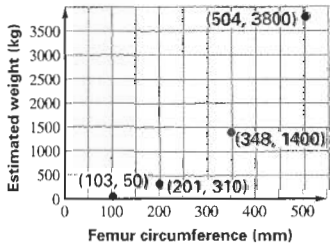
CHAPTER 7

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 $1^{\frac{1}{a}} = \dfrac{1}{1^n}$

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.** $\sqrt[6]{-1} = \text{none}$ **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.** $4^{-\frac{1}{2}} = \sqrt[2]{\dfrac{1}{4}} = \dfrac{1}{2}$

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

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

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

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

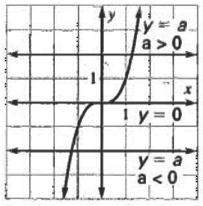
e. The fraction increases to almost 10%.

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

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

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

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

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

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

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

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

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. $2a^{\frac{1}{3}} - 6a^{\frac{1}{3}} = (2 - 6)a^{\frac{1}{3}} = -4a^{\frac{1}{3}}$

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

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

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

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

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

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

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

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. $\frac{125^{(\frac{2}{9} + \frac{1}{9})}}{5^{\frac{1}{4}}} = \frac{125^{\frac{1}{3}}}{5^{\frac{1}{4}}} = 5^{(1 - \frac{1}{4})} = 5^{\frac{3}{4}}$

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

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

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

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

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

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

38. $7^{(\frac{1}{2}-\frac{1}{5})} = 7^{\frac{3}{10}} \approx 1.79$ **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. $\dfrac{(9 \cdot 6)^{\frac{1}{3}}}{(4)^{\frac{1}{6}}} = \dfrac{(54)^{\frac{1}{3}}}{2^{\frac{1}{3}}} \div 27^{\frac{1}{3}} = 3$

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. $\dfrac{2^{\frac{2}{3}}}{2^{\frac{1}{5}}} = 2^{(\frac{2}{3}-\frac{1}{5})} = 2^{\frac{7}{15}}$ **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. $x^{(\frac{3}{7}-\frac{1}{3})} = x^{\frac{9-7}{21}} = x^{\frac{2}{21}}$ **61.** $\dfrac{(x^{12})^{\frac{1}{4}}}{(y^4)^{\frac{1}{4}}} = \dfrac{x^3}{y}$

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

64. $\left(x \sqrt[4]{x^3 \cdot x}\right)^{-2} = \dfrac{1}{x^4}$ **65.** $x^{(\frac{3}{4}-\frac{1}{4})}yz^{\left(-\frac{1}{3}-\frac{2}{6}\right)} = \dfrac{x^{\frac{1}{2}}y}{z}$

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. $(8xy^7 \cdot 6x^6)^{\frac{1}{3}} = (48x^7y^7)^{\frac{1}{3}} = xy\sqrt[3]{48x^2y^2}$

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. $x^{(\frac{1}{5}-\frac{4}{7})} = x^{\left(\frac{7-20}{35}\right)} = x^{\frac{-13}{35}}$ **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. $f = 440 \cdot 2^{\frac{-2}{12}} = 261.6$

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

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.** $(1 + 2)8^{\frac{1}{3}} = 3\sqrt[3]{8}$

