

- b. We first rewrite the given equation in the standard form $x^2 + 3x - 8 = 0$, from which we see that $a = 1$, $b = 3$, and $c = -8$. Using the quadratic formula, we find

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-3 \pm \sqrt{3^2 - 4(1)(-8)}}{2(1)} \\ = \frac{-3 \pm \sqrt{41}}{2}$$

That is, the solutions are

$$\frac{-3 + \sqrt{41}}{2} \approx 1.7 \quad \text{and} \quad \frac{-3 - \sqrt{41}}{2} \approx -4.7$$

In this case, the quadratic formula proves quite handy!

1.1 Exercises

In Exercises 1–6, show the interval on a number line.

1. (3, 6) 2. (-2, 5] 3. [-1, 4)
4. $\left[-\frac{6}{5}, -\frac{1}{2}\right]$ 5. (0, ∞) 6. $(-\infty, 5]$

In Exercises 7–22, evaluate the expression.

7. $27^{2/3}$ 8. $8^{-4/3}$
9. $\left(\frac{1}{\sqrt{3}}\right)^0$ 10. $(7^{1/2})^4$
11. $\left[\left(\frac{1}{8}\right)^{1/3}\right]^{-2}$ 12. $\left[\left(\frac{1}{3}\right)^2\right]^{-3}$
13. $\left(\frac{7^{-5} \cdot 7^2}{7^{-2}}\right)^{-1}$ 14. $\left(\frac{9}{16}\right)^{-1/2}$
15. $(125^{2/3})^{-1/2}$ 16. $\sqrt[3]{2^6}$
17. $\frac{\sqrt{32}}{\sqrt{8}}$ 18. $\sqrt[3]{\frac{-8}{27}}$
19. $\frac{16^{5/8} 16^{1/2}}{16^{7/8}}$ 20. $\left(\frac{9^{-3} \cdot 9^5}{9^{-2}}\right)^{-1/2}$
21. $16^{1/4} \cdot 8^{-1/3}$ 22. $\frac{6^{2.5} \cdot 6^{-1.9}}{6^{-1.4}}$

In Exercises 23–32, determine whether the statement is true or false. Give a reason for your choice.

23. $x^4 + 2x^4 = 3x^4$ 24. $3^2 \cdot 2^2 = 6^2$
25. $x^3 \cdot 2x^2 = 2x^6$ 26. $3^3 + 3 = 3^4$
27. $\frac{2^{4x}}{1^{3x}} = 2^{4x-3x}$ 28. $(2^2 \cdot 3^2)^2 = 6^4$
29. $\frac{1}{4^{-3}} = \frac{1}{64}$ 30. $\frac{4^{3/2}}{2^4} = \frac{1}{2}$
31. $(1.2^{1/2})^{-1/2} = 1$ 32. $5^{2/3} \cdot (25)^{2/3} = 25$

In Exercises 33–38, rewrite the expression using positive exponents only.

33. $(xy)^{-2}$ 34. $3s^{1/3} \cdot s^{-7/3}$
35. $\frac{x^{-1/3}}{x^{1/2}}$ 36. $\sqrt{x^{-1}} \cdot \sqrt{9x^{-3}}$
37. $12^0(s+t)^{-3}$ 38. $(x-y)(x^{-1} + y^{-1})$

In Exercises 39–54, simplify the expression. (Assume that x , y , r , s , and t are positive.)

39. $\frac{x^{7/3}}{x^{-2}}$ 40. $(49x^{-2})^{-1/2}$
41. $(x^2y^{-3})(x^{-5}y^3)$ 42. $\frac{5x^6y^3}{2x^2y^7}$
43. $\frac{x^{3/4}}{x^{-1/4}}$ 44. $\left(\frac{x^3y^2}{z^2}\right)^2$
45. $\left(\frac{x^3}{-27y^{-6}}\right)^{-2/3}$ 46. $\left(\frac{e^x}{e^{x-2}}\right)^{-1/2}$
47. $\left(\frac{x^{-3}}{y^{-2}}\right)^2 \left(\frac{y}{x}\right)^4$ 48. $\frac{(r^n)^4}{r^{5-2n}}$
49. $\sqrt[3]{x^{-2}} \cdot \sqrt{4x^5}$ 50. $\sqrt{81x^6y^{-4}}$
51. $-\sqrt[4]{16x^4y^8}$ 52. $\sqrt[3]{x^{3a+b}}$
53. $\sqrt[6]{64x^8y^3}$ 54. $\sqrt[3]{27r^6} \cdot \sqrt{s^2t^4}$

