Chapter 1: Real Numbers and Variable Expressions

Prep Test

1. 127.16

2. $3416 + 42{,}561 + 537 = 46{,}514$

3. $5004 - 487 = 4517$

4. $407 \times 28 = 11{,}396$

5. $11{,}684 \div 23 = 508$

6. 24

7. 4

8. $3 \cdot 7$

9. $\frac{4}{10} = \frac{2}{5}$

10. **iv** Division by 0 is undefined.

Section 1.1

Concept Check

1. **a.** left

b. right

2. **a.** positive

b. negative

3. absolute

4. Add the absolute values. The sign is the sign of the addends.

5. Find the absolute value of each number. Subtract the smaller number from the larger one. The sign of the final answer is the sign of the number with the larger absolute value.

6. *Minus* is the operation subtraction; *negative* indicates the opposite of a number.

7. Add the opposite of the second integer to the first integer.

8. **a.** positive

b. negative

Objective A Exercises

9. $8 > -6$

10. $-14 < 16$

11. $-12 < 1$

12. $35 > 28$

13. $42 > 19$

14. $-42 < 27$

15. $0 > -31$

16. $-17 < 0$

17. $53 > -46$

18. $-27 > -38$

19. $-23 < -8$

$-18 < -8$

$-8 = -8$

$0 > -8$

The elements −23 and −18 are less than −8.

20. $-33 < -10$

$-24 < -10$

$-10 = -10$

$0 > -10$

The elements −33 and −24 are less than −10.

21. $-33 < -10$

$-13 < -10$

$21 > -10$

$37 > 10$

The elements 21 and 37 are greater than −10.

22. $-27 < -15$

$-14 > -15$

$14 > -15$

$27 > -15$

The elements −14, 14, and 27 are greater than −15.

23. (i) n is positive.

24. (iv) n can be positive, negative, or 0.

Objective B Exercises

25. −4

26. −8

27. 9

28. 12

29. 28

30. 36

31. 14

32. 40

33. −77

34. −39

35. 0

36. 13

37. 74

38. 96

39. −82

40. −53

41. −81

42. –38

43. $|-83| > |58|$

44. $|22| > |-19|$

45. $|43| < |-52|$

46. $|-71| < |-92|$

47. $|-68| > |-42|$

48. $|12| < |-31|$

49. $|-45| < |-61|$

50. $|-28| < |43|$

51. $p = -19$; $-p = 19$
$p = 0$; $-p = 0$
$p = 28$; $-p = -28$

52. $q = -34$; $-q = 34$
$q = 0$; $-q = 0$
$q = 31$; $-q = -31$

53. $x = -45$; $-x = 45$
$x = 0$; $-x = 0$
$x = 17$; $-x = -17$

54. $y = -91$; $-|y| = -91$
$y = 0$; $-|y| = 0$
$y = -48$; $-|y| = -48$

55. True

Objective C Exercises

56. Change the sign on –6 to positive and change the subtraction sign to addition.

57. $-3 + (-8) = -11$

58. $-6 + (-9) = -15$

59. $-8 + 3 = -5$

60. $-9 + 2 = -7$

61. $-3 + (-80) = -83$

62. $-12 + (-1) = -13$

63. $-23 + (-23) = -46$

64. $-12 + (-12) = -24$

65. $16 + (-16) = 0$

66. $-17 + 17 = 0$

67. $48 + (-53) = -5$

68. $19 + (-41) = -22$

69. $-17 + (-3) + 29 = -20 + 29 = 9$

70. $13 + 62 + (-38) = 75 + (-38) = 37$

71. $-3 + (-8) + 12 = -11 + 12 = 1$

72. $-27 + (-42) + (-18) = -69 + (-18) = -87$

73. $16 - 8 = 16 + (-8) = 8$

74. $12 - 3 = 12 + (-3) = 9$

75. $7 - 14 = 7 + (-14) = -7$

76. $6 - 9 = 6 + (-9) = -3$

77. $-7 - 2 = -7 + (-2) = -9$

78. $-9 - 4 = -9 + (-4) = -13$

79. $7-(-2)=7+2=9$

80. $3-(-4)=3+4=7$

81. $-6-(-3)=-6+3=-3$

82. $-4-(-2)=-4+2=-2$

83. $6-(-12)=6+12=18$

84. $-12-16=-12+(-16)=-28$

85. $13+(-22)+4+(-5)=-9+4+(-5)$
$=-5+(-5)=-10$

86. $-14+(-3)+7+(-21)=-17+7+(-21)$
$=-10+(-21)=-31$

87. $-16+(-17)+(-18)+10=-33+(-18)+10$
$=-51+10=-41$

88. $-25+(-31)+24+19=-56+24+19$
$=-32+19=-13$

89. $26+(-15)+(-11)+(-12)=11+(-11)+(-12)$
$=0+(-12)=-12$

90. $-32+40+(-8)+(-19)=8+(-8)+(-19)$
$=0+(-19)=-19$

91. $-14+(-15)+(-11)+40=-29+(-11)+40$
$=-40+40=0$

92. $28+(-19)+(-8)+(-1)=9+(-8)+(-1)$
$=1+(-1)=0$

93. $-4-3-2=-4+(-3)+(-2)$
$=-7+(-2)=-9$

94. $4-5-12=4+(-5)+(-12)$
$=-1+(-12)=-13$

95. $12-(-7)-8=12+7+(-8)$
$=19+(-8)=11$

96. $-12-(-3)-(-15)=-12+3+15$
$=-9+15=6$

97. $-19-(-19)-18=-19+19+(-18)$
$=0+(-18)=-18$

98. $-8-(-8)-14=-8+8+(-14)$
$=0+(-14)=-14$

99. $-17-(-8)-(-9)=-17+8+9$
$=-9+9=0$

100. $7-8-(-1)=7+(-8)+1$
$=-1+1=0$

101. $-30-(-65)-29-4=-30+65+(-29)+(-4)$
$=35+(-29)+(-4)$
$=6+(-4)=2$

102. $42-(-82)-65-7=42+82-65-7$
$=124-65-7=59-7=52$

103. $-16-47-63-12=-63-63-12$
$=-126-12=-138$

104. $42-(-30)-65-(-11)=42+30-65+11$
$=72-65+11$
$=7+11=18$

105. $-47-(-67)-13-15=-47+(67)+(-13)+(-15)$
$=20+(-13)+(-15)$
$=7+(-15)=-8$

106. $-18-49-(-84)-27=-18+(-49)+84+(-27)$
$=-67+84+(-27)$
$=17+(-27)=-10$

107. $-19-17-(-36)-12=-19+(-17)+36+(-12)$
$=-36+36+(-12)$
$=0+(-12)=-12$

108. Positive

109. Negative

110. Negative

111. Positive

Objective D Exercises

112. **a.** multiplication; When parentheses are used and there is no operation symbol, the operation is multiplication.

b. addition; Add 8 and negative 7.

c. subtraction; Subtract negative 7 from 8.

d. multiplication; When a variable is written next to another variable and there is no operation symbol, the operation is multiplication.

e. multiplication; When parentheses are used and there is no operation symbol, the operation is multiplication.

f. addition; Add negative x and negative y.

113. $14(3) = 42$

114. $(17)6 = 102$

115. $-7 \cdot 4 = -28$

116. $-8 \cdot 7 = -56$

117. $(-12)(-5) = 60$

118. $(-13)(-9) = 117$

119. $-11(23) = -253$

120. $-8(21) = -168$

121. $(-17)(14) = -238$

122. $(-15)(12) = -180$

123. $6(-19) = -114$

124. $17(-13) = -221$

125. $12 \div (-6) = -2$

126. $18 \div (-3) = -6$

127. $(-72) \div (-9) = 8$

128. $(-64) \div (-8) = 8$

129. $-42 \div 6 = -7$

130. $(-56) \div 8 = -7$

131. $(-144) \div 12 = -12$

132. $(-93) \div (-3) = 31$

133. $48 \div (-8) = -6$

134. $57 \div (-3) = -19$

135. $\frac{-49}{7} = -7$

136. $\frac{-45}{5} = -9$

137. $\frac{-44}{-4} = 11$

138. $\frac{-36}{-9} = 4$

139. $\frac{98}{-7} = -14$

140. $\frac{85}{-5} = -17$

141. $-\frac{-120}{8} = -(-15) = 15$

142. $-\frac{-72}{4} = -(-18) = 18$

143. $-\frac{-80}{-5} = -16$

144. $-\frac{-114}{-6} = -19$

145. $0 \div (-9) = 0$

146. $0 \div (-14) = 0$

147. $\frac{-261}{9} = -29$

148. $\frac{-128}{4} = -32$

149. $9 \div 0$ is undefined.

150. $(-21) \div 0$ is undefined.

151. $\frac{132}{-12} = -11$

152. $\frac{250}{-25} = -10$

153. $\frac{0}{0}$ is undefined

154. $\frac{-58}{0}$ is undefined

155. $7(5)(-3) = 35(-3) = -105$

156. $(-3)(-2)8 = 6(8) = 48$

157. $9(-7)(-4) = -63(-4) = 252$

158. $(-2)(6)(-4) = -12(-4) = 48$

159. $7(-2)(5)(-6) = -14(5)(-6) = -70(-6) = 420$

160. $(-3)7(-2)8 = -21(-2)8 = (42)8 = 336$

161. $(-14)9(-11)0 = -126(-11)0 = (1386)0 = 0$

162. $(-13)(15)(-19)0 = -195(-19)0 = (3705)0 = 0$

163. Negative

Objective E Exercises

164. **Strategy** To find the difference, subtract the record low (–51° F) from the low in International Falls (–40° F).

Solution $-40° - (-51°) = -40° + 51° = 11$

The difference is 11° F.

165. **Strategy** To find the difference, subtract record low (–36°) from the record high (117°).

Solution $117 - (-36) = 117 + 36 = 153$

The difference is 153° F.

166. **Strategy** To find new temperature, add the rise (7°) to the original temperature (–8°).

Solution $-8 + 7 = -1$

The temperature is –1°.

167. **Strategy** To find new temperature, add the rise (5°) to the original temperature (–19°).

Solution $-19 + 5 = -14$

The temperature is –14°.

168. **Strategy** To find the difference, subtract the depth of the Mariana Trench (−11,520 m) from depth of the Philippine Trench (−10,540 m).

Solution

$-10{,}540 - (-11{,}520) = -10{,}540 + 11{,}520 = 980$

The difference in 980 m.

169. **Strategy** To find the difference, subtract the depth of the Mariana Trench (−11,520 m) from the height of Mt. Everest (8850 m).

Solution

$8850 - (-11{,}520) = 8850 + 11{,}520 = 20{,}370$

The difference is 20,370 m.

170. **Strategy** To determine if Mt. Everest could fit in the Tonga Trench, compare the height of Mt. Everest (8850 m) with the absolute value of the depth of the Tonga Trench (−10,630 m).

Solution $8850 < |-10{,}630|$

Yes, Mt. Everest would fit in the Tonga Trench.

171. **a. Strategy** To find the score for each day relative to par, subtract par (72) from each day's scores.

Solution Day 1: 72 – 72 = 0
Day 2: 68 – 72 = –4
Day 3: 70 – 72 = –2

Ken Duke's scores for the first three days were 0, –4, –2.

b. Strategy To find the score for the first three days, add the three scores.

Solution $0 + (-4) + (-2) = -4 + (-2) = -6$

Ken Duke's score for the first three days was −6.

c. Strategy To find the score for the first four days, find the score for the fourth day and add the fourth day's score to the first three day's scores.

Solution

Score for the fourth day: $68 - 72 = -4$

Score for the first four days: $-6 + (-4) = -10$

Ken Duke's score for the first four days was −10.

172. **Strategy** To find the average daily temperature:
• Add the seven temperature readings.
• Divide the total by 7.

Solution

$$4+(-5)+8+(-1)+(-12)+(-14)+(-8)$$
$$=-1+8+(-1)+(-12)+(-14)+(-8)$$
$$=7+(-1)+(-12)+(-14)+(-8)$$
$$=6+(-12)+(-14)+(-8)=-156$$
$$=-6+(-14)+(-8)$$
$$=-20+-8=-28$$
$$-28\div 7=-4$$

The average daily low temperature was -4° F.

173. **Strategy** To find the average daily temperature:
• Add the seven temperature readings.
• Divide by the total by 7.

Solution

$$-6+(-11)+1+5+(-3)+(-9)+(-5)$$
$$=-17+1+5+(-3)+(-9)+(-5)$$
$$=-16+5+(-3)+(-9)+(-5)$$
$$=-11+(-3)+(-9)+(-5)$$
$$=-14+(-9)+(-5)$$
$$=-23+(-5)=-28$$
$$-28\div 7=-4$$

The average daily low temperature was -4° F.

174. True

175. False

176. **a.** Below

b. **Strategy** To find the boiling point of neon, multiply the highest boiling point on the graph (–35) by seven.

Solution

$$-35\times 7=-245$$

The boiling point of neon is –245° C.

177. **Strategy** To find average score, divide the total of the scores (–20) by ten.

Solution

$$-20\div 10=-2$$

The average score is –2.

178. **Strategy** To find score, add the loss (–26) to the previous score (11).

Solution

$$11+(-26)=-15$$

The score is –15 points.

179. **Strategy** To find the grade:
• Multiply the number of correct answers (20) by 5.
• Multiply the number of incorrect answers (5) by –5.
• Multiply the number of blank questions (2) by –2.
• Add the products.

Solution

$$20\times 5=100$$
$$5\times(-5)=-25$$
$$2\times(-2)=-4$$
$$100+(-25)+(-4)=75+(-4)=71$$

The grade is 71.

Critical Thinking

180. The integers can be –1 and –8, –2 and –7, –3 and –6, or –4 and –5.

181. **Strategy** To find largest difference, subtract the smallest number (–10) from the largest number (15).

Solution $15-(-10)=15+10=25$

The largest difference is 25.

182. Sometimes true

183. **a.** True

b. True

Projects or Group Activities

184. Answers will vary. For example –7 + 3 = –4 or 8 + (–12) = –4.

Strategy: Write any number. If you pick a positive number first, then write a negative number whose absolute value is 4 more than the positive number you picked. If you write a negative number first, write a positive number that is 4 less than the absolute value of the negative number you picked.

185. Answers will vary. For example:

–12 – (–6) = 12 + 6 = –6.

Strategy: Write any negative number. Then subtract a negative number whose absolute value is 6 less than the absolute value of the first number.

186. 5, –15, 45, – 135, . . .
To get each successive number, multiply by –3.
–135(–3) = 405
405(–3) = –1215
–1215(–3) = 3645
405, –1215, 3645

187. –2, 4, –8, 16, . . .
To get each successive number, multiply by –2.
16(–2) = –32
–32(–2) = 64
64(–2) = –128
–32, 64, –128

188. –3, –12, –48, – 192, . . .
To get each successive number, multiply by 4.
–192(4) = –768
–768(4) = –3072
–3072(4) = –12,288
–768, –3072, –12,288

Section 1.2

Concept Check

1. 3; 4; terminating

2. 100%

3. 0.01

4. numerators, common denominator

5. equivalent, common denominator

6. numerators, denominators

7. reciprocal

8. radical sign, radicand

9. $(-5)^6$

10. $2\sqrt{2}$ is in simplest form because the radicand does not have a perfect square factor. $\sqrt{8}$ is not in simplest form because the radicand does have a perfect square factor: 4 is a perfect square that is a factor of 8.

Objective A

11. $\frac{1}{8} = 1 \div 8 = 0.125$

12. $\frac{7}{8} = 7 \div 8 = 0.875$

13. $\frac{2}{9} = 2 \div 9 = 0.\overline{2}$

14. $\frac{8}{9} = 8 \div 9 = 0.\overline{8}$

15. $\frac{1}{6} = 1 \div 6 = 0.1\overline{6}$

16. $\frac{5}{6} = 5 \div 6 = 0.8\overline{3}$

17. $\frac{9}{16} = 9 \div 16 = 0.5625$

18. $\frac{15}{16} = 15 \div 16 = 0.9375$

19. $\frac{7}{12} = 7 \div 12 = 0.58\overline{3}$

20. $\frac{11}{12} = 11 \div 12 = 0.91\overline{6}$

21. $\frac{21}{40} = 21 \div 40 = 0.525$

22. $\frac{5}{11} = 5 \div 11 = 0.\overline{45}$

Objective B Exercises

23. 100% = 100(0.01) = 1, multiplying by 1 does not change the value of the number.

