 400)*

1. $3x - 2y = 12$

$y = \dfrac{3x - 12}{2}$

2. $x + \dfrac{1}{2}y = 5$

$y = 2(5 - x)$

3. $x = 4y - 1$

$y = \dfrac{x + 1}{4}$

4. $x^2 + 10x + 21 = (x + 3)(x + 7)$

5. $x^2 + 5x - 36 = (x + 9)(x - 4)$

6. $2x^2 - 16x + 30 = 2(x - 3)(x - 5)$

7. $(abc^2)^4 = a^4b^4c^8$

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

9. $\left(\dfrac{x^2}{y}\right)^2 = \dfrac{x^4}{y^2}$

10. $\dfrac{3x}{y} \cdot \dfrac{3x^2y^{-2}}{12y^3} = \dfrac{3x^3}{4y^6}$

11. $5x^2(x - 8) = 5x^3 - 40x^2$

12. $(3y - 2)^2 = 9y^2 - 12y + 4$

13. $(7x^2 + x) - (6x - 4) = 7x^2 - 5x + 4$

7.1 Guided Practice *(p. 404)*

1. n is the index of the radical $\sqrt[n]{a}$ (the nth root of a).

2. **a.** Always true; take the 4th root of each side of the first equation to get the second equation.

b. Sometimes true; if $a = 1$ then $1^{\frac{1}{n}} = \dfrac{1}{1^n}$

3. -5; no real 4th root; When n is even, there are only nth roots for nonnegative numbers.

4. $\sqrt[4]{81} = 3$ **5.** $-(49^{\frac{1}{2}}) = -7$ **6.** $\left(\sqrt[3]{-8}\right)^5 = -32$

7. $(3125)^{\frac{2}{5}} = 25$ **8.** $x^3 = 125$

$x = 5$

9. $3x^5 = -3$

$x^5 = -1$

$x = -1$

10. $(x + 4)^2 = 0$

$x = -4$

11. $x^4 - 7 = 9993$

$x^4 = 1000$

$x = \pm 10$

12. $905 = \dfrac{4}{3}\pi r^3$

$\dfrac{2715}{4\pi} = r^3$

$\sqrt[3]{216} \approx r$

$6 \text{ cm} \approx r$

7.1 Practice and Applications *(pp. 404–406)*

13. $14^{\frac{1}{4}}$ **14.** $11^{\frac{1}{3}}$ **15.** $5^{\frac{2}{7}}$ **16.** $16^{\frac{5}{9}}$ **17.** $2^{\frac{11}{8}}$ **18.** $\sqrt[3]{6}$

19. $\sqrt[4]{7}$ **20.** $\left(\sqrt[7]{10}\right)^3$ **21.** $\left(\sqrt[5]{5}\right)^2$ **22.** $\left(\sqrt[4]{8}\right)^7$

23. $\sqrt[2]{100} = \pm 10$ **24.** $\sqrt[4]{0} = 0$ **25.** $\sqrt[3]{-8} = -2$

26. $\sqrt[7]{128} = 2$ **27.** $\sqrt[6]{-1} =$ none **28.** $\sqrt[5]{0} = 0$

29. $\sqrt[3]{64} = \sqrt[3]{4 \cdot 4 \cdot 4} = 4$

30. $\sqrt[3]{-1000} = \sqrt[3]{-10^3} = -10$

31. $-\sqrt[6]{64} = -\sqrt[6]{2^6} = -2$ **32.** $4^{-\frac{1}{2}} = \sqrt{\dfrac{1}{4}} = \dfrac{1}{2}$

33. $1^{\frac{1}{3}} = \sqrt[3]{1} = 1$ **34.** $-\left(256^{\frac{1}{4}}\right) = -\sqrt[4]{4^4} = -4$

35. $\left(\sqrt[4]{16}\right)^2 = (2)^2 = 4$ **36.** $\left(\sqrt[3]{-27}\right)^{-4} = (-3)^{-4} = \frac{1}{81}$

37. $\left(\sqrt[6]{0}\right)^3 = 0$ **38.** $-(25^{-\frac{3}{2}}) = -\left(\sqrt{\dfrac{1}{25}}\right)^3 = -\left(\dfrac{1}{5}\right)^3 = -\dfrac{1}{125}$

39. $32^{\frac{4}{5}} = \left(\sqrt[5]{32}\right)^4 = (2)^4 = 16$

40. $(-125)^{-\frac{2}{3}} = \left(\sqrt[3]{\frac{1}{-125}}\right)^2 = \left(-\frac{1}{5}\right)^2 = \frac{1}{25}$

41. $\sqrt[5]{-16{,}807} = -7$ **42.** $\sqrt[9]{1124} = 2.18$

43. $\sqrt[8]{65{,}536} = 4$ **44.** $4^{\frac{1}{10}} = 1.15$ **45.** $10^{-\frac{1}{4}} = 0.56$

46. $-(1331^{\frac{1}{3}}) = -11$ **47.** $\left(\sqrt[3]{112}\right)^{-4} = 0.0019$

48. $\left(\sqrt[7]{-280}\right)^3 = -11.19$ **49.** $\left(\sqrt[6]{6}\right)^2 = 1.82$

50. $(-190)^{-\frac{4}{5}} = 0.015$ **51.** $26^{-\frac{3}{4}} = 0.087$

52. $522^{\frac{2}{7}} = 5.98$ **53.** $x^5 = 243$

$x = 3$

54. $6x^3 = -1296$

$x^3 = -216$

$x = -6$

55. $x^6 + 10 = 10$

$x^6 = 0$

$x = 0$

56. $(x - 4)^4 = 81$

$x - 4 = \pm 3$

$x = 7$ or $x = 1$

57. $-x^7 = 40$

$x^7 = -40$

$x = -1.69$

58. $-12x^4 = -48$

$x^4 = 4$

$x = \pm 1.41$

59. $(x + 12)^3 = 21$

$x + 12 = 2.76$

$x = -9.24$

60. $x^3 - 14 = 22$

$x^3 = 36$

$x = 3.30$

61. $x^8 - 25 = -10$

$x^8 = 15$

$x = \pm 1.40$

62. Mongoose $V = 170(1.14)^{\frac{4}{5}} = 188.79$ mL

Camel $V = 170(229)^{\frac{4}{5}} = 13{,}131.59$ mL

Horse $V = 170(510)^{\frac{4}{5}} = 24{,}917.53$ mL

Swiss cow $V = 170(700)^{\frac{4}{5}} = 32{,}101.65$ mL

63. $q = clh^{\frac{3}{2}}$

$q = 2.79 \times 40 \times (5)^{\frac{3}{2}}$

$q = 1247.73 \text{ ft}^3/\text{sec}$

64. $i = \left(\frac{p_2}{p_1}\right)^{\frac{1}{n}} - 1$

$i = \left(\frac{79{,}100}{2900}\right)^{\frac{1}{50}} - 1$

$i = 0.068$

65. $V \approx 7.66a^3$

$30 \approx 7.66a^3$

$3.92 \approx a^3$

$1.58 \text{ ft} = a$

66. $v \approx 2.18a^3$

$21 \approx 2.18a^3$

$9.63 \approx a^3$

$2.13 \text{ cm} \approx a$

67. $A = 0.0779s^3$

$4000 = 0.0779s^3$

$51{,}348 = s^3$

$37 \approx s$

about 37 species

68. $b = l\left(\frac{r-2}{2}\right)^2 \quad V = 250r^3$

a. $V = 144 \times 5000 = 720{,}000 \text{ in.}^3$

b. $5000 = 20\left(\frac{r-2}{2}\right)^2$

$1000 = (r-2)^2$

$31.62 = r - 2$

$33.62 \text{ in.} = r$

c. $V = 250 \times (33.62)^3$

$V \approx 9{,}500{,}000 \text{ in.}^3$

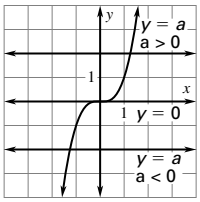
d. $\frac{720{,}000}{9{,}500{,}000} \times 100 = 7.6\%$

e. The fraction increases to almost 10%.

69.

	$a < 0$	$a = 0$	$a > 0$
n is even	no real	1	2
n is odd	1	1	1

70. Real roots exist whenever the line $y = a$ crosses the graph. This happens twice for $a > 0$, once for $a = 0$, not at all for $a < 0$.

71. 

$y = x^n$ where n is odd

7.1 Mixed Review (p. 406)

72. $A = \begin{bmatrix} 1 & 4 \\ 2 & 5 \end{bmatrix}$ $\det = 5 - 8 = -3$

$x = \frac{\begin{vmatrix} 12 & 4 \\ 18 & 5 \end{vmatrix}}{-3} = \frac{60 - 72}{-3} = \frac{-12}{-3} = 4$

$y = \frac{\begin{vmatrix} 1 & 12 \\ 2 & 18 \end{vmatrix}}{-3} = \frac{18 - 24}{-3} = \frac{-6}{-3} = 2$

73. $A = \begin{bmatrix} 1 & -2 \\ 2 & 5 \end{bmatrix}$ $\det = 5 + 4 = 9$

$x = \frac{\begin{vmatrix} 11 & -2 \\ -14 & 5 \end{vmatrix}}{9} = \frac{55 - 28}{9} = \frac{27}{9} = 3$

$y = \frac{\begin{vmatrix} 1 & 11 \\ 2 & -14 \end{vmatrix}}{9} = \frac{-14 - 22}{9} = \frac{-36}{9} = -4$

74. $A = \begin{bmatrix} 2 & -4 \\ -1 & 1 \end{bmatrix}$ $\det = 2 - 4 = -2$

$x = \frac{\begin{vmatrix} 7 & -4 \\ 1 & 1 \end{vmatrix}}{-2} = \frac{7 + 4}{-2} = \frac{11}{-2}$

$y = \frac{\begin{vmatrix} 2 & 7 \\ -1 & 1 \end{vmatrix}}{-2} = \frac{2 + 7}{-2} = \frac{9}{-2}$

75. $A = \begin{bmatrix} -3 & 2 \\ 1 & -4 \end{bmatrix}$ $\det = 12 - 2 = 10$

$x = \frac{\begin{vmatrix} -9 & 2 \\ 2 & -4 \end{vmatrix}}{10} = \frac{36 - 4}{10} = \frac{32}{10} = \frac{16}{5}$

$y = \frac{\begin{vmatrix} -3 & -9 \\ 1 & 2 \end{vmatrix}}{10} = \frac{-6 + 9}{10} = \frac{3}{10}$

76. $A = \begin{bmatrix} -1 & -8 \\ 10 & 1 \end{bmatrix}$ $\det = -1 + 80 = 79$

$x = \frac{\begin{vmatrix} 10 & -8 \\ 1 & 1 \end{vmatrix}}{79} = \frac{10 + 8}{79} = \frac{18}{79}$

$y = \frac{\begin{vmatrix} -1 & 10 \\ 10 & 1 \end{vmatrix}}{79} = \frac{-1 - 100}{79} = \frac{-101}{79}$

77. $A = \begin{bmatrix} -1 & -1 \\ 5 & -6 \end{bmatrix}$ $\det = 6 + 5 = 11$

$$x = \frac{\begin{vmatrix} 0 & -1 \\ 13 & -6 \end{vmatrix}}{11} = \frac{0 + 13}{11} = \frac{13}{11}$$

$$y = \frac{\begin{vmatrix} -1 & 0 \\ 5 & 13 \end{vmatrix}}{11} = \frac{-13 - 0}{11} = \frac{-13}{11}$$

78. x^2; product of powers property

79. $\frac{1}{x^{15}}$; power of a power and negative exponent properties

80. $\frac{1}{4x^2y^6}$; power of a power, power of a product, and negative exponent properties

81. $\frac{5}{x^2}$; negative exponents and zero exponents properties

82. x^7; quotient of powers property

83. $\frac{1}{x^4y^2}$; negative exponents and power of a quotient properties

84. $\frac{x^2y^{10}}{2}$; quotient of powers property

85. $4x^2y$; product of powers and quotient of powers properties

86. $f(x) = x^4 + 9x^3 - 5x^2 - 153x - 140$
$= (x + 1)(x^3 + 8x^2 - 13x - 140)$
$= (x + 1)(x + 7)(x^2 + x - 20)$
$= (x + 1)(x + 7)(x + 5)(x - 4)$
$x = -1, -7, -5, 4$

87. $f(x) = x^4 + x^3 - 19x^2 + 11x + 30$
$= (x + 1)(x^3 - 19x + 30)$
$= (x + 1)(x - 2)(x^2 + 2x - 15)$
$= (x + 1)(x - 2)(x + 5)(x - 3)$
$x = -1, 2, -5, 3$

88. $f(x) = x^3 - 5x^2 + 16x - 80$
$= (x - 5)(x^2 + 16)$
$= (x - 5)(x - 4i)(x + 4i)$
$x = 5, 4i, -4i$

89. $f(x) = x^3 - x^2 + 9x - 9$
$= (x^2 + 9)(x - 1)$
$= (x - 3i)(x + 3i)(x - 1)$
$x = 3i, -3i, 1$

Lesson 7.2

7.2 Guided Practice (p. 411)

1. *Sample answer:* $5\sqrt{10}, 2\sqrt{10}; 7\sqrt[3]{4}, \sqrt[3]{4}; 9\sqrt[6]{37}, 8\sqrt[6]{37}$

2. $(46{,}656{,}000)^{\frac{1}{3}} = (2^9 \cdot 3^6 \cdot 5^3)^{\frac{1}{3}} = 2^3 \cdot 3^2 \cdot 5 = 360$

3. $5\sqrt[4]{5}$; to add or subtract like radicals, use the Distributive Property

4. $\frac{x^{\frac{1}{3}}}{y^{\frac{8}{3}}}$; use the power of a power property

5. $3^{\frac{1}{4}} \cdot 3^{\frac{3}{4}} = 3^{\left(\frac{1}{4} + \frac{3}{4}\right)} = 3$

6. $(5^{\frac{1}{3}})^6 = 5^2 = 25$

7. $\sqrt[3]{16} \cdot \sqrt[3]{4} = \sqrt[3]{64} = 4$

8. $4^{-\frac{1}{2}} = \sqrt[2]{\frac{1}{4}} = \frac{1}{2}$

9. $\sqrt[4]{\frac{16}{81}} = \frac{\sqrt[4]{16}}{\sqrt[4]{81}} = \frac{2}{3}$

10. $\sqrt[3]{\frac{1}{4}} = \frac{1}{\sqrt[3]{2 \cdot 2}} \cdot \frac{\sqrt[3]{2}}{\sqrt[3]{2}} = \frac{\sqrt[3]{2}}{2}$

11. $8^{\frac{1}{7}} + 2\left(8^{\frac{1}{7}}\right) = (1 + 2)\left(8^{\frac{1}{7}}\right) = 3\sqrt[7]{8}$

12. $\sqrt{200} - 3\sqrt{2} = 10\sqrt{2} - 3\sqrt{2} = (10 - 3)\left(\sqrt{2}\right)$
$= 7\sqrt{2}$

13. $x^{\frac{2}{3}} \cdot x^{\frac{4}{3}} = x^{\left(\frac{2}{3} + \frac{4}{3}\right)} = x^2$

14. $\left(y^{\frac{1}{6}}\right)^3 = y^{\frac{1}{2}}$

15. $\sqrt{4a^6} = 2a^3$

16. $b^{-\frac{1}{3}} = \frac{1}{\sqrt[3]{b}} = \frac{\sqrt[3]{b^2}}{b}$

17. $\sqrt[5]{\frac{x^{10}}{y^5}} = \frac{x^2}{y}$

18. $\sqrt[3]{\frac{x^2}{z}} = \frac{\sqrt[3]{x^2}}{\sqrt[3]{z}} = \frac{\sqrt[3]{x^2z^2}}{z}$

19. $2a^{\frac{1}{5}} - 6a^{\frac{1}{5}} = (2 - 6)a^{\frac{1}{5}} = -4a^{\frac{1}{5}}$

20. $x\sqrt[3]{y^6} + y^2\sqrt[3]{x^3} = xy^2 + xy^2 = 2xy^2$

21. $S = km^{\frac{2}{3}}$
$= 9.75(1.6 \times 10^3)^{\frac{2}{3}}$
$= 9.75 \times (1.6)^{\frac{2}{3}} \times (10^3)^{\frac{2}{3}}$
$= 9.75 \times (1.37) \times 10^2$
$= 1333.78 \text{ cm}^2$

7.2 Practice and Applications (pp. 411–413)

22. $3^{\left(\frac{5}{3} + \frac{1}{3}\right)} = 3^2 = 9$

23. $\left(5^{\frac{2}{3}}\right)^{\frac{1}{2}} = 5^{\frac{1}{3}}$

24. $4^{\frac{1}{4}} \cdot 64^{\frac{1}{4}} = (256)^{\frac{1}{4}} = 4$

25. $36^{\frac{1}{2}} = 6$

26. $7^{\left(\frac{1}{5} - \frac{2}{5}\right)} = 7^{-\frac{2}{5}} = \frac{7^{\frac{3}{5}}}{7}$

