7.1 Exercise Set

FOR EXTRA HELP

Concept Reinforcement *Select the appropriate word to complete each of the following.*

1. Every positive number has ___two___ (one/two) square root(s).
2. The principal square root is never ___negative___ (negative/positive).
3. For any ___positive___ (negative/positive) number a, we have $\sqrt{a^2} = a$.
4. For any ___negative___ (negative/positive) number a, we have $\sqrt{a^2} = -a$.
5. If a is a whole number that is not a perfect square, then $\sqrt{a}$ is a(n) ___irrational___ (irrational/rational) number.
6. The domain of the function f given by $f(x) = \sqrt[3]{x}$ is the set of all ___real___ (whole/real/positive) numbers.
7. If $\sqrt[4]{x}$ is a real number, then x must be ___nonnegative___ (negative/positive/nonnegative).
8. If $\sqrt[3]{x}$ is negative, then x must be ___negative___ (negative/positive).

For each number, find all of its square roots.

9. 49 7, −7
10. 81 9, −9
11. 144 12, −12
12. 9 3, −3
13. 400 20, −20
14. 2500 50, −50
15. 900 30, −30
16. 225 15, −15

Simplify.

17. $\sqrt{49}$ 7
18. $\sqrt{144}$ 12
19. $-\sqrt{16}$ −4
20. $-\sqrt{100}$ −10
21. $\sqrt{\frac{36}{49}}$ $\frac{6}{7}$
22. $\sqrt{\frac{4}{9}}$ $\frac{2}{3}$
23. $-\sqrt{\frac{16}{81}}$ $-\frac{4}{9}$
24. $-\sqrt{\frac{81}{144}}$ $-\frac{3}{4}$
25. $\sqrt{0.04}$ 0.2
26. $\sqrt{0.36}$ 0.6
27. $\sqrt{0.0081}$ 0.09
28. $\sqrt{0.0016}$ 0.04

⊡ Answers to Exercises 34–36, 42, and 46 are on p. IA-15.

Identify the radicand and the index for each expression.

29. $5\sqrt{p^2 + 4}$ p^2; 2
30. $-7\sqrt{y^2 - 8}$ y^2; 2
31. $xy\sqrt[5]{\frac{x}{y+4}}$ $\frac{x}{y+4}$; 5
32. $\frac{a}{b}\sqrt[6]{a^2+1}$ $a^2 + 1$; 6

For each function, find the specified function value, if it exists. If it does not exist, state this.

33. $f(t) = \sqrt{5t - 10}$; $f(3), f(2), f(1), f(-1)$ $\sqrt{5}$; 0; does not exist; does not exist
34. $g(x) = \sqrt{x^2 - 25}$; $g(-6), g(3), g(6), g(13)$ ⊡
35. $t(x) = -\sqrt{2x^2 - 1}$; $t(5), t(0), t(-1), t\left(-\frac{1}{2}\right)$ ⊡
36. $p(z) = \sqrt{2z - 20}$; $p(4), p(10), p(12), p(0)$ ⊡
37. $f(t) = \sqrt{t^2 + 1}$; $f(0), f(-1), f(-10)$ 1; $\sqrt{2}$; $\sqrt{101}$
38. $g(x) = -\sqrt{(x+1)^2}$; $g(-3), g(4), g(-5)$ −2; −5; −4

Simplify. Remember to use absolute-value notation when necessary. If a root cannot be simplified, state this.