24. $75\% = 75\left(\frac{1}{100}\right) = \frac{75}{100} = \frac{3}{4}$

$75\% = 75(0.01) = 0.75$

25. $40\% = 40\left(\frac{1}{100}\right) = \frac{40}{100} = \frac{2}{5}$

$40\% = 40(0.01) = 0.40$

26. $64\% = 64\left(\frac{1}{100}\right) = \frac{64}{100} = \frac{16}{25}$

$64\% = 64(0.01) = 0.64$

27. $88\% = 88\left(\frac{1}{100}\right) = \frac{88}{100} = \frac{22}{25}$

$88\% = 88(0.01) = 0.88$

28. $125\% = 125\left(\frac{1}{100}\right) = \frac{125}{100} = \frac{5}{4}$

$125\% = 125(0.01) = 1.25$

29. $160\% = 160\left(\frac{1}{100}\right) = \frac{160}{100} = \frac{8}{5}$

$160\% = 160(0.01) = 1.60$

30. $19\% = 19\left(\frac{1}{100}\right) = \frac{19}{100}$

$19\% = 19(0.01) = 0.19$

31. $87\% = 87\left(\frac{1}{100}\right) = \frac{87}{100}$

$87\% = 87(0.01) = 0.87$

32. $5\% = 5\left(\frac{1}{100}\right) = \frac{5}{100} = \frac{1}{20}$

$5\% = 5(0.01) = 0.05$

33. $450\% = 450\left(\frac{1}{100}\right) = \frac{450}{100} = \frac{9}{2}$

$450\% = 450(0.01) = 4.50$

34. $11\frac{1}{9}\% = 11\frac{1}{9}\left(\frac{1}{100}\right) = \frac{100}{9}\left(\frac{1}{100}\right) = \frac{1}{9}$

35. $4\frac{2}{7}\% = 4\frac{2}{7}\left(\frac{1}{100}\right) = \frac{30}{7}\left(\frac{1}{100}\right) = \frac{3}{70}$

36. $12\frac{1}{2}\% = 12\frac{1}{2}\left(\frac{1}{100}\right) = \frac{25}{2}\left(\frac{1}{100}\right) = \frac{1}{8}$

37. $37\frac{1}{2}\% = 37\frac{1}{2}\left(\frac{1}{100}\right) = \frac{75}{2}\left(\frac{1}{100}\right) = \frac{3}{8}$

38. $66\frac{2}{3}\% = 66\frac{2}{3}\left(\frac{1}{100}\right) = \frac{200}{3}\left(\frac{1}{100}\right) = \frac{2}{3}$

39. $\frac{1}{4}\% = \frac{1}{4}\left(\frac{1}{100}\right) = \frac{1}{400}$

40. $\frac{1}{2}\% = \frac{1}{2}\left(\frac{1}{100}\right) = \frac{1}{200}$

41. $6\frac{1}{4}\% = 6\frac{1}{4}\left(\frac{1}{100}\right) = \frac{25}{4}\left(\frac{1}{100}\right) = \frac{1}{16}$

42. $83\frac{1}{3}\% = 83\frac{1}{3}\left(\frac{1}{100}\right) = \frac{250}{3}\left(\frac{1}{100}\right) = \frac{5}{6}$

43. $5\frac{3}{4}\% = 5\frac{3}{4}\left(\frac{1}{100}\right) = \frac{23}{4}\left(\frac{1}{100}\right) = \frac{23}{400}$

44. $7.3\% = 7.3(0.01) = 0.073$

45. $9.1\% = 9.1(0.01) = 0.091$

46. $15.8\% = 15.8(0.01) = 0.158$

47. $16.7\% = 16.7(0.01) = 0.167$

48. $0.3\% = 0.3(0.01) = 0.003$

49. $0.9\% = 0.9(0.01) = 0.009$

50. $9.9\% = 9.9(0.01) = 0.099$

51. $9.15\% = 9.15(0.01) = 0.0915$

52. $121.2\% = 121.2(0.01) = 1.212$

53. $18.23\% = 18.23(0.01) = 0.1823$

54. $0.15 = 0.15(100\%) = 15\%$

55. $0.37 = 0.37(100\%) = 37\%$

56. $0.05 = 0.05(100\%) = 5\%$

57. $0.02 = 0.02(100\%) = 2\%$

58. $0.175 = 0.175(100\%) = 17.5\%$

59. $0.125 = 0.125(100\%) = 12.5\%$

60. $1.15 = 1.15(100\%) = 115\%$

61. $1.36 = 1.36(100\%) = 136\%$

62. $0.008 = 0.008(100\%) = 0.8\%$

63. $0.004 = 0.004(100\%) = 0.4\%$

64. $\frac{27}{50} = \frac{27}{50}(100\%) = \frac{2700}{50}\% = 54\%$

65. $\frac{83}{100} = \frac{83}{100}(100\%) = \frac{8300}{100}\% = 83\%$

66. $\frac{1}{3} = \frac{1}{3}(100\%) = \frac{100}{3}\% = 33\frac{1}{3}\%$

67. $\frac{3}{8} = \frac{3}{8}(100\%) = \frac{300}{8}\% = 37\frac{1}{2}\%$

68. $\frac{5}{11} = \frac{5}{11}(100\%) = \frac{500}{11}\% = 45\frac{5}{11}\%$

69. $\frac{4}{9} = \frac{4}{9}(100\%) = \frac{400}{9}\% = 44\frac{4}{9}\%$

70. $\frac{7}{8} = \frac{7}{8}(100\%) = \frac{700}{8}\% = 87\frac{1}{2}\%$

71. $\frac{9}{20} = \frac{9}{20}(100\%) = \frac{900}{20}\% = 45\%$

72. $1\frac{2}{3} = 1\frac{2}{3}(100\%) = \frac{5}{3}(100\%) = \frac{500}{3}\%$
$= 166\frac{2}{3}\%$

73. $2\frac{1}{2} = 2\frac{1}{2}(100\%) = \frac{5}{2}(100\%) = \frac{500}{2}\%$
$= 250\%$

74. Greater than 100%.

75. Greater than 1%.

Objective C Exercises

76. $-\frac{5}{6} - \frac{5}{9} = \frac{-15}{18} + \frac{-10}{18} = \frac{-15-10}{18} = -\frac{25}{18}$

77. $-\frac{6}{13} + \frac{17}{26} = \frac{-12}{26} + \frac{17}{36} = \frac{-12+17}{26} = \frac{5}{26}$

78. $-\frac{7}{12} + \frac{5}{8} = \frac{-14}{24} + \frac{15}{24} = \frac{-14+15}{24} = \frac{1}{24}$

79. $\frac{5}{8} - \left(-\frac{3}{4}\right) = \frac{5}{8} + \frac{6}{8} = \frac{5+6}{8} = \frac{11}{8}$

80. $\frac{3}{5} - \frac{11}{12} = \frac{36}{60} - \frac{55}{60} = \frac{36-55}{60} = -\frac{19}{60}$

81. $\frac{11}{12} - \frac{5}{6} = \frac{11}{12} - \frac{10}{12} = \frac{11-10}{12} = \frac{1}{12}$

82. $-\frac{2}{3} - \left(-\frac{11}{18}\right) = \frac{-12}{18} + \frac{11}{18} = \frac{-12+11}{18} = -\frac{1}{18}$

83. $-\frac{5}{8} - \left(-\frac{11}{12}\right) = \frac{-15}{24} + \frac{22}{24} = \frac{-15+22}{24} = \frac{7}{24}$

84. $\frac{1}{3} + \frac{5}{6} - \frac{2}{9} = \frac{6}{18} + \frac{15}{18} - \frac{4}{18} = \frac{6+15-4}{18} = \frac{17}{18}$

85. $\frac{1}{2} - \frac{2}{3} + \frac{1}{6} = \frac{3}{6} - \frac{4}{6} + \frac{1}{6} = \frac{3-4+1}{6} = \frac{0}{6} = 0$

86. $-\frac{5}{16} + \frac{3}{4} - \frac{7}{8} = -\frac{5}{16} + \frac{12}{16} - \frac{14}{16} = \frac{-5+12-14}{16}$
$= -\frac{7}{16}$

87. $\frac{1}{2} - \frac{3}{8} - \left(-\frac{1}{4}\right) = \frac{4}{8} - \frac{3}{8} + \frac{2}{8} = \frac{4-3+2}{8} = \frac{3}{8}$

88. $-13.092 + 6.9 = -6.192$

89. $2.54 - 3.6 = -1.06$

90. $5.43 + 7.925 = 13.355$

91. $-16.92 - 6.925 = -23.845$

92. $-3.87 + 8.546 = 4.676$

93. $6.9027 - 17.692 = -10.7893$

94. $2.09 - 6.72 - 5.4 = -4.63 - 5.4 = -10.03$

95. $-3.09 - 4.6 - (-27.3) = -7.69 + 27.3 = 19.61$

96. $16.4 - (-3.09) - 7.93 = 16.4 + 3.09 - 7.93$
$= 19.49 - 7.93 = 11.56$

97. $2.66 - (-4.66) - 8.2 = 2.66 + 4.66 - 8.2$
$= 7.32 - 8.2 = -0.88$

98. $\frac{7}{8} + \frac{4}{5} \approx 2$

99. $-0.125 + 1.25 \approx 1$

100. $-1.3 + 0.2 \approx -1$

Objective D Exercises

101. $\left(-\frac{3}{4}\right)\left(-\frac{8}{27}\right)=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{3}}\cdot 3\cdot 3}=\frac{2}{9}$

102. $\left(-\frac{1}{2}\right)\left(\frac{8}{9}\right)=-\frac{\overset{1}{\cancel{2}}\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot 3\cdot 3}=-\frac{4}{9}$

103. $\left(\frac{5}{12}\right)\left(-\frac{8}{15}\right)=-\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot 3\cdot\underset{1}{\cancel{5}}}=-\frac{2}{9}$

104. $\frac{5}{8}\left(-\frac{7}{12}\right)\frac{16}{25}=-\frac{\overset{1}{\cancel{5}}\cdot 7\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot 3\cdot\underset{1}{\cancel{5}}\cdot 5}=-\frac{7}{30}$

105. $\frac{5}{12}\left(-\frac{8}{15}\right)\frac{1}{3}=-\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot 3\cdot\underset{1}{\cancel{5}}\cdot 3}=-\frac{2}{27}$

106. $\frac{1}{2}\left(-\frac{3}{4}\right)\left(-\frac{5}{8}\right)=\frac{3\cdot 5}{2\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2}=\frac{15}{64}$

107. $\frac{3}{8}\div\frac{1}{4}=\frac{3}{8}\cdot\frac{4}{1}=\frac{3\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2}=\frac{3}{2}$

108. $\frac{5}{6}\div\left(-\frac{3}{4}\right)=\frac{5}{6}\cdot\left(-\frac{4}{3}\right)=-\frac{5\cdot\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot 3\cdot 3}=-\frac{10}{9}$

109. $-\frac{5}{12}\div\frac{15}{32}=-\frac{5}{12}\cdot\frac{32}{15}=-\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 3\cdot 3\cdot\underset{1}{\cancel{5}}}=-\frac{8}{9}$

110. $\frac{1}{8}\div\left(-\frac{5}{12}\right)=\frac{1}{8}\cdot\left(-\frac{12}{5}\right)=-\frac{\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 3}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}\cdot 2\cdot 5}=-\frac{3}{10}$

111. $-\frac{4}{9}\div\left(-\frac{2}{3}\right)=-\frac{4}{9}\cdot\left(-\frac{3}{2}\right)=\frac{\overset{1}{\cancel{2}}\cdot 2\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}\cdot 3\cdot\underset{1}{\cancel{2}}}=\frac{2}{3}$

112. $-\frac{6}{11}\div\frac{4}{9}=-\frac{6}{11}\cdot\frac{9}{4}=-\frac{\overset{1}{\cancel{2}}\cdot 3\cdot 3\cdot 3}{11\cdot\underset{1}{\cancel{2}}\cdot 2}=-\frac{27}{22}$

113. $1.2(3.47)=4.164$

114. $(-0.8)6.2=-4.96$

115. $(-1.89)(-2.3)=4.347$

116. $(6.9)(-4.2)=-28.98$

117. $1.2(-0.5)(3.7)=(-0.6)(3.7)=-2.22$

118. $2.3(-0.6)(0.8)=-1.38(0.8)=-1.104$

119. $-1.27\div(-1.7)\approx 0.75$

120. $9.07\div(-3.5)\approx -2.59$

121. $0.0976\div 0.042\approx 2.32$

122. $-6.904\div 1.35\approx -5.11$

123. $-7.894\div(-2.06)\approx 3.83$

124. $-354.2086\div 0.1719\approx -2060.55$

125. **a.** Less than 1

b. Greater than 1

Objective E Exercises

126. $6^2=6\cdot 6=36$

127. $7^4=7\cdot 7\cdot 7\cdot 7=2401$

128. $-7^2=-(7\cdot 7)=-49$

129. $-4^3=-(4\cdot 4\cdot 4)=-64$

130. $(-3)^2=(-3)(-3)=9$

131. $(-2)^3=(-2)(-2)(-2)=-8$

132. $(-3)^4=(-3)(-3)(-3)(-3)=81$

133. $(-5)^3=(-5)(-5)(-5)=-125$

134. $\left(\frac{1}{2}\right)^2=\left(\frac{1}{2}\right)\left(\frac{1}{2}\right)=\frac{1\cdot 1}{2\cdot 2}=\frac{1}{4}$

135. $\left(-\frac{3}{4}\right)^3=\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)=-\frac{3\cdot 3\cdot 3}{4\cdot 4\cdot 4}=-\frac{27}{64}$

136. $(0.3)^2=(0.3)(0.3)=0.09$

137. $(1.5)^3=(1.5)(1.5)(1.5)=3.375$

138. $\left(\frac{2}{3}\right)^2\cdot 3^3=\left(\frac{2}{3}\right)\left(\frac{2}{3}\right)\cdot 3\cdot 3\cdot 3=\frac{2\cdot 2\cdot\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{3}}\cdot 3}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{3}}}=12$

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

$$= -\frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}}} = -1$$

140. $(0.3)^3 \cdot 2^3 = (0.3)(0.3)(0.3) \cdot 2 \cdot 2 \cdot 2 = 0.216$

141. $(-2) \cdot (-2)^2 = (-2)(-2)(-2) = -8$

142. $2^3 \cdot 3^3 \cdot (-4) = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot (-4)$

$= 8 \cdot 27 \cdot (-4) = 216 \cdot (-4) = -864$

143. $(-3)^3 \cdot 5^2 \cdot 10 = (-3)(-3)(-3) \cdot 5 \cdot 5 \cdot 10$

$= -27 \cdot 25 \cdot 10 = -675 \cdot 10 = -6750$

144. $(-7) \cdot 4^2 \cdot 3^2 = (-7) \cdot 4 \cdot 4 \cdot 3 \cdot 3 = (-7) \cdot 16 \cdot 9$

$= -112 \cdot 9 = -1008$

145. Negative

146. Negative

147. Positive

148. Positive

Objective F Exercises

149. $\sqrt{16} = 4$

150. $\sqrt{64} = 8$

151. $\sqrt{49} = 7$

152. $\sqrt{144} = 12$

153. $\sqrt{32} = \sqrt{16 \cdot 2} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$

154. $\sqrt{50} = \sqrt{25 \cdot 2} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}$

155. $\sqrt{8} = \sqrt{4 \cdot 2} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2}$

156. $\sqrt{12} = \sqrt{4 \cdot 3} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

157. $6\sqrt{18} = 6\sqrt{9 \cdot 2} = 6\sqrt{9} \cdot \sqrt{2}$

$= 6 \cdot 3\sqrt{2} = 18\sqrt{2}$

158. $-3\sqrt{48} = -3\sqrt{16 \cdot 3} = -3\sqrt{16} \cdot \sqrt{3}$

$= -3 \cdot 4\sqrt{3} = -12\sqrt{3}$

159. $5\sqrt{40} = 5\sqrt{4 \cdot 10} = 5\sqrt{4} \cdot \sqrt{10}$

$= 5 \cdot 2\sqrt{10} = 10\sqrt{10}$

160. $2\sqrt{28} = 2\sqrt{4 \cdot 7} = 2\sqrt{4} \cdot \sqrt{7} = 2 \cdot 2\sqrt{7} = 4\sqrt{7}$

161. $\sqrt{15} = \sqrt{3 \cdot 5} = \sqrt{15}$

162. $\sqrt{21} = \sqrt{3 \cdot 7} = \sqrt{21}$

163. $\sqrt{29}$

164. $\sqrt{13}$

165. $-9\sqrt{72} = -9\sqrt{4 \cdot 9 \cdot 2} = -9\sqrt{4} \cdot \sqrt{9} \cdot \sqrt{2}$

$= -9 \cdot 2 \cdot 3\sqrt{2} = -54\sqrt{2}$

166. $11\sqrt{80} = 11\sqrt{16 \cdot 5} = 11\sqrt{16} \cdot \sqrt{5}$

$= 11 \cdot 4\sqrt{5} = 44\sqrt{5}$

167. $\sqrt{45} = \sqrt{9 \cdot 5} = \sqrt{9} \cdot \sqrt{5} = 3\sqrt{5}$

168. $\sqrt{225} = \sqrt{25 \cdot 9} = \sqrt{25} \cdot \sqrt{3} = 5 \cdot 3 = 15$

169. $\sqrt{0} = 0$

170. $\sqrt{210} = \sqrt{2 \cdot 3 \cdot 5 \cdot 7} = \sqrt{210}$

171. $6\sqrt{128} = 6\sqrt{64 \cdot 2} = 6\sqrt{64} \cdot \sqrt{2}$

$= 6 \cdot 8\sqrt{2} = 48\sqrt{2}$

172. $9\sqrt{288} = 9\sqrt{16 \cdot 9 \cdot 2} = 9\sqrt{16} \cdot \sqrt{9} \cdot \sqrt{2}$

$= 9 \cdot 4 \cdot 3\sqrt{2} = 108\sqrt{2}$

173. $\sqrt{240} \approx 15.492$

174. $\sqrt{300} \approx 17.321$

175. $\sqrt{288} \approx 16.971$

176. $\sqrt{600} \approx 24.495$

177. $\sqrt{256} = 16$

178. $\sqrt{324} = 18$

179. Between –11 and –10

180. Not a real number

181. Between 2 and 3

182. Between 14 and 15

Objective G Exercises

183. **Strategy** To find the difference, subtract the low temperature (-48.9°) from the high temperature (6.67°).

Solution $6.67-(-48.9)=6.67+48.9=55.57$

The difference between the record high and record low temperature in Browing is 55.57° C.

184. **Strategy** To find the amount the temperature fell, subtract the first temperature (-20°) from the second temperature (12.22°).

Solution $12.22-(-20)=12.22+20=32.22$

The temperature fell 32.22° C.

185. **Strategy** To find the difference, subtract the melting point (-218.4°) from the boiling point (-182.962°).

Solution

$-182.962-(-218.4)=-182.962+218.4=35.438$

The difference between the boiling point and melting point is 35.438° C.

186. **Strategy** To find the difference, subtract the melting point (-209.86°) from the boiling point (-195.8°).

Solution

$-195.8-(-209.86)=-195.8+209.86=14.06$

The difference between the boiling point and melting point is 14.06° C.

187. **a. Strategy** To find the difference, subtract the oil production in 2008 (4.9 million) from the oil production in 1973 (9.2 million).

Solution

$9.2-4.9=4.3$

The difference in oil production is 4.3 million barrels per day.

b. Strategy To find the increase, subtract the oil production in 2008 (4.9) from the predicted production in 2020 (6.0).

Solution $6.0-4.9=1.1$

The increase in oil production from 2008 to 2020 is 1.1 million barrels per day.

188. **Strategy** To find the total cost of the two fabrics, add the cost of the $12\frac{1}{2}$ yd at \$5.43 per yard to the cost of the $5\frac{3}{4}$ yd at \$6.94 per yard.

Solution

$12\frac{1}{2}(5.43)=12.5(5.43)$

$5\frac{3}{4}(6.94)=5.75(6.94)$

$12.5(5.43)+5.75(6.94)=107.78$

The total cost of the two fabrics is \$107.78.

189. **Strategy** To find how much butter the chef should use, add $\frac{1}{2}$ of $\frac{3}{4}$ c to $\frac{3}{4}$ c.

Solution $\frac{3}{4}\cdot\frac{1}{2}+\frac{3}{4}=\frac{3}{8}+\frac{3}{4}=\frac{3}{8}+\frac{6}{8}=\frac{9}{8}=1\frac{1}{8}$

The chef should use $1\frac{1}{8}$ c of butter.

190. **Strategy** To find number of servings, divide the total weight (18 oz.) by the number of ounces per serving $\left(\frac{3}{4}\right)$.

Solution

$$18\div\frac{3}{4}=\frac{18}{1}\div\frac{3}{4}=\frac{\overset{6}{\cancel{18}}}{1}\cdot\frac{4}{\underset{1}{\cancel{3}}}=\frac{6\cdot4}{1}=24$$

There are 24 servings in 1 box.