27. $\left(\frac{70}{14}\right)^{\frac{1}{3}} = 5^{\frac{1}{3}}$

28. $\left(2^{\frac{1}{4}}\right)^6 \cdot \left(2^{\frac{1}{3}}\right)^6 = 2^{\left(\frac{2}{3} + 2\right)} = 2^{\frac{7}{2}}$

29. $\left(\frac{8^2}{5^2}\right)^{\frac{1}{2}} = \frac{8}{5}$

30. $\frac{(6 \cdot 4)^{\frac{2}{3}}}{3^{\frac{2}{3}}} = \left(\frac{24}{3}\right)^{\frac{2}{3}} = 8^{\frac{2}{3}} = 4$

31. $\frac{125^{\left(\frac{2}{6} + \frac{1}{6}\right)}}{5^{\frac{1}{4}}} = \frac{125^{\frac{1}{3}}}{5^{\frac{1}{4}}} = 5^{\left(1 - \frac{1}{4}\right)} = 5^{\frac{3}{4}}$

32. $12^{\left(\frac{10}{8} + \frac{3}{8}\right)} = 12^{\frac{13}{8}}$

33. $\left(40^{\frac{3}{4}}\right)^{-4} = \frac{1}{40^3} = \frac{1}{64{,}000}$

34. $64^{\left(\frac{1}{2} + \frac{1}{3}\right)} = 64^{\frac{5}{6}} = 32$

35. $(8 \cdot 2)^{\frac{1}{4}} = 16^{\frac{1}{4}} = 2$

36. $(25)^{\frac{1}{4}} = 5^{\frac{1}{2}} = 2.24$

37. $\left[6^{\left(\frac{1}{3} + \frac{1}{4}\right)}\right]^{12} = \left(6^{\frac{7}{12}}\right)^{12} = 6^7 = 279{,}936$

38. $7^{\left(\frac{1}{2}-\frac{1}{5}\right)} = 7^{\frac{3}{10}} \approx 1.79$ **39.** $\left(\frac{4}{32}\right)^{\frac{1}{3}} = \left(\frac{1}{8}\right)^{\frac{1}{3}} = \frac{1}{2}$

40. $\dfrac{(8 \cdot 16)^{\frac{1}{6}}}{2^{\frac{1}{6}}} = \left(\dfrac{128}{2}\right)^{\frac{1}{6}} = 2$

41. $\dfrac{(9 \cdot 6)^{\frac{1}{3}}}{(4)^{\frac{1}{6}}} = \dfrac{(54)^{\frac{1}{3}}}{2^{\frac{1}{3}}} = 27^{\frac{1}{3}} = 3$

42. $\sqrt{50} = \sqrt{5 \cdot 5 \cdot 2} = 5\sqrt{2}$

43. $\sqrt[5]{5 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3} = 3\sqrt[5]{5}$

44. $\sqrt[3]{2 \cdot 3 \cdot 3 \cdot 3 \cdot 5} = 3\sqrt[3]{10}$

45. $15\sqrt[4]{2 \cdot 2 \cdot 2 \cdot 3 \cdot 2} = 30\sqrt[4]{3}$

46. $\sqrt[3]{\dfrac{1}{7} \cdot \dfrac{7 \cdot 7}{7 \cdot 7}} = \dfrac{\sqrt[3]{49}}{7}$

47. $\dfrac{2}{\sqrt[6]{9^2}} = \dfrac{2 \cdot \sqrt[3]{3}}{\sqrt[3]{3 \cdot 3 \cdot 3}} = \dfrac{2\sqrt[3]{3}}{3}$

48. $\sqrt[4]{\dfrac{2 \cdot 2 \cdot 2 \cdot 2 \cdot 5 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3}} = \dfrac{2\sqrt[4]{45}}{3}$

49. $\dfrac{2^{\frac{2}{3}}}{2^{\frac{3}{5}}} = 2^{\left(\frac{2}{3}-\frac{3}{5}\right)} = 2^{\frac{1}{15}}$ **50.** $(5 + 1)\sqrt[5]{6} = 6\sqrt[5]{6}$

51. $(5 - 7)5^{\frac{1}{7}} = -2 \cdot 5^{\frac{1}{7}}$ **52.** $(-1 + 5)\left(2^{\frac{1}{4}}\right) = 4\sqrt[4]{2}$

53. $4\sqrt{10} - \sqrt{10} = 3\sqrt{10}$ **54.** $5\sqrt[3]{3} + 3\sqrt[3]{3} = 8\sqrt[3]{3}$

55. $4\sqrt[4]{11} + 5\sqrt[4]{11} = 9\sqrt[4]{11}$ **56.** $x^{\frac{1}{3}+\frac{1}{5}} = x^{\frac{8}{15}}$

57. $(y^3)^{\frac{1}{6}} = y^{\frac{1}{2}}$ **58.** $\sqrt[5]{32x^5} = \sqrt[5]{2^5x^5} = 2x$ **59.** $\dfrac{1}{x^{-\frac{5}{4}}} = x^{\frac{5}{4}}$

60. $x^{\left(\frac{3}{7}-\frac{1}{3}\right)} = x^{\frac{9-7}{21}} = x^{\frac{2}{21}}$ **61.** $\dfrac{(x^{12})^{\frac{1}{4}}}{(y^4)^{\frac{1}{4}}} = \dfrac{x^3}{y}$

62. $x^{\left(\frac{5}{3}-\frac{3}{5}\right)}y^{\left(1+\frac{1}{2}\right)} = x^{\frac{2}{3}}y^{\frac{3}{2}}$ **63.** $\left[y^{\left(\frac{5}{4}\right)}\right]^{\frac{4}{3}} = y^{\frac{5}{3}}$

64. $\left(x\sqrt[4]{x^3 \cdot x}\right)^{-2} = \dfrac{1}{x^4}$ **65.** $x^{\left(\frac{3}{4}-\frac{1}{4}\right)}yz^{\left(-\frac{1}{3}-\frac{2}{3}\right)} = \dfrac{x^{\frac{1}{2}}y}{z}$

66. $\dfrac{2x\sqrt{x^2}}{3x^5} = \dfrac{2}{3x^3}$

67. $\dfrac{(y^6)^{\frac{1}{3}}}{3\sqrt[3]{y} \cdot y^3\sqrt[3]{y^2}} = \dfrac{y^2}{3y^3\sqrt[3]{y^3}} = \dfrac{y^2}{3y^4} = \dfrac{1}{3y^2}$

68. $\sqrt{6^2x^2x} = 6x\sqrt{x}$ **69.** $\sqrt[4]{10xx^4y^4y^4z^4z^4z^2} = xy^2z^2\sqrt[4]{10xz^2}$

70. $(8xy^7 \cdot 6x^6)^{\frac{1}{5}} = (48x^7y^7)^{\frac{1}{5}} = xy\sqrt[5]{48x^2y^2}$

71. $(xyz \cdot 2y^3z^4)^{\frac{1}{2}} = (2xy^4z^5)^{\frac{1}{2}} = y^2z^2\sqrt{2xz}$

72. $\dfrac{4\sqrt[3]{x \cdot x}}{\sqrt[3]{x \cdot x \cdot x}} = \dfrac{4\sqrt[3]{x^2}}{x}$ **73.** $\dfrac{\sqrt[3]{x^3 \cdot y}}{\sqrt[3]{y^2 \cdot y}} = \dfrac{x\sqrt[3]{y}}{y}$

74. $\left(\dfrac{9x^2y}{32z^3}\right)^{\frac{1}{2}} = \dfrac{3x\sqrt{y \cdot 2z}}{4z\sqrt{2z \cdot 2z}} = \dfrac{3x\sqrt{2yz}}{8z^2}$

75. $x^{\left(\frac{3}{5}-\frac{4}{7}\right)} = x^{\left(\frac{21-20}{35}\right)} = x^{\frac{1}{35}}$ **76.** $(2 + 7)\sqrt[5]{y} = 9\sqrt[5]{y}$

77. $(9 - 2)x^{\frac{1}{5}} = 7x^{\frac{1}{5}}$ **78.** $(-1 + 2)\sqrt[4]{x} = \sqrt[4]{x}$

79. $(x^9y)^{\frac{1}{3}} + \left(xy^{\frac{1}{9}}\right)^3 = x^3y^{\frac{1}{3}} + x^3y^{\frac{1}{3}} = 2x^3y^{\frac{1}{3}}$

80. $2x^2\sqrt{x} - x^2\sqrt{x} = x^2\sqrt{x}$

81. $2xy\sqrt[3]{3x^2} - y\sqrt{3x^2} = (2x - 1)y\sqrt[3]{3x^2}$ **82.** $x^{2+\sqrt{3}}$

83. $y^{\sqrt{2} \cdot \sqrt{2}} = y^2$ **84.** $x^{\pi}y^{\pi}$ **85.** $4^{-\sqrt{7}} = \dfrac{1}{4^{\sqrt{7}}}$

86. $x^{2\sqrt{5}-\sqrt{5}} = x^{\sqrt{5}}$ **87.** $\dfrac{x}{y^2}$ **88.** $(3 + 1)x^{\sqrt{2}} = 4x^{\sqrt{2}}$

89. $(x - 3x)y^{\sqrt{11}} = -2xy^{\sqrt{11}}$

90. $\left(\sqrt{5}\right) + \left(\sqrt{4 + 16}\right) + \left(\sqrt{16 + 9}\right) = \sqrt{5} + 2\sqrt{5} + 5$
$= 3\sqrt{5} + 5$

91. $r^2 = \dfrac{15}{20} = \dfrac{3}{4}$

$r = \dfrac{\sqrt{3}}{2}$

92. $S = 11.0(68 \times 10^3)^{\frac{2}{3}}$
$= 11.0\left(68^{\frac{2}{3}} \times 10^2\right)$
$= 11.0 \times 16.67 \times 10^2$
$= 18{,}325.90 \text{ cm}^2$

93. $d = 1.9[(5.5 \times 10^{-4})100]^{\frac{1}{2}}$
$= 1.9(5.5 \times 10^{-2})^{\frac{1}{2}}$
$= 1.9(0.055)^{\frac{1}{2}}$
$= 0.45 \text{ mm}$

94. lowest; $f = 440 \cdot 2^{\frac{-17}{12}} = 164.81$

highest; $f = 440 \cdot 2^{\frac{13}{12}} = 932.33$

ratio: $2^{\left(\frac{13}{12}+\frac{17}{12}\right)} = 2^{\left(\frac{30}{12}\right)} = 2^{\frac{5}{2}} = 5.66$

95. $f = 440 \cdot 2^{\frac{-9}{12}} = 261.6$

$f = 440\ 2^{\frac{3}{12}} = 523.3$

Higher notes have frequencies twice as high as lower notes of the same letter.

96. $d = \dfrac{v_0\sqrt{(v_0)^2 + 2g(0)}}{g} = \dfrac{v_0\sqrt{(v_0)^2}}{g} = \dfrac{(v_0)^2}{g}$

97. $\dfrac{S_1}{S_2} = \dfrac{(4\pi)^{\frac{1}{3}}(3 \cdot 2V)^{\frac{2}{3}}}{(4\pi)^{\frac{1}{3}}(3V)^{\frac{2}{3}}} = \dfrac{3^{\frac{2}{3}}2^{\frac{2}{3}}V^{\frac{2}{3}}}{3^{\frac{2}{3}} \cdot V^{\frac{2}{3}}} = 2^{\frac{2}{3}}$

98. **a.** $S = 2\pi(0.15)(0.8) + 2\pi(0.15 \times 0.15)$
$= 2\pi(0.12) + 2\pi(0.0225)$
$= 2\pi(0.1425)$
$= 0.90 \text{ cm}^2$

$V = \pi(0.15)(0.15)(0.8) = 0.057 \text{ cm}^3$

Yes, the surface area is large enough.

b. $S = 2\pi(150)(800) + 2\pi(150 \times 150)$
$= 2\pi(120{,}000 + 22{,}500)$
$= 2\pi(142{,}500)$
$\approx 900{,}000 \text{ cm}^2$

$V = \pi(150)(150)(800) = 57{,}000{,}000 \text{ cm}^3$

No, the surface area is not large enough.

c. $S = 2\pi rh + 2\pi r^2$ $\qquad V = \pi r^2h$
$= 2\pi(1000)^2rh + 2\pi(1000)r^2$ $\qquad = \pi(1000)^3r^2h;$

Surface Area increased by a factor of 1,000,000; Volume increased by a factor of 1,000,000,000; Giant ants don't exist because their volume increases 1000 times as fast as their surface areas, so they could not meet their oxygen needs.

99. When m and n are both even, you must use an absolute value symbol around any odd power of x in the answer. For example, $\sqrt{x^6} = |x^3|$

7.2 Mixed Review (p. 414)

100. $x^2 + 14x + c = x^2 + 14x + 49 = (x + 7)^2$

101. $x^2 - 21x + c = x^2 - 21x + \frac{441}{4} = \left(x - \frac{21}{2}\right)^2$

102. $x^2 - 7.6x + c = x^2 - 7.6x + 14.44 = (x - 3.8)^2$

103. $x^2 + 9.9x + c = x^2 + 9.9x + 24.5 = (x + 4.95)^2$

104. $x^2 + \frac{2}{3}x + c = x^2 + \frac{2}{3}x + \frac{1}{9} = \left(x + \frac{1}{3}\right)^2$

105. $x^2 - \frac{1}{4}x + c = x^2 - \frac{1}{4}x + \frac{1}{64} = \left(x - \frac{1}{8}\right)^2$

106. $-11x^3 - x^2 + 10x$ **107.** $8x^3 + 9x^2 + 52x + 1$

108. $20x^3 - 180x^2$ **109.** $4x^2 + 28x + 49$

110.
$$\begin{array}{r} x^2 - 4x - 12 \\ x + 4 \overline{)\, x^3 + 0x^2 - 28x - 48} \\ \underline{-x^3 - 4x^2} \\ -4x^2 - 28x \\ \underline{4x^2 + 16x} \\ -12x - 48 \\ \underline{12x + 48} \\ 0 \end{array}$$

111.
$$\begin{array}{r} 4x - 1 - \dfrac{2}{x+1} \\ x + 1 \overline{)\, 4x^2 + 3x - 3} \\ \underline{-4x^2 - 4x} \\ -x - 3 \\ \underline{x + 1} \\ -2 \end{array}$$

112.
$$\begin{array}{r} 4x + 2 + \dfrac{4}{x-2} \\ x - 2 \overline{)\, 4x^2 - 6x + 0} \\ \underline{-4x^2 + 8x} \\ 2x + 0 \\ \underline{-2x + 4} \\ 4 \end{array}$$

113.
$$\begin{array}{r} x^3 + 3x^2 + 15x + 5 + \dfrac{45}{x-5} \\ x - 5 \overline{)\, x^4 - 2x^3 - 0x^2 - 70x + 20} \\ \underline{-x^4 + 5x^3} \\ 3x^3 - 0x^2 \\ \underline{-3x^3 + 15x^2} \\ 15x^2 - 70x \\ \underline{-15x^2 + 75x} \\ 5x + 20 \\ \underline{-5x + 25} \\ 45 \end{array}$$

Quiz 1 (p. 414)

1. $\left(\sqrt[3]{8}\right)^2 = 2^2 = 4$ **2.** $\left(\sqrt[5]{32}\right)^{-3} = (2)^{-3} = \frac{1}{8}$

3. $-\left(\sqrt[4]{81}\right) = -(3) = -3$ **4.** $\left(\sqrt[3]{-64}\right)^2 = (-4)^2 = 16$

5. $\sqrt[5]{10} \approx 1.58$ **6.** $-9x^6 = -18$ **7.** $x^4 = 13$

$x^6 = 2$ $x = \pm 1.90$

$x = \pm 1.12$

8. $(x + 2)^3 = -15$ **9.** $4^{\frac{1}{4}}$ or $2^{\frac{1}{2}}$

$x + 2 = -2.47$

$x = -4.47$

10. $\sqrt[4]{\dfrac{2^4 \cdot 27}{3 \cdot 27}} = \dfrac{2\sqrt[4]{27}}{3}$ **11.** $\left(\dfrac{512}{8}\right)^{\frac{1}{3}} = (64)^{\frac{1}{3}} = 4$

12. $3\sqrt{5}$ **13.** $\sqrt[3]{7 \cdot 49} = 7$ **14.** $(1 + 2)8^{\frac{1}{5}} = 3\sqrt[5]{8}$

15. $x^{\left(\frac{2}{3} + \frac{1}{4}\right)} = x^{\frac{8+3}{12}} = x^{\frac{11}{12}}$ **16.** $\left(x^{\frac{1}{5}}\right)^{\frac{5}{2}} = x^{\frac{1}{2}}$

17. $x^{\left(\frac{4}{4} - \frac{3}{4}\right)}y^{\left(\frac{1}{2} + \frac{4}{2}\right)} = x^{\frac{1}{4}}y^{\frac{5}{2}}$ **18.** $xy\sqrt[3]{5y^2}$

19. $\sqrt{\dfrac{36xy}{y^3 \cdot y}} = \dfrac{6\sqrt{xy}}{y^2}$ **20.** $3xy^{\frac{1}{2}} - xy^{\frac{1}{2}} = 2xy^{\frac{1}{2}}$

21. $P = \dfrac{(30{,}090)^{\frac{2}{3}}(22.5)^3}{370}$

$= 29{,}782$

about 30,000 horsepower

22. No; $\dfrac{S_1}{S_2} = \dfrac{11.2(3m)^{\frac{2}{3}}}{11.2(m)^{\frac{2}{3}}} = 3^{\frac{2}{3}} \approx 2.08$

Lesson 7.3

7.3 Guided Practice (p. 418)

1. power function; real; rational

2. Sometimes; the sum is a power if the exponents (b) are the same.

3. The equation is $g(f(x))$.

4. $f(3x) = (3x)^2 + 2 = 9x^2 + 2$; The entire quantity $(3x)$ is squared.