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

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. $\frac{2x^{\frac{2}{3}}}{3x^{\frac{1}{2}}} = \frac{2}{3}x^{\frac{2}{3}-\frac{1}{2}} = \frac{2x^{\frac{1}{6}}}{3}$; positive real numbers
25. $\frac{3x^{\frac{1}{2}}}{2x^{\frac{2}{3}}} = \frac{3}{2}x^{\frac{1}{2}-\frac{2}{3}} = \frac{3}{2x^{\frac{1}{6}}}$; positive real numbers
26. 1; all real numbers except $x = 0$
27. 1; all real numbers except $x = 0$
28. $f(x^{\frac{1}{4}}) = 4(x^{\frac{3}{4}})^{-5} = 4x^{-\frac{15}{4}}$; 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. $f(4x^{-5}) = 4(4x^{-5})^{-5} = \frac{4x^{25}}{4^5} = \frac{x^{25}}{256}$; all real numbers except 0.
31. $g(-x^{\frac{3}{4}}) = -(-x^{\frac{3}{4}})^{\frac{3}{4}} = x^{\frac{9}{16}}$; 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. $\frac{10x}{x + 4}$; 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. $(7x^{\frac{2}{5}})(-2x^3) = -14x^{\frac{17}{5}}$; all real numbers
45. $(x - 4)(4x^2) = 4x^3 - 16x^2$; all real numbers
46. $\frac{9x^{-1}}{x^{\frac{1}{4}}} = 9x^{(-1-\frac{1}{4})} = 9x^{-\frac{5}{4}}$; all positive real numbers
47. $\frac{x^2 - 5x}{x} = x - 5$; all real numbers but $x = 0$
48. $f(5x - 2) = 6(5x - 2)^{-1} = \frac{6}{5x - 2}$; 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. $f(2x^{\frac{1}{5}}) = 2(2x^{\frac{1}{5}})^{\frac{1}{5}} = 2^{\frac{6}{5}}x^{\frac{1}{25}}$; all real numbers
51. $g(9x - 2) = 9(9x - 2) - 2 = 81x - 20$; all real numbers
52. $(241m^{-\frac{1}{4}})(6 \times 10^6)(m^{\frac{1}{5}}) = 1446 \times 10^6 m^{(-\frac{1}{4}+\frac{1}{5})}$
$= 1.45 \times 10^9 m^{-\frac{1}{20}}$;
Multiplying beats per minute by number of minutes per lifetime gives us the number of beats per lifetime.
53. $r(w) = \frac{1.1w^{0.734}}{0.005w} = 220w^{-0.266}$
$r(6.5) = 220(6.5)^{-0.266} \approx 134$
$r(12{,}300) = 220(12{,}300)^{-0.266} \approx 18$
$r(70{,}000) = 220(70{,}000)^{-0.266} \approx 11$
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. $h(x) = \frac{\sqrt[4]{x}}{2}$; *Sample answer:* $f(x) = \sqrt[4]{x}$, $g(x) = \frac{x}{16}$

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

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

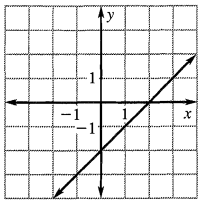
$\dfrac{3}{4}x - \dfrac{3}{2} = y$

73. $ax + by = c$

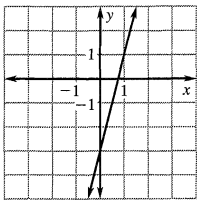
$by = c - ax$

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

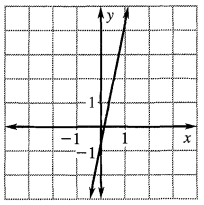
74. $y = x - 2$



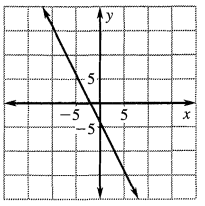
75. $y = 4x - 3$



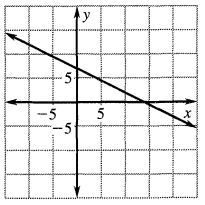
76. $y = 5x - \frac{2}{3}$



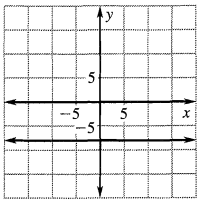
77. $y = -2x - 4$



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

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

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

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

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

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

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

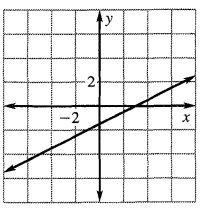
$[103 \quad 44]\begin{bmatrix} 1 & -2 \\ -2 & 5 \end{bmatrix} = [15 \quad 14]$ ON

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

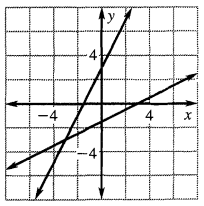
Lesson 7.4

Developing Concepts Activity 7.4 (p. 421)

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



2.



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

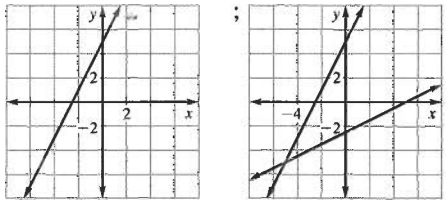
5. g is a function that multiplies x by 2 then adds 3.