191. **Strategy** To find number of servings, divide the total weight (24 oz.) by the number of ounces per serving $\left(1\frac{1}{2}\right)$.

Solution

$$24\div1\frac{1}{2}=\frac{24}{1}\div\frac{3}{2}=\frac{\overset{8}{\cancel{24}}}{1}\cdot\frac{2}{\underset{1}{\cancel{3}}}=\frac{8\cdot2}{1}=16$$

There are 16 servings in 1 box.

Critical Thinking

192. **a.** True
b. True
c. False
d. False

193. Answers will vary. For example:
a. 0.15
b. 1.05
c. 0.001

194. **Strategy** To find a rational number that is one-half the difference between $\frac{5}{11}$ and $\frac{4}{11}$, subtract the two numbers and divide by 2.

Solution

$\left(\frac{5}{11}-\frac{4}{11}\right)\div 2=\frac{1}{11}\div 2=\frac{1}{11}\cdot\frac{1}{2}=\frac{1}{22}$

$\frac{1}{22}$ is one-half the difference between $\frac{5}{11}$ and $\frac{4}{11}$.

195. Yes, it is always possible to find a rational number between two given numbers. Explanations will vary. One method is to add the two numbers and divide the sum by 2

Projects or Group Activities

196. $\frac{17}{99}=0.\overline{17}$, $\frac{45}{99}=0.\overline{45}$, $\frac{73}{99}=0.\overline{73}$, $\frac{83}{99}=0.\overline{83}$, $\frac{33}{99}=0.\overline{33}=0.\overline{3}$, yes; $\frac{1}{99}=0.\overline{01}$, yes

197. $a=2$, $b=3$, $c=6$

Section 1.3

Concept Check

1. We need an Order of Operations Agreement to prevent there being more than one answer for a numerical expression.

2. The Order of Operations Agreement:
Step 1 Perform operations inside grouping symbols.
Step 2 Simplify exponential expressions.
Step 3 Do multiplication and division as they occur from left to right
Step 4 Do addition and subtraction as they occur from left to right.

Objective A Exercises

3. $4-8\div 2=4-4=0$

4. $2^2\cdot 3-3=4\cdot 3-3=12-3=9$

5. $2(3-4)-(-3)^2=2(-1)-(-3)^2$
$=2(-1)-9$
$=-2-9$
$=-11$

6. $16-32\div 2^3=16-32\div 8=16-4=12$

7. $24-18\div 3+2=24-6+2=18+2=20$

8. $8-(-3)^2-(-2)=8-(9)-(-2)$
$=8-9+2$
$=-1+2$
$=1$

9. $8-2(3)^2=8-2(9)$
$=8-18$
$=-10$

10. $16-16\cdot 2\div 4=16-32\div 4$
$=16-8$
$=8$

11. $12+16\div 4\cdot 2=12+4\cdot 2$
$=12+8$
$=20$

12. $16-2\cdot 4^2=16-2\cdot 16$
$=16-32$
$=-16$

13. $27-18\div(-3^2)=27-18\div(-9)$
$=27+2$
$=29$

14. $4+12\div 3\cdot 2=4+4\cdot 2$
$=4+8$
$=12$

15. $16+15\div(-5)-2=16+(-3)-2$
$=13-2$
$=11$

16. $14-2^2-(4-7)=14-2^2-(-3)$
$=14-4-(-3)$
$=14-4+3$
$=10+3$
$=13$

17. $14-2^2-|4-7|=14-2^2-|-3|=14-2^2-3$
$=14-4-3=10-3=7$

18. $10-|5-8|+2^3 = 10-|-3|+2^3 = 10-3+2^3$
$= 10-3+8 = 7+8 = 15$

19. $3-2\left[8-(3-2)\right] = 3-2\left[8-(1)\right]$
$= 3-2[7]$
$= 3-14$
$= -11$

20. $-2^2+4\left[16\div(3-5)\right] = -2^2+4\left[16\div-(2)\right]$
$= -2^2+4[-8]$
$= -4+4[-8]$
$= -4+(-32)$
$= -36$

21. $6+\dfrac{16-4}{2^2+2}-2 = 6+\dfrac{12}{4+2}-2$
$= 6+\dfrac{12}{6}-2$
$= 6+2-2$
$= 8-2$
$= 6$

22. $24\div\dfrac{3^2}{8-5}-(-5) = 24\div\dfrac{9}{3}-(-5)$
$= 24\div 3-(-5)$
$= 8-(-5)$
$= 8+5$
$= 13$

23. $18\div|9-2^3|+(-3) = 18\div|9-8|+(-3)$
$= 18\div 1+(-3)$
$= 18+(-3)$
$= 15$

24. $96\div 2\left[12+(6-2)\right]-3^2 = 96\div 2[12+4]-3^2$
$= 96\div 2[16]-3^2$
$= 96\div 2[16]-9$
$= 48[16]-9$
$= 768-9$
$= 759$

25. $4\left[16-(7-1)\right]\div 10 = 4[16-6]\div 10$
$= 4[10]\div 10$
$= 40\div 10$
$= 4$

26. $18\div 2-4^2-(-3)^2 = 18\div 2-16-9$
$= 9-16-9$
$= -7-9$
$= -16$

27. $20\div\left(10-2^3\right)+(-5) = 20\div(10-8)+(-5)$
$= 20\div 2+(-5) = 10+(-5) = 5$

28. $16-3(8-3)^2\div 5 = 16-3(5)^2\div 5$
$= 16-3(25)\div 5$
$= 16-75\div 5 = 16-15 = 1$

29. $4(-8)\div\left[2(7-3)^2\right] = 4(-8)\div\left[2(4)^2\right]$
$= 4(-8)\div\left[2(16)\right] = 4(-8)\div 32$
$= -32\div 32 = -1$

30. $\dfrac{(-10)+(-2)}{6^2-30}\div|2-4| = \dfrac{-12}{36-30}\div|-2|$
$= \dfrac{-12}{6}\div 2 = -2\div 2 = -1$

31. $16-4\cdot\dfrac{3^3-7}{2^3+2}-(-2)^2 = 16-4\cdot\dfrac{27-7}{8+2}-(4)$
$= 16-4\cdot\dfrac{20}{10}-4$
$= 16-4\cdot 2-4$
$= 16-8-4 = 8-4 = 4$

32. $(0.2)^2\cdot(-0.5)+1.72 = (0.04)(-0.5)+1.72$
$= -0.02+1.72 = 1.70$

33. $0.3(1.7-4.8)+(1.2)^2 = 0.3(-3.1)+1.44$
$= -0.93+1.44 = 0.51$

34. $(1.8)^2-2.52\div 1.8 = 3.24-2.52\div 1.8$
$= 3.24-1.4 = 1.84$

35. $(1.65-1.05)^2\div 0.4+0.8 = (0.6)^2\div 0.4+0.8$
$= 0.36\div 0.4+0.8$
$= 0.9+0.8 = 1.7$

36. $15+15\div 3-4^2 = 15+15\div 3-16$
$= 15+5-16$ ii

Critical Thinking

37. Answers will vary. For example,
$\frac{17}{24}$ and $\frac{33}{48}$.

38.

$\frac{2}{3}$	$-\frac{1}{6}$	0
$-\frac{1}{2}$	$\frac{1}{6}$	$\frac{5}{6}$
$\frac{1}{3}$	$\frac{1}{2}$	$-\frac{1}{3}$

39. Answers will vary. For example:

a. $\frac{1}{2}$

b. 1

c. 2

40. No, the Order of Operations Agreement was not followed in the given simplification of $6+2(4-9)$ because the addition was performed before the multiplication. The correct simplification is:

$$\begin{aligned} 6+2(4-9) &= 6+2(-5) \\ &= 6+(-10) \\ &= -4 \end{aligned}$$

Projects and Group Activities

41. $1{,}000{,}000 = 100^3$

A	B	C		A	B	C
1	8	27	is	1^3	2^3	3^3
64	125	216		4^3	5^3	6^3

A: $(1+3n)^3$

B: $(2+3n)^3$

C: $(3+3n)^3$

$100^3 = [1+3(33)]^3$

1,000,000 is in Column A.

Check Your Progress: Chapter 1

1. $\{1, 2, 3, 4, 5, 6, 7, 8\}$

2. $-7 < 1$

$0 < 1$

$2 > 1$

$5 > 1$

-7 and 0 are less than 1.

3. 13

4. $|-44| = 44$

$-|-18| = -18$

5. $|31| > |-13|$

6. $-47 + 23 = -24$

7. $-11-(-27) = -11+27 = 16$

8. $-32+40+(-9) = 8+(-9) = -1$

9. $42-(-82)-65-7 = 42+82-65-7$

$= 124-65-7 = 59-7 = 52$

10. $16(-2) = -32$

11. $-9(7)(-5) = -63(-5) = 315$

12. $250 \div (-25) = -10$

13. $-\frac{-80}{-5} = -16$

14. $\frac{-58}{0}$ is undefined

15. $\frac{11}{16} = 11 \div 16 = 0.6875$

16. $\frac{7}{11} = 7 \div 11 = 0.\overline{63}$

17. $45\% = 45\left(\frac{1}{100}\right) = \frac{45}{100} = \frac{9}{20}$

$45\% = 45(0.01) = 0.45$

18. $14\frac{1}{2}\% = 14\frac{1}{2}\left(\frac{1}{100}\right) = \frac{29}{2}\left(\frac{1}{100}\right) = \frac{29}{200}$

19. $\frac{7}{8} = \frac{7}{8} \times 100\% = \frac{700}{8}\% = 87.5\%$

20. $0.08 = 0.08(100\%) = 8\%$

21. $\frac{5}{6}+\frac{3}{18} = \frac{15}{18}+\frac{3}{18} = \frac{18}{18} = 1$

22. $\frac{3}{24}-\frac{1}{6} = \frac{3}{24}-\frac{4}{24} = -\frac{1}{24}$

23. $-18.39+4.9-23.7 = -13.49-23.7 = -37.19$

24. $\frac{5}{8}\left(-\frac{9}{12}\right)\left(\frac{16}{25}\right) = -\frac{\overset{1}{\cancel{5}} \cdot \overset{3}{\cancel{9}} \cdot \overset{1}{\cancel{16}}}{\underset{1}{\cancel{8}} \cdot \underset{4}{\cancel{12}} \cdot \underset{5}{\cancel{25}}} = -\frac{3}{10}$

25. $-\frac{6}{11}\div\frac{9}{4}=-\frac{\cancel{6}^{2}}{11}\cdot\frac{4}{\cancel{9}_{3}}=-\frac{8}{33}$

26. $-1.6(0.2)=-0.32$

27. $3\sqrt{18}=3\sqrt{9\cdot 2}=3\sqrt{3}\cdot\sqrt{2}=3\cdot 3\sqrt{2}=6\sqrt{2}$

28. $\sqrt{27}=\sqrt{9\cdot 3}=\sqrt{9}\cdot\sqrt{3}=3\sqrt{3}$

29. $-3^2\cdot(-2)^4=-9(16)=-144$

30. $5-4[3-2(7-1)]\div 9=5-4[3-2(6)]\div 9$
$=5-4[3-12]\div 9$
$=5-4[-9]\div 9$
$=5+36\div 9$
$=5+4$
$=9$

31. $-4\cdot 2^3-\frac{1-13}{2^2\cdot 3}=-4\cdot 2^3-\frac{-12}{4\cdot 3}$
$=-4\cdot 2^3-(-1)$
$=-4\cdot 8-(-1)$
$=-32-(-1)$
$=-32+1$
$=-31$

32. $\left(8-3^2\right)^6+(2\cdot 3-7)^9=(8-9)^6+(6-7)^9$
$=(-1)^6+(-1)^9$
$=1-1$
$=0$

33. **Strategy** To find the temperature, add the rise (8º) to the previous temperature (–3º).

Solution $-3°+8°=5°$
The temperature is 5º C.

34. **Strategy** To find the average low temperature:
- add the temperatures (–8º, –12º, 0º, –4º, 5º, –7º, –9º).
- add divide by the number of days in a week (7).

Solution $-8+(-12)+0+(-4)+5+(-7)+(-9)$
$=-20+0+(-4)+5+(-7)+(-9)$
$=-20+(-4)+5+(-7)+(-9)$
$=-24+5+(-7)+(-9)$
$=-19+(-7)+(-9)$
$=-26+(-9)$
$=-35$
$-35\div 7=-5$
The average low temperature is –5º C.

35. **Strategy** To find the temperature, subtract the rise (20.3º) from the high temperature (15.7º).

Solution $15.7°-20.3°=-4.6°$
The temperature was –4.6º C.

Section 1.4

Concept Check

1. $2x^2$, $5x$, $\underline{-8}$

2. $-3n^2$, $-4n$, $\underline{7}$

3. $-a^4$, $\underline{6}$

4. coefficient of x^2: 1
coefficient of $-9x$: –9

5. coefficient of $12a^2$: 12
coefficient of $-8ab$: −8
coefficient of $-b^2$: −1

6. coefficient of n^3: 1
coefficient of $-4n^2$: −4
coefficient of $-n$: −1

7. reciprocal (or multiplicative inverse)

8. opposite (or additive inverse)

9. Like terms are variable terms with the same variable part. Constant terms are also like terms. Examples of like terms are $4x$ and $-9x$.

Examples of terms that are not alike are $4x^2$ and $-9x$. The terms 4 and 9 are also like terms; 4 and $4x$ are not.

10. To simplify a variable term, add like terms.

11. less than, quotient

12. subtracted from, product, cube

13. $25 - x$

14. $5W$

Objective A Exercises

15. $6b \div (-a)$

$6(3) \div (-2) = 18 \div (-2) = -9$

16. $bc \div (2a)$

$3(-4) \div (2 \cdot 2) = -12 \div 4 = -3$

17. $b^2 - 4ac$

$$(3)^2 - 4(2)(-4) = 9 - 4(2)(-4)$$
$$= 9 - (-32) = 9 + 32$$
$$= 41$$

18. $a^2 - b^2$

$2^2 - 3^2 = 4 - 9 = -5$

19. $b^2 - c^2$

$3^2 - (-4)^2 = 9 - 16 = -7$

20. $(a + b)^2$

$(2 + 3)^2 = 5^2 = 25$

21. $a^2 + b^2$

$2^2 + 3^2 = 4 + 9 = 13$

22. $2a - (c + a)^2$

$$2(2) - (-4) + 2^2 = 2(2) - (-2)^2$$
$$= 4 - 4 = 0$$

23. $\frac{5ab}{6} - 3cb$

$$\frac{5(2)(3)}{6} - 3(-4)(3) = \frac{30}{6} - (-36)$$
$$= 5 - (-36) = 41$$

24. $\frac{d - b}{c}$

$\frac{3 - 4}{-1} = \frac{-1}{-1} = 1$

25. $\frac{2d + b}{-a}$

$\frac{2(3) + 4}{-(-2)} = \frac{6 + 4}{2} = \frac{10}{2} = 5$

26. $\frac{b + 2d}{b}$

$\frac{4 + 2(3)}{4} = \frac{4 + 6}{4} = \frac{10}{4} = \frac{5}{2}$

27. $\frac{b - d}{c - a}$

$\frac{4 - 3}{-1 - (-2)} = \frac{1}{1} = 1$

28. $\frac{2c - d}{-ad}$

$\frac{2(-1) - 3}{-(-2)(3)} = \frac{-2 - 3}{-(-6)} = -\frac{5}{6}$

29. $(b + d)^2 - 4a$

$$(4 + 3)^2 - 4(-2) = 7^2 - 4(-2)$$
$$= 49 - (-8) = 57$$

30. $(d - a)^2 - 3c$

$$\left[3 - (-2)\right]^2 - 3(-1) = 5^2 - 3(-1)$$
$$= 25 - (-3) = 28$$

31. $(d - a)^2 \div 5$

$\left[3 - (-2)\right]^2 \div 5 = 5^2 \div 5 = 25 \div 5 = 5$

32. $3(b - a) - bc$

$$3\,4 - (-2) - 4(-1) = 3(6) - 4(-1)$$
$$= 18 - (-4) = 22$$

33. $\frac{b - 2a}{bc^2 - d}$

$\frac{4 - 2(-2)}{4(-1)^2 - 3} = \frac{4 - (-4)}{4(1) - 3} = \frac{8}{4 - 3} = \frac{8}{1} = 8$

34. $\frac{b^2 - a}{ad + 3c}$

$\frac{4^2 - (-2)}{(-2)(3) + 3(-1)} = \frac{16 - (-2)}{-6 + (-3)} = \frac{18}{-9} = -2$

35. $\frac{1}{3}d^2 - \frac{3}{8}b^2$

$\frac{1}{3}(3)^2 - \frac{3}{8}(4)^2 = \frac{1}{3}(9) - \frac{3}{8}(16) = 3 - 6 = -3$

36. $\frac{5}{8}a^4 - c^2$

$\frac{5}{8}(-2)^4 - (-1)^2 = \frac{5}{8}(16) - (1) = 10 - 1 = 9$

37. $\frac{-4bc}{2a-b}$

$\frac{-4(4)(-1)}{2(-2)-4} = \frac{16}{-4-4} = \frac{16}{-8} = -2$

38. $-\frac{3}{4}b + \frac{1}{2}(ac + bd)$

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

$= -\frac{3}{4}(4) + \frac{1}{2}[14]$

$= -3 + 7 = 4$

39. $-\frac{2}{3}d - \frac{1}{5}(bd - ac)$

$-\frac{2}{3}(3) - \frac{1}{5}\left[4(3) - (-2)(-1)\right] = -\frac{2}{3}(3) - \frac{1}{5}[12 - 2]$

$= -\frac{2}{3}(3) - \frac{1}{5}(10)$

$= -2 - 2 = -4$

40. $(b-a)^2 - (d-c)^2$

$\left[4 - (-2)\right]^2 - \left[3 - (-1)\right]^2 = 6^2 - 4^2$

$= 36 - 16 = 20$

41. Positive

42. Positive

43. Negative

44. Negative

Objective B Exercises

45. $6x + 8x = 14x$

46. $12x + 13x = 25x$

47. $9a - 4a = 5a$

48. $12a - 3a = 9a$

49. $7 - 3b = 7 - 3b$

50. $5 + 2a = 5 + 2a$

51. $-12a + 17a = 5a$

52. $-3a + 12a = 9a$

53. $-12xy + 17xy = 5xy$

54. $-15xy + 3xy = -12xy$

55. $-3ab + 3ab = 0$

56. $-7ab + 7ab = 0$

57. $-\frac{1}{2}x - \frac{1}{3}x = -\frac{3}{6}x - \frac{2}{6}x = -\frac{5}{6}x$

58. $-\frac{2}{5}y + \frac{3}{10}y = -\frac{4}{10}y + \frac{3}{10}y = -\frac{1}{10}y$