5. $4x + (x - 1) = 5x - 1$; all real numbers

6. $4x - (x - 1) = 3x + 1$; all real numbers

7. $(4x)(x - 1) = 4x^2 - 4x$; all real numbers

8. $\dfrac{4x}{x - 1}$; all real numbers except $x = 1$

9. $4(x - 1) = 4x - 4$; all real numbers

10. $4x - 1$; all real numbers

11. $g(f(x))$; The bonus is 0.02 times the amount over \$200,000 $(x - 200{,}000)$, so calculate the amount first and then take 2%.

7.3 Practice and Applications (pp. 418–420)

12. $(x^2 - 5x + 8) + (x^2 - 4) = 2x^2 - 5x + 4$; all real numbers

13. $(x^2 - 4) + (x^2 - 5x + 8) = 2x^2 - 5x + 4$; all real numbers

14. $(x^2 - 5x + 8) + (x^2 - 5x + 8) = 2x^2 - 10x + 16$; all real numbers

15. $(x^2 - 4) + (x^2 - 4) = 2x^2 - 8$; all real numbers

16. $(x^2 - 5x + 8) - (x^2 - 4) = -5x + 12$; all real numbers

17. $(x^2 - 4) - (x^2 - 5x + 8) = 5x - 12$; all real numbers

18. $f(x) - f(x) = 0$; all real numbers

19. $g(x) - g(x) = 0$; all real numbers

20. $2x^{\frac{2}{3}} \cdot 3x^{\frac{1}{2}} = 6x^{\frac{7}{6}}$; nonnegative real numbers

21. $3x^{\frac{1}{2}} \cdot 2x^{\frac{2}{3}} = 6x^{\frac{7}{6}}$; nonnegative real numbers

22. $2x^{\frac{2}{3}} \cdot 2x^{\frac{2}{3}} = 4x^{\frac{4}{3}}$; all real numbers

23. $3x^{\frac{1}{2}} \cdot 3x^{\frac{1}{2}} = 9x$; nonnegative real numbers

24. $\dfrac{2x^{\frac{2}{3}}}{3x^{\frac{1}{2}}} = \dfrac{2}{3}x^{\frac{2}{3}-\frac{1}{2}} = \dfrac{2x^{\frac{1}{6}}}{3}$; positive real numbers

25. $\dfrac{3x^{\frac{1}{2}}}{2x^{\frac{2}{3}}} = \dfrac{3}{2}x^{\frac{1}{2}-\frac{2}{3}} = \dfrac{3}{2x^{\frac{1}{6}}}$; positive real numbers

26. 1; all real numbers except $x = 0$

27. 1; all real numbers except $x = 0$

28. $f(x^{\frac{3}{4}}) = 4(x^{\frac{3}{4}})^{-5} = 4x^{-\frac{15}{4}}$; positive real numbers

29. $g(4x^{-5}) = (4x^{-5})^{\frac{3}{4}} = 4^{\frac{3}{4}}x^{-\frac{15}{4}} = 2^{\frac{3}{2}}x^{-\frac{15}{4}}$; positive real numbers

30. $f(4x^{-5}) = 4(4x^{-5})^{-5} = \dfrac{4x^{25}}{4^5} = \dfrac{x^{25}}{256}$; all real numbers except 0.

31. $g\left(-x^{\frac{3}{4}}\right) = -\left(-x^{\frac{3}{4}}\right)^{\frac{3}{4}} = x^{\frac{9}{16}}$; nonnegative real numbers

32. $10x + (x + 4) = 11x + 4$; all real numbers

33. $10x - (x + 4) = 9x - 4$; all real numbers

34. $10x(x + 4) = 10x^2 + 40x$; all real numbers

35. $\dfrac{10x}{x + 4}$; all real numbers except $x = -4$

36. $f(x + 4) = 10(x + 4) = 10x + 40$; all real numbers

37. $g(10x) = 10x + 4$; all real numbers

38. $f(10x) = 10(10x) = 100x$; all real numbers

39. $g(x + 4) = x + 4 + 4 = x + 8$; all real numbers

40. $x + 3 + 5x = 6x + 3$; all real numbers

41. $3x^{\frac{1}{2}} - 2x^{\frac{1}{2}} = x^{\frac{1}{2}}$; all nonnegative real numbers

42. $-x^{\frac{2}{3}} - x^{\frac{2}{3}} = -2x^{\frac{2}{3}}$; all real numbers

43. $x^2 - 3 - (x + 5) = x^2 - x - 8$; all real numbers

44. $\left(7x^{\frac{2}{5}}\right)(-2x^3) = -14x^{\frac{17}{5}}$; all real numbers

45. $(x - 4)(4x^2) = 4x^3 - 16x^2$; all real numbers

46. $\dfrac{9x^{-1}}{x^{\frac{1}{4}}} = 9x^{\left(-1-\frac{1}{4}\right)} = 9x^{-\frac{5}{4}}$; all positive real numbers

47. $\dfrac{x^2 - 5x}{x} = x - 5$; all real numbers but $x = 0$

48. $f(5x - 2) = 6(5x - 2)^{-1} = \dfrac{6}{5x - 2}$; all real numbers except $x = \frac{2}{5}$

49. $g(x^2 - 3) = (x^2 - 3)^2 + 1 = x^4 - 6x^2 + 10$; all real numbers

50. $f\left(2x^{\frac{1}{5}}\right) = 2\left(2x^{\frac{1}{5}}\right)^{\frac{1}{5}} = 2^{\frac{6}{5}}x^{\frac{1}{25}}$; all real numbers

51. $g(9x - 2) = 9(9x - 2) - 2 = 81x - 20$; all real numbers

52. $\left(241m^{-\frac{1}{4}}\right)(6 \times 10^6)\left(m^{\frac{1}{5}}\right) = 1446 \times 10^6 m^{\left(-\frac{1}{4}+\frac{1}{5}\right)}$
$= 1.45 \times 10^9 m^{-\frac{1}{20}}$;
Multiplying beats per minute by number of minutes per lifetime gives us the number of beats per lifetime.

53. $r(w) = \dfrac{1.1w^{0.734}}{0.005w} = 220w^{-0.266}$
$r(6.5) = 220(6.5)^{-0.266} \approx 134$
$r(12{,}300) = 220(12{,}300)^{-0.266} \approx 18$
$r(70{,}000) = 220(70{,}000)^{-0.266} \approx 11$

54. $0.9(x - 50)$
$0.9(175 - 50) = \$112.50$

55. *Sample answer:* 10% off of \$175 is \$17.50 rather than \$12.50. There is a smaller discount after the subtraction.

56. $h = 3.49(1.5f)^{1.02}$
$= 3.49(45)^{1.02}$
$= 169.47$ cm

57. For addition and subtraction, add or subtract the expressions for f and g, and combine like terms.
For multiplication and division, multiply or divide the equations for f and g, and simplify the result.
For composition of functions $f(g(x))$, substitute the expression for $g(x)$ for the "x" in the expression for $f(x)$ and simplify.

58. $f(g(4)) = f(48) = 288$; $f(g(2)) = f(-4) \approx -2.52$; A

59. $g(f(-1)) = g(5) = 5$; $g(f(0)) = g(5) = 25$; B

60. $f(f(3)) = f(2) = -1$;
$f(f(-2)) = f(-80) = -5{,}120{,}000$; A

61. $g(g(5)) = g(10.7) \approx 8.85$; $g(g(7)) = g(57) = 3257$; B

62. $h(x) = (6x - 5)^3$; *Sample answer:* $f(x) = x^3$; $g(x) = 6x - 5$

63. $h(x) = \sqrt[3]{x + 2}$; *Sample answer:* $f(x) = \sqrt[3]{x}$, $g(x) = x + 2$

64. $h(x) = \dfrac{\sqrt[4]{x}}{2}$; *Sample answer:* $f(x) = \sqrt[4]{x}$, $g(x) = \dfrac{x}{16}$

65. $h(x) = 3x^2 + 7$; *Sample answer:* $f(x) = x + 7$; $g(x) = 3x^2$

66. $h(x) = |2x + 9|$; *Sample answer:* $f(x) = |x|$, $g(x) = 2x + 9$

67. $h(x) = 21x$; *Sample answer:* $f(x) = 3x$, $g(x) = 7x$

7.3 Mixed Review (p. 420)

68. $y - 3x = 10$

$y = 10 + 3x$

69. $2x + 3y = -8$

$3y = -8 - 2x$

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

70. $x = -2y + 6$

$2y = 6 - x$

$y = 3 - \dfrac{x}{2}$

71. $xy + 2 = 7$

$xy = 5$

$y = \dfrac{5}{x}$

72. $\dfrac{1}{2}x - \dfrac{2}{3}y = 1$

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

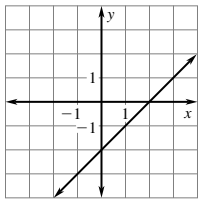
$\dfrac{3}{4}x - \dfrac{3}{2} = y$

73. $ax + by = c$

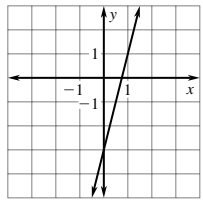
$by = c - ax$

$y = \dfrac{c - ax}{b}$

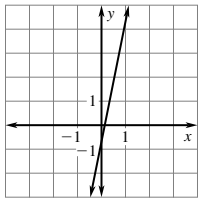
74. $y = x - 2$



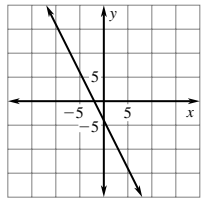
75. $y = 4x - 3$



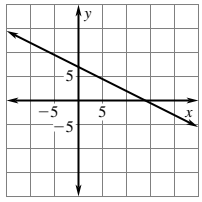
76. $y = 5x - \frac{2}{3}$



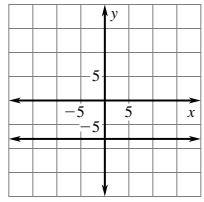
77. $y = -2x - 4$



78. $y = -\frac{1}{2}x + 7$



79. $y = -8$



80. $3x^3 - 2x^2 = 0$

$x^2(3x - 2) = 0$

$x = 0, x = \frac{2}{3}$

81. $2x^3 - 6x^2 + x - 3 = 0$

$(2x^2 + 1)(x - 3) = 0$

$x = 3$

82. $5x^4 + 19x^2 - 4 = 0$

$(5x^2 - 1)(x^2 + 4) = 0$

$x = \pm\sqrt{0.2}$

83. $x^4 + 6x^3 + 8x + 48 = 0$

$x^3(x + 6) + 8(x + 6) = 0$

$(x + 6)(x^3 + 8) = 0$

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

84. $A = \begin{bmatrix} 5 & 2 \\ 2 & 1 \end{bmatrix}$ $A^{-1} = \begin{bmatrix} 2 & -2 \\ -2 & 5 \end{bmatrix}$

$\begin{bmatrix} 45 & 21 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 3 & 15 \end{bmatrix}$ CO

$\begin{bmatrix} 84 & 35 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 14 & 7 \end{bmatrix}$ NG

$\begin{bmatrix} 92 & 37 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 18 & 1 \end{bmatrix}$ RA

$\begin{bmatrix} 142 & 61 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 20 & 21 \end{bmatrix}$ TU

$\begin{bmatrix} 62 & 25 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 12 & 1 \end{bmatrix}$ LA

$\begin{bmatrix} 118 & 49 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 20 & 9 \end{bmatrix}$ TI

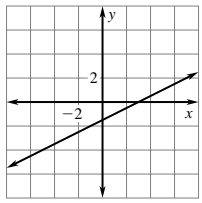
$\begin{bmatrix} 103 & 44 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 15 & 14 \end{bmatrix}$ ON

$\begin{bmatrix} 95 & 38 \end{bmatrix}\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = \begin{bmatrix} 19 & 0 \end{bmatrix}$ S_

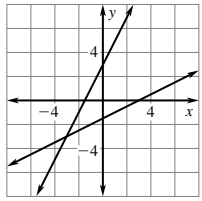
Lesson 7.4

Developing Concepts Activity 7.4 (p. 421)

1. $y = \dfrac{x - 3}{2}$



2.



3. $g(x) = 2x + 3$ **4.** They reflect one another.

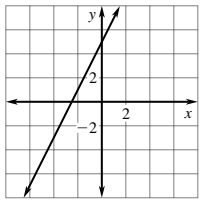
5. g is a function that multiplies x by 2 then adds 3.

6. $f(g(x)) = \dfrac{(2x + 3) - 3}{2} = x$;

$g(f(x)) = 2\left(\dfrac{x - 3}{2}\right) + 3 = x$

Developing Concepts Activity 7.4 (p. 421)
Exploring the Concept

1. a. $y = 2x + 5$



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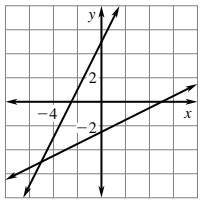


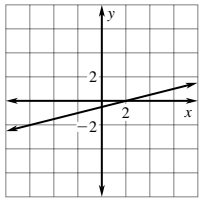
$g(x) = \dfrac{x - 5}{2}$

2. Graph the reflection.

3. g is the function that subtracts 5 from x and then divides by 2. Both compositions equal x. Since both compositions equal x, then the functions are inverses.

Drawing Conclusions

1.b. $y = \dfrac{x - 2}{4}$



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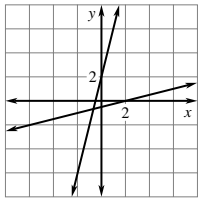
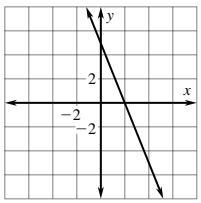


$g(x) = 4x$

2. Graph the reflection.

3. g is the function that multiplies x by 4 and then adds 2. Both compositions equal x. Since both compositions equal x, the functions are inverses.

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



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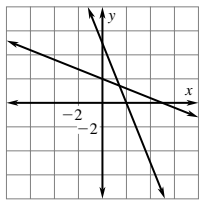


$g(x) = \dfrac{2(5 - x)}{5}$

2. Graph the reflections.

3. g is the function that subtracts x from 5 and then multiplies by $\frac{2}{5}$. Both compositions equal x, and therefore are inverse of one another.

7.4 Guided Practice (p. 426)

1. If no horizontal line crosses the graph of the function more than once, then the inverse relations is an inverse function.