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. $y = 2x + 5$



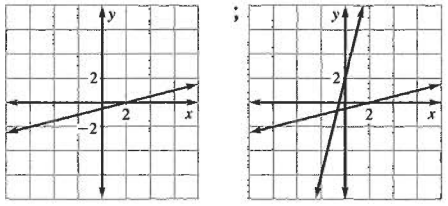
$$g(x) = \frac{x - 5}{2}$$

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

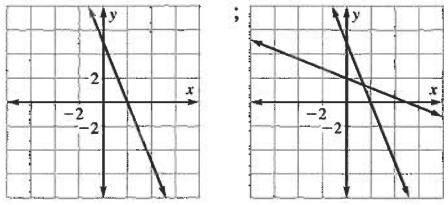


$$g(x) = 4x$$

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



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

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. $y = 5x$
$x = 5y$
$\frac{x}{5} = y$

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

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

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

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

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

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

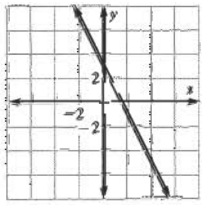
$x = \frac{1}{6}y^5 + \frac{2}{3}$

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

$6x - 4 = y^5$

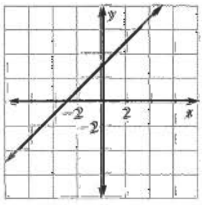
$\sqrt[5]{6x - 4} = y$

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



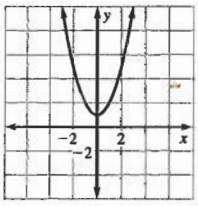
Yes, the inverse is a function.

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



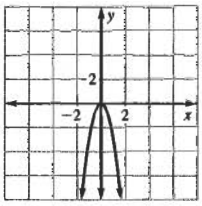
Yes, the inverse is a function.

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



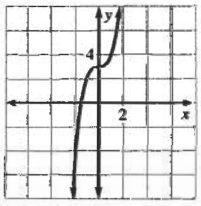
No, the inverse is not a function.

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



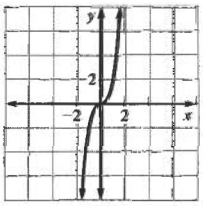
No, the inverse is not a function.

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



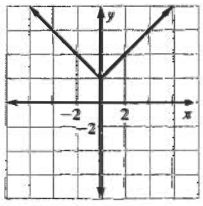
Yes, the inverse is a function.

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



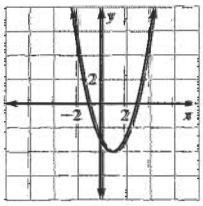
Yes, the inverse is a function.

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



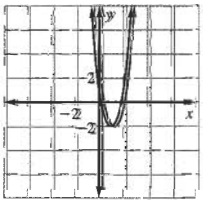
No, the inverse is not a function.

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.

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

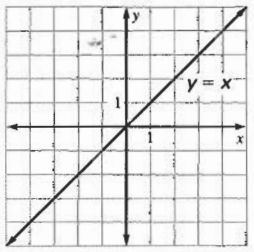
B

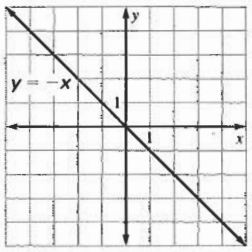
64.

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

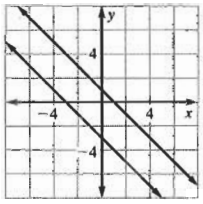
A

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.

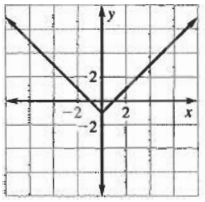


67. $y = -x + 1$; $y = -x - 3$

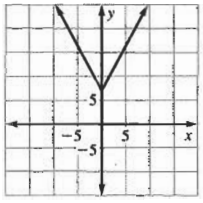
68. $y = -x + a$, where a is a real number