59. $2.3x + 4.2x = 6.5x$

60. $6.1y - 9.2y = -3.1y$

61. $x - 0.55x = 0.45x$

62. $0.65A - A = -0.35A$

63. $5a - 3a + 5a = 7a$

64. $10a - 17a + 3a = -4a$

65. $-5x^2 - 12x^2 + 3x^2 = -14x^2$

66. $-y^2 - 8y^2 + 7y^2 = -2y^2$

67. $\frac{3}{4}x - \frac{1}{3}x - \frac{7}{8}x = \frac{18}{24}x - \frac{8}{24}x - \frac{21}{24}x = -\frac{11}{24}x$

68. $-\frac{2}{5}a - \left(-\frac{3}{10}a\right) - \frac{11}{15}a = \frac{-12}{30}a + \frac{9}{30}a - \frac{22}{30}a$

$= -\frac{25}{30}a = -\frac{5}{6}a$

69. $7x - 3y + 10x = 17x - 3y$

70. $8y + 8x - 8y = 8x$

71. $3a + (-7b) - 5a + b = -2a - 6b$

72. $-5b + 7a - 7b + 12a = 19a - 12b$

73. $3x + (-8y) - 10x + 4x = -3x - 8y$

74. $3y + (-12x) - 7y + 2y = -12x - 2y$

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

76. $3x^2 + 5x - 10x^2 - 10x = -7x^2 - 5x$

77. $-10x-10y-10y-10x=-20x-20y$

i. 0 No

ii. -20 No

iii. $-20y$ No

iv. $-20x-20y$ Yes

v. $-20y-20x$ Yes

(iv) and (v)

Objective C Exercises

78. $4(3x)=12x$

79. $12(5x)=60x$

80. $-3(7a)=-21a$

81. $-2(5a)=-10a$

82. $-2(-3y)=6y$

83. $-5(-6y)=30y$

84. $(4x)2=8x$

85. $(6x)12=72x$

86. $(3a)(-2)=-6a$

87. $(7a)(-4)=-28a$

88. $(-3b)(-4)=12b$

89. $(-12b)(-9)=108b$

90. $-5(3x^2)=-15x^2$

91. $-8(7x^2)=-56x^2$

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

93. $\frac{1}{6}(6x^2)=x^2$

94. $\frac{1}{5}(5a)=a$

95. $\frac{1}{8}(8x)=x$

96. $-\frac{1}{2}(-2x)=x$

97. $-\frac{1}{4}(-4a)=a$

98. $-\frac{1}{7}(-7n)=n$

99. $-\frac{1}{9}(-9b)=b$

100. $(3x)\left(\frac{1}{3}\right)=x$

101. $(12x)\left(\frac{1}{12}\right)=x$

102. $(-6y)\left(-\frac{1}{6}\right)=y$

103. $(-10n)\left(-\frac{1}{10}\right)=n$

104. $\frac{1}{3}(9x)=3x$

105. $\frac{1}{7}(14x)=2x$

106. $-0.2(10x)=-2x$

107. $-0.25(8x)=-2x$

108. $-\frac{2}{3}(12a^2)=-8a^2$

109. $-\frac{5}{8}(24a^2)=-15a^2$

110. $-0.5(-16y)=8y$

111. $-0.75(-8y)=6y$

112. $(16y)\left(\frac{1}{4}\right)=4y$

113. $(33y)\left(\frac{1}{11}\right)=3y$

114. $(-6x)\left(\frac{1}{3}\right)=-2x$

115. $(-10x)\left(\frac{1}{5}\right)=-2x$

116. $(-8a)\left(-\frac{3}{4}\right)=6a$

117. $(21y)\left(-\frac{3}{7}\right) = -9y$

118. Less than one

Objective D Exercises

119. $2(4x - 3) = 8x - 6$

120. $5(2x - 7) = 10x - 35$

121. $-2(a + 7) = -2a - 14$

122. $-5(a + 16) = -5a - 80$

123. $-3(2y - 8) = -6y + 24$

124. $-5(3y - 7) = -15y + 35$

125. $-(x + 2) = -x - 2$

126. $-(x + 7) = -x - 7$

127. $(5 - 3b)7 = 35 - 21b$

128. $(10 - 7b)2 = 20 - 14b$

129. $\frac{1}{3}(6 - 15y) = 2 - 5y$

130. $\frac{1}{2}(-8x + 4y) = -4x + 2y$

131. $3(5x^2 + 2x) = 15x^2 + 6x$

132. $6(3x^2 + 2x) = 18x^2 + 12x$

133. $-2(-y + 9) = 2y - 18$

134. $-5(-2x + 7) = 10x - 35$

135. $(-3x - 6)5 = -15x - 30$

136. $(-2x + 7)7 = -14x + 49$

137. $2(-3x^2 - 14) = -6x^2 - 28$

138. $5(-6x^2 - 3) = -30x^2 - 15$

139. $-3(2y^2 - 7) = -6y^2 + 21$

140. $-8(3y^2 - 12) = -24y^2 + 96$

141. $3(x^2 - y^2) = 3x^2 - 3y^2$

142. $5(x^2 + y^2) = 5x^2 + 5y^2$

143. $-\frac{2}{3}(6x - 18y) = -4x + 12y$

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

145. $-(6a^2 - 7b^2) = -6a^2 + 7b^2$

146. $3(x^2 + 2x - 6) = 3x^2 + 6x - 18$

147. $4(x^2 - 3x + 5) = 4x^2 - 12x + 20$

148. $-2(y^2 - 2y + 4) = -2y^2 + 4y - 8$

149. $\frac{3}{4}(2x - 6y + 8) = \frac{3}{2}x - \frac{9}{2}y + 6$

150. $-\frac{2}{3}(6x - 9y + 1) = -4x + 6y - \frac{2}{3}$

151. $4(-3a^2 - 5a + 7) = -12a^2 - 20a + 28$

152. $-5(-2x^2 - 3x + 7) = 10x^2 + 15x - 35$

153. $-3(-4x^2 + 3x - 4) = 12x^2 - 9x + 12$

154. $3(2x^2 + xy - 3y^2) = 6x^2 + 3xy - 9y^2$

155. $5(2x^2 - 4xy - y^2) = 10x^2 - 20xy - 5y^2$

156. $-(3a^2 + 5a - 4) = -3a^2 - 5a + 4$

157. $-(8b^2 - 6b + 9) = -8b^2 + 6b - 9$

158. Positive

159. $12 - 7(y - 9) = 12 - 7y + 63 = -7y + 75$

i. $5(y - 9) = 5y - 45$ No

ii. $12 - 7y - 63 = -7y - 51$ No

iii. $12 - 7y + 63 = -7y + 75$ Yes

iv. $12 - 7y - 9 = -7y + 3$ No

160. $4x - 2(3x + 8) = 4x - 6x - 16 = -2x - 16$

161. $6a - (5a + 7) = 6a - 5a - 7 = a - 7$

162. $9 - 3(4y + 6) = 9 - 12y - 18 = -12y - 9$

163. $10 - (11x - 3) = 10 - 11x + 3 = -11x + 13$

164. $5n - (7 - 2n) = 5n - 7 + 2n = 7n - 7$

165. $8 - (12 + 4y) = 8 - 12 - 4y = -4y - 4$

166. $3(x+2)-5(x-7)=3x+6-5x+35$
$=-2x+41$

167. $2(x-4)-4(x+2)=2x-8-4x-8$
$=-2x-16$

168. $12(y-2)+3(7-3y)=12y-24+21-9y$
$=3y-3$

169. $6(2y-7)-(3-2y)=12y-42-3+2y$
$=14y-45$

170. $3(a-b)-(a+b)=3a-3b-a-b=2a-4b$

171. $2(a+2b)-(a-3b)=2a+4b-a+3b=a+7b$

172. $4\left[x-2(x-3)\right]=4\left[x-2x+6\right]=4\left[-x+6\right]$
$=-4x+24$

173. $2\left[x+2(x+7)\right]=2\left[x+2x+14\right]=2\left[3x+14\right]$
$=6x+28$

174. $-2\left[3x+2(4-x)\right]=-2\left[3x+8-2x\right]$
$=-2\left[x+8\right]=-2x-16$

175. $-5\left[2x+3(5-x)\right]=-5\left[2x+15-3x\right]$
$=-5\left[-x+15\right]=5x-75$

176. $-3\left[2x-(x+7)\right]=-3\left[2x-x-7\right]$
$=-3\left[x-7\right]=-3x+21$

177. $-2\left[3x-(5x-2)\right]=-2\left[3x-5x+2\right]$
$=-2\left[-2x+2\right]=4x-4$

178. $2x-3\left[x-(4-x)\right]=2x-3\left[x-4+x\right]$
$=2x-3\left[2x-4\right]$
$=2x-6x+12=-4x+12$

179. $-7x+3\left[x-(3-2x)\right]=-7x+3\left[x-3+2x\right]$
$=-7x+3\left[3x-3\right]$
$=-7x+9x-9=2x-9$

180. $-5x-2\left[2x-4(x+7)\right]-6$
$=-5x-2\left[2x-4x-28\right]-6$
$=-5x-2\left[-2x-28\right]-6$
$=-5x+4x+56-6=-x+50$

181. $0.12(2x+3)+x=0.24x+0.36+x$
$=1.24x+0.36$

182. $0.05x+0.02(4-x)=0.05x+0.08-0.02x$
$=0.03x+0.08$

183. $0.03x+0.04(1000-x)=0.03x+40-0.04x$
$=-0.01x+40$

Objective E Exercises

184. the unknown number: x
$12-x$

185. the unknown number: x
$\frac{x}{18}$

186. the unknown number: x
$\frac{2}{3}x$

187. the unknown number: x
$x+20$

188. the unknown number: x
twice the unknown number: $2x$
$\frac{2x}{9}$

189. the unknown number: x
the product of eleven and the number: $11x$
$11x-8$

190. the unknown number: x
the sum of the number and twelve: $x + 12$
$\frac{15}{x+12}$

191. the unknown number: x
the quotient of the number and twenty: $\frac{x}{20}$
$40-\frac{x}{20}$

192. the unknown number: x
twice the number: $2x$
five more than twice the number: $2x + 5$
$\frac{2x+5}{x}$

193. the unknown number: x
the square of the number: x^2
twice the number: $2x$
$x^2 + 2x$

194. (i) the difference between thirty-two and the quotient of a number and seven: $32 - \frac{a}{7}$
Yes
(ii) thirty-two decreased by the quotient of a number and seven $32 - \frac{a}{7}$ Yes
(iii) thirty-two minus the ratio of a number to seven $32 - \frac{a}{7}$ Yes

195. the unknown number: x
the difference between the number and 50: $x - 50$
$10(x - 50) = 10x - 500$

196. the unknown number: x
the total of the number and two: $x + 2$
$(x + 2) - 9 = x + 2 - 9 = x - 7$

197. the unknown number: x
three more than the number: $x + 3$
$x - (x + 3) = x - x - 3 = -3$

198. the unknown number: x
the sum of the number and nineteen: $x + 19$
$4(x + 19) = 4x + 76$

199. the unknown number: x
twice the number: $2x$
the difference between twice the number and four: $2x - 4$
$(2x - 4) + x = 2x - 4 + x = 3x - 4$

200. the unknown number: x
five less than the number: $x - 5$
$(x - 5)7 = 7x - 35$

201. the unknown number: x
the product of three and the number: $3x$
$x + 3x = 4x$

202. the unknown number: x
the total of the number and 9: $x + 9$
$x + (x + 9) = x + x + 9 = 2x + 9$

203. the unknown number: x
the sum of the number and six: $x + 6$
$(x + 6) + 5 = x + 6 + 5 = x + 11$

204. the unknown number: x
the difference between eight and the number: $8 - x$
$x - (8 - x) = x - 8 + x = 2x - 8$

205. the unknown number: x
the sum of the number and ten: $x + 10$
$x - (x + 10) = x - x - 10 = -10$

206. the unknown number: x
the total of a number a 5: $x + 5$
$(x + 5) + 2 = x + 5 + 2 = x + 7$

207. number of visitors to the Metropolitan Museum of Art: M
number of visitors to the Louvre: $M +$ 3,800,000

208. diameter of Dione: d
diameter of Rhea: $d + 253$

209. noise level of a car horn: d
noise level of an ambulance siren: $d + 10$

210. genes in a roundworm genome: G
genes in the human genome: $G + 11{,}000$

211. U2's concert ticket sales: T
E Street Band's concert ticket sales: $T -$ 28,500,000

212. total number of Americans: N
number who think money should be spent on exploration of Mars: $\frac{3}{4}N$

213. number of bones in your body: N
number of bones in your foot: $\frac{1}{4}N$

214. points for a safety: s
points for a touchdown: $3s$

215. attendance at major league basketball games: B
attendance at major league baseball games: $B +$ 50,000,000

216. number of people surveyed: N
number of people who would pay down their debt: $0.43N$

217. number of U.S. undergraduate students: N
number who attend a two-year college: $0.46N$

218. width of the rectangle: W
length of the rectangle: $2W + 5$

219. measure of the largest angle: L
measure of the smallest angle: $\frac{1}{2}L - 10$

220. hours of overtime worked: h
weekly pay: $1172 + 38h$

Critical Thinking

221. The number of students enrolled in fall-term science classes.

222. The number of students enrolled in spring-term science classes.

223. length of wire: x
length of side of square: $\frac{1}{4}x$

224. number of oxygen atoms: x
number of hydrogen atoms: $2x$

225. Two examples of translation of $5x + 8$ are "eight more than the product of five and a number" and "the sum of five times a number and eight." Two examples of the translation of $5(x + 8)$ are "five times the sum of a number and eight" and "the product of five and eight more than a number.

Projects or Group Activities

226. (a) False. For example, $8 \div 2 \neq 2 \div 8$.
(b) False. For example, $(12 \div 4) \div 2 \neq 12 \div (4 \div 2)$.
(c) False. For example, $(9 - 2) - 3 \neq 9 - (2 - 3)$.
(d) False. For example, $10 - 4 \neq 4 - 10$.

227. a. Yes; $7 \otimes 5 = 5 \otimes 7$

$7 \otimes 5 = 23$ $\quad$ $5 \otimes 7$

$= (5 \cdot 7) - (5 + 7) = 35 - 12 = 23$

b. No; $(7 \otimes 5) \otimes 2 \neq 7 \otimes (5 \otimes 2)$

$$
\begin{aligned}
&(7 \otimes 5) \otimes 2 \\
&= 23 \otimes 2 \\
&= (23 \cdot 2) - (23 + 2) \\
&= 46 - 25 \\
&= 21
\end{aligned}
$$

$$
\begin{aligned}
&7 \otimes (5 \otimes 2) \\
&= 7 \otimes [(5 \cdot 2) - (5 + 2)] \\
&= 7 \otimes [10 - 7] \\
&= 7 \otimes 3 \\
&= (7 \cdot 3) - (7 + 3) \\
&= 21 - 10 \\
&= 11
\end{aligned}
$$

228. Answers will vary. One example is unbuckling the seat belt and then getting out of the car.

229. (i) $2x + 4(2x + 1) = 2x + 8x + 4 = 10x + 4$

(ii) $x - (4 - 9x) + 8 = x - 4 + 9x + 8 = 10x + 4$

(iii) $7(x - 4) - 3(2x + 6) = 7x - 28 - 6x - 18$
$= x - 46$

(iv) $3(2x + 8) + 4(x - 5) = 6x + 24 + 4x - 20$
$= 10x + 4$

(v) $6 - 2[x + (3x - 4)] + 2(9x - 5)$
$= 6 - 2[x + 3x - 4] + 2(9x - 5)$
$= 6 - 2[4x - 4] + 2(9x - 5)$
$= 6 - 8x + 8 + 18x - 10$
$= 10x + 4$

i, ii, iv, and v are equivalent; they are equal to $10x + 4$.

Section 1.5

Concept Check

1. roster, set-builder, interval

2. **a.** Student explanations should include the idea that to find the union of two sets, we list all the elements of the first set and then list all the elements of the second set that are not elements of the first set.
b. Student explanations should include the idea that to find the intersection of two sets, we list only those elements that are elements of both sets.

Objective A Exercises

3. $A = \{16, 17, 18, 19, 20, 21\}$

4. $A = \{-9, -8, -7, -6, -5\}$

5. $A = \{9, 11, 13, 15, 17\}$

6. $A = \{-10, -8, -6, -4, -2\}$

7. $A \cup B = \{3, 4, 5, 6\}$

8. $A \cup B = \{-3, -2, -1, 0\}$

9. $A \cup B = \{-10, -9, -8, 8, 9, 10\}$

10. $A \cup B = \{\text{m, n, o, p, q}\}$

11. $A \cup B = \{1, 3, 7, 9, 11, 13\}$

12. $A \cup B = \{-3, -2, -1, 1, 2\}$

13. $A \cap B = \{4, 5\}$

14. $A \cap B = \{-4\}$

15. $A \cap B = \varnothing$

16. $A \cap B = \{1, 2, 3, 4\}$

17. $A \cap B = \{\text{c, d, e}\}$

18. $A \cap B = \{\text{m, n}\}$

Objective B

19. $\{x \mid x > -5,\ x \in \text{negative integers}\}$

20. $\{x \mid x < 5,\ x \in \text{positive integers}\}$

21. $\{x \mid x > 30,\ x \in \text{integers}\}$

22. $\{x \mid x < -70,\ x \in \text{integers}\}$

23. $\{x \mid x > 8,\ x \in \text{real numbers}\}$

24. $\{x \mid x < 57,\ x \in \text{real numbers}\}$

25. $(1, 2)$

26. $(-2, 4]$

27. $(3, \infty)$

28. $(-\infty, 0]$

29. $[-4, 5)$

30. $[-3, 0]$

31. $(-\infty, 2]$

32. $[-3, \infty)$

33. $[-3, 1]$

34. $\{x \mid -4 \le x \le 5\}$

35. $\{x \mid -5 < x < -3\}$

36. $\{x \mid x > 4\}$

37. $\{x \mid x \le -2\}$

38. $\{x \mid 4 < x \le 9\}$

39. $\{x \mid -3 \le x \le -2\}$

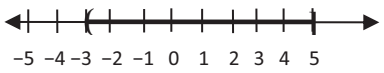
40. $\{x \mid x \ge 0\}$

41. $\{x \mid x \le 6\}$

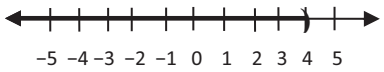
42. $\{x \mid -\infty < x < \infty\}$

43. $[-5, 4]$

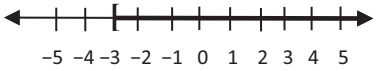
44. $(-3, 5]$



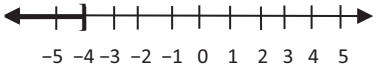
45. $\{x \mid x < 4\}$



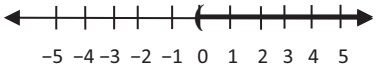
46. $\{x \mid x \geq -3\}$



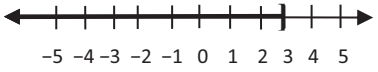
47. $\{x \mid x \leq -4\}$



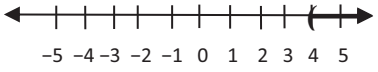
48. $\{x \mid x > 0\}$



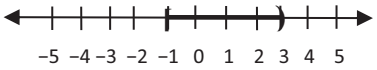
49. $(-\infty, 3]$



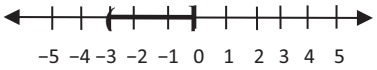
50. $(4, \infty)$



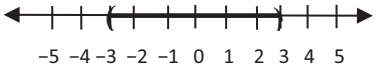
51. $[-1, 3)$



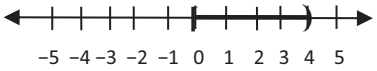
52. $(-3, 0]$



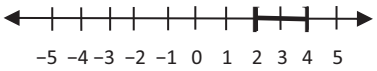
53. $\{x \mid -3 < x < 3\}$



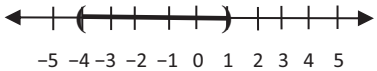
54. $\{x \mid 0 \leq x < 4\}$



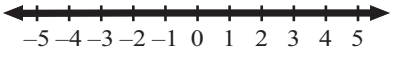
55. $\{x \mid 2 \leq x \leq 4\}$



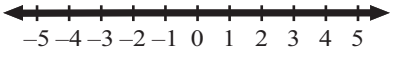
56. $\{x \mid -4 < x < 1\}$



57. $\{x \mid -\infty < x < \infty\}$



58. $(-\infty, \infty)$



59. None

60. One, 4.

Critical Thinking

61. $m \geq 250$

62. $t \leq 32$

63. True

Projects of Group Activities

64. Answers will vary. For example, $A = \{1, 2\}$ and $B = 3\}$.

65. Answers will vary. For example, $A = \{1, 2, 3, 4\}$ and $B = \{1, 2, 3, 4\}$.

66. Answers will vary. For example, $A = \{1, 2, 3\}$ and $B = \{1, 2, 3, 5\}$.

Chapter 1 Review Exercises

1. $-4 < 1$ True
$0 < 1$ True
$11 < 1$ False
$x < 1$ for the values -4 and 0.