2. The graphs of a relation and its inverse are reflections of one another in the line $y = x$.

3. Switch x and y in the original equation and solve for y.

4.

x	-1	-2	-3	-4	-5
y	1	2	3	4	5

5.

x	2	1	0	1	2
y	-4	-2	0	2	4

6. $y = 5x$

$x = 5y$

$\dfrac{x}{5} = y$

7. $y = 2x - 1$

$x = 2y - 1$

$x + 1 = 2y$

$\dfrac{x + 1}{2} = y$

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

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

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

$-\frac{3}{2}x + 9 = y$

9. $f(g(x)) = f\left(\dfrac{x^{\frac{1}{3}}}{2}\right) = 8\left(\dfrac{x^{\frac{1}{3}}}{2}\right)^3 = 8\left(\dfrac{x}{8}\right) = x;$

$g(f(x)) = g(8x^3) = \dfrac{(8x^3)^{\frac{1}{3}}}{2} = \dfrac{2x}{2} = x$

10. $f(g(x)) = 6\left(\frac{1}{6}x - \frac{1}{2}\right) + 3 = x - 3 + 3 = x;$
$g(f(x)) = \frac{1}{6}(6x + 3) - \frac{1}{2} = x + \frac{1}{2} - \frac{1}{2} = x$

11. $y = 3x^4$

$x = 3y^4$

$\dfrac{x}{3} = y^4$

$\left(\dfrac{x}{3}\right)^{\frac{1}{4}} = y$

12. $y = 2x^3 + 1$

$x = 2y^3 + 1$

$x - 1 = 2y^3$

$\dfrac{x - 1}{2} = y^3$

$\left(\dfrac{x - 1}{2}\right)^{\frac{1}{3}} = y$

13. No. Horizontal lines such as $y = 0$ cross the graph more than once.

7.4 Practice and Applications (pp. 426–428)

14.

x	3	-1	6	-3	9
y	1	4	1	0	1

15.

x	0	3	-2	2	-1
y	1	-2	4	2	-2

16. $x = -2y + 5$

$x - 5 = -2y$

$\dfrac{-x + 5}{2} = y$

17. $x = 3y - 3$

$x + 3 = 3y$

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

18. $x = \frac{1}{2}y + 6$

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

$2x - 12 = y$

19. $x = -\frac{4}{5}y + 11$

$x - 11 = -\frac{4}{5}y$

$\frac{-5(x - 11)}{4} = y$

20. $x = 11y - 5$

$x + 5 = 11y$

$\frac{x + 5}{11} = y$

21. $x = -12y + 7$

$x - 7 = -12y$

$\frac{-x + 7}{12} = y$

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

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

$\frac{1}{3}x + \frac{1}{12} = y$

23. $x = 8y - 13$

$x + 13 = 8y$

$\frac{x + 13}{8} = y$

24. $x = -\frac{3}{7}y + \frac{5}{7}$

$x - \frac{5}{7} = -\frac{3}{7}y$

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

25. $f(x - 7) = (x - 7) + 7 = x$

$g(x + 7) = (x + 7) - 7 = x$

26. $f\left(\frac{1}{3}x + \frac{1}{3}\right) = 3\left(\frac{1}{3}x + \frac{1}{3}\right) - 1 = x + 1 - 1 = x$

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

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

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

28. $f\left(-\frac{1}{2}x + 2\right) = -2\left(-\frac{1}{2}x + 2\right) + 4 = x - 4 + 4 = x$

$g(-2x + 4) = -\frac{1}{2}(-2x + 4) + 2 = x - 2 + 2 = x$

29. $f\left[\left(\frac{x - 1}{3}\right)^{\frac{1}{3}}\right] = 3\left[\left(\frac{x - 1}{3}\right)^{\frac{1}{3}}\right]^3 + 1 = x - 1 + 1 = x$

$g(3x^3 + 1) = \left(\frac{3x^3 + 1 - 1}{3}\right)^{\frac{1}{3}} = (x^3)^{\frac{1}{3}} = x$

30. $f\left(\sqrt{3x}\right) = \frac{1}{3}\left(\sqrt{3x}\right)^2 = \frac{3x}{3} = x$

$g\left(\frac{1}{3}x^2\right) = \sqrt{\frac{3x^2}{3}} = \sqrt{x^2} = x$

31. $f\left(\sqrt[5]{7x - 2}\right) = \frac{\left(\sqrt[5]{7x - 2}\right)^5 + 2}{7} = \frac{7x - 2 + 2}{7} = x$

$g\left(\frac{x^5 + 2}{7}\right) = \sqrt[5]{7\left(\frac{x^5 + 2}{7}\right) - 2} = \sqrt[5]{x^5} = x$

32. $f\left(\frac{\sqrt[4]{x}}{4}\right) = 256\left(\frac{\sqrt[4]{x}}{4}\right)^4 = 256\left(\frac{x}{256}\right) = x$

$g(256x^4) = \frac{\sqrt[4]{256x^4}}{4} = \frac{4x}{4} = x$

33. A **34.** C **35.** B

36. $y = x^7$

$x = y^7$

$\sqrt[7]{x} = y$

37. $y = -x^6$

$x = -y^6$

$\sqrt[6]{-x} = y$

38. $y = 3x^4$

$x = 3y^4$

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

$-\sqrt[4]{\frac{x}{3}} = y$

39. $y = \frac{1}{32}x^5$

$x = \frac{1}{32}y^5$

$32x = y^5$

$2\sqrt[5]{x} = y$

40. $y = 10x^3$

$x = 10y^3$

$\frac{1}{10}x = y^3$

$\frac{\sqrt[3]{100x}}{10} = y$

41. $y = -\frac{9}{4}x^2$

$x = -\frac{9}{4}y^2$

$-\frac{4}{9}x = y^2$

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

42. $y = x^3 + 2$

$x = y^3 + 2$

$x - 2 = y^3$

$\sqrt[3]{x - 2} = y$

43. $y = -2x^5 + \frac{1}{3}$

$x = -2y^5 + \frac{1}{3}$

$x - \frac{1}{3} = -2y^5$

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

$\sqrt[5]{-\frac{1}{2}x + \frac{1}{6}} = y$

44. $y = 2 - 2x^2$

$x = 2 - 2y^2$

$x - 2 = -2y^2$

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

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

45. $y = \frac{3}{5}x^3 - 9$

$x = \frac{3}{5}y^3 - 9$

$x + 9 = \frac{3}{5}y^3$

$\frac{5}{3}x + 15 = y^3$

$\sqrt[3]{\frac{5}{3}x + 15} = y$

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

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

$x + \frac{1}{2} = y^4$

$\sqrt[4]{x + \frac{1}{2}} = y$

47. $y = \frac{1}{6}x^5 + \frac{2}{3}$

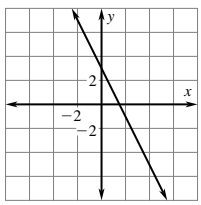
$x = \frac{1}{6}y^5 + \frac{2}{3}$

$x - \frac{2}{3} = \frac{1}{6}y^5$

$6x - 4 = y^5$

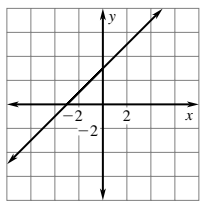
$\sqrt[5]{6x - 4} = y$

48. $f(x) = -2x + 3$



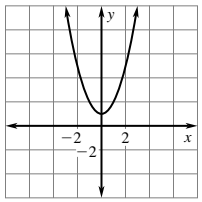
Yes, the inverse is a function.

49. $f(x) = x + 3$



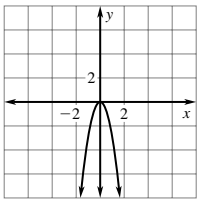
Yes, the inverse is a function.

50. $f(x) = x^2 + 1$



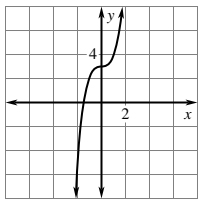
No, the inverse is not a function.

51. $f(x) = -3x^2$



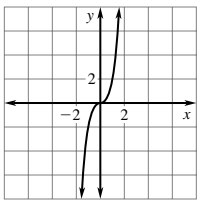
No, the inverse is not a function.

52. $f(x) = x^3 + 3$



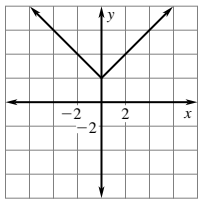
Yes, the inverse is a function.

53. $f(x) = 2x^3$



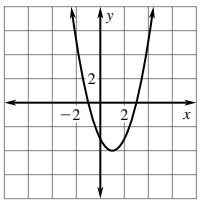
Yes, the inverse is a function.

54. $f(x) = |x| + 2$



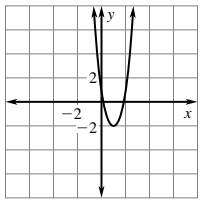
No, the inverse is not a function.

55. $f(x) = (x + 1)(x - 3)$



No, the inverse is not a function.

56. $f(x) = 6x^4 - 9x + 1$



No, the inverse is not a function.

57. $D_C = 1.5226D_{us}$

$y = 1.5226x$

$x = 1.5226y$

$0.65677x = y$

$0.65677D_C = D_{us}$

58. $C = \frac{5}{9}(F - 32)$

$\frac{9}{5}C + 32 = F$

$\frac{9}{5}(29) + 32 = 84.2°F$

$\frac{9}{5}(10) + 32 = 50°F$

$\frac{9}{5}(0) + 32 = 32°F$

59. $h = .9(200 - a)$

$\frac{10}{9}h = 200 - a$

$200 - \frac{10}{9}h = a$

$200 - \frac{10}{9}(27) = 200 - 30 = 170$

60. $2(x^2) + 3 = 53$

$2x^2 = 50$

$x^2 = 25$

$x = 5$

61. $w = (9.37 \times 10^{-6})l^3$

$$\frac{w}{(9.37 \times 10^{-6})} = l^3$$

$$\sqrt[3]{\frac{w}{(9.37 \times 10^{-6})}} = l$$

$$\sqrt[3]{\frac{0.679}{9.37 \times 10^{-6}}} = 41.69 \text{ cm}$$

62. $w = \left(\frac{82.9}{d}\right)^3$

$$\sqrt[3]{w} = \frac{82.9}{d}$$

$$d = \frac{82.9}{\sqrt[3]{w}}$$

$$d = \frac{82.9}{\sqrt[3]{66}} = 20.51 \text{ in.}$$

63.

$f(x) = 6x - 1$;	$f(x) = -2x + 9$
$y = 6x - 1$	$y = -2x + 9$
$x = 6y - 1$	$x = -2y + 9$
$x + 1 = 6y$	$-x + 9 = 2y$
$f^{-1}(x) = \frac{x + 1}{6}$	$f^{-1}(x) = \frac{-x + 9}{2}$
$f^{-1}(3) = \frac{2}{3}$	$f^{-1}(-4) = \frac{13}{2}$

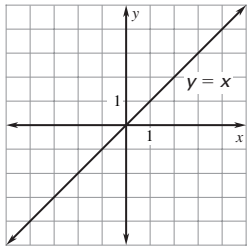
B

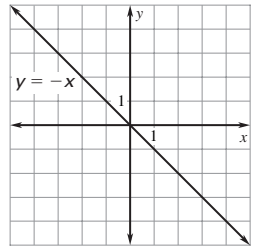
64.

$f(x) = -5x^3$;	$f(x) = x^3 + 14$
$y = -5x^3$	$y = x^3 + 14$
$x = -5y^3$	$x = y^3 + 14$
$\sqrt[3]{\frac{-x}{5}} = y$	$\sqrt[3]{x - 14} = y$
$f^{-1}(x) = \sqrt[3]{\frac{-x}{5}}$	$f^{-1}(x) = \sqrt[3]{x - 14}$
$f^{-1}(2) = \sqrt[3]{\frac{-2}{5}}$	$f^{-1}(0) = \sqrt[3]{-14}$
$f^{-1}(2) = -0.7368$	$f^{-1}(0) = -2.4101$

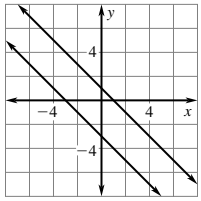
A

65. $f(x) = x$ and $g(x) = -x$ are their own inverses because each graph is its own reflection in the line $y = x$.





66.

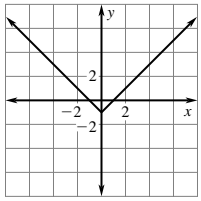


67. $y = -x + 1;\ y = -x - 3$

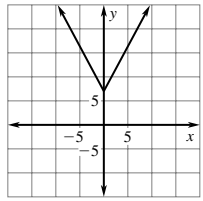
68. $y = -x + a$, where a is a real number

7.4 Mixed Review (p.429)

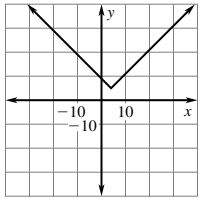
69. $f(x) = |x| - 1$



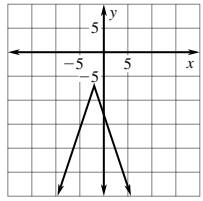
70. $f(x) = 2|x| + 7$



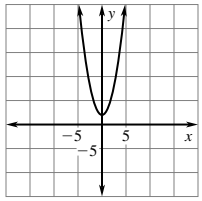
71. $f(x) = |x - 4| + 5$



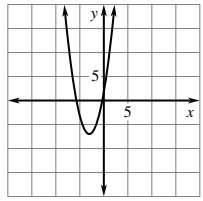
72. $f(x) = -3|x + 2| - 7$



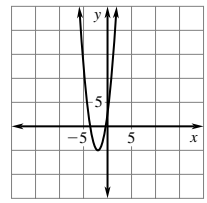
73. $f(x) = x^2 + 2$



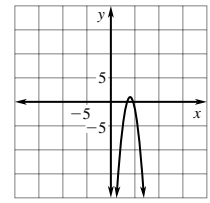
74. $f(x) = (x + 3)^2 - 7$



75. $f(x) = 2(x + 2)^2 - 5$



76. $f(x) = -3(x - 4)^2 + 1$



77. $\sqrt[4]{20 \cdot \frac{4}{5}} = \sqrt[4]{4 \cdot 4} = 2$

78. $\left(\frac{1}{9}\right)^{\left(\frac{1}{6} + \frac{1}{3}\right)} = \sqrt{\frac{1}{9}} = \frac{1}{3}$

79. $(5y)^{\left(\frac{1}{5} - \frac{6}{5}\right)} = (5y)^{-1} = \dfrac{1}{5y}$

80. $\sqrt[6]{2x^6} = x\sqrt[6]{2}$

81. $(3 + 2)\sqrt[7]{5} = 5\sqrt[7]{5}$

82. $\sqrt[3]{27 \cdot 10} + 2\sqrt[3]{10} = 3\sqrt[3]{10} + 2\sqrt[3]{10} = 5\sqrt[3]{10}$

83. $3b + 3a = 3.72$

$p + 2b + 3a = 5.06$

$2p + 4b = 6.58$

$$A = \begin{bmatrix} 0 & 3 & 3 \\ 1 & 2 & 3 \\ 2 & 4 & 0 \end{bmatrix}$$

$\det A = (0 + 18 + 12) - (12 + 0 + 0) = 18$

$$b = \frac{\begin{vmatrix} 0 & 3.72 & 3 \\ 1 & 5.06 & 3 \\ 2 & 6.58 & 0 \end{vmatrix}}{18}$$

$$= \frac{(0 + 22.32 + 19.74) - (30.36 + 0 + 0)}{18}$$

$$= \frac{11.70}{18} = \$.65$$

Quiz 2 (p. 429)

1. $6x^2 - x^{\frac{1}{2}} + 2x^{\frac{1}{2}} = 6x^2 + x^{\frac{1}{2}}$; nonnegative real numbers

2. $6x^2 - x^{\frac{1}{2}} - 2x^{\frac{1}{2}} = 6x^2 - 3x^{\frac{1}{2}}$; nonnegative real numbers

3. $2x^{\frac{1}{2}}\left(6x^2 - x^{\frac{1}{2}}\right) = 2x\left(6x^{\frac{3}{2}} - 1\right)$; nonnegative real numbers

4. $\dfrac{x^{\frac{1}{2}}\left(6x^{\frac{3}{2}} - 1\right)}{2x^{\frac{1}{2}}} = 3x^{\frac{3}{2}} - \dfrac{1}{2}$; all positive real numbers

5. $f(x - 8) = \dfrac{3}{x - 8}$; all real numbers except $x = 8$

6. $g\left(\dfrac{3}{x}\right) = \dfrac{3}{x} - 8$; all real numbers except $x = 0$

7. $f\left(\dfrac{3}{x}\right) = \dfrac{3}{\frac{3}{x}} = x$; all real numbers except 0

8. $g(x - 8) = (x - 8) - 8 = x - 16$; all real numbers

9. $f\left(\frac{1}{2}x + \frac{3}{2}\right) = 2\left(\frac{1}{2}x + \frac{3}{2}\right) - 3 = x + 3 - 3 = x$

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

10. $f(x^3 - 1) = (x^3 - 1 + 1)^{\frac{1}{3}} = (x^3)^{\frac{1}{3}} = x$

$g\left[(x + 1)^{\frac{1}{3}}\right] = \left[(x + 1)^{\frac{1}{3}}\right]^3 - 1 = x + 1 - 1 = x$

11. $y = x + 8$

$x = y + 8$

$x - 8 = y$

12. $y = 2x^4$

$x = 2y^4$

$-\sqrt[4]{\frac{x}{2}} = y$

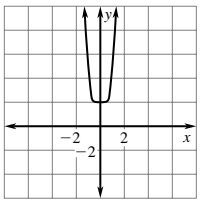
13. $y = -x^5 + 6$

$x = -y^5 + 6$

$-x + 6 = y^5$

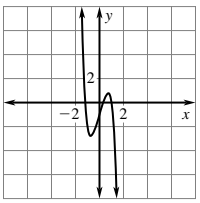
$\sqrt[5]{-x + 6} = y$

14. $f(x) = 3x^6 + 2$



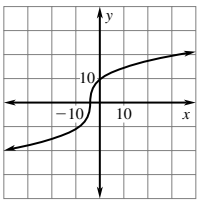
No, the inverse is not a function.