In Exercises 55–58, use the fact that $2^{1/2} \approx 1.414$ and $3^{1/2} \approx 1.732$ to evaluate the expression without using a calculator.

55. $2^{3/2}$ 56. $8^{1/2}$ 57. $9^{3/4}$ 58. $6^{1/2}$

In Exercises 59–62, use the fact that $10^{1/2} \approx 3.162$ and $10^{1/3} \approx 2.154$ to evaluate the expression without using a calculator.

59. $10^{3/2}$ 60. $1000^{3/2}$
61. $10^{2.5}$ 62. $(0.0001)^{-1/3}$

In Exercises 63–68, rationalize the denominator of the expression.

63. $\frac{3}{2\sqrt{x}}$

64. $\frac{3}{\sqrt{xy}}$

65. $\frac{2y}{\sqrt{3y}}$

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

67. $\frac{1}{\sqrt[3]{x}}$

68. $\sqrt{\frac{2x}{y}}$

In Exercises 69–74, rationalize the numerator of the expression.

69. $\frac{2\sqrt{x}}{3}$

70. $\frac{\sqrt[3]{x}}{24}$

71. $\sqrt{\frac{2y}{x}}$

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

73. $\frac{\sqrt[3]{x^2z}}{y}$

74. $\frac{\sqrt[3]{x^2y}}{2x}$

In Exercises 75–96, perform the indicated operations and simplify each expression.

75. $(7x^2 - 2x + 5) + (2x^2 + 5x - 4)$

76. $(3x^2 + 5xy + 2y) + (4 - 3xy - 2x^2)$

77. $(5y^2 - 2y + 1) - (y^2 - 3y - 7)$

78. $3(2a - b) - 4(b - 2a)$

79. $x - \{2x - [-x - (1 - x)]\}$

80. $3x^2 - \{x^2 + 1 - x[x - (2x - 1)]\} + 2$

81. $\left(\frac{1}{3} - 1 + e\right) - \left(-\frac{1}{3} - 1 + e^{-1}\right)$

82. $-\frac{3}{4}y - \frac{1}{4}x + 100 + \frac{1}{2}x + \frac{1}{4}y - 120$

83. $3\sqrt{8} + 8 - 2\sqrt{y} + \frac{1}{2}\sqrt{x} - \frac{3}{4}\sqrt{y}$

84. $\frac{8}{9}x^2 + \frac{2}{3}x + \frac{16}{3}x^2 - \frac{16}{3}x - 2x + 2$

85. $(x + 8)(x - 2)$

86. $(5x + 2)(3x - 4)$

87. $(a + 5)^2$

88. $(3a - 4b)^2$

89. $(x + 2y)^2$

90. $(6 - 3x)^2$

91. $(2x + y)(2x - y)$

92. $(3x + 2)(2 - 3x)$

93. $(x^2 - 1)(2x) - x^2(2x)$

94. $(x^{1/2} + 1)\left(\frac{1}{2}x^{-1/2}\right) - (x^{1/2} - 1)\left(\frac{1}{2}x^{-1/2}\right)$

95. $2(t + \sqrt{t})^2 - 2t^2$

96. $2x^2 + (-x + 1)^2$

In Exercises 97–104, factor out the greatest common factor from each expression.