2. 4

3. $-|-5| = -(5) = -5$

4. $-3 + (-12) + 6 + (-4) = -15 + 6 + (-4)$
$= -9 + (-4) = -13$

5. $16 - (-3) - 18 = 16 + 3 - 18 = 19 - 18 = 1$

6. $-6(7) = -42$

7. $-100 \div 5 = -20$

8.
$$\begin{array}{r} 0.28 \\ 25\overline{)\,7.00} \\ \underline{50} \\ 200 \\ \underline{200} \\ 0 \end{array}$$
$$\frac{7}{25} = 0.28$$

9. $6.2\% = 6.2(0.01) = 0.062$

10. $\frac{5}{8} = \frac{5}{8}(100\%) = \frac{500}{8}\% = 62.5\%$

11. $\frac{1}{3} - \frac{1}{6} + \frac{5}{12} = \frac{4}{12} - \frac{2}{12} + \frac{5}{12} = \frac{4-2+5}{12} = \frac{7}{12}$

12. $5.17 - 6.238 = -1.068$

13. $-\frac{18}{35} \div \frac{17}{28} = -\frac{18}{35} \cdot \frac{28}{17} = -\frac{2 \cdot 3 \cdot 3 \cdot 2 \cdot 2 \cdot \overset{1}{\cancel{7}}}{5 \cdot \underset{1}{\cancel{7}} \cdot 17} = -\frac{72}{85}$

14. $4.32(-1.07) = -4.6224$

15. $\left(-\frac{2}{3}\right)^4 = \left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right) = \frac{16}{81}$

16. $2\sqrt{36} = 2 \cdot 6 = 12$

17. $-3\sqrt{120} = -3\sqrt{4 \cdot 30} = -3 \cdot 2\sqrt{30} = -6\sqrt{30}$

18.
$$\begin{aligned} -3^2 + 4\left[18 + (12 - 20)\right] &= -3^2 + 4\left[18 + (-8)\right] \\ &= -3^2 + 4[10] \\ &= -9 + 40 = 31 \end{aligned}$$

19. $(b-a)^2 + c$

$$\begin{aligned} \left[3 - (-2)\right]^2 + 4 &= \left[3 + 2\right]^2 + 4 = \left[5\right]^2 + 4 \\ &= 25 + 4 = 29 \end{aligned}$$

20.
$$\begin{aligned} 6a - 4b + 2a &= 6a + 2a - 4b \\ &= (6+2)a - 4b \\ &= 8a - 4b \end{aligned}$$

21. $-3(-12y) = -3(-12)y = 36y$

22. $5(2x-7) = 5(2x) + 5(-7) = 10x - 35$

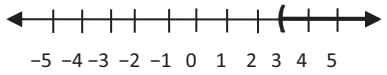
23.
$$\begin{aligned} &-4(2x-9) + 5(3x+2) \\ &= -4(2x) - 4(-9) + 5(3x) + 5(2) \\ &= -8x + 36 + 15x + 10 \\ &= -8x + 15x + 36 + 10 \\ &= 7x + 46 \end{aligned}$$

24.
$$\begin{aligned} 5\left[2 - 3(6x-1)\right] &= 5\left[2 - 18x + 3\right] \\ &= 5\left[5 - 18x\right] \\ &= 25 - 90x \\ &= -90x + 25 \end{aligned}$$

25. $\{1, 3, 5, 7\}$

26. $A \cap B = \{1,\ 5,\ 9\}$

27. $\{x \mid x > 3\}$



28. $[1, 4]$

29. $(-4, \infty)$

30. **Strategy** To find the score:
- Multiply the number of correct answers by 6.
- Multiply the number of incorrect answers by −4.
- Multiply the number of blank answers by −2.
- Add the results.

Solution

$21(6) = 126$

$5(-4) = -20$

$4(-2) = -8$

$126 + (-20) + (-8) = 98$

The student's score was 98.

31. **Strategy** To find the percent
- Find the total number by adding the numbers in the three categories together.
- Divide the number opposing (1260) by the total number and multiply by 100%.

Solution $491 + 385 + 1260 = 2136$

$\left(\frac{1260}{2136}\right)100\% = 59.0\%$

59.0% oppose abolishing the penny.

32. the unknown number: x
twice the number: $2x$
one-half the number: $\frac{1}{2}x$

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

33. number of American League cards: A
number of National League cards: $5A$

Chapter 1Test

1. $-2 > -40$

2. 7

3. $-|-4|=-(4)=-4$

4. $16-30=-14$

5. $-22+14+(-8)=-8+(-8)=-16$

6. $16-(-30)-42=16+30-42=46-42=4$

7. $-561\div(-33)=17$

8. $\frac{7}{9}=0.\overline{7}$

9. $45\%=45\left(\frac{1}{100}\right)=\frac{45}{100}=\frac{9}{20}$

$45\% = 45(0.01) = 0.45$

10. $-\frac{2}{5}+\frac{7}{15}=-\frac{6}{15}+\frac{7}{15}=\frac{-6+7}{15}=\frac{1}{15}$

11. $6.02(-0.89)=-5.3578$

12. $\frac{5}{12}\div\left(-\frac{5}{6}\right)=\frac{5}{12}\cdot\left(-\frac{6}{5}\right)=-\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}}\cdot 2\cdot\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{5}}}=-\frac{1}{2}$

13. $\frac{3}{4}\cdot(4)^2=\frac{3}{4}\cdot 16=\frac{3\cdot\overset{1}{\cancel{2}}\cdot\overset{1}{\cancel{2}}\cdot 2\cdot 2}{\underset{1}{\cancel{2}}\cdot\underset{1}{\cancel{2}}}=12$

14. $-2\sqrt{45}=-2\sqrt{9\cdot 5}=-2\sqrt{9}\cdot\sqrt{5}=-2\cdot 3\sqrt{5}=-6\sqrt{5}$

15. $16\div 2\left[8-3(4-2)\right]+1=16\div 2\left[8-3(2)\right]+1$
$=16\div 2[8-6]+1$
$=16\div 2[2]+1$
$=8[2]+1$
$=16+1$
$=17$

16. b^2-3ab
$(-2)^2-3(3)(-2)=4+18=22$

17. $3x-5x+7x=(3-5+7)x=5x$

18. $\frac{1}{5}(10x)=\frac{1}{5}(10)x=2x$

19. $-3\left(2x^2-7y^2\right)=-3\left(2x^2\right)-3\left(-7y^2\right)$
$=-6x^2+21y^2$

20. $2x-3(x-2)=2x-3(x)-3(-2)$
$=2x-3x+6$
$=-x+6$

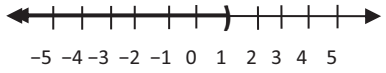
21. $2x+3\left[4-(3x-7)\right]=2x+3[4-3x+7]$
$=2x+3[11-3x]$
$=2x+33-9x$
$=2x-9x+33$
$=-7x+33$

22. $\{-2, -1, 0, 1, 2, 3\}$

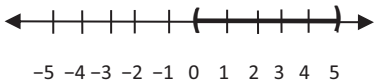
23. $\{x \mid x<-3, x\in \text{ real numbers}\}$

24. $A\cup B=\{1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 7,\ 8\}$

25. $\{x \mid x<1\}$



26. (0, 5)



27. the number: x
the difference between a number and 3: $x-3$
$10(x-3)=10x-30$

28. catcher's throw: s
pitcher's fastball: $2s$

29. **a.** 1981, 1988, 1989, 1990, 1991, 1995

b. $-369.7-(-81.1)=-369.7+81.1=-288.6$

The difference between the trade balance in 1990 and 2000 was –$288.6 billion.

c. The difference in trade was greatest from 1999 to 2000.

d. $\frac{-81.1}{-19.4}=4.18\approx 4$ times greater

e. $\frac{-369.7}{4}=-\$92.425$ billion

30. **Strategy** To find the difference between the highest temperature and the lowest temperature, subtract the lowest temperature (-81.4°) from the highest temperature (134.0^{0}).

Solution $134.0-(-81.4)=134.0+81.4=215.4$

The difference between the highest temperature recorded in North America and the lowest temperature recorded is 215.4° F.

Chapter 2: First-Degree Equations and Inequalities

Prep Test

1. $\frac{9}{100} = 0.09$

2. $\frac{3}{4} = \frac{3}{4}(100\%) = \frac{300}{4}\% = 75\%$

3. $3x^2 - 4x - 1$

$3(-4)^2 - 4(-4) - 1$

$= 3(16) - 4(-4) - 1$

$= 48 + 16 - 1$

$= 63$

4. $R - 0.35R = (1 - 0.35)R = 0.65R$

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

$= \left(\frac{3}{6} + \frac{4}{6}\right)x$

$= \frac{7}{6}x$

6. $6x - 3(6 - x) = 6x - 3(6) - 3(-x)$

$= 6x - 18 + 3x$

$= 9x - 18$

7. $0.22(3x + 6) + x = 0.66x + 1.32 + x = 1.66x + 1.32$

8. the unknown number: n
twice a number: $2n$
$5 - 2n$

9. speed of old card: s
speed of new card: $5s$

10. length of longer piece: x
length of shorter piece: $5 - x$

Section 2.1

Concept Check

1. **a.** equation
b. expression
c. expression
d. equation
e. expression

2. The solution is 8.

3. i, ii, and iv are equations in the form $x + a = b$.
You would subtract a from both sides.

4. i, ii, and iv are equations in the form $ax = b$.
You would divide both sides by a.

5. Amount: 30; base: 40

6. Amount: 8; base: 20

7. unknown; 30; 24

8. 25%; 16,000; unknown

9. Keith

10. **a.** 12 mph **b.** 4 mph

Objective A Exercises

11.
$$\begin{array}{r|l} 2x = 8 \\ \hline 2(4) \mid 8 \\ 8 = 8 \end{array}$$

Yes, 4 is a solution.

12.
$$\begin{array}{r|l} y + 4 = 7 \\ \hline 3 + 4 \mid 7 \\ 7 = 7 \end{array}$$

Yes, 3 is a solution.

13.
$$\begin{array}{r|l} 2b - 1 = 3 \\ \hline 2(-1) - 1 \mid 3 \\ -2 - 1 \mid 3 \\ -3 \neq 3 \end{array}$$

No, -1 is not a solution.

14.
$$\begin{array}{r|l} 3a - 4 = 10 \\ \hline 3(-2) - 4 \mid 10 \\ -6 - 4 \mid 10 \\ -10 \neq 10 \end{array}$$

No, -2 is not a solution.

15.
$$\begin{array}{r|l} 4 - 2m = 3 \\ \hline 4 - 2(1) \mid 3 \\ 4 - 2 \mid 3 \\ 2 \neq 3 \end{array}$$

No, 1 is not a solution.

16.
$$\begin{array}{r|l} 7-3n & 2 \\ \hline 7-3(2) & 2 \\ 7-6 & 2 \\ 1 \neq 2 & \end{array}$$
No, 2 is not a solution.

17.
$$\begin{array}{r|l} 2x+5 & 3x \\ \hline 2(5)+5 & 3(5) \\ 10+5 & 15 \\ 15=15 & \end{array}$$
Yes, 5 is a solution.

18.
$$\begin{array}{r|l} 3y-4 & 2y \\ \hline 3(4)-4 & (2)4 \\ 12-4 & 8 \\ 8=8 & \end{array}$$
Yes, 4 is a solution.

19.
$$\begin{array}{r|l} 3a+2 & 2-a \\ \hline 3(-2)+2 & 2-(-2) \\ -6+2 & 2+2 \\ -4 \neq 4 & \end{array}$$
No, −2 is not a solution.

20.
$$\begin{array}{r|l} z^2+1 & 4+3z \\ \hline 3^2+1 & 4+3(3) \\ 9+1 & 4+9 \\ 10 \neq 13 & \end{array}$$
No, 3 is not a solution.

21.
$$\begin{array}{r|l} 2x^2-1 & 4x-1 \\ \hline 2(2)^2-1 & 4(2)-1 \\ 2(4)-1 & 8-1 \\ 8-1 & 7 \\ 7=7 & \end{array}$$
Yes, 2 is a solution.

22.
$$\begin{array}{r|l} y^2-1 & 4y+3 \\ \hline (-1)^2-1 & 4(-1)+3 \\ 1-1 & -4+3 \\ 0 \neq -1 & \end{array}$$
No, −1 is not a solution.

23.
$$\begin{array}{r|l} 4y+1 & 3 \\ \hline 4(1/2)+1 & 3 \\ 2+1 & 3 \\ 3=3 & \end{array}$$
Yes, $\frac{1}{2}$ is a solution.

24.
$$\begin{array}{r|l} 5m+1 & 10m-3 \\ \hline 5(2/5)+1 & 10(2/5)-3 \\ 2+1 & 4-3 \\ 3 \neq 1 & \end{array}$$
No, $\frac{2}{5}$ is not a solution.

25.
$$\begin{array}{r|l} 8x-1 & 12x+3 \\ \hline 8(3/4)-1 & 12(3/4)+3 \\ 6-1 & 9+3 \\ 5 \neq 12 & \end{array}$$
No, $\frac{3}{4}$ is not a solution.

26. Negative

Objective B Exercises

27. x will be greater than $\frac{19}{24}$ because you will add $\frac{11}{16}$ to solve the equation.

28. x will be less than $-\frac{21}{43}$ because a $-\frac{13}{15}$ will be added to solve the equation.

29.
$$\begin{aligned} x+5&=7 \\ x+5-5&=7-5 \\ x&=2 \end{aligned}$$
The solution is 2.

30.
$$\begin{aligned} y+3&=9 \\ y+3-3&=9-3 \\ y&=6 \end{aligned}$$
The solution is 6.

31.
$$\begin{aligned} b-4&=11 \\ b-4+4&=11+4 \\ b&=15 \end{aligned}$$
The solution is 15.

32.
$$\begin{aligned} z-6&=10 \\ z-6+6&=10+6 \\ z&=16 \end{aligned}$$
The solution is 16.

33.
$$\begin{aligned} 2+a&=8 \\ 2-2+a&=8-2 \\ a&=6 \end{aligned}$$
The solution is 6.

34. $5+x=12$
$5-5+x=12-5$
$x=7$
The solution is 7.

35. $n-5=-2$
$n-5+5=-2+5$
$n=3$
The solution is 3.

36. $x-6=-5$
$x-6+6=-5+6$
$x=1$
The solution is 1.

37. $b+7=7$
$b+7-7=7-7$
$b=0$
The solution is 0.

38. $y-5=-5$
$y-5+5=-5+5$
$y=0$
The solution is 0.

39. $z+9=2$
$z+9-9=2-9$
$z=-7$
The solution is −7.

40. $n+11=1$
$n+11-11=1-11$
$n=-10$
The solution is −10.

41. $10+m=3$
$10-10+m=3-10$
$m=-7$
The solution is −7.

42. $8+x=5$
$8-8+x=5-8$
$x=-3$
The solution is −3.

43. $9+x=-3$
$9-9+x=-3-9$
$x=-12$
The solution is −12.

44. $10+y=-4$
$10-10+y=-4-10$
$y=-14$
The solution is −14.

45. $2=x+7$
$2-7=x+7-7$
$-5=x$
The solution is −5.

46. $-8=n+1$
$-8-1=n+1-1$
$-9=n$
The solution is −9.

47. $4=m-11$
$4+11=m-11+11$
$15=m$
The solution is 15.

48. $-6=y-5$
$-6+5=y-5+5$
$-1=y$
The solution is −1.

49. $12=3+w$
$12-3=3-3+w$
$9=w$
The solution is 9.

50. $-9=5+x$
$-9-5=5-5+x$
$-14=x$
The solution is −14.

51. $4=-10+b$
$4+10=-10+10+b$
$14=b$
The solution is 14.

52. $-7=-2+x$
$-7+2=-2+2+x$
$-5=x$
The solution is −5.

53. $m+\frac{2}{3}=-\frac{1}{3}$
$m+\frac{2}{3}-\frac{2}{3}=-\frac{1}{3}-\frac{2}{3}$
$m=-1$
The solution is −1.

54. $c+\frac{3}{4}=-\frac{1}{4}$
$c+\frac{3}{4}-\frac{3}{4}=-\frac{1}{4}-\frac{3}{4}$
$c=-1$
The solution is −1.

55.
$$x-\frac{1}{2}=\frac{1}{2}$$
$$x-\frac{1}{2}+\frac{1}{2}=\frac{1}{2}+\frac{1}{2}$$
$$x=1$$
The solution is 1.