15. $f(x) = -2x^5 + 3x - 1$



No, the inverse is not a function.

16. $f(x) = 6(x + 4)^{\frac{1}{3}}$



Yes, the inverse is a function.

17. $A[r(t)] = A(0.6t) = (0.6t)^2\pi = 0.36t^2\pi$

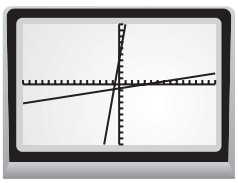
$A(t) = 0.36t^2\pi$

$A(2) = 0.36(2)^2\pi$

$\approx 4.52 \text{ ft}^3$

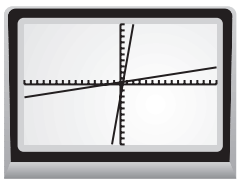
Technology Activity 7.4 (p. 430)

1. $f(x) = 6x + 4$



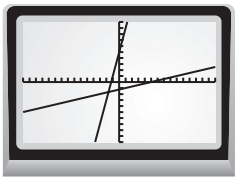
Yes, the inverse passes the vertical line test.

2. $f(x) = 0.6x - 2$



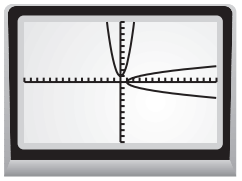
Yes, the inverse passes the vertical line test.

3. $f(x) = 0.4x + 5$



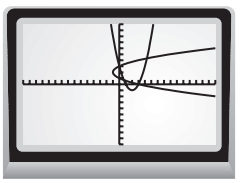
Yes, the inverse passes the vertical line test.

4. $f(x) = 0.2x^2 + 1$



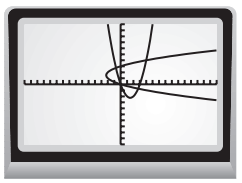
No, the inverse does not pass the vertical line test.

5. $f(x) = x^2 - 4x + 3$



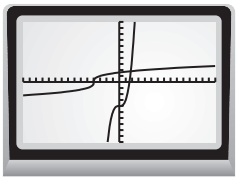
No, the inverse does not pass the vertical line test.

6. $f(x) = x^2 - 3x$



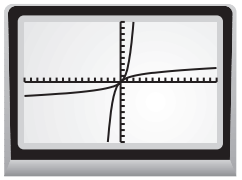
No, the inverse does not pass the vertical line test.

7. $f(x) = x^3 - 4$



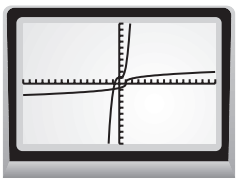
Yes, the inverse passes the vertical line test.

8. $f(x) = x^3 + x$



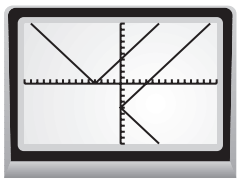
Yes, the inverse passes the vertical line test.

9. $f(x) = 2.1x^3 - 0.4x^2 + 1$



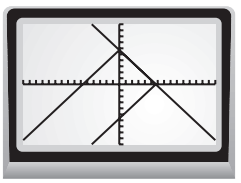
Yes, the inverse passes the vertical line test.

10. $f(x) = |x + 4|$



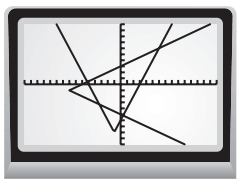
No, the inverse does not pass the vertical line test.

11. $f(x) = -|x| + 5.7$



No, the inverse does not pass the vertical line test.

12. $f(x) = 2|x + 1| - 8$

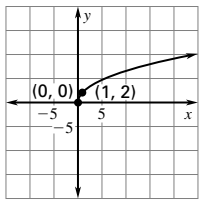


No, the inverse does not pass the vertical line test.

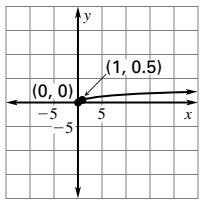
Lesson 7.5

Activity 7.5 (p. 431)

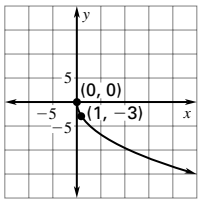
1. a. $y = 2(x)^{\frac{1}{2}}$



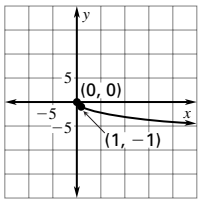
b. $y = \frac{1}{2}(x)^{\frac{1}{2}}$



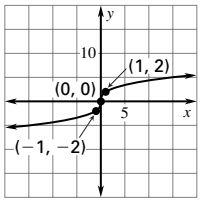
c. $y = -3(x)^{\frac{1}{2}}$



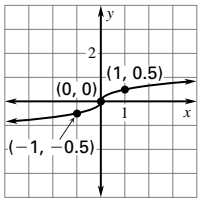
d. $y = -1(x)^{\frac{1}{2}}$



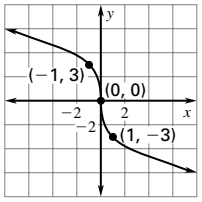
2. a. $y = 2(x)^{\frac{1}{3}}$



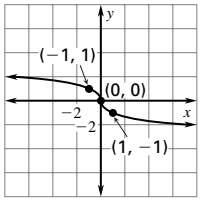
b. $y = \frac{1}{2}(x)^{\frac{1}{3}}$



c. $y = -3(x)^{\frac{1}{3}}$



d. $y = -1(x)^{\frac{1}{3}}$



In Step 1 and Step 2 the absolute value of a determines how much the graph $y = a(x)^{\frac{1}{2}}$ is stretched or compressed compared with the graph of $y = (x)^{\frac{1}{2}}$. The sign of a determines whether there is a reflection in the x-axis. The variable a affects the graph of $y = a(x)^{\frac{1}{3}}$ in a similar fashion as compared with the graph of $y = (x)^{\frac{1}{3}}$.

7.5 Guided Practice (p. 434)

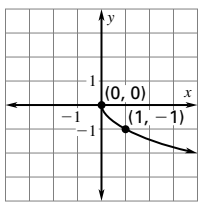
1. radical **2.** The coordinates have been switched. They should be (1, 2) and (2, 3).

3. The coordinates given do not solve the equation. They should be $(-2, -3)$, $(-1, -2)$, and $(-3, -4)$.

4. Shift the graph of $f(x)$ left 5 units.

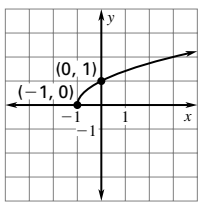
5. Shift the graph of $f(x)$ down 10 units.

6. $y = -\sqrt{x}$



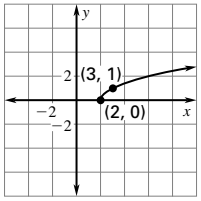
$x \geq 0, y \leq 0$

7. $y = \sqrt{x + 1}$



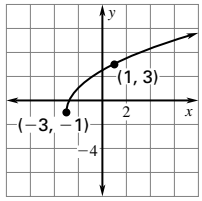
$x \geq -1, y \geq 0$

8. $y = \sqrt{x - 2}$



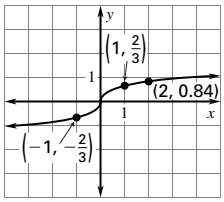
$x \geq 2, y \geq 0$

9. $y = 2\sqrt{x + 3} - 1$



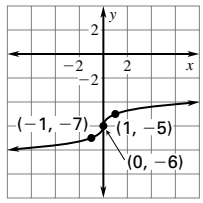
$x \geq -3, y \geq -1$

10. $y = \frac{2}{3}\sqrt[3]{x}$



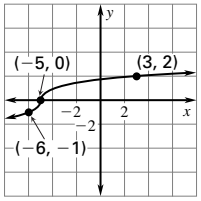
x, y are all real numbers

11. $y = \sqrt[3]{x} - 6$



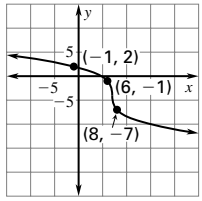
x, y are all real numbers

12. $y = \sqrt[3]{x + 5}$



x, y are all real numbers

13. $y = -3\sqrt[3]{x - 7} - 4$



x, y are all real numbers

14. about 21.65 years

7.5 Practice and Applications (pp. 434–436)

15. Shift the function left 14 units.

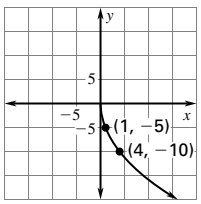
16. Shift the function right 10 units and 3 units down.

17. Shift the function down 10 units.

18. Shift the function left 6 units and down 5 units.

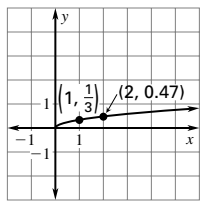
19. B **20.** A **21.** C

22. $y = -5(x)^{\frac{1}{2}}$



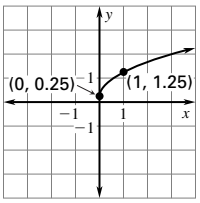
$x \geq 0, y \leq 0$

23. $y = \frac{1}{3}(x)^{\frac{1}{2}}$



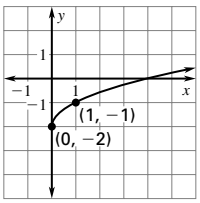
$x \geq 0, y \geq 0$

24. $y = x^{\frac{1}{2}} + \frac{1}{4}$



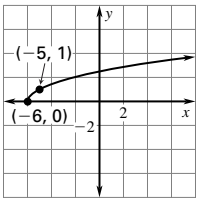
$x \geq 0, y \geq \frac{1}{4}$

25. $y = x^{\frac{1}{2}} - 2$



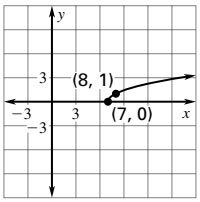
$x \geq 0, y \geq -2$

26. $y = (x + 6)^{\frac{1}{2}}$



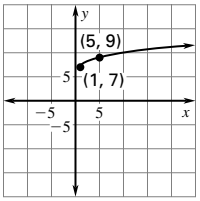
$x \geq -6, y \geq 0$

27. $y = (x - 7)^{\frac{1}{2}}$



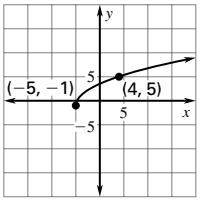
$x \geq 7, y \geq 0$

28. $y = (x - 1)^{\frac{1}{2}} + 7$



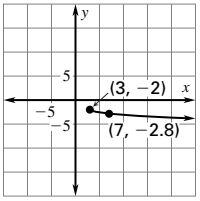
$x \geq 1, y \geq 7$

29. $y = 2(x + 5)^{\frac{1}{2}} - 1$



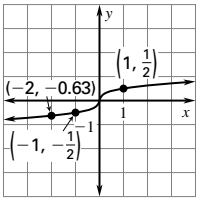
$x \geq -5, y \geq -1$

30. $y = -\frac{2}{5}(x - 3)^{\frac{1}{2}} - 2$

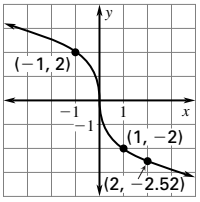


$x \geq 3, y \leq -2$

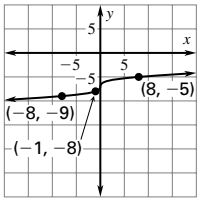
31. $y = \frac{1}{2}x^{\frac{1}{3}}$



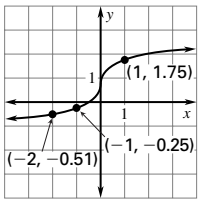
32. $y = -2x^{\frac{1}{3}}$



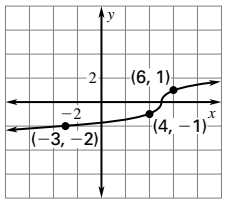
33. $y = x^{\frac{1}{3}} - 7$



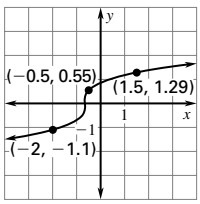
34. $y = x^{\frac{1}{3}} + \frac{3}{4}$



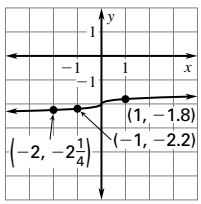
35. $y = (x - 5)^{\frac{1}{3}}$



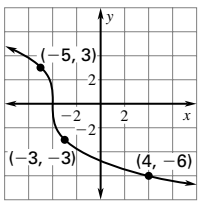
36. $y = \left(x + \frac{2}{3}\right)^{\frac{1}{3}}$



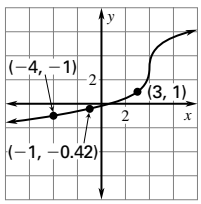
37. $y = \frac{1}{5}x^{\frac{1}{3}} - 2$



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



39. $y = 2(x - 4)^{\frac{1}{3}} + 3$



40. *Sample answer:* $x \geq 13, y \geq 0$

41. *Sample answer:* $x \geq 0, y \geq -2$

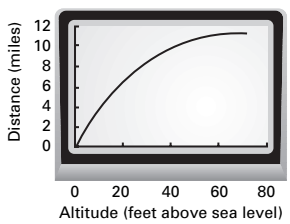
42. *Sample answer:* $x \geq 3, y \leq -7$

43. *Sample answer: x, y* are all real numbers.

44. *Sample answer: x, y* are all real numbers.

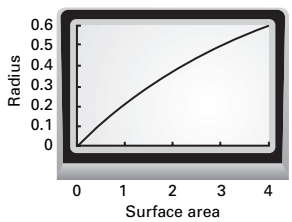
45. *Sample answer: x, y* are all real numbers.

46.

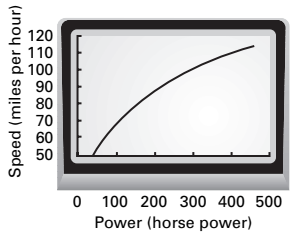


about 67.19 ft

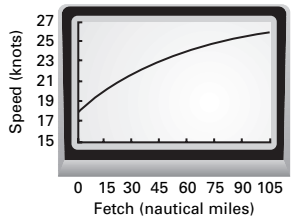
47.



about 2.36

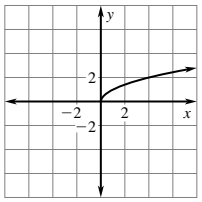
48. 

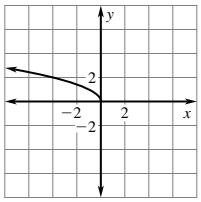
about 300 horsepower

49. 

about 80.15 nautical miles

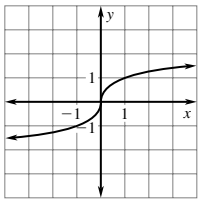
50. a. $f_1(x) = (x)^{\frac{1}{2}}$ $\quad f_2(x) = (-x)^{\frac{1}{2}}$

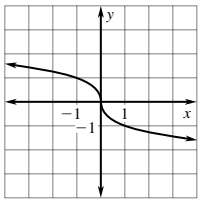




The graphs are reflections across the *y*-axis.

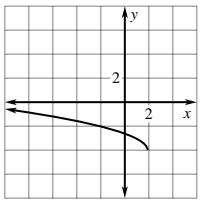
b. $g_1(x) = (x)^{\frac{1}{3}}$ $\quad g_2(x) = (-x)^{\frac{1}{3}}$

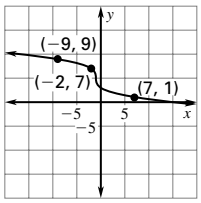




The graphs are reflections across the *y*-axis.

c. $f_3(x) = [-(x-2)]^{\frac{1}{2}} - 4$ $\quad g_3(x) = 2[-(x+1)]^{\frac{1}{3}} + 5$





d. To graph radical functions of the form $f(x) = a\sqrt{-(x-h)} + k$ or $g(x) = a\sqrt[3]{-(x-h)} + k$

1. sketch $y = a\sqrt{x}$ or $y = a\sqrt[3]{x}$.

2. reflect graph across *y*-axis.

3. shift the graph *h* units horizontally and *k* units vertically.