39. $\sqrt{64x^2}$ $|8x|$, or $8|x|$
40. $\sqrt{25t^2}$ $|5t|$, or $5|t|$
41. $\sqrt{(-4b)^2}$ $|-4b|$, or $4|b|$
42. $\sqrt{(-7c)^2}$ ⊡
43. $\sqrt{(8-t)^2}$ $|8 - t|$
44. $\sqrt{(a+3)^2}$ $|a + 3|$
45. $\sqrt{y^2 + 16y + 64}$ $|y + 8|$
46. $\sqrt{x^2 - 4x + 4}$ ⊡
47. $\sqrt{4x^2 + 28x + 49}$ $|2x + 7|$
48. $\sqrt{9x^2 - 30x + 25}$ $|3x - 5|$
49. $-\sqrt[4]{256}$ −4
50. $-\sqrt[4]{625}$ −5
51. $\sqrt[5]{-1}$ −1
52. $-\sqrt[3]{-1000}$ 10
53. $-\sqrt[5]{-\frac{32}{243}}$ $\frac{2}{3}$
54. $\sqrt[5]{-\frac{1}{32}}$ $-\frac{1}{2}$
55. $\sqrt[6]{x^6}$ $|x|$
56. $\sqrt[8]{y^8}$ $|y|$
57. $\sqrt[9]{t^9}$ t
58. $\sqrt[5]{a^5}$ a
59. $\sqrt[4]{(6a)^4}$ $|6a|$, or $6|a|$
60. $\sqrt[4]{(8y)^4}$ $|8y|$, or $8|y|$
61. $\sqrt[10]{(-6)^{10}}$ 6
62. $\sqrt[12]{(-10)^{12}}$ 10
63. $\sqrt[414]{(a+b)^{414}}$ $|a + b|$
64. $\sqrt[1976]{(2a+b)^{1976}}$ $|2a + b|$
65. $\sqrt{a^{22}}$ $|a^{11}|$
66. $\sqrt{x^{10}}$ $|x^5|$
67. $\sqrt{-25}$ Cannot be simplified
68. $\sqrt{-16}$ Cannot be simplified

Simplify. Assume that no radicands were formed by raising negative quantities to even powers.

69. $\sqrt{16x^2}$ $4x$
70. $\sqrt{25t^2}$ $5t$
71. $-\sqrt{(3t)^2}$ $-3t$
72. $-\sqrt{(7c)^2}$ $-7c$

73. $\sqrt{(a+1)^2}$ $a+1$

74. $\sqrt{(5+b)^2}$ $5+b$

75. $\sqrt{9t^2-12t+4}$ $3t-2$

76. $\sqrt{25t^2-20t+4}$ $5t-2$

77. $\sqrt[3]{27a^3}$ $3a$

78. $-\sqrt[3]{64y^3}$ $-4y$

79. $\sqrt[4]{16x^4}$ $2x$

80. $\sqrt[4]{81x^4}$ $3x$

81. $\sqrt[5]{(x-1)^5}$ $x-1$

82. $-\sqrt[7]{(1-x)^7}$ $x-1$

83. $-\sqrt[3]{-125y^3}$ $5y$

84. $-\sqrt[3]{-64x^3}$ $4x$

85. $\sqrt{t^{18}}$ t^9

86. $\sqrt{a^{14}}$ a^7

87. $\sqrt{(x-2)^8}$ $(x-2)^4$

88. $\sqrt{(x+3)^{10}}$ $(x+3)^5$

For each function, find the specified function value, if it exists. If it does not exist, state this.

89. $f(x)=\sqrt[3]{x+1}$; $f(7), f(26), f(-9), f(-65)$ 2; 3; −2; −4

90. $g(x)=-\sqrt[3]{2x-1}$; $g(0), g(-62), g(-13), g(63)$

91. $g(t)=\sqrt[4]{t-3}$; $g(19), g(-13), g(1), g(84)$ 1; 5; 3; −5

92. $f(t)=\sqrt[4]{t+1}$; $f(0), f(15), f(-82), f(80)$ 2; does not exist; does not exist; 3

Determine the domain of each function described.

93. $f(x)=\sqrt{x-6}$ ⊡

94. $g(x)=\sqrt{x+8}$ ⊡

95. $g(t)=\sqrt[4]{t+8}$ ⊡

96. $f(x)=\sqrt[4]{x-9}$ ⊡

97. $g(x)=\sqrt[4]{2x-10}$ ⊡

98. $g(t)=\sqrt[3]{2t-6}$ $\mathbb{R}$

99. $f(t)=\sqrt[5]{8-3t}$ $\mathbb{R}$

100. $f(t)=\sqrt[6]{4-3t}$ ⊡

101. $h(z)=-\sqrt[6]{5z+2}$ ⊡

102. $d(x)=-\sqrt[4]{7x-5}$ ⊡

Aha! **103.** $f(t)=7+\sqrt[8]{t^8}$ $\mathbb{R}$

104. $g(t)=9+\sqrt[6]{t^6}$ $\mathbb{R}$

Determine algebraically the domain of each function described. Then use a graphing calculator to confirm your answer and to estimate the range.