56.
$$x-\frac{2}{5}=\frac{3}{5}$$
$$x-\frac{2}{5}+\frac{2}{5}=\frac{3}{5}+\frac{2}{5}$$
$$x=1$$
The solution is 1.

57.
$$\frac{5}{8}+y=\frac{1}{8}$$
$$\frac{5}{8}-\frac{5}{8}+y=\frac{1}{8}-\frac{5}{8}$$
$$y=-\frac{4}{8}$$
$$y=-\frac{1}{2}$$
The solution is $-\frac{1}{2}$.

58.
$$\frac{4}{9}+a=-\frac{2}{9}$$
$$\frac{4}{9}-\frac{4}{9}+a=-\frac{2}{9}-\frac{4}{9}$$
$$a=-\frac{6}{9}$$
$$a=-\frac{2}{3}$$
The solution is $-\frac{2}{3}$.

59.
$$-\frac{5}{6}=x-\frac{1}{4}$$
$$-\frac{5}{6}+\frac{1}{4}=x-\frac{1}{4}+\frac{1}{4}$$
$$-\frac{10}{12}+\frac{3}{12}=x$$
$$-\frac{7}{12}=x$$
The solution is $-\frac{7}{12}$.

60.
$$-\frac{1}{4}=c-\frac{2}{3}$$
$$-\frac{1}{4}+\frac{2}{3}=c-\frac{2}{3}+\frac{2}{3}$$
$$-\frac{3}{12}+\frac{8}{12}=c$$
$$\frac{5}{12}=c$$
The solution is $\frac{5}{12}$.

61.
$$d+1.3619=2.0148$$
$$d+1.3619-1.3619=2.0148-1.3619$$
$$d=0.6529$$
The solution is 0.6529.

62.
$$w+2.932=4.801$$
$$w+2.932-2.932=4.801-2.932$$
$$w=1.869$$
The solution is 1.869.

63.
$$6.149=-3.108+z$$
$$6.149+3.108=-3.108+3.108+z$$
$$9.257=z$$
The solution is 9.257.

64.
$$5.237=-2.014+x$$
$$5.237+2.014=-2.014+2.014+x$$
$$7.251=x$$
The solution is 7.251.

Objective C Exercises

65.
$$5x=-15$$
$$\frac{5x}{5}=\frac{-15}{5}$$
$$x=-3$$
The solution is –3.

66.
$$4y=-28$$
$$\frac{4y}{4}=\frac{-28}{4}$$
$$y=-7$$
The solution is −7.

67.
$$3b=0$$
$$\frac{3b}{3}=\frac{0}{3}$$
$$b=0$$
The solution is 0.

68. $2a = 0$

$\frac{2a}{2} = \frac{0}{2}$

$a = 0$

The solution is 0.

69. $-3x = 6$

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

$x = -2$

The solution is −2.

70. $-5m = 20$

$\frac{-5m}{-5} = \frac{20}{-5}$

$m = -4$

The solution is −4.

71. $-\frac{1}{6}n = -30$

$-6\left(-\frac{1}{6}n\right) = -6(-30)$

$n = 180$

The solution is 180.

72. $20 = \frac{1}{4}c$

$4(20) = 4\left(\frac{1}{4}c\right)$

$80 = c$

The solution is 80.

73. $0 = -5x$

$\frac{0}{-5} = \frac{-5x}{-5}$

$0 = x$

The solution is 0.

74. $0 = -8a$

$\frac{0}{-8} = \frac{-8a}{-8}$

$0 = a$

The solution is 0.

75. $\frac{x}{3} = 2$

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

$x = 6$

The solution is 6.

76. $\frac{x}{4} = 3$

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

$x = 12$

The solution is 12.

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

$-2\left(-\frac{1}{2}y\right) = -2(5)$

$y = -10$

The solution is −10.

78. $-\frac{b}{3} = 6$

$-3\left(-\frac{1}{3}b\right) = -3(6)$

$b = -18$

The solution is −18.

79. $\frac{3}{4}y = 9$

$\frac{4}{3}\left(\frac{3}{4}y\right) = \frac{4}{3}(9)$

$y = 12$

The solution is 12.

80. $\frac{2}{5}x = 6$

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

$x = 15$

The solution is 15.

81. $-\frac{2}{3}d = 8$

$-\frac{3}{2}\left(-\frac{2}{3}d\right) = -\frac{3}{2}(8)$

$d = -12$

The solution is −12.

82. $-\frac{3}{5}m = 12$

$-\frac{5}{3}\left(-\frac{3}{5}m\right) = -\frac{5}{3}(12)$

$m = -20$

The solution is −20.

83. $\frac{2n}{3} = 0$

$\frac{3}{2}\left(\frac{2}{3}n\right) = \frac{3}{2}(0)$

$n = 0$

The solution is 0.

84. $\frac{5x}{6} = 0$

$\frac{6}{5}\left(\frac{5}{6}x\right) = \frac{6}{5}(0)$

$x = 0$

The solution is 0.

85. $\frac{-3z}{8} = 9$

$-\frac{8}{3}\left(-\frac{3}{8}z\right) = -\frac{8}{3}(9)$

$z = -24$

The solution is −24.

86. $\frac{3}{4}x = 2$

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

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

The solution is $\frac{8}{3}$.

87. $\frac{2}{9} = \frac{2}{3}y$

$\frac{3}{2}\left(\frac{2}{9}\right) = \frac{3}{2}\left(\frac{2}{3}y\right)$

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

The solution is $\frac{1}{3}$.

88. $-\frac{6}{7} = -\frac{3}{4}b$

$-\frac{4}{3}\left(-\frac{6}{7}\right) = -\frac{4}{3}\left(-\frac{3}{4}b\right)$

$\frac{8}{7} = b$

The solution is $\frac{8}{7}$.

89. $\frac{x}{1.46} = 3.25$

$1.46\left(\frac{1}{1.46}x\right) = 1.46(3.25)$

$x = 4.745$

The solution is 4.745.

90. $\frac{z}{2.95} = -7.88$

$2.95\left(\frac{1}{2.95}z\right) = 2.95(-7.88)$

$z = -23.246$

The solution is −23.246.

91. $3.47a = 7.1482$

$\frac{3.47a}{3.47} = \frac{7.1482}{3.47}$

$a = 2.06$

The solution is 2.06.

92. $2.31m = 2.4255$

$\frac{2.31m}{2.31} = \frac{2.4255}{2.31}$

$m = 1.05$

The solution is 1.05.

93. $2m + 5m = 49$

$7m = 49$

$\frac{7m}{7} = \frac{49}{7}$

$m = 7$

The solution is 7.

94. $5x + 2x = 14$

$7x = 14$

$\frac{7x}{7} = \frac{14}{7}$

$x = 2$

The solution is 2.

95. $3n + 2n = 20$

$5n = 20$

$\frac{5n}{5} = \frac{20}{5}$

$n = 4$

The solution is 4.

96. $7d - 4d = 9$

$3d = 9$

$\frac{3d}{3} = \frac{9}{3}$

$c = 3$

The solution is 3.

97. $10y - 3y = 21$
$7y = 21$
$\frac{7y}{7} = \frac{21}{7}$
$y = 3$
The solution is 3.

98. $2x - 5x = 9$
$-3x = 9$
$\frac{-3x}{-3} = \frac{9}{-3}$
$x = -3$
The solution is –3.

99. Positive

100. Negative

101. Negative

102. Negative

Objective D Exercises

103. $P \cdot B = A$
$0.35(80) = A$
$A = 28$
35% of 80 is 28.

104. $P \cdot B = A$
$P(8) = 0.5$
$\frac{P(8)}{8} = \frac{0.5}{8}$
$P = 0.0625$
$P = 6.25\%$
The percent is 6.25%.

105. $P \cdot B = A$
$0.012(60) = A$
$A = 0.72$
1.2% of 60 is 0.72.

106. $P \cdot B = A$
$P(5) = 8$
$\frac{P(5)}{5} = \frac{8}{5}$
$P = 1.6$
$P = 160\%$
The percent is 160%.

107. $P \cdot B = A$
$(1.25)B = 80$
$\frac{(1.25)B}{1.25} = \frac{80}{1.25}$
$B = 64$
The number is 64.

108. $P \cdot B = A$
$P(20) = 30$
$\frac{P(20)}{20} = \frac{30}{20}$
$P = 1.5$
$P = 150\%$
The percent is 150%.

109. $P \cdot B = A$
$P(50) = 12$
$\frac{P(50)}{50} = \frac{12}{50}$
$P = 0.24$
$P = 24\%$
The percent is 24%.

110. $P \cdot B = A$
$P(125) = 50$
$\frac{P(125)}{125} = \frac{50}{125}$
$P = 0.40$
$P = 40\%$
The percent is 40%.

111. $P \cdot B = A$
$0.18(40) = A$
$A = 7.2$
18% of 40 is 7.2.

112. $P \cdot B = A$
$0.25(60) = A$
$A = 15$
25% of 60 is 15.

113. $P \cdot B = A$
$0.12(B) = 48$
$\frac{0.12(B)}{0.12} = \frac{48}{0.12}$
$B = 400$
The number is 400.

114. $P \cdot B = A$
$0.45(B) = 9$
$\frac{0.45(B)}{0.45} = \frac{9}{0.45}$
$B = 20$
The number is 20.

115. $\frac{1}{3}(27) = A \quad \left(33\frac{1}{3}\% = \frac{1}{3}\right)$
$9 = A$
$33\frac{1}{3}\%$ of 27 is 9.

116. $\frac{1}{6}(30) = A \quad \left(16\frac{2}{3}\% = \frac{1}{6}\right)$
$5 = A$
$16\frac{2}{3}\%$ percent of 30 is 5.

117. $P(12) = 3$
$\frac{12P}{12} = \frac{3}{12}$
$P = 0.25$
The percent is 25%.

118. $P(15) = 10$
$\frac{15P}{15} = \frac{10}{15}$
$P = \frac{2}{3}$
The percent is $66\frac{2}{3}\%$.

119. $P \cdot B = A$
$P(6) = 12$
$\frac{P(6)}{6} = \frac{12}{6}$
$P = 2$
$P = 200\%$
The percent is 200%.

120. $P \cdot B = A$
$P(16) = 20$
$\frac{P(16)}{16} = \frac{20}{16}$
$P = 1.25$
$P = 125\%$
The percent is 125%.

121. $P \cdot B = A$
$0.0525B = 21$
$\frac{0.0525B}{0.0525} = \frac{21}{0.0525}$
$B = 400$
The number is 400.

122. $P \cdot B = A$
$0.375B = 15$
$\frac{0.375B}{0.375} = \frac{15}{0.375}$
$B = 40$
The number is 40.

123. $P \cdot B = A$
$0.154(50) = A$
$A = 7.7$
15.4% of 50 is 7.7.

124. $P \cdot B = A$
$0.185(46) = A$
$A = 8.51$
The number is 8.51.

125. $P \cdot B = A$
$0.005B = 1$
$\frac{0.005B}{0.005} = \frac{1}{0.005}$
$B = 200$
The number is 200.

126. $P \cdot B = A$
$0.015B = 3$
$\frac{0.015B}{0.015} = \frac{3}{0.015}$
$B = 200$
The number is 200.

127. $P \cdot B = A$
$0.0075B = 3$
$\frac{0.0075B}{0.0075} = \frac{3}{0.0075}$
$B = 400$
The number is 400.

128. $P \cdot B = A$
$0.005B = 3$
$\frac{0.005B}{0.005} = \frac{3}{0.005}$
$B = 600$
The number is 600.

129. $P \cdot B = A$
$2.5(12) = A$
$A = 30$
250% of 12 is 30.

130. Equal to

131. Less than

132. **Strategy** To find the amount, solve the basic percent equations, using $B = 100$ and $P = 66\frac{2}{3}\%$ or 0.6666…. The amount is unknown.

Solution

$$\begin{aligned} P \cdot B &= A \\ 0.66666...(100) &= A \\ 66.666... &= A \end{aligned}$$

67 votes are needed to override a veto.

133. **Strategy** To find the percent, solve the basic percent equation $P \cdot B = A$ using B = 26735 and A = 23126.

Solution

$$\begin{aligned} P \cdot B &= A \\ P \cdot 26735 &= 23126 \\ P &= \frac{23126}{26735} \\ P &= 0.979 \end{aligned}$$

97.9% of those that started, finished.

134. **Strategy** To find the total users next year, solve the basic percent equation $P \cdot B = A$ using P = 0.178 and A = 13.2.

Solution

$$\begin{aligned} P \cdot B &= A \\ 0.178B &= 13.2 \\ B &\approx 74 \end{aligned}$$

The total water usage per day is 74 gal per person.

135. **Strategy** To find the percent:
• Add the deaths to get the total number.
•Add the deaths from a fall (30), fire (47), and drowning (200).
• Solve the basic percent equation $P \cdot B = A$ using B = total deaths and A = total deaths from a fall, fire, and drowning

Solution

Total deaths: $30 + 47 + 200 + 1950 = 2227$

Deaths from a fall, fire, or drowning:

$30 + 47 + 200 = 277$

$$\begin{aligned} P \cdot B &= A \\ P2227 &= 277 \\ P &\approx .12 \end{aligned}$$

12% of accidental deaths are not car accidents.

136. You need to know the number of people three years old and older in the U.S that are enrolled in school.

137. **Strategy** To find the percent, solve the basic percent equation $P \cdot B = A$ using B = 2252 and A = 1850.

Solution

$$\begin{aligned} P \cdot B &= A \\ P2252 &= 1850 \\ P &\approx .821 \end{aligned}$$

The percent of the vacation costs that are charged is 82.1%.

138. **Strategy** To find the total electricity, solve the basic percent equation $P \cdot B = A$ using P = 0.33 and A = 31.7.

Solution

$$\begin{aligned} P \cdot B &= A \\ 0.33B &= 31.7 \\ B &\approx 96.1 \end{aligned}$$

The total electricity used was 96.1 billion killowatts.

139. **Strategy** To find the simple interest rate, solve the simple interest equation using I = \$72, P = \$1200, and t = 8 months = $\frac{8}{12}$ years, for r.

Solution

$$\begin{aligned} I &= Prt \\ 72 &= (1200)r\left(\frac{8}{12}\right) \\ 72 &= 800r \\ \frac{72}{800} &= \frac{800r}{800} \\ 0.09 &= r \end{aligned}$$

The annual simple interest rate is 9%.

140. **Strategy** To find the principal, solve the simple interest equation using I = \$300, r = 8% = 0.08, and t = 2 years, for P.

Solution

$$\begin{aligned} I &= Prt \\ 300 &= P(0.08)(2) \\ 300 &= 0.16P \\ \frac{300}{0.16} &= \frac{0.16P}{0.16} \\ 1875 &= P \end{aligned}$$

Andrea must invest \$1875.

141. Strategy To find the interest, solve the simple interest equation for each account:
First, using $P = \$1000$, $r = 7.5\% = 0.075$, and $t = 1$ year, for I.
Second, using $P = 3000 - 1000 = \$2000$, $r = 8.25\% = 0.0825$, and $t = 1$ year, for I.
Finally, find the total interest by adding the interest earned in each account.

Solution

$I = Prt$
$I = (1000)(0.075)(1)$
$I = 75$
$I = Prt$
$I = (2000)(0.0825)(1)$
$I = 165$

$75 + 165 = \$240$

Sal earned \$240 after one year.

142. Strategy To determine who will earn more interest after one year, solve the simple interest equation for each account:
First, using $P = \$2500$, $r = 8\% = 0.08$, and $t = 1$ year, for I.
Second, using $P = \$3000$, $r = 7\% = 0.07$, and $t = 1$ year, for I.
Finally, compare the interest earned.

Solution

$I = Prt$
$I = (2500)(0.08)(1)$
$I = 200$ Americo's interest

$I = Prt$
$I = (3000)(0.07)(1)$
$I = 210$ Octavia's interest

Americo's interest was \$200. Octavia's interest was \$210.
Octavia earns more interest after one year.

143. Strategy To find the amount of interest earned by Makana:
First, find the interest rate of Marlys by solving simple interest equation with $I = 51$, $P = \$850$, and $t = 1$ year, for r.
Second, find Makana's interest rate by increasing Marlys' interest rate by 1%.
Finally, using the rate found in the previous step, $P = \$900$, $t = 1$ year, and solve for I.

Solution

$I = Prt$
$51 = (850)(r)(1)$
$\frac{51}{850} = r$
$0.06 = r$

Marlys' rate is 6%: $0.06 + 0.01 = 0.07$

$I = Prt$
$I = (900)(0.07)(1)$
$I = 63$

Makana would earn \$63.

144. Strategy To determine how much was invested at 8%, solve the simple interest equation for each account:
First, using $P = \$2000$, $r = 6\% = 0.06$, and $t = 1$ year, for I.
Second, using the amount of interest found the first step for I, $r = 8\% = 0.08$, and $t = 1$ year, for P.

Solution

$I = Prt$
$I = (2000)(0.06)(1)$
$I = 120$

The interest on \$2000 at 6% is \$120.

$I = Prt$
$120 = P(0.08)(1)$
$\frac{120}{0.08} = P$
$1500 = P$

\$1500 was invested at 8%.

145. Strategy The principal for each investment is the same amount. The time the interest accrued is the same for each account. If one account earns 6% and the other earns 9%, the combined interest earned is between 6% and 9%. To find simple interest rate on the combined accounts, solve the simple interest equation for each account:
First, using $P = \$1000$, $r = 9\% = 0.09$, and $t = 1$ year, for I.
Second, using $P = \$1000$, $r = 6\% = 0.06$, and $t = 1$ year, for I.
Finally, to find the combined interest rate, add the value of $P = 1000 + 1000 = \$2000$, and total the interest earned in both accounts, using the simple interest equation to find r.

Solution

$$I = Prt$$
$$I = (1000)(0.09)(1)$$
$$I = 90$$

$$I = Prt$$
$$I = (1000)(0.06)(1)$$
$$I = 60$$

$$90 + 60 = (2000)r(1)$$
$$\frac{150}{2000} = \frac{2000r}{2000}$$
$$0.075 = r$$

The interest rate earned on the combined accounts is between 6% and 9%.

146. Strategy To find the amount of platinum, solve the basic percent equation using $P = 15\% = 0.15$ and $B = 12$g. The amount is unknown.

Solution

$$PB = A$$
$$0.15(12) = A$$
$$1.8 = A$$

There is 1.8 g of platinum in the necklace.

147. Strategy To find the percent, solve the basic percent equation using $B = 250$ and $A = 5$. The percent is the unknown.

Solution

$$PB = A$$
$$P(250) = 5$$
$$\frac{250P}{250} = \frac{5}{250}$$
$$P = 0.02$$

There is a 2% concentration of hydrogen peroxide.