51. $y = \sqrt{x+2} - 3$ $\quad$ **52.** $y = 2\sqrt[3]{x-2}$

53. $y = 3\sqrt{x-1} + 1$

7.5 Mixed Review (p. 436)

54. $2x^2 = 32$

$x^2 = 16$

$x = \pm 4$

55. $(x+7)^2 = 10$

$x + 7 = \pm\sqrt{10}$

$x = -7 \pm \sqrt{10}$

56. $9x^2 = 2$

$x^2 = \frac{2}{9}$

$x = \pm\frac{\sqrt{2}}{3}$

57. $\frac{1}{2}x^2 = 18$

$x^2 = 36$

$x = \pm 6$

58. $\frac{1}{4}(x+6)^2 = 22$

$(x+6)^2 = 4 \cdot 22$

$x + 6 = \pm 2\sqrt{22}$

$x = -6 \pm 2\sqrt{22}$

59. $2(x-0.25)^2 = 16.5$

$(x-0.25)^2 = \frac{16.5}{2}$

$x - 0.25 = \pm\frac{\sqrt{33}}{2}$

$x = \frac{1}{4} \pm \frac{\sqrt{33}}{2}$

60. $(x+4)^2 = x^2 + 8x + 16$

61. $(x-9y)^2 = x^2 - 18xy + 81y^2$

62. $(2x^3+7)^2 = 4x^6 + 28x^3 + 49$

63. $(-3x+4y^4)^2 = 9x^2 - 24xy^4 + 16y^8$

64. $(6-5x)^2 = 36 - 60x + 25x^2$

65. $(-1-2x^2)^2 = 1 + 4x^2 + 4x^4$

66. $f(2x) = 2x + 7$

$g(x+7) = 2(x+7) = 2x + 14$

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

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

68. $f(x+2) = (x+2)^2 - 1 = x^2 + 4x + 4 - 1$

$= x^2 + 4x + 3$

$g(x^2-1) = (x^2-1) + 2 = x^2 + 1$

69. $f(3x-3) = (3x-3)^2 + 7 = 9x^2 - 18x + 9 + 7$

$= 9x^2 - 18x + 16$

$g(x^2+7) = 3(x^2+7) - 3 = 3x^2 + 21 - 3$

$= 3x^2 + 18$

70. a. $c = 3i$

$z_0 = 0$

$z_1 = 3i$

$z_2 = -9 + 3i$

$z_3 = 72 - 51i$

no

b. $c = 2 + 2i$

$z_0 = 0$

$z_1 = 2 + 2i$

$z_2 = 2 + 10i$

$z_3 = -94 + 42i$

no

c. $c = 6$

$z_0 = 0$

$z_1 = 6$

$z_2 = 42$

$z_3 = 1770$

no

Lesson 7.6

7.6 Guided Practice (p. 441)

1. An extraneous solution is a solution to an equation raised to a power that is not a solution to the original equation.

2. Next, she will have to take the square root of both sides. To solve the equation in one step, she could have raised both sides to the $\frac{3}{2}$ power.

3. First, he should have rewritten the equation with only one radical expression on each side:

$\sqrt{5x - 2} = \sqrt{7x - 4}$.

4. $3x^{\frac{1}{4}} = 4$

$x^{\frac{1}{4}} = \frac{4}{3}$

$x = \frac{256}{81}$

5. $(2x + 7)^{\frac{3}{2}} = 27$

$2x + 7 = 9$

$2x = 2$

$x = 1$

6. $x^{\frac{4}{3}} + 9 = 25$

$x^{\frac{4}{3}} = 16$

$x = 8$

7. $4x^{\frac{2}{3}} - 6 = 10$

$4x^{\frac{2}{3}} = 16$

$x^{\frac{2}{3}} = 4$

$x = 8$

8. $5(x - 8)^{\frac{3}{4}} = 40$

$(x - 8)^{\frac{3}{4}} = 8$

$x - 8 = 16$

$x = 24$

9. $(x + 9)^{\frac{5}{2}} - 1 = 31$

$(x + 9)^{\frac{5}{2}} = 32$

$x + 9 = 4$

$x = -5$

10. $\sqrt[4]{x} = 3$

$x = 81$

11. $\sqrt[3]{3x} + 6 = 10$

$\sqrt[3]{3x} = 4$

$3x = 64$

$x = \frac{64}{3}$

12. $\sqrt[5]{2x + 1} + 5 = 9$

$\sqrt[5]{2x + 1} = 4$

$2x + 1 = 1024$

$2x = 1023$

$x = \frac{1023}{2}$

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

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

$x^2 - 5x + 6 = 0$

$(x - 3)(x - 2) = 0$

$x = 2, x = 3$

14. $\sqrt[3]{x + 4} = \sqrt[3]{2x - 5}$

$x + 4 = 2x - 5$

$x = 9$

15. $6\sqrt{x} - \sqrt{x - 1} = 0$

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

$36x = x - 1$

$x = -\frac{1}{35}$

does not work in original equation; no solution

16. $2 = 1.69\sqrt{s + 4.45} - 3.49$

$5.49 = 1.69\sqrt{s + 4.45}$

$3.25 = \sqrt{s + 4.45}$

$10.55 = s + 4.45$

$6.10 = s$; 6.10 mi/hr

7.6 Practice and Applications (pp. 441–443)

17. $\sqrt{x} - 3 = 6$

$\sqrt{81} - 3 = 6$

$9 - 3 = 6$

yes

18. $4(x - 5)^{\frac{1}{2}} = 28$

$4(12 - 5)^{\frac{1}{2}} = 28$

$4(7)^{\frac{1}{2}} \neq 28$

no

19. $(x + 7)^{\frac{3}{2}} - 20 = 7$

$(2 + 7)^{\frac{3}{2}} = 27$

$9^{\frac{3}{2}} = 27$

yes

20. $\sqrt[3]{4x} + 11 = 5$

$\sqrt[3]{-216} = -6$

$-6 = -6$

yes

21. $2\sqrt{5x + 4} + 10 = 10$

$2\sqrt{4} + 10 = 10$

$4 + 10 \neq 10$

no

22. $\sqrt{4x - 3} - \sqrt{3x} = 0$

$\sqrt{12 - 3} - \sqrt{9} = 0$

$\sqrt{9} - \sqrt{9} = 0$

yes

23. $x^{\frac{5}{2}} = 32$

$x = 4$

24. $x^{\frac{1}{3}} - \frac{2}{5} = 0$

$x^{\frac{1}{3}} = \frac{2}{5}$

$x = \frac{8}{125}$

25. $x^{\frac{2}{3}} + 15 = 24$

$x^{\frac{2}{3}} = 9$

$x = 27$

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

$x^{\frac{1}{5}} = -20$

$x = -3{,}200{,}000$

27. $4x^{\frac{3}{4}} = 108$

$x^{\frac{3}{4}} = 27$

$x = 81$

28. $(x - 4)^{\frac{3}{2}} = -6$

$x - 4 = -3.3$

$x = 0.7$

Solution does not solve original equation, therefore there is no solution.

29. $(2x + 5)^{\frac{1}{2}} = 4$

$2x + 5 = 16$

$2x = 11$

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

30. $3(x + 1)^{\frac{4}{3}} = 48$

$(x + 1)^{\frac{4}{3}} = 16$

$x + 1 = 8$

$x = 7$

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

$-(x - 5)^{\frac{1}{4}} = -\frac{1}{3}$

$(x - 5)^{\frac{1}{4}} = \frac{1}{3}$

$x - 5 = \frac{1}{81}$

$x = \frac{406}{81}$

32. $\sqrt{x} = \frac{1}{9}$

$x = \frac{1}{81}$

33. $\sqrt[3]{x} + 10 = 16$

$\sqrt[3]{x} = 6$

$x = 216$

34. $\sqrt[4]{2x} - 13 = -9$

$\sqrt[4]{2x} = 4$

$2x = 256$

$x = 128$

35. $\sqrt{x + 56} = 16$

$x + 56 = 256$

$x = 200$

36. $\sqrt[3]{x + 40} = -5$

$x + 40 = -125$

$x = -165$

37. $\sqrt{6x - 5} + 10 = 3$

$\sqrt{6x - 5} = -7$

The square root of any number will never be negative, therefore there is no solution.

38. $\frac{2}{5}\sqrt{10x + 6} = 12$

$\sqrt{10x + 6} = 30$

$10x + 6 = 900$

$10x = 894$

$x = 89.4$

39. $2\sqrt{7x + 4} - 1 = 7$

$2\sqrt{7x + 4} = 8$

$\sqrt{7x + 4} = 4$

$7x + 4 = 16$

$7x = 12$

$x = \frac{12}{7}$

40. $-2\sqrt[5]{2x - 1} + 4 = 0$

$-2\sqrt[5]{2x - 1} = -4$

$\sqrt[5]{2x - 1} = 2$

$2x - 1 = 32$

$2x = 33$

$x = \frac{33}{2}$

41. $x - 12 = \sqrt{16x}$

$x^2 - 24x + 144 = 16x$

$x^2 - 40x + 144 = 0$

$(x - 36)(x - 4) = 0$

$x = 36$

42. $\sqrt[4]{x^4 + 1} = 3x$

$x^4 + 1 = 81x^4$

$80x^4 = 1$

$x^4 = \frac{1}{80}$

$x = \frac{\sqrt[4]{125}}{10}$

43. $\sqrt{x^2 + 5} = x + 3$

$x^2 + 5 = x^2 + 6x + 9$

$6x = -4$

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

44. $\sqrt[3]{x} = x - 6$

$x = x^3 - 18x^2 + 108x - 216$

$x^3 - 18x^2 + 107x - 216 = 0$

$(x - 8)(x^2 - 10x + 27) = 0$

$x = 8$

45. $\sqrt{8x + 1} = x + 2$

$8x + 1 = x^2 + 4x + 4$

$x^2 - 4x + 3 = 0$

$(x - 3)(x - 1) = 0$

$x = 3, x = 1$

46. $\sqrt{2x + \frac{1}{6}} = x + \frac{5}{6}$

$2x + \frac{1}{6} = x^2 + \frac{10}{6}x + \frac{25}{36}$

$x^2 - \frac{1}{3}x + \frac{19}{36} = 0$

$\left(x - \frac{1}{6}\right)^2 = -\frac{18}{36}$

no solution

47. $\sqrt{2x - 1} = \sqrt{x + 4}$

$2x - 1 = x + 4$

$x = 5$

48. $\sqrt[4]{6x - 5} = \sqrt[4]{x + 10}$

$6x - 5 = x + 10$

$5x = 15$

$x = 3$

49. $-\sqrt{8x + \frac{4}{3}} = \sqrt{2x + \frac{1}{3}}$

$8x + \frac{4}{3} = 2x + \frac{1}{3}$

$6x = -1$

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

50. $2\sqrt[3]{10 - 3x} = \sqrt[3]{2 - x}$

$8(10 - 3x) = 2 - x$

$80 - 24x = 2 - x$

$23x = 78$

$x = \frac{78}{23}$

51. $\sqrt[4]{2x} + \sqrt[4]{x + 3} = 0$

Two positive numbers never add up to zero.
no solution

52. $\sqrt{x - 6} - \sqrt{\frac{1}{3}x} = 0$

$\sqrt{x - 6} = \sqrt{\frac{1}{3}x}$

$x - 6 = \frac{1}{3}x$

$3x - 18 = x$

$2x = 18$

$x = 9$

53. $\sqrt{2x + 10} - 2\sqrt{x} = 0$

$\sqrt{2x + 10} = 2\sqrt{x}$

$2x + 10 = 4x$

$2x = 10$

$x = 5$

54. $\sqrt[3]{2x + 15} - \frac{3}{2}\sqrt[3]{x} = 0$

$\sqrt[3]{2x + 15} = \frac{3}{2}\sqrt[3]{x}$

$2x + 15 = \frac{27}{8}x$

$16x + 120 = 27x$

$11x = 120$

$x = \frac{120}{11}$

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

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

$x = -18.96296$

56. $2(x + 19)^{\frac{2}{5}} - 1 = 17$

$2(x + 19)^{\frac{2}{5}} = 18$

$(x + 19)^{\frac{2}{5}} = 9$

$x + 19 = 243$

$x = 224$

57. $(3.5x + 1)^{\frac{2}{7}} = (6.4x + 0.7)^{\frac{2}{7}}$

$3.5x + 1 = 6.4x + 0.7$

$2.9x = 0.3$

$x = 0.10345$

58. $\left(\frac{1}{5}x\right)^{\frac{3}{4}} = x - \frac{3}{8}$

$x = 0.57160$

59. $\sqrt{6.7x + 14} = 9.4$

$6.7x + 14 = 88.36$

$6.7x = 74.36$

$x = 11.099$

60. $\sqrt[3]{70 - 2x} - 10 = -6$

$\sqrt[3]{70 - 2x} = 4$

$70 - 2x = 64$

$-2x = -6$

$x = 3$

61. $\sqrt[4]{x - \frac{1}{6}} = 2\sqrt[4]{3x}$

$x - \frac{1}{6} = 48x$

$47x = -\frac{1}{6}$

$x = -\frac{1}{282}$ Cannot take the 4th root of a negative number; no solution.

62. $\sqrt{1.1x + 2.4} = 19x - 4.2$

$1.1x + 2.4 = 361x^2 - 159.6x + 17.64$

$361x^2 - 160.7x + 15.24 = 0$

$x = 0.30816$

63. $3 = 54d^{\frac{3}{2}}$

$\frac{1}{18} = d^{\frac{3}{2}}$

$0.146 \text{ in.} = d$

64. $4500 = (1.6 \times 10^{-4})C^{\frac{273}{100}}$

$2.8125 \times 10^7 = C^{\frac{273}{100}}$

$535.31 \text{ mm} = C$

65. $36 = (0.867t^2 + 39.2t + 57.1)^{\frac{1}{2}}$

$1296 = 0.867t^2 + 39.2t + 57.1$

$0.867t^2 + 39.2t - 1238.9 = 0$

$t \approx 21$

1991

66. $2 = 1.5\sqrt[3]{t}$

$\frac{4}{3} = \sqrt[3]{t}$

$\frac{64}{27} = t$

2.37 sec

67. $7 = 1.69\sqrt{s + 4.45} - 3.49$

$10.49 = 1.69\sqrt{s + 4.45}$

$6.21 = \sqrt{s + 4.45}$

$38.53 = s + 4.45$

$34.078 = s$

68. $\frac{20 + 1.25\sqrt{300} - 9.8\sqrt[3]{d}}{0.679} \leq 24$

$20 + 21.65 - 9.8\sqrt[3]{d} \leq 16.296$

$-9.8\sqrt[3]{d} \leq -25.355$

$\sqrt[3]{d} \geq 2.587$

$d \geq 17.32 \text{ m}^3$

69. $5 = \sqrt{h^2 + \frac{1}{4}(2)^2}$

$25 = h^2 + 1$

$24 = h^2$

$4.90 = h$

70. In this case, $x = 2$ is a solution to the equation, but $x = 8$ is an extraneous solution.

71. $\sqrt{6x - 4} = 3$

$6x - 4 = 9$

$6x = 13$

$x = \frac{13}{6}$

E

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

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

$8x - 12 = x^2$

$x^2 - 8x + 12 = 0$

$(x - 6)(x - 2) = 0$

$x = 6, x = 2$

B

73. $\sqrt[3]{x - 7} = \sqrt[3]{\frac{3}{4}x + 1}$

$x - 7 = \frac{3}{4}x + 1$

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

$x = 32$

E

74. $\sqrt{x + 5} = 5 - \sqrt{x}$

$x + 5 = 25 - 10\sqrt{x} + x$

$10\sqrt{x} = 20$

$\sqrt{x} = 2$

$x = 4$

75. $\sqrt{2x + 3} = 3 - \sqrt{2x}$

$2x + 3 = 9 - 6\sqrt{2x} + 2x$

$6\sqrt{2x} = 6$

$\sqrt{2x} = 1$

$2x = 1$

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

76. $\sqrt{x + 3} - \sqrt{x - 1} = 1$

$\sqrt{x + 3} = \sqrt{x - 1} + 1$

$x + 3 = x - 1 + 2\sqrt{x - 1} + 1$

$3 = 2\sqrt{x - 1}$

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

$\frac{9}{4} = x - 1$

$\frac{13}{4} = x$

77. $\sqrt{2x + 4} + \sqrt{3x - 5} = 4$

$\sqrt{2x + 4} = 4 - \sqrt{3x - 5}$

$2x + 4 = 16 - 8\sqrt{3x - 5} + 3x - 5$

$8\sqrt{3x - 5} = x + 7$

$64(3x - 5) = x^2 + 14x + 49$

$192x - 320 = x^2 + 14x + 49$

$x^2 - 178x + 369 = 0$

$x \approx 2.1$

78. $\sqrt{3x - 2} = 1 + \sqrt{2x - 3}$

$3x - 2 = 1 + 2\sqrt{2x - 3} + 2x - 3$

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

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

$x^2 = 8x - 12$

$x^2 - 8x + 12 = 0$

$(x - 6)(x - 2) = 0$

$x = 6, x = 2$

79. $\frac{1}{2}\sqrt{2x - 5} - \frac{1}{2}\sqrt{3x + 4} = 1$

$\sqrt{2x - 5} - \sqrt{3x + 4} = 2$

$\sqrt{2x - 5} = 2 + \sqrt{3x + 4}$

$2x - 5 = 4 + 4\sqrt{3x + 4} + 3x + 4$

$-x - 13 = 4\sqrt{3x - 4}$

$-\frac{1}{4}(x + 13) = \sqrt{3x - 4}$

no solution

7.6 Mixed Review (p. 444)

80. $6 + 24 \div 3 = 6 + 8 = 14$

81. $3 \cdot 5 + 10 \div 2 = 15 + 5 = 20$

82. $27 - 4 \cdot 16 \div 8 = 27 - 64 \div 8 = 27 - 8 = 19$

83. $2 - (10 \cdot 2)^2 \div 5 = 2 - (400) \div 5 = 2 - 80 = -78$

84. $8 + (3 \cdot 10) \div 6 - 1 = 8 + 30 \div 6 - 1$

$= 8 + 5 - 1 = 12$

85. $11 - 8 \div 2 + 48 \div 4 = 11 - 4 + 12 = 19$

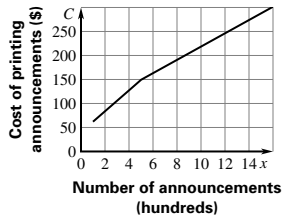
86. x-intercepts: ≈ -0.791, 1, ≈ 3.79
local min.: $(2.67, -6.48)$
local max.: $(0, 3)$

87. x-intercept: ≈ -0.95
local min.: none
local min.: none

88. x-intercepts: ± 1
local min.: $\left(0, -\frac{1}{2}\right)$
local max.: none

89. x-intercepts: 0, $\approx \pm 1.41$
local min.: $(0.914, -4.08)$
local max.: $(-0.914, 4.08)$

90.