7.4 Mixed Review (p.429)

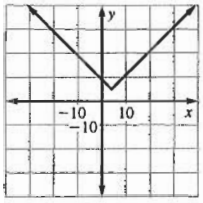
69. $f(x) = |x| - 1$



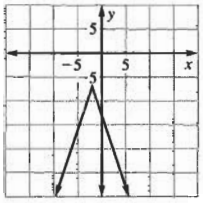
70. $f(x) = 2|x| + 7$



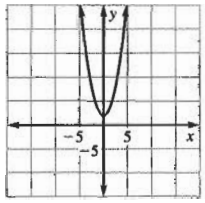
71. $f(x) = |x - 4| + 5$



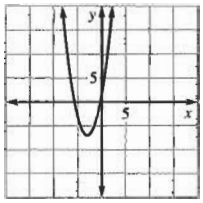
72. $f(x) = -3|x + 2| - 7$



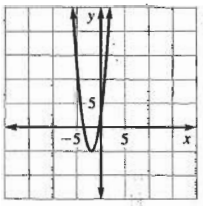
73. $f(x) = x^2 + 2$



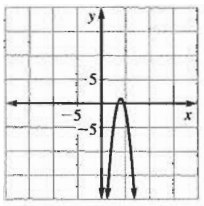
74. $f(x) = (x + 3)^2 - 7$



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

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

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

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

7. $f\left(\frac{3}{x}\right) = \frac{3}{\frac{3}{x}} = x$; 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. $y = 2x^4$

$x = 2y^4$

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

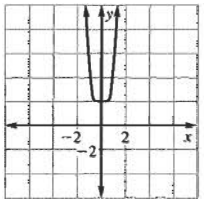
13. $y = -x^5 + 6$

$x = -y^5 + 6$

$-x + 6 = y^5$

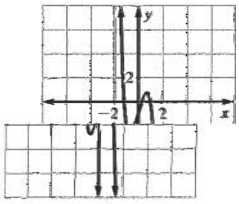
$\sqrt[5]{-x + 6} = y$

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



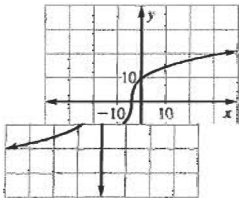
No, the inverse is not a function.

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

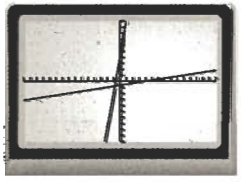
$A(t) = 0.36t^2\pi$

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

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

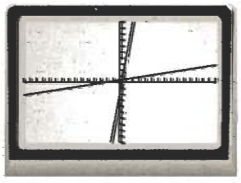
Technology Activity 7.4 (p. 430)

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



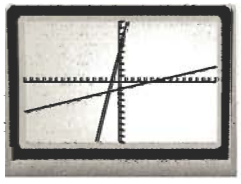
Yes, the inverse passes the vertical line test.

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



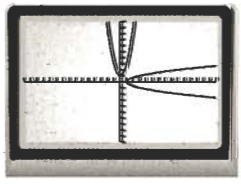
Yes, the inverse passes the vertical line test.

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



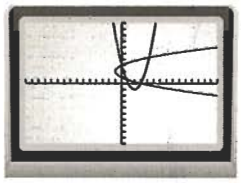
Yes, the inverse passes the vertical line test.

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



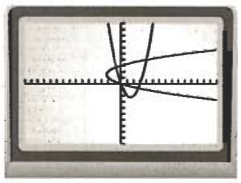
No, the inverse does not pass the vertical line test.

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



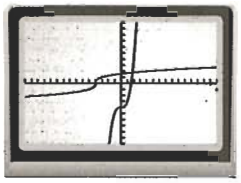
No, the inverse does not pass the vertical line test.

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



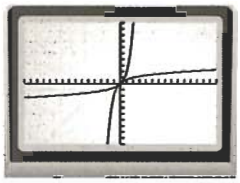
No, the inverse does not pass the vertical line test.

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



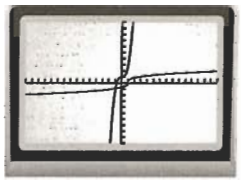
Yes, the inverse passes the vertical line test.

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



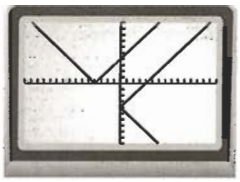
Yes, the inverse passes the vertical line test.

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



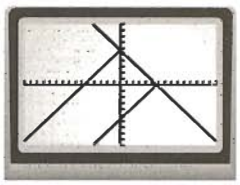
Yes, the inverse passes the vertical line test.

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



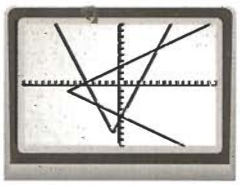
No, the inverse does not pass the vertical line test.

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



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

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

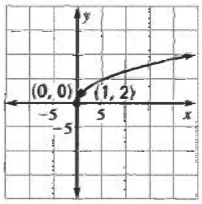


No, the inverse does not pass the vertical line test.

Lesson 7.5

Activity 7.5 (p. 431)

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



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