148. Strategy To find the amount of wool, solve the basic percent equation using $P = 75\% = 0.75$ and $B = 175$ lb. The amount is unknown.

Solution

$$PB = A$$
$$0.75(175) = A$$
$$131.25 = A$$

There is a 131.25 lb of wool in the carpet.

149. Strategy To find which brand has the greater concentration, solve the basic percent equation for Apple Dan's using $B = 32$ and $A = 8$. The percent is the unknown. Then solve the basic percent equation for the generic brand using $B = 40$ and $A = 9$. The percent is the unknown. Compare the percent of concentration.

Solution

$$PB = A$$
$$P(32) = 8$$
$$\frac{32P}{32} = \frac{8}{32}$$
$$P = 0.25 \text{ Apple Dan's}$$

$$PB = A$$
$$P(40) = 9$$
$$\frac{40P}{40} = \frac{9}{40}$$
$$P = 0.225 \text{ generic}$$

$25\% > 22.5\%$
Apple Dan's concentration is 25%. The generic's concentration is 22.5%.
Apple Dan's has the greater concentration.

150. **Strategy** To find the percent, solve the basic percent equation using $B = 500 + 500 = 1000$ and $A = 500$. The percent is unknown.

Solution

$$\begin{aligned} PB &= A \\ P(1000) &= 500 \\ \frac{1000P}{1000} &= \frac{500}{1000} \\ P &= 0.5 \end{aligned}$$

The percent concentration is 50%.

151. **Strategy** To find the amount that is not glycerin, solve the basic percent equation, find the percent that is not glycerin using $P = 100 - 75\% = 25\% = 0.25$ and $B = 50$ g. The amount is unknown.

Solution

$$\begin{aligned} PB &= A \\ 0.25(50) &= A \\ 12.5 &= A \end{aligned}$$

There is 12.5 g of cream that is not glycerin.

152. **Strategy** To find the percent, solve the basic percent equation using $B = 100 + 50 = 150$ and $A = 100(9\%) = 9$. The percent is unknown.

Solution

$$\begin{aligned} PB &= A \\ P(150) &= 9 \\ \frac{150P}{150} &= \frac{9}{150} \\ P &= 0.06 \end{aligned}$$

The percent concentration is 6%.

153. **Strategy** To find the percent, solve the basic percent equation using $B = 500 - 100 = 400$ and $A = 50$. The percent is unknown.

Solution

$$\begin{aligned} PB &= A \\ P(400) &= 50 \\ \frac{400P}{400} &= \frac{50}{400} \\ P &= 0.125 \end{aligned}$$

The percent concentration is 12.5%.

Objective E Exercises

154. (a) greater than
(b) equal to
(c) 2 mi

155. (a) equal to
(b) less than

156. **Strategy** To find the time, solve $d = rt$ for t using $d = 1069$ km and $r = 350$.

Solution

$$\begin{aligned} d &= rt \\ 1069 &= 350t \\ \frac{1069}{350} &= \frac{350t}{350} \\ 3.1 &\approx t \end{aligned}$$

The time to travel between the two cities is 3.1 h.

157. **Strategy** To find the number of miles per hour, solve $d = rt$ for d using $d = 20$ mi and $t = \frac{40}{60} = \frac{2}{3}$ h.

Solution

$$\begin{aligned} d &= rt \\ 20 &= r\left(\frac{2}{3}\right) \\ \frac{3}{2}(20) &= r\left(\frac{2}{3}\right)\left(\frac{3}{2}\right) \\ 30 &= r \end{aligned}$$

The dietician's average rate of speed is 30 mph.

158. **Strategy** To find the number of miles traveled, solve $d = rt$ for d using $r = 9$ mph and $t = \frac{20}{60} = \frac{1}{3}$ h.

Solution

$$\begin{aligned} d &= rt \\ d &= 9\left(\frac{1}{3}\right) \\ d &= 3 \end{aligned}$$

The runner will travel 3 mi.

159. Strategy To find the number of miles traveled, solve $d = rt$ for d using $d = 27$ mi and $t = \frac{45}{60} = \frac{3}{4}$ h.

Solution

$$d = rt$$
$$27 = r\left(\frac{3}{4}\right)$$
$$36 = r$$

Marcella's average rate of speed is 36 mph.

160. Strategy To find the number of hours to complete the trip:
Find the number of hours riding by solving $d = rt$ for t using $d = 36$ mi and $r = 12$ mph.
Add the time taken for lunch (1 h) to the above time.

Solution

$$d = rt$$
$$36 = 12t$$
$$\frac{36}{12} = t$$
$$3 = r$$
$$3 \text{ h} + 1 \text{ h} = 4 \text{ h}$$

It will take them 4 h to complete the trip.

161. Strategy To find the number of hours to walk the course:
Find the rate to run the course by solving $d = rt$ for r using $d = 30$ km and $t = 2$ h.

Decrease the rate by 3 km/h to find his walking rate.

Solve for $d = rt$ for t using $d = 30$ km and r equal to his walking rate.

Solution

$$d = rt$$
$$30 = r(2)$$
$$\frac{30}{2} = r$$
$$15 = r \quad \text{His running rate}$$
$$15 - 3 = 12 \quad \text{His walking rate}$$
$$d = rt$$
$$30 = 12t$$
$$\frac{30}{12} = t$$
$$2.5 = t$$

It would take Palmer 2.5 h to walk the course.

162. Strategy The distance is 250 ft. Therefore $d = 250$. You are traveling at 5 ft/s and the moving sidewalk is traveling at 3 ft/s. Your rate is the sum of the two rates, or 8 ft/s. Therefore, $r = 8$. To find the time, solve $d = rt$ for t.

Solution

$$d = rt$$
$$250 = 8t$$
$$\frac{250}{8} = t$$
$$31.25 = t$$

It would take 31.25 s to walk from one end to the other.

163. Strategy The distance is 8 mi. Therefore $d = 8$. The joggers are running toward each other, one at 5 mph and one at 7 mph. The rate is the sum of the two rates, or 12 mph. So, $r = 12$. To find the time solve $d = rt$ for t. Convert the answer to minutes.

Solution

$$d = rt$$
$$8 = 12t$$
$$\frac{8}{12} = t$$
$$\frac{2}{3} = t$$
$$\frac{2}{3} \text{ h} = \frac{2}{3} \cdot 60 \text{ min} = 40 \text{ min}$$

The two joggers will meet 40 min after they start.

164. **Strategy** To find the time when they will meet:
• find the distance the sQuba on top of the water will travel in using $r = 3$ and using $t = t$.
• find the distance the sQuba on bottom of the water will travel in using $r = 1.8$ and using $t = t$.
• the total of the two distances must be 1.6, so write an equation and solve for t.

Solution

On top: $d = rt$, $d = 3t$

On bottom: $d = rt$, $d = 1.8t$

$$3t + 1.8t = 1.6$$
$$4.8t = 1.6$$
$$\frac{4.8t}{4.8} = \frac{1.6}{4.8}$$
$$t = \frac{1}{3}$$

$\frac{1}{3} \cdot 60 \text{ min} = 20 \text{ min}$

The sQuba on top of the water will be over the other sQuba in 20 min.

165. **Strategy** The two cyclists are traveling in opposite directions, one at 8 mph and one at 9 mph. The rate is the sum of the two rates, or 17 mph. So, $r = 17$. The time traveled is $30 \text{ min} = \frac{1}{2} \text{ h}$. So, $t = \frac{1}{2}$. To find the distance, solve $d = rt$ for d.

Solution

$$d = rt$$
$$d = 17 \cdot \frac{1}{2}$$
$$d = 8.5$$

The two cyclists are 8.5 mi apart.

166. **Strategy** The distance is 4 mi. So, $d = 4$. The canoe is traveling against a 2 mph current. In calm water they can paddle at 10 mph. The rate is $10 \text{ mph} - 2 \text{ mph} = 8 \text{ mph}$. So $r = 8$. Solve $d = rt$ for t.

Solution

$$d = rt$$
$$4 = 8t$$
$$\frac{4}{8} = t$$
$$\frac{1}{2} = t$$

It will take them 0.5 h.

167. **Strategy** To find the number of miles apart:
Find the distance the first train travels by solving $d = rt$ for d using $r = 45$ and $t = 2$.
Find the distance the second train travels by solving $d = rt$ for d using $r = 60$ and $t = 1$.
Find the difference between these distances.

Solution

First train: $d = rt$, $d = 45(2)$, $d = 90$

Second train: $d = rt$, $d = 60(1)$, $d = 60$

$90 - 60 = 30$

The trains are 30 mi apart.

Critical Thinking

168.
$$\frac{3y - 8y}{7} = 15$$
$$\frac{-5y}{7} = 15$$
$$\frac{7}{-5} \cdot \frac{-5y}{7} = 15 \cdot \frac{7}{-5}$$
$$y = -21$$

The solution is –21.

169. $\dfrac{2m+m}{5}=-9$

$\dfrac{3m}{5}=-9$

$\dfrac{5}{3}\cdot\dfrac{3m}{5}=-9\cdot\dfrac{5}{3}$

$m=-15$

The solution is –15.

170. $\dfrac{1}{\frac{1}{x}}+8=-19$

$\dfrac{1}{\frac{1}{x}}+8-8=-19-8$

$\dfrac{1}{\frac{1}{x}}=-27$

$\dfrac{1}{x}\cdot\dfrac{1}{\frac{1}{x}}=\dfrac{1}{x}\cdot(-27)$

$1=\dfrac{-27}{x}$

$x\cdot 1=x\cdot\dfrac{-27}{x}$

$x=-27$

The solution is –27.

171. $\dfrac{1}{\frac{1}{x}}=5$

$\dfrac{1}{x}\cdot\dfrac{1}{\frac{1}{x}}=\dfrac{1}{x}\cdot 5$

$1=\dfrac{5}{x}$

$x\cdot 1=x\cdot\dfrac{5}{x}$

$x=5$

The solution is 5.

172. $\dfrac{5}{\frac{7}{a}}-\dfrac{3}{\frac{7}{a}}=6$

$\dfrac{7}{a}\cdot\dfrac{5}{\frac{7}{a}}-\dfrac{7}{a}\cdot\dfrac{3}{\frac{7}{a}}=\dfrac{7}{a}\cdot 6$

$5-3=\dfrac{42}{a}$

$2=\dfrac{42}{a}$

$a\cdot 2=a\cdot\dfrac{42}{a}$

$2a=42$

$\dfrac{2a}{2}=\dfrac{42}{2}$

$a=21$

The solution is 21.

173. $\dfrac{4}{\frac{3}{b}}=8$

$\dfrac{3}{b}\cdot\dfrac{4}{\frac{3}{b}}=\dfrac{3}{b}\cdot 8$

$4=\dfrac{24}{b}$

$b\cdot 4=b\cdot\dfrac{24}{b}$

$4b=24$

$\dfrac{4b}{4}=\dfrac{24}{4}$

$b=6$

The solution is 6.

174. **Strategy** To find the p:
• find the amount of the bill without tax by solving the equation $B + BP = T$ for B, where $P = 0.725$ and $T = 92.74$
• find the amount of the tip by solving $BP = A$ for A using $P = 0.15$ and B as the total of the bill without tax.

Solution

$$B + BP = T$$
$$B + B.0725 = 92.74$$
$$1.0725B = 92.74$$
$$\frac{1.0725B}{1.0725} = \frac{92.74}{1.0725}$$
$$B = 86.47$$

$$BP = A$$
$$86.47 \cdot 0.15 = A$$
$$13 \approx A$$

The tip should be \$13.

175. Lower
After the increase, the cost is now $1.1C$ $(C + 0.1C = 1.1C)$. After the decrease, the new price is $0.99C$
$[1.1C - 0.1(1.1C) = 1.1C - 0.11C$
$= 0.99C]$.

176. $B + PB = A$
$B + 1B = 2B$
It is 2 times its original amount.

177. Employee B. If Employee B earned more before the raise and they got the same percent raise, then Employee B will get more after the raise.

178. Employee B. If they earned the same before the raise and Employee B got a bigger percent raise, then Employee B will earn more after the raise.

Projects and Group Activities

179. Answers will vary. One example is $x + 7 = 9$.

180. Answer will vary. One example is $3x = -3$.

181.
$$\frac{3}{7} + \frac{1}{b} = 2$$
$$7b \cdot \frac{3}{7} + 7b \cdot \frac{1}{b} = 7b \cdot 2$$
$$3b + 7 = 14b$$
$$3b - 3b + 7 = 14b - 3b$$
$$7 = 11b$$
$$\frac{7}{11} = \frac{11b}{11}$$
$$\frac{7}{11} = b$$

The solution is $\frac{7}{11}$.

182.
$$x + 5 = 10 - 15$$
$$x + 5 = -5$$
$$x + 5 - 5 = -5 - 5$$
$$x = -10$$

$$x + 5 = 15 - 10$$
$$x + 5 = 5$$
$$x + 5 - 5 = 5 - 5$$
$$x = 0$$

$$x + 10 = 5 - 15$$
$$x + 10 = -10$$
$$x + 10 - 10 = -10 - 10$$
$$x = -20$$

$$x + 10 = 15 - 5$$
$$x + 10 = 10$$
$$x + 10 - 10 = 10 - 10$$
$$x = 0$$

$$x + 15 = 5 - 10$$
$$x + 15 = -5$$
$$x + 15 - 15 = -5 - 15$$
$$x = -20$$

$$x + 15 = 10 - 5$$
$$x + 15 = 5$$
$$x + 15 - 15 = 5 - 15$$
$$x = -10$$

a. The largest solution is 0.

b. The smallest solution is –20.

183. a. Strategy To find the percent for each region:
• find the total population by adding the number in each region (67.4, 113.6, 72.2, and 55.8)
• find the percent by solving $BP = A$ for P using A = the total population and B as the population for each region.

Solution

Total: 67.4 + 113.6 + 72.2 + 55.8 = 309

Midwest: 21.8%

$$BP = A$$
$$309P = 67.4$$
$$P = \frac{67.4}{309}$$
$$P = 0.218$$

South: 36.8%

$$BP = A$$
$$309P = 113.6$$
$$P = \frac{113.6}{309}$$
$$P = 0.368$$

West: 23.4%

$$BP = A$$
$$309P = 72.2$$
$$P = \frac{72.2}{309}$$
$$P = 0.234$$

Northwest: 18.1%

$$BP = A$$
$$309P = 55.8$$
$$P = \frac{55.8}{309}$$
$$P = 0.181$$

b. South, South

c. Strategy To find the percent California, solve the formula $BP = A$ for P using P = the total population and A = 38.

Solution

$$BP = A$$
$$309P = 38$$
$$P = \frac{38}{309}$$
$$P = 0.123$$

12.3% of the population lives in California.

d. Strategy To find the population for Wyoming, solve the formula $BP = A$ for A using B = the total population and P = 0.00168.

Solution

$$BP = A$$
$$309(0.00168) = A$$
$$0.52 = P$$

0.52 million = 520,000

The population of Wyoming is 520,000.

e. Answers will vary.

Section 2.2

Concept Check

1. a and i, b and iii, c and ii, d and iv

2. False

3. 5; 8

4. 18

5. True

6. True

7. Subtract $2x$ from each side.

8. –2

Objective A Exercises

9.
$$3x + 1 = 10$$
$$3x + 1 - 1 = 10 - 1$$
$$3x = 9$$
$$\frac{3x}{3} = \frac{9}{3}$$
$$x = 3$$

The solution is 3.

10.
$$4y + 3 = 11$$
$$4y + 3 - 3 = 11 - 3$$
$$4y = 8$$
$$\frac{4y}{4} = \frac{8}{4}$$
$$y = 2$$

The solution is 2.

11.
$$2a - 5 = 7$$
$$2a - 5 + 5 = 7 + 5$$
$$2a = 12$$
$$\frac{2a}{2} = \frac{12}{2}$$
$$a = 6$$

The solution is 6.

12.
$$5m - 6 = 9$$
$$5m - 6 + 6 = 9 + 6$$
$$5m = 15$$
$$\frac{5m}{5} = \frac{15}{5}$$
$$m = 3$$

The solution is 3.

13.
$$5 = 4x + 9$$
$$5 - 9 = 4x + 9 - 9$$
$$-4 = 4x$$
$$\frac{-4}{4} = \frac{4x}{4}$$
$$-1 = x$$
The solution is -1.

14.
$$2 = 5b + 12$$
$$2 - 12 = 5b + 12 - 12$$
$$-10 = 5b$$
$$\frac{-10}{5} = \frac{5b}{5}$$
$$-2 = b$$
The solution is -2.

15.
$$2x - 5 = -11$$
$$2x - 5 + 5 = -11 + 5$$
$$2x = -6$$
$$\frac{2x}{2} = \frac{-6}{2}$$
$$x = -3$$
The solution is -3.

16.
$$3n - 7 = -19$$
$$3n - 7 + 7 = -19 + 7$$
$$3n = -12$$
$$\frac{3n}{3} = \frac{-12}{3}$$
$$n = -4$$
The solution is -4.

17.
$$4 - 3w = -2$$
$$4 - 4 - 3w = -2 - 4$$
$$-3w = -6$$
$$\frac{-3w}{-3} = \frac{-6}{-3}$$
$$w = 2$$
The solution is 2.

18.
$$5 - 6x = -13$$
$$5 - 5 - 6x = -13 - 5$$
$$-6x = -18$$
$$\frac{-6x}{-6} = \frac{-18}{-6}$$
$$x = 3$$
The solution is 3.

19.
$$8 - 3t = 2$$
$$8 - 8 - 3t = 2 - 8$$
$$-3t = -6$$
$$\frac{-3t}{-3} = \frac{-6}{-3}$$
$$t = 2$$
The solution is 2.

20.
$$12 - 5x = 7$$
$$12 - 12 - 5x = 7 - 12$$
$$-5x = -5$$
$$\frac{-5x}{-5} = \frac{-5}{-5}$$
$$x = 1$$
The solution is 1.

21.
$$4a - 20 = 0$$
$$4a - 20 + 20 = 0 + 20$$
$$4a = 20$$
$$\frac{4a}{4} = \frac{20}{4}$$
$$a = 5$$
The solution is 5.

22.
$$3y - 9 = 0$$
$$3y - 9 + 9 = 0 + 9$$
$$3y = 9$$
$$\frac{3y}{3} = \frac{9}{3}$$
$$y = 3$$
The solution is 3.

23.
$$6 + 2b = 0$$
$$6 - 6 + 2b = 0 - 6$$
$$2b = -6$$
$$\frac{2b}{2} = \frac{-6}{2}$$
$$b = -3$$
The solution is -3.

24.
$$10 + 5m = 0$$
$$10 - 10 + 5m = 0 - 10$$
$$5m = -10$$
$$\frac{5m}{5} = \frac{-10}{5}$$
$$m = -2$$
The solution is -2.