Math and History (p. 444)

1. $60 = 356\sqrt{d}$

$0.17 = \sqrt{d}$

$0.284 \text{ km} = d$

2. $\frac{\text{distance}}{\text{time}} = \text{rate}$

$\frac{7546}{15.2} = 496.45 \text{ km/h}$

3. $496.45 = 356\sqrt{d}$

$1.39 = \sqrt{d}$

$1.945 \text{ km} = d$

Lesson 7.7

7.7 Guided Practice (p. 449)

1. The mean is the average. It is calculated by dividing the sum of the numbers by n, the number of numbers. The median is the middle number when the numbers are written in ascending order. If n is even, the median is the mean of the two middle numbers. The mode is the number or numbers that occur most frequently. The range is the difference between the greatest and least data values.

2. *Sample answers:* 3, 5, 6, 6; 2, 4, 5, 9; second set

3. Set A has greater range because $10 - 3 = 7 > 11 - 5 = 6$.

4. mean $= \frac{68 + 72 + 76 + 81 + 84 + 86 + 86 + 86 + 89 + 91 + 95 + 99}{12}$

$= \frac{1013}{12} \approx 84.4$

median $= 86$

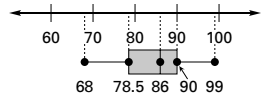
mode $= 86$

5. range $= 99 - 68 = 31$

6. $\sigma \approx \sqrt{\frac{269 + 154 + 71 + 12 + 0.16 + 2.6 + 2.6 + 2.6 + 21 + 43 + 112 + 213}{12}}$

$\approx \sqrt{\frac{903}{12}} \approx 8.67$

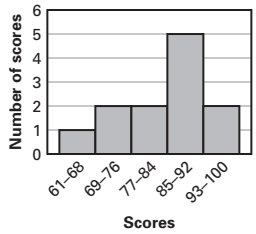
7.



8.

Interval	*Tally*	*Frequency*
61–68	|	1
69–76	||	2
77–84	||	2
85–92	𝍸 |	5
93–100	||	2

9.



7.7 Practice and Applications (pp. 449–451)

10. mean $= \frac{50}{6} = 8.33$; median $= 9$; mode $= 9$

11. mean $= \frac{347}{7} = 49.57$; median $= 47$; mode $= 47$

12. mean $= \frac{685}{8} = 85.625$; median $= 85.5$; mode $= 91$

13. mean $= \frac{1740}{7} = 248.57$; median $= 230$; mode $= 230$

14. mean $= \frac{19.4}{7} = 2.77$; median $= 2.9$; mode $= 2.9$

15. mean $= \frac{3.2}{9} = 0.356$; median $= 0.3$; mode $= 0, 0.5$

16. range $= 60 - 10 = 50$; $\sigma \approx \sqrt{\frac{1750}{6}} \approx 17.08$

17. range $= 9 - 1 = 8$; $\sigma \approx \sqrt{\frac{44.83}{6}} \approx 2.73$

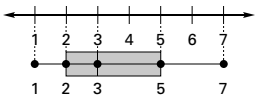
18. range $= 20 - 6 = 14$; $\sigma = \sqrt{\frac{144}{9}} = 4$

19. range $= 1429 - 1012 = 417$;
$\sigma \approx \sqrt{\frac{123{,}353}{6}} \approx 143.4$

20. range $= 6.0 - 1.3 = 4.7$; $\sigma \approx \sqrt{\frac{19.67}{7}} \approx 1.68$

21. range $= 24.8 - 12.7 = 12.1$; $\sigma \approx \sqrt{\frac{87.37}{6}} \approx 3.82$

22.



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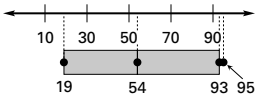

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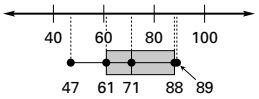

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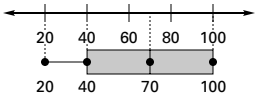

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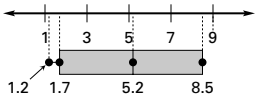

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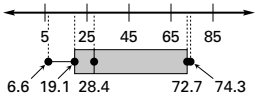
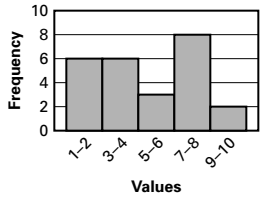


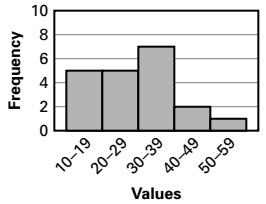
28.

Interval	*Tally*	*Frequency*
1–2	𝍸 I	6
3–4	𝍸 I	6
5–6	III	3
7–8	𝍸 III	8
9–10	II	2



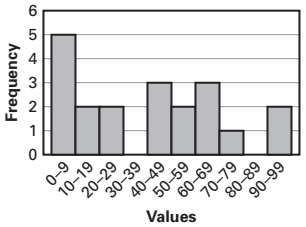
29.

Interval	*Tally*	*Frequency*
10–19	𝍸	5
20–29	𝍸	5
30–39	𝍸 II	7
40–49	II	2
50–59	I	1



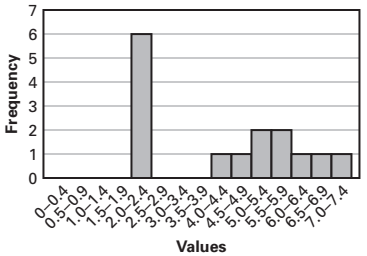
30.

Interval	*Tally*	*Frequency*
0–9	𝍸	5
10–19	II	2
20–29	II	2
30–39		0
40–49	III	3
50–59	II	2
60–69	III	3
70–79	I	1
80–89		0
90–99	II	2



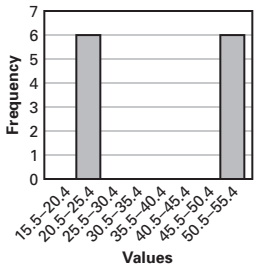
31.

Interval	*Tally*	*Frequency*
0–.4		0
.5–.9		0
1.0–1.4		0
1.5–1.9		0
2.0–2.4	𝍸 I	6
2.5–2.9		0
3.0–3.4		0
3.5–3.9		0
4.0–4.4	I	1
4.5–4.9	I	1
5.0–5.4	II	2
5.5–5.9	II	2
6.0–6.4	I	1
6.5–6.9	I	1
7.0–7.4	I	1



32.

Interval	*Tally*	*Frequency*
15.5–20.4		0
20.5–25.4	𝍸 |	6
25.5–30.4		0
30.5–35.4		0
35.5–40.4		0
40.5–45.4		0
45.5–50.4		0
50.5–55.4	𝍸 |	6



33. Machine 1: mean $= \frac{10.37}{4} = 2.59$; median $= 2.59$; mode $=$ none

Machine 2: mean $= \frac{10.37}{4} = 2.59$; median $= 2.59$; mode $=$ none

34. Machine 1: range $= 2.72 - 2.47 = 0.25$;

$\sigma = \sqrt{\frac{0.0345}{4}} = 0.09$

Machine 2: range $= 4.10 = 1.09 = 3.01$;

$\sigma = \sqrt{\frac{4.9719}{4}} = 1.11$

35. Machine 1 is more consistent because it has a smaller range and standard deviation.

36. mean $= \frac{1{,}631{,}500}{7} = \$233{,}071.43$; median $= 142{,}000$; mode $=$ none

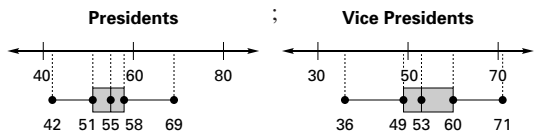
37. range $= 750{,}000 - 104{,}900 = \$645{,}100$;

$\sigma = \sqrt{\frac{3.1831}{7} \times 10^{11}} \approx \$213{,}243.66$

38. The highest selling price makes the mean price higher than six out of the seven of the home prices. Reporting the median rather than the mean eliminates the huge effect of one outlying value.

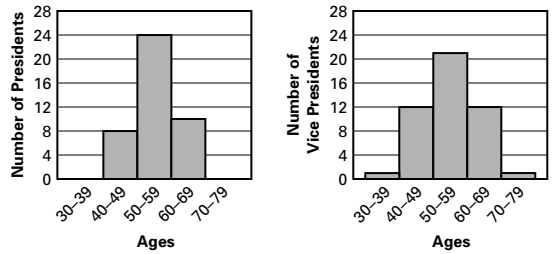
39. The mode is the most appropriate measure because it would indicate that most people have a positive opinion on the issue. Because the categories are not part of an order scale, means and medians are not meaningful.

40.



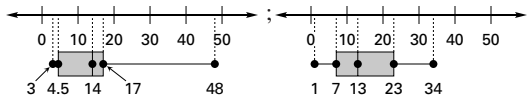
41.

Age	*Pres.*	*V.P.*
30–39	0	1
40–49	8	12
50–59	24	21
60–69	10	12
70–79	0	1



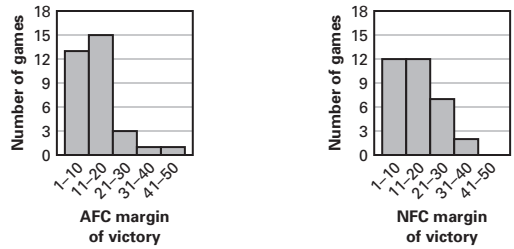
42. *Sample answer:* The range of ages of Vice-Presidents is greater than the range of ages of Presidents.

43.



44.

Points	*AFC*	*NFC*
1–10	13	12
11–20	15	12
21–30	3	7
31–40	1	2
41–50	1	0



45. *Sample answer:* You cannot conclude that one conference has a larger margin of victory than the other.

46. Answers may vary. **47.** B **48.** B **49.** C

50.

$$\sigma = \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + (x_3 - \bar{x})^2}{3}}$$

$$= \sqrt{\frac{x_1^2 - 2x_1\bar{x} + \bar{x}^2 + x_2^2 - 2x_2\bar{x} + \bar{x}^2 + x_3^2 - 2x_3\bar{x} + \bar{x}^2}{3}}$$

$$= \sqrt{\frac{3\bar{x}^2 + x_1^2 + x_2^2 + x_3^2 - 2\bar{x}(x_1 + x_2 + x_3)}{3}}$$

$$= \sqrt{\frac{\frac{1}{3}(x_1 + x_2 + x_3)^2 + x_1^2 + x_2^2 + x_3^2 - \frac{2}{3}(x_1 + x_2 + x_3)(x_1 + x_2 + x_3)}{3}}$$

$$= \sqrt{\frac{x_1^2 + x_2^2 + x_3^2 - \frac{1}{3}(x_1 + x_2 + x_3)^2}{3}}$$

$$= \sqrt{\frac{x_1^2 + x_2^2 + x_3^2 - 3\bar{x}^2}{3}}$$

$$= \sqrt{\frac{x_1^2 + x_2^2 + x_3^2}{3} - \bar{x}^2}$$

7.7 Mixed Review (p. 452)

51. $x^5 - 8 = 2^5 - 8 = 32 - 8 = 24$

52. $3x^3 + 7 = 3\left(\frac{3}{7}\right)^3 + 7 = \frac{81}{343} + \frac{2401}{343} = \frac{2482}{343}$

53. $(7x)^3 + 17 = (-7)^3 + 17 = -343 + 17 = -326$

54. $\frac{4x}{x^4 - 1} = \frac{2}{-0.9375} \approx -2.13$

55. $3^3 \cdot 3^4 = 3^7 = 2187$; product of powers property

56. $(4^{-3})^2 = 4^{-6} = \frac{1}{4096}$; power of a power and negative exponent properties

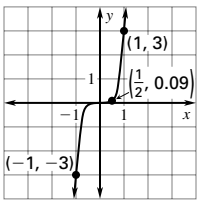
57. $(-2)(-2)^{-3} = (-2)^{-2} = \frac{1}{4}$; product of powers and negative exponent properties

58. $(5^{-2})^{-2} = 5^4 = 625$; product of powers property

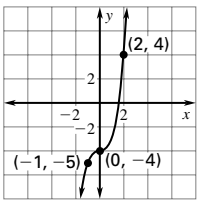
59. $10^{-2} \cdot 10^0 = 10^{-2} \cdot 1 = \frac{1}{100}$; zero exponent and negative exponent properties

60. $7^0 \cdot 7^2 \cdot 7^{-2} = 1 \cdot 7^{2-2} = 7^0 = 1$; zero exponent and product of powers properties

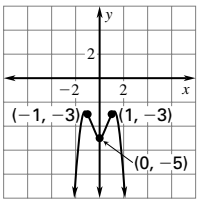
61. $f(x) = 3x^{-5}$



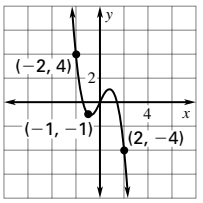
62. $f(x) = x^3 - 4$



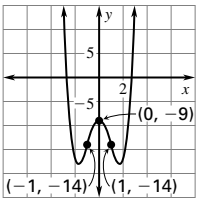
63. $f(x) = -x^4 + 3x^2 - 5$



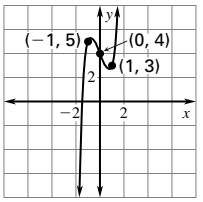
64. $f(x) = -x^3 + 2x$



65. $f(x) = x^4 - 6x^2 - 9$

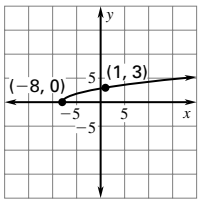


66. $f(x) = x^5 - 2x + 4$



Quiz 3 (p. 452)

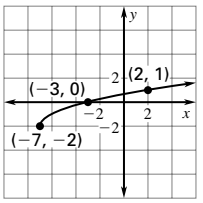
1. $y = (x + 8)^{\frac{1}{2}}$



$x \geq -8$

$y \geq 0$

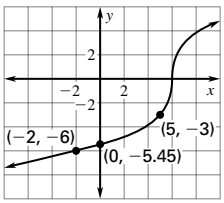
2. $y = (x + 7)^{\frac{1}{2}} - 2$



$x \geq -7$

$y \geq -2$

3. $x = 3(x - 6)^{\frac{1}{3}}$



x, y all real numbers

4. $\sqrt[4]{2x} = 5$

$2x = 625$

$x = 312.5$

5. $\sqrt{3x + 7} = x - 1$

$3x + 7 = x^2 - 2x + 1$

$x^2 - 5x - 6 = 0$

$(x + 1)(x - 6) = 0$

$x = 6$

6. $\sqrt[3]{2x} - 2\sqrt[3]{x} = 0$

$\sqrt[3]{2x} = 2\sqrt[3]{x}$

$2x = 8x$

$x = 0$

7. mean $= \frac{44}{10} = 4.4$

median $= 5.5$

mode $= 6$

range $= 9$

$\sigma = \sqrt{\frac{87}{10}} = 2.95$

8. mean $= \frac{167}{7} \approx 23.86$

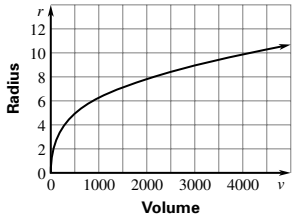
median $= 21$

mode $=$ none

range $= 43 - 12 = 31$

$\sigma \approx \sqrt{\frac{698.9}{7}} = 9.99$

9.