97. $4x^5 - 12x^4 - 6x^3$

98. $4x^2y^2z - 2x^5y^2 + 6x^3y^2z^2$

99. $7a^4 - 42a^2b^2 + 49a^3b$

100. $3x^{2/3} - 2x^{1/3}$

101. $e^{-x} - xe^{-x}$

102. $2ye^{xy^2} + 2xy^3e^{-xy^2}$

103. $2x^{-5/2} - \frac{3}{2}x^{-3/2}$

104. $\frac{1}{2}\left(\frac{2}{3}u^{3/2} - 2u^{1/2}\right)$

In Exercises 105–118, factor each expression completely.

105. $6ac + 3bc - 4ad - 2bd$

106. $3x^3 - x^2 + 3x - 1$

107. $4a^2 - b^2$

108. $12x^2 - 3y^2$

109. $10 - 14x - 12x^2$

110. $x^2 - 2x - 15$

111. $3x^2 - 6x - 24$

112. $3x^2 - 4x - 4$

113. $12x^2 - 2x - 30$

114. $(x + y)^2 - 1$

115. $9x^2 - 16y^2$

116. $8a^2 - 2ab - 6b^2$

117. $x^6 + 125$

118. $x^3 - 27$

In Exercises 119–126, perform the indicated operations and simplify each expression.

119. $(x^2 + y^2)x - xy(2y)$

120. $2kr(R - r) - kr^2$

121. $2(x - 1)(2x + 2)^3[4(x - 1) + (2x + 2)]$

122. $5x^2(3x^2 + 1)^4(6x) + (3x^2 + 1)^5(2x)$

123. $4(x - 1)^2(2x + 2)^3(2) + (2x + 2)^4(2)(x - 1)$

124. $(x^2 + 1)(4x^3 - 3x^2 + 2x) - (x^4 - x^3 + x^2)(2x)$

125. $(x^2 + 2)^2[5(x^2 + 2)^2 - 3](2x)$

126. $(x^2 - 4)(x^2 + 4)(2x + 8) - (x^2 + 8x - 4)(4x^3)$

In Exercises 127–132, find the real roots of each equation by factoring.

127. $x^2 + x - 12 = 0$

128. $3x^2 - x - 4 = 0$

129. $4t^2 + 2t - 2 = 0$

130. $-6x^2 + x + 12 = 0$

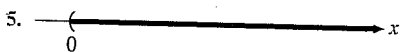
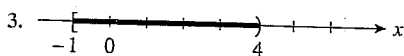
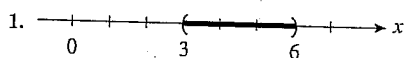
131. $\frac{1}{4}x^2 - x + 1 = 0$

132. $\frac{1}{2}a^2 + a - 12 = 0$

Answers to Odd-Numbered Exercises

CHAPTER 1

Exercises 1.1, page 13



7. 9 9. 1 11. 4 13. 7 15. $\frac{1}{5}$ 17. 2

19. 2 21. 1 23. True 25. False 27. False

29. False 31. False 33. $\frac{1}{(xy)^2}$ 35. $\frac{1}{x^{5/6}}$ 37. $\frac{1}{(s+t)^3}$

39. $x^{13/3}$ 41. $\frac{1}{x^3}$ 43. x 45. $\frac{9}{x^2y^4}$ 47. $\frac{y^8}{x^{10}}$

49. $2x^{11/6}$ 51. $-2xy^2$ 53. $2x^{4/3}y^{1/2}$ 55. 2.828

57. 5.196 59. 31.62 61. 316.2 63. $\frac{3\sqrt{x}}{2x}$

65. $\frac{2\sqrt{3}y}{3}$ 67. $\frac{\sqrt[3]{x^2}}{x}$ 69. $\frac{2x}{3\sqrt{x}}$ 71. $\frac{2y}{\sqrt{2xy}}$

73. $\frac{xz}{y\sqrt[3]{xz^2}}$ 75. $9x^2 + 3x + 1$ 77. $4y^2 + y + 8$

79. $-x - 1$ 81. $\frac{2}{3} + e - e^{-1}$ 83. $6\sqrt{2} + 8 + \frac{1}{2}\sqrt{x} - \frac{1}{4}\sqrt{y}$