105. $f(x)=\sqrt{5-x}$ ⊡

106. $g(x)=\sqrt{2x+1}$ ⊡

107. $f(x)=1-\sqrt{x+1}$ ⊡

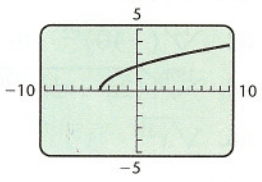
108. $g(x)=2+\sqrt{3x-5}$ ⊡

109. $g(x)=3+\sqrt{x^2+4}$ ⊡

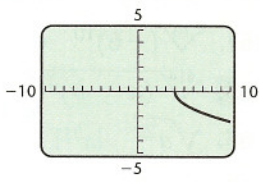
110. $f(x)=5-\sqrt{3x^2+1}$ ⊡

In Exercises 111–114, match each function with one of the following graphs without using a calculator.

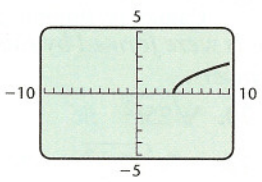
a)



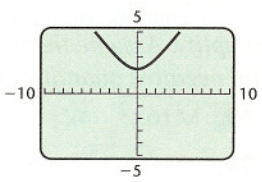
b)



c)



d)



⊡ Answers to Exercises 93–97, 100–102, and 105–110 are on p. IA-15.

111. $f(x)=\sqrt{x-4}$ (c)

112. $g(x)=\sqrt{x+4}$ (a)

113. $h(x)=\sqrt{x^2+4}$ (d)

114. $f(x)=-\sqrt{x-4}$ (b)

In Exercises 115–120, determine whether a radical function would be a good model of the given situation.

115. *Sports Salaries.* The table below lists the average salary of a major-league baseball player, based on the number of years in his contract. Yes

Length of Contract (in years)	Average Salary (in millions)
1	$ 2.1
2	3.6
3	7.0
4	9.6
5	10.5
6	12.5
7	13.8
8	14.3
9	14.6

Source: "Long-term contracts" by Dave Studeman, 12/06/07, on www.hardballtimes.com

116. *Firefighting.* The number of gallons per minute discharged from a fire hose depends on the diameter of the hose and the nozzle pressure. The table below lists the amount of water flow for a 2-in. diameter solid bore nozzle at various nozzle pressures. Yes

Nozzle Pressure (in pounds per square inch, psi)	Water Flow (in gallons per minute, GPM)
40	752
60	921
80	1063
100	1188
120	1302
150	1455
200	1681

Source: www.firetactics.com

117. *Koi Growth.* Koi, a popular fish for backyard pools, grow from $\frac{1}{40}$ cm when newly hatched to an average length of 80 cm. The table below lists the length of a koi at various ages. Yes

Age (in months)	Length (in centimeters)
1	2.9
2	5.0
4	9.1
13	24.9
16	29.3
30	45.8
36	51.1
48	59.3
60	65.2
72	69.4

Source: www.coloradokoi.com

118. *Farm Size.* The table below lists the average size of United States' farms for various years from 1960 to 2007. No

Year	Average Size of Farm (in acres)
1960	303
1980	426
1997	431
2002	441
2007	418

Source: U.S. Department of Agriculture

119. *Cancer Research.* The table below lists the amount of federal funds allotted to the National Cancer Institute for cancer research in the United States from 2005 to 2010. No

Year	Funds (in billions)
2005	$4.83
2006	4.79
2007	4.70
2008	4.93
2009	4.97
2010*	5.15

*Requested
Source: National Cancer Institute

120. *Cable Television.* The table below lists the percent of households with basic cable television service for various years. No

Year	Percent of Households Served by Basic Cable Television
1985	46.2
1990	59.0
1995	65.7
2000	67.9
2005	66.8
2007	58.0

Source: Nielsen Media Research

121. *Firefighting.* The water flow, in number of gallons per minute (GPM), for a 2-in. diameter solid bore nozzle is given by

$$f(x) = 118.8\sqrt{x},$$

where x is the nozzle pressure, in pounds per square inch (psi). (See Exercise 116.) Use the function to estimate the water flow when the nozzle pressure is 50 psi and when it is 175 psi.
Approximately 840 GPM; approximately 1572 GPM

122. *Koi Growth.* The length, in centimeters, of a koi of age x months can be estimated using the function

$$f(x) = 0.27 + \sqrt{71.94x - 164.41}.$$

(See Exercise 117.) Use the function to estimate the length of a koi at 8 months and at 20 months.
20.5 cm; 36.0 cm

TW **123.** Explain how to write the negative square root of a number using radical notation.

TW **124.** Does the square root of a number's absolute value always exist? Why or why not?