4196 cubic units

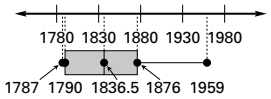
10. $686.2 = 0.199a^{\frac{3}{2}}$

$3448.24 = a^{\frac{3}{2}}$

$228.24 = a$

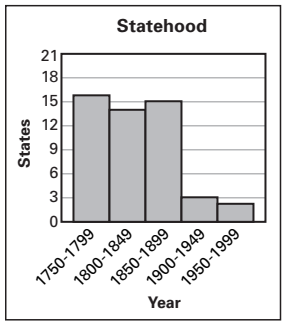
228.24 million km

11.



12.

1750–1799	16
1800–1849	14
1850–1899	15
1900–1949	3
1950–1999	2



Technology Activity 7.7 (p. 453)

1. mean $= \frac{173}{10} = 17.3$

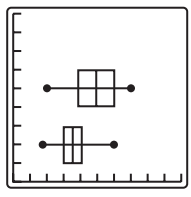
median $= 17.5$

range $= 30 - 8 = 22$

$\sigma = \sqrt{\frac{326}{10}} = 5.71$

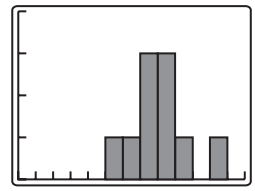
2. The restaurant in the exercise has a lower mean and median fat content and a lower standard deviation than the restaurant in the example. Overall the second restaurant has sandwiches with less fat than the first restaurant.

3, 4.



4. The second restaurant has sandwiches with a lower fat content. The box-and-whisker plots make it easy to compare the medians and ranges, so it is clear that the second restaurant's sandwiches have less fat.

5. The histograms show that half of the sandwiches in the first restaurant contain over 500 Calories, while only 1 out of 10 sandwiches at the second restaurant contain over 500 Calories.



Chapter 7 Review *(pp. 456–458)*

1. $\sqrt[4]{16} = \sqrt[4]{2 \cdot 2 \cdot 2 \cdot 2} = 2$

2. $\left(\sqrt[3]{64}\right)^2 = \left(\sqrt[3]{4 \cdot 4 \cdot 4}\right)^2 = 4^2 = 16$

3. $9^{-\frac{5}{2}} = \sqrt{\frac{1}{9^5}} = \frac{1}{243}$

4. $216^{\frac{1}{3}} = \sqrt[3]{216} = \sqrt[3]{6 \cdot 6 \cdot 6} = 6$

5. $\sqrt[5]{-32} = \sqrt[5]{-2 \cdot -2 \cdot -2 \cdot -2 \cdot -2} = -2$

6. $\sqrt[4]{81} = \pm\sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3} = \pm 3$

7. $\sqrt[5]{-1} = -1$

8. $\sqrt[7]{0} = 0$

9. $5^{\frac{1}{4}} \cdot 5^{-\frac{9}{4}} = 5^{-2} = \frac{1}{25}$

10. $\left(100^{\frac{1}{3}}\right)^{\frac{3}{4}} = 100^{\frac{1}{4}} = (10^2)^{\frac{1}{4}} = 10^{\frac{1}{2}}$

11. $\sqrt{\frac{16}{1000}} = \sqrt{\frac{2 \cdot 2 \cdot 2 \cdot 2}{10 \cdot 10 \cdot 10}} = \frac{2\sqrt{2}}{10} = \frac{\sqrt{2}}{5}$

12. $5\sqrt[3]{17} - 4\sqrt[3]{17} = \sqrt[3]{17}$

13. $(81x)^{\frac{1}{4}} = \sqrt[4]{3 \cdot 3 \cdot 3 \cdot 3 \cdot x} = 3\sqrt[4]{x}$

14. $\frac{(4x)^2}{(4x)^{\frac{1}{2}}} = (4x)^{2-\frac{1}{2}} = (4x)^{\frac{3}{2}} = 8x^{\frac{3}{2}}$

15. $\sqrt[6]{6x^6y^7z^{10}} = xyz\sqrt[6]{6yz^4}$

16. $\sqrt[3]{4a^6} + a\sqrt[3]{108a^3} = a^2\sqrt[3]{4} + 3a^2\sqrt[3]{4} = 4a^2\sqrt[3]{4}$

17. $f(x) + g(x) = 2x - 4 + x - 2 = 3x - 6$

18. $f(x) - g(x) = (2x - 4) - (x - 2)$

$= 2x - 4 - x + 2$

$= x - 2$

19. $f(x) \cdot g(x) = (2x - 4)(x - 2) = 2x^2 - 8x + 8$

20. $\frac{f(x)}{g(x)} = \frac{2(x-2)}{x-2} = 2$

21. $f(g(x)) = f(x - 2) = 2(x - 2) - 4 = 2x - 8$

22. $y = -2x + 1$

$x = -2y + 1$

$x - 1 = -2y$

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

23. $y = -x^4$

$x = -y^4$

$\sqrt[4]{-x} = y$

$x \leq 0$

24. $y = 5x^3 + 7$

$x = 5y^3 + 7$

$x - 7 = 5y^3$

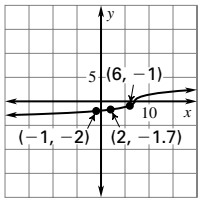
$\sqrt[3]{\frac{x-7}{5}} = y$

25. $f(x) = -2x^5 \quad g(x) = \sqrt[5]{\frac{-x}{2}}$

$f(g(x)) = -2\left(\sqrt[5]{\frac{-x}{2}}\right)^5 = -2\left(\frac{-x}{2}\right) = x$

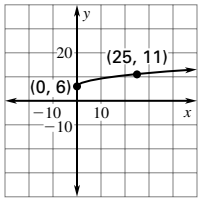
$g(f(x)) = \sqrt[5]{\frac{-(-2x^5)}{2}} = \sqrt[5]{\frac{2x^5}{2}} = x$

26. $y = (x - 7)^{\frac{1}{3}}$



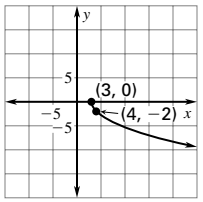
x and y are all real numbers

27. $y = \sqrt{x} + 6$



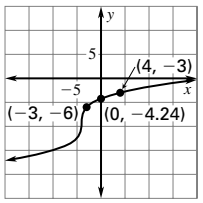
$x \geq 0; y \geq 6$

28. $y = -2(x - 3)^{\frac{1}{2}}$



$x \geq 3; y \leq 0$

29. $y = 3\sqrt[3]{x + 4} - 9$



x and y are all real numbers

30. $3(x + 1)^{\frac{1}{5}} + 5 = 11$

$3(x + 1)^{\frac{1}{5}} = 6$

$(x + 1)^{\frac{1}{5}} = 2$

$x + 1 = 32$

$x = 31$

31. $\sqrt[3]{5x + 3} - \sqrt[3]{4x} = 0$

$5x + 3 = 4x$

$x = -3$

32. $\sqrt{4x} = x - 8$

$4x = x^2 - 16x + 64$

$x^2 - 20x + 64 = 0$

$(x - 4)(x - 16) = 0$

$x = 16$

33. mean $= \frac{491}{12} = 40.9$

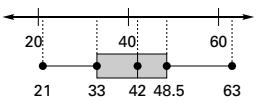
median $= 42$

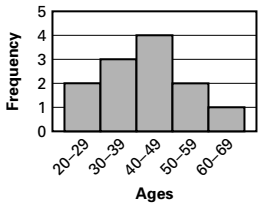
mode $= 51$

range $= 63 - 21 = 42$

$\sigma = \sqrt{\frac{1541}{12}} \approx 11.33$

34.





Chapter 7 Test *(p. 459)*

1. $\sqrt[3]{-1000} = -10$ **2.** $4^{\frac{5}{2}} = \left(\sqrt{4}\right)^5 = 2^5 = 32$

3. $(-64)^{\frac{2}{3}} = \left(\sqrt[3]{-64}\right)^2 = (-4)^2 = 16$

4. $243^{-\frac{1}{5}} = \frac{1}{\sqrt[5]{243}} = \frac{1}{3}$ **5.** $\sqrt[4]{16} = \pm 2$

6. $\left(2^{\frac{1}{3}} \cdot 5^{\frac{1}{2}}\right)^4 = 2^{\frac{4}{3}} \cdot 5^2 = 2 \cdot 25 \cdot \sqrt[3]{2} = 50\sqrt[3]{2}$

7. $\sqrt[3]{27x^3y^6z^9} = 3xy^2z^3$

8. $\frac{3xy^{-1}}{12x^{\frac{1}{2}}y} = \frac{x^{\frac{1}{2}}}{4y^2}$ **9.** $\left(\frac{81x^2}{y}\right)^{\frac{3}{4}} = \frac{27x^{\frac{3}{2}}}{y^{\frac{3}{4}}}$

10. $\sqrt{18} + \sqrt{200} = 3\sqrt{2} + 10\sqrt{2} = 13\sqrt{2}$

11. $x - 8 + 3x = 4x - 8$; all real numbers

12. $2x^{\frac{1}{4}} - 5x^{\frac{1}{4}} = -3x^{\frac{1}{4}}; x \geq 0$

13. $(5x + 7)(x - 9) = 5x^2 - 38x - 63$; all real numbers

14. $\frac{x^{-\frac{1}{5}}}{x^{\frac{2}{5}}} = \frac{1}{x^{\frac{4}{5}}}$; all real numbers except 0

15. $f(g(x)) = f(-x) = 4x^2 - 5$

16. $g(f(x)) = g(x^2 + 3x) = 2(x^2 + 3x) + 1 = 2x^2 + 6x + 1$; all real numbers

17. $f(x) = \frac{1}{3}x - 4$

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

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

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

$3x + 12 = y$

18. $f(x) = -5x + 5$

$y = -5x + 5$

$x = -5y + 5$

$x - 5 = -5y$

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

19. $f(x) = \frac{3}{4}x^2$

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

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

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

$\left(\frac{4}{3}x\right)^{\frac{1}{2}} = y$

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

20. $f(x) = x^5 - 2$

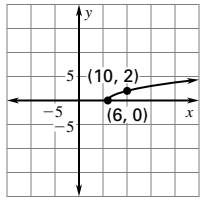
$y = x^5 - 2$

$x = y^5 - 2$

$x + 2 = y^5$

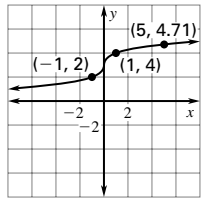
$(x + 2)^{\frac{1}{5}} = y$

21. $f(x) = \sqrt{x - 6}$



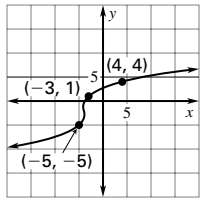
$x \geq 6$; $y \geq 0$

22. $f(x) = \sqrt[3]{x} + 3$



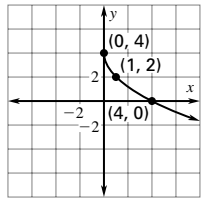
x and y are all real numbers

23. $f(x) = 3(x + 4)^{\frac{1}{3}} - 2$



x and y are all real numbers

24. $f(x) = -2x^{\frac{1}{2}} + 4$



$x \geq 0$; $y \leq 4$

25. $x^{\frac{5}{2}} - 10 = 22$

$x^{\frac{5}{2}} = 32$

$x = 4$

26. $(x + 8)^{\frac{1}{4}} + 1 = 0$

$(x + 8)^{\frac{1}{4}} = -1$

no solution

27. $\sqrt[3]{7x - 9} + 11 = 14$

$\sqrt[3]{7x - 9} = 3$

$7x - 9 = 27$

$7x = 36$

$x = \frac{36}{7}$

28. $\sqrt{4x + 15} - 3\sqrt{x} = 0$

$\sqrt{4x + 15} = 3\sqrt{x}$

$4x + 15 = 9x$

$15 = 5x$

$x = 3$

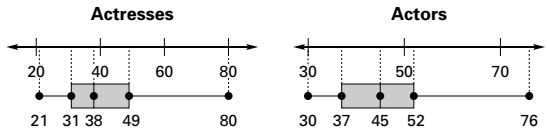
29. $\ell = 24.1(20)^{\frac{2}{3}}$

$\ell = 177.57$ mm

30.

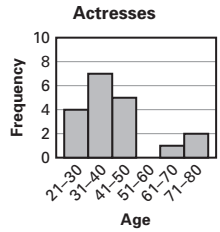
Best Actress	Best Actor
mean $= \frac{782}{19} = 41$	mean $= \frac{875}{19} = 46$
median: 38	median: 45
mode: 33, 34, 49	mode: 37, 45, 52
range: $80 - 21 = 59$	range: $76 - 30 = 46$
$\sigma = \sqrt{\frac{4391}{19}} = 15.2$	$\sigma = \sqrt{\frac{2357}{19}} = 11.1$

31.



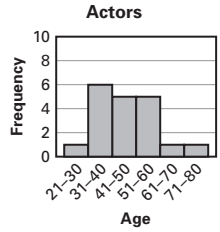
32. Best Actress

Interval	*Freq.*
21–30	4
31–40	7
41–50	5
51–60	0
61–70	1
71–80	2



Best Actor

Interval	*Freq.*
21–30	1
31–40	6
41–50	5
51–60	5
61–70	1
71–80	1



33. A good answer should include references to statistics and graphs. *Sample answers:*

- On average (both mean and median), winning actors are older than actresses.
- Ages of actresses have more variability (both a larger range and standard deviation; see box-and-whisker plots).
- Both histograms show a cluster in the middle (30s and 40s), but more younger actresses (20s) and older actors (50s) win.
- Few people older than 60 win in either category.

Chapter 7 Standardized Test *(p. 460–461)*

1. $x^4 = 625$

$x = \pm 5$

C

2. $\sqrt{18} + \sqrt{200} + \sqrt{2} - \sqrt{8}$

$= 3\sqrt{2} + 10\sqrt{2} + \sqrt{2} - 2\sqrt{2}$

$= 12\sqrt{2}$

A

3. $\sqrt[3]{54x^3y^6z^{10}} = 3xy^2z^3\ \sqrt[3]{2z}$

D

4. $h(x) = f(x) \cdot g(x)$

$18x^{\frac{1}{4}} = 3x^{-\frac{1}{2}} \cdot 6x^{\frac{3}{4}}$

C

5. $f(x^2 + 2) = (x^2 + 2)^2 - 3x^2 - 6 + 7$

$= x^4 + 4x^2 + 4 - 3x^2 - 6 + 7$

$= x^4 + x^2 + 5$

B

6. $f(x) = \frac{1}{2}x - 5$

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

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

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

$2x + 10 = y$

C

7. C

8. $(3x + 5)^{\frac{1}{2}} - 3 = 4$

$(3x + 5)^{\frac{1}{2}} = 7$

$3x + 5 = 49$

$3x = 44$

$x = \frac{44}{3}$

B

E

9. $4\sqrt[3]{x - 5} = 20$

$\sqrt[3]{x - 5} = 5$

$x - 5 = 125$

$x = 130$

B

10. B

11. D

12. $f(8) = (8)^{-\frac{2}{3}} = \frac{1}{4}$

$f(2) = 2^{-2} = \frac{1}{4}$

C

13. $f(f(0)) = f(-2) = -10 - 2 = -12$

$f(f(0)) = f(1) = 1 + 1 = 2$

B

14. **a.** $11{,}700 = k(922)^{\frac{3}{4}}$

$k = 69.93$

b. $s = \dfrac{69.93}{\mathrm{m}^{\frac{1}{4}}}$

c. $s = \dfrac{69.93}{(922)^{\frac{1}{4}}} \approx 12.7$ kilocalories per day per kilogram

d. $s = \dfrac{69.93}{(0.016)^{\frac{1}{4}}} \approx 197$ kilocalories per day per kilogram

e. *Sample Answer:* Specific metabolic rate increases as body mass decreases because the rate is proportional to $m^{-\frac{1}{4}}$. In other words, as mass decreases, the denominator gets smaller so the rate increases.

15. **a.** $d = f(w) = 70\pi w = 220w$

b. gear ratio $(g) = \dfrac{\text{\# of chainwheel teeth}}{\text{\# of freewheel teeth}}$

so $w(p) = gp = 0.75p$

c. $d = f(w(p)) = 220gp$

d. $1^{\text{st}} = f\left(\frac{24}{32}\right) = 220 \times 0.75 = 165$ cm per pedal revolution

$5^{\text{th}} = f\left(\frac{24}{19}\right) = 220 \times 1.26 = 278$ cm per pedal revolution

$10^{\text{th}} = f\left(\frac{40}{22}\right) = 220 \times 1.82 = 400$ cm per pedal revolution

$15^{\text{th}} = f\left(\frac{50}{19}\right) = 220 \times 2.63 = 579$ cm per pedal revolution

The distance traveled per pedal rotation increases as gear numbers increase.