85. $x^2 + 6x - 16$ 87. $a^2 + 10a + 25$ 89. $x^2 + 4xy + 4y^2$

91. $4x^2 - y^2$ 93. $-2x$ 95. $2t(2\sqrt{t} + 1)$

97. $2x^3(2x^2 - 6x - 3)$ 99. $7a^2(a^2 + 7ab - 6b^2)$

101. $e^{-x}(1 - x)$ 103. $\frac{1}{2}x^{-5/2}(4 - 3x)$ 105. $(2a + b)(3c - 2d)$

107. $(2a + b)(2a - b)$ 109. $-2(3x + 5)(2x - 1)$

111. $3(x - 4)(x + 2)$ 113. $2(3x - 5)(2x + 3)$

115. $(3x - 4y)(3x + 4y)$ 117. $(x^2 + 5)(x^4 - 5x^2 + 25)$

119. $x^3 - xy^2$ 121. $4(x - 1)(3x - 1)(2x + 2)^3$

123. $4(x - 1)(3x - 1)(2x + 2)^3$

125. $2x(x^2 + 2)^2(5x^4 + 20x^2 + 17)$

127. -4 and 3 129. -1 and $\frac{1}{2}$ 131. 2 and 2

133. -2 and $\frac{3}{4}$ 135. $\frac{1}{2} + \frac{1}{4}\sqrt{10}$ and $\frac{1}{2} - \frac{1}{4}\sqrt{10}$

137. $-1 + \frac{1}{2}\sqrt{10}$ and $-1 - \frac{1}{2}\sqrt{10}$

139. a. 53,886 b. 19,052 c. 4820 141. True

Exercises 1.2, page 23

1. $\frac{x-1}{x-2}$ 3. $\frac{3(2t+1)}{2t-1}$ 5. $\frac{7}{(4x-1)^2}$ 7. -8

9. $\frac{3x-1}{2}$ 11. $\frac{t+20}{3t+2}$ 13. $\frac{x(2x-13)}{(2x-1)(2x+5)}$

15. $\frac{x+27}{(x-3)^2(x+3)}$ 17. $\frac{x+1}{x-1}$ 19. $\frac{4x^2+7}{\sqrt{2x^2+7}}$

21. $\frac{x-1}{x^2\sqrt{x+1}}$ 23. $\frac{x-1}{(2x+1)^{3/2}}$ 25. $\frac{\sqrt{3}+1}{2}$

27. $\frac{\sqrt{x}+\sqrt{y}}{x-y}$ 29. $\frac{(\sqrt{a}+\sqrt{b})^2}{a-b}$ 31. $\frac{x}{3\sqrt{x}}$

33. $\frac{2}{3(1+\sqrt{3})}$ 35. $\frac{x+1}{\sqrt{x+2}(1-\sqrt{x+2})}$

37. False 39. False 41. $(-\infty, 2)$ 43. $(-\infty, -5]$

45. $(-4, 6)$ 47. $(-\infty, -3) \cup (3, \infty)$ 49. $(-2, 3)$

51. $[-3, 5]$ 53. $(-\infty, 1] \cup [\frac{3}{2}, \infty)$ 55. $(-\infty, -3] \cup (2, \infty)$

57. $(-\infty, 0] \cup (1, \infty)$ 59. 4 61. 2 63. $5\sqrt{3}$ 65. $\pi + 1$

67. 2 69. False 71. False 73. True 75. False

77. True 79. False 81. [362, 488.7] 83. \$12,300

85. \$32,000 87. $|x - 0.5| < 0.01$

89. Between 1000 and 4000 units

91. Between 98.04 and 98.36% of the toxic pollutants

93. Between 10:18 a.m. and 12:42 a.m. 95. False 97. True

Exercises 1.3, page 30

1. (3, 3); Quadrant I 3. (2, -2); Quadrant IV

5. (-4, -6); Quadrant III 7. A 9. E, F, and G

11. F 13-19. See the accompanying figure.