25. $-2x + 5 = -7$

$-2x + 5 - 5 = -7 - 5$

$-2x = -12$

$\frac{-2x}{-2} = \frac{-12}{-2}$

$x = 6$

The solution is 6.

26. $-5d + 3 = -12$

$-5d + 3 - 3 = -12 - 3$

$-5d = -15$

$\frac{-5d}{-5} = \frac{-15}{-5}$

$d = 3$

The solution is 3.

27. $-1.2x + 3 = -0.6$

$-1.2x + 3 - 3 = -0.6 - 3$

$-1.2x = -3.6$

$\frac{-1.2x}{-1.2} = \frac{-3.6}{-1.2}$

$x = 3$

The solution is 3.

28. $-1.3 = -1.1y + 0.9$

$-1.3 - 0.9 = -1.1y + 0.9 - 0.9$

$-2.2 = -1.1y$

$\frac{-2.2}{-1.1} = \frac{-1.1y}{-1.1}$

$2 = y$

The solution is 2.

29. $2 = 7 - 5a$

$2 - 7 = 7 - 7 - 5a$

$-5 = -5a$

$\frac{-5}{-5} = \frac{-5a}{-5}$

$1 = a$

The solution is 1.

30. $3 = 11 - 4n$

$3 - 11 = 11 - 11 - 4n$

$-8 = -4n$

$\frac{-8}{-4} = \frac{-4n}{-4}$

$2 = n$

The solution is 2.

31. $-35 = -6b + 1$

$-35 - 1 = -6b + 1 - 1$

$-36 = -6b$

$\frac{-36}{-6} = \frac{-6b}{-6}$

$6 = b$

The solution is 6.

32. $-8x + 3 = -29$

$-8x + 3 - 3 = -29 - 3$

$-8x = -32$

$\frac{-8x}{-8} = \frac{-32}{-8}$

$x = 4$

The solution is 4.

33. $-3m - 21 = 0$

$-3m - 21 + 21 = 0 + 21$

$-3m = 21$

$\frac{-3m}{-3} = \frac{21}{-3}$

$m = -7$

The solution is -7.

34. $-5x - 30 = 0$

$-5x - 30 + 30 = 0 + 30$

$-5x = 30$

$\frac{-5x}{-5} = \frac{30}{-5}$

$x = -6$

The solution is -6.

35. $-4y + 15 = 15$

$-4y + 15 - 15 = 15 - 15$

$-4y = 0$

$\frac{-4y}{-4} = \frac{0}{-4}$

$y = 0$

The solution is 0.

36. $-3x + 19 = 19$

$-3x + 19 - 19 = 19 - 19$

$-3x = 0$

$\frac{-3x}{-3} = \frac{0}{-3}$

$x = 0$

The solution is 0.

37.
$$\begin{aligned} 9-4x &= 6 \\ 9-9-4x &= 6-9 \\ -4x &= -3 \\ \frac{-4x}{-4} &= \frac{-3}{-4} \\ x &= \frac{3}{4} \end{aligned}$$
The solution is $\frac{3}{4}$.

38.
$$\begin{aligned} 3t-2 &= 0 \\ 3t-2+2 &= 0+2 \\ 3t &= 2 \\ \frac{3t}{3} &= \frac{2}{3} \\ t &= \frac{2}{3} \end{aligned}$$
The solution is $\frac{2}{3}$.

39.
$$\begin{aligned} 9x-4 &= 0 \\ 9x-4+4 &= 0+4 \\ 9x &= 4 \\ \frac{9x}{9} &= \frac{4}{9} \\ x &= \frac{4}{9} \end{aligned}$$
The solution is $\frac{4}{9}$.

40.
$$\begin{aligned} 7-8z &= 0 \\ 7-7-8z &= 0-7 \\ -8z &= -7 \\ \frac{-8z}{-8} &= \frac{-7}{-8} \\ z &= \frac{7}{8} \end{aligned}$$
The solution is $\frac{7}{8}$.

41.
$$\begin{aligned} 1-3x &= 0 \\ 1-1-3x &= 0-1 \\ -3x &= -1 \\ \frac{-3x}{-3} &= \frac{-1}{-3} \\ x &= \frac{1}{3} \end{aligned}$$
The solution is $\frac{1}{3}$.

42.
$$\begin{aligned} 9d+10 &= 7 \\ 9d+10-10 &= 7-10 \\ 9d &= -3 \\ \frac{9d}{9} &= \frac{-3}{9} \\ d &= -\frac{3}{9} \\ d &= -\frac{1}{3} \end{aligned}$$
The solution is $-\frac{1}{3}$.

43.
$$\begin{aligned} 12w+11 &= 5 \\ 12w+11-11 &= 5-11 \\ 12w &= -6 \\ \frac{12w}{12} &= \frac{-6}{12} \\ w &= -\frac{6}{12} \\ w &= -\frac{1}{2} \end{aligned}$$
The solution is $-\frac{1}{2}$.

44.
$$\begin{aligned} 6y-5 &= -7 \\ 6y-5+5 &= -7+5 \\ 6y &= -2 \\ \frac{6y}{6} &= \frac{-2}{6} \\ y &= -\frac{2}{6} \\ y &= -\frac{1}{3} \end{aligned}$$
The solution is $-\frac{1}{3}$.

45.
$$\begin{aligned} 8b-3 &= -9 \\ 8b-3+3 &= -9+3 \\ 8b &= -6 \\ \frac{8b}{8} &= \frac{-6}{8} \\ b &= -\frac{6}{8} \\ b &= -\frac{3}{4} \end{aligned}$$
The solution is $-\frac{3}{4}$.

46. $5-6m=2$

$5-5-6m=2-5$

$-6m=-3$

$\frac{-6m}{-6}=\frac{-3}{-6}$

$m=\frac{3}{6}$

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

The solution is $\frac{1}{2}$.

47. $7-9a=4$

$7-7-9a=4-7$

$-9a=-3$

$\frac{-9a}{-9}=\frac{-3}{-9}$

$a=\frac{3}{9}$

$a=\frac{1}{3}$

The solution is $\frac{1}{3}$.

48. $9=-12c+5$

$9-5=-12c+5-5$

$4=-12c$

$\frac{4}{-12}=\frac{-12c}{-12}$

$-\frac{4}{12}=c$

$-\frac{1}{3}=c$

The solution is $-\frac{1}{3}$.

49. $10=-18x+7$

$10-7=-18x+7-7$

$3=-18x$

$\frac{3}{-18}=\frac{-18x}{-18}$

$-\frac{3}{18}=x$

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

The solution is $-\frac{1}{6}$.

50. $5y+\frac{3}{7}=\frac{3}{7}$

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

$5y=0$

$\frac{5y}{5}=\frac{0}{5}$

$y=0$

The solution is 0.

51. $9x+\frac{4}{5}=\frac{4}{5}$

$9x+\frac{4}{5}-\frac{4}{5}=\frac{4}{5}-\frac{4}{5}$

$9x=0$

$\frac{9x}{9}=\frac{0}{9}$

$x=0$

The solution is 0.

52. $0.8=7d+0.1$

$0.8-0.1=7d+0.1-0.1$

$0.7=7d$

$\frac{0.7}{7}=\frac{7d}{7}$

$0.1=d$

The solution is 0.1.

53. $0.9=10x-0.6$

$0.9+0.6=10x-0.6+0.6$

$1.5=10x$

$\frac{1.5}{10}=\frac{10x}{10}$

$0.15=x$

The solution is 0.15.

54. $-6y+5=13$

$-6y+5-5=13-5$

$-6y=8$

$\frac{-6y}{-6}=\frac{8}{-6}$

$y=-\frac{8}{6}$

$y=-\frac{4}{3}$

The solution is $-\frac{4}{3}$.

55. $-4x+3=9$

$-4x+3-3=9-3$

$-4x=6$

$\frac{-4x}{-4}=\frac{6}{-4}$

$x=-\frac{6}{4}$

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

The solution is $-\frac{3}{2}$.

56. $\frac{1}{2}a-3=1$

$\frac{1}{2}a-3+3=1+3$

$\frac{1}{2}a=4$

$2\left(\frac{1}{2}a\right)=2\cdot 4$

$a=8$

The solution is 8.

57. $\frac{1}{3}m-1=5$

$\frac{1}{3}m-1+1=5+1$

$\frac{1}{3}m=6$

$3\left(\frac{1}{3}m\right)=3\cdot 6$

$m=18$

The solution is 18.

58. $\frac{2}{5}y+4=6$

$\frac{2}{5}y+4-4=6-4$

$\frac{2}{5}y=2$

$\frac{5}{2}\left(\frac{2}{5}y\right)=\frac{5}{2}(2)$

$y=5$

The solution is 5.

59. $\frac{3}{4}n+7=13$

$\frac{3}{4}n+7-7=13-7$

$\frac{3}{4}n=6$

$\frac{4}{3}\left(\frac{3}{4}n\right)=\frac{4}{3}(6)$

$n=8$

The solution is 8.

60. $-\frac{2}{3}x+1=7$

$-\frac{2}{3}x+1-1=7-1$

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

$-\frac{3}{2}\left(-\frac{2}{3}x\right)=-\frac{3}{2}(6)$

$x=-9$

The solution is −9.

61. $-\frac{3}{8}b+4=10$

$-\frac{3}{8}b+4-4=10-4$

$-\frac{3}{8}b=6$

$-\frac{8}{3}\left(-\frac{3}{8}b\right)=-\frac{8}{3}(6)$

$b=-16$

The solution is −16.

62. $\frac{x}{4}-6=1$

$\frac{x}{4}-6+6=1+6$

$\frac{x}{4}=7$

$4\left(\frac{1}{4}x\right)=4\cdot 7$

$x=28$

The solution is 28.

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

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

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

$5\left(\frac{1}{5}y\right) = 5 \cdot 5$

$y = 25$

The solution is 25.

64. $\frac{2x}{3} - 1 = 5$

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

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

$\frac{3}{2}\left(\frac{2}{3}x\right) = \frac{3}{2}(6)$

$x = 9$

The solution is 9.

65. $\frac{2}{3}x - \frac{5}{6} = -\frac{1}{3}$

$6\left(\frac{2}{3}x - \frac{5}{6}\right) = 6\left(-\frac{1}{3}\right)$

$4x - 5 = -2$

$4x = 3$

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

The solution is $\frac{3}{4}$.

66. $\frac{5}{4}x + \frac{2}{3} = \frac{1}{4}$

$12\left(\frac{5}{4}x + \frac{2}{3}\right) = 12\left(\frac{1}{4}\right)$

$15x + 8 = 3$

$15x = -5$

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

The solution is $-\frac{1}{3}$.

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

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

$6 - 8x = 3$

$-8x = -3$

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

The solution is $\frac{3}{8}$.

68. $\frac{3}{4} - \frac{3}{5}x = \frac{19}{20}$

$20\left(\frac{3}{4} - \frac{3}{5}x\right) = 20\left(\frac{19}{20}\right)$

$15 - 12x = 19$

$-12x = 4$

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

The solution is $-\frac{1}{3}$.

69. $\frac{3}{2} = \frac{5}{6} + \frac{3x}{8}$

$\frac{3}{2} - \frac{5}{6} = \frac{5}{6} - \frac{5}{6} + \frac{3x}{8}$

$\frac{2}{3} = \frac{3x}{8}$

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

$\frac{16}{9} = x$

The solution is $\frac{16}{9}$.

70. $-\frac{1}{4} = \frac{5}{12} + \frac{5x}{6}$

$-\frac{1}{4} - \frac{5}{12} = \frac{5}{12} - \frac{5}{12} + \frac{5x}{6}$

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

$\frac{6}{5}\left(-\frac{2}{3}\right) = \frac{6}{5}\left(\frac{5x}{6}\right)$

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

The solution is $-\frac{4}{5}$.

71. $\frac{11}{27} = \frac{4}{9} - \frac{2x}{3}$

$\frac{11}{27} - \frac{4}{9} = \frac{4}{9} - \frac{4}{9} - \frac{2x}{3}$

$-\frac{1}{27} = -\frac{2x}{3}$

$-\frac{3}{2}\left(-\frac{1}{27}\right) = -\frac{3}{2}\left(-\frac{2x}{3}\right)$

$\frac{1}{18} = x$

The solution is $\frac{1}{18}$.

72.
$$\frac{37}{24} = \frac{7}{8} - \frac{5x}{6}$$
$$24\left(\frac{37}{24}\right) = 24\left(\frac{7}{8} - \frac{5x}{6}\right)$$
$$37 = 21 - 20x$$
$$37 - 21 = 21 - 20x - 21$$
$$16 = -20x$$
$$-\frac{4}{5} = x$$

The solution is $-\frac{4}{5}$.

73.
$$7 = \frac{2x}{5} + 4$$
$$7 - 4 = \frac{2x}{5} + 4 - 4$$
$$3 = \frac{2x}{5}$$
$$\frac{5}{2}(3) = \frac{5}{2}\left(\frac{2}{5}x\right)$$
$$\frac{15}{2} = x$$

The solution is $\frac{15}{2}$.

74.
$$5 - \frac{4}{7}c = 8$$
$$5 - 5 - \frac{4}{7}c = 8 - 5$$
$$-\frac{4}{7}c = 3$$
$$-\frac{7}{4}\left(-\frac{4}{7}c\right) = -\frac{7}{4}(3)$$
$$c = -\frac{21}{4}$$

The solution is $-\frac{21}{4}$.

75.
$$7 - \frac{5}{9}y = 9$$
$$7 - 7 - \frac{5}{9}y = 9 - 7$$
$$-\frac{5}{9}y = 2$$
$$-\frac{9}{5}\left(-\frac{5}{9}y\right) = -\frac{9}{5}(2)$$
$$y = -\frac{18}{5}$$

The solution is $-\frac{18}{5}$.

76.
$$6a + 3 + 2a = 11$$
$$8a + 3 = 11$$
$$8a + 3 - 3 = 11 - 3$$
$$8a = 8$$
$$\frac{8a}{8} = \frac{8}{8}$$
$$a = 1$$

The solution is 1.

77.
$$5y + 9 + 2y = 23$$
$$7y + 9 = 23$$
$$7y + 9 - 9 = 23 - 9$$
$$7y = 14$$
$$\frac{7y}{7} = \frac{14}{7}$$
$$y = 2$$

The solution is 2.

78.
$$7x - 4 - 2x = 6$$
$$5x - 4 = 6$$
$$5x - 4 + 4 = 6 + 4$$
$$5x = 10$$
$$\frac{5x}{5} = \frac{10}{5}$$
$$x = 2$$

The solution is 2.

79.
$$11z - 3 - 7z = 9$$
$$4z - 3 = 9$$
$$4z - 3 + 3 = 9 + 3$$
$$4z = 12$$
$$\frac{4z}{4} = \frac{12}{4}$$
$$z = 3$$

The solution is 3.

80.
$$2x - 6x + 1 = 9$$
$$-4x + 1 = 9$$
$$-4x + 1 - 1 = 9 - 1$$
$$-4x = 8$$
$$\frac{-4x}{-4} = \frac{8}{-4}$$
$$x = -2$$

The solution is −2.

81. Negative

82. Positive

83. Negative

84. Positive

85. $3x+4y=13$ **when** $y=-2$

$$3x+4(-2)=13$$
$$3x-8=13$$
$$3x-8+8=13+8$$
$$3x=21$$
$$\frac{3x}{3}=\frac{21}{3}$$
$$x=7$$

The solution is 7.

86. $2x-3y=8,$ **when** $y=0$

$$2x-3(0)=8$$
$$2x=8$$
$$\frac{2x}{2}=\frac{8}{2}$$
$$x=4$$

The solution is 4.

87.
$$4-5x=-1$$
$$4-4-5x=-1-4$$
$$-5x=-5$$
$$\frac{-5x}{-5}=\frac{-5}{-5}$$
$$x=1$$

$x^2-3x+1;\ x=1$

$$(1)^2-3(1)+1$$
$$1-3+1$$
$$-1$$

Objective B Exercises

88.
$$8x+5=4x+13$$
$$8x-4x+5=4x-4x+13$$
$$4x+5=13$$
$$4x+5-5=13-5$$
$$4x=8$$
$$\frac{4x}{4}=\frac{8}{4}$$
$$x=2$$

The solution is 2.

89.
$$6y+2=y+17$$
$$6y-y+2=y-y+17$$
$$5y+2=17$$
$$5y+2-2=17-2$$
$$5y=15$$
$$\frac{5y}{5}=\frac{15}{5}$$
$$y=3$$

The solution is 3.

90.
$$5x-4=2x+5$$
$$5x-2x-4=2x-2x+5$$
$$3x-4+4=5+4$$
$$3x=9$$
$$\frac{3x}{3}=\frac{9}{3}$$
$$x=3$$

The solution is 3.

91.
$$13b-1=4b-19$$
$$13b-4b-1=4b-4b-19$$
$$9b-1=-19$$
$$9b-1+1=-19+1$$
$$9b=-18$$
$$\frac{9b}{9}=\frac{-18}{9}$$
$$b=-2$$

The solution is –2.

92.
$$15x-2=4x-13$$
$$15x-4x-2=4x-4x-13$$
$$11x-2=-13$$
$$11x-2+2=-13+2$$
$$11x=-11$$
$$\frac{11x}{11}=\frac{-11}{11}$$
$$x=-1$$

The solution is –1.

93.
$$7a-5=2a-20$$
$$7a-2a-5=2a-2a-20$$
$$5a-5=-20$$
$$5a-5+5=-20+5$$
$$5a=-15$$
$$\frac{5a}{5}=\frac{-15}{5}$$
$$a=-3$$

The solution is –3.

94.
$$\begin{aligned} 3x+1 &= 11-2x \\ 3x+2x+1 &= 11-2x+2x \\ 5x+1 &= 11 \\ 5x+1-1 &= 11-1 \\ 5x &= 10 \\ \frac{5x}{5} &= \frac{10}{5} \\ x &= 2 \end{aligned}$$
The solution is 2.

95.
$$\begin{aligned} n-2 &= 6-3n \\ n+3n-2 &= 6+3n+3n \\ 4n-2 &= 6 \\ 4n-2+2 &= 6+2 \\ 4n &= 8 \\ \frac{4n}{4} &= \frac{8}{4} \\ n &= 2 \end{aligned}$$
The solution is 2.

96.
$$\begin{aligned} 2x-3 &= -11-2x \\ 2x+2x-3 &= -11-2x+2x \\ 4x-3 &= -11 \\ 4x-3+3 &= -11+3 \\ 4x &= -8 \\ \frac{4x}{4} &= \frac{-8}{4} \\ x &= -2 \end{aligned}$$
The solution is –2.

97.
$$\begin{aligned} 4y-2 &= -16-3y \\ 4y+3y-2 &= -16-3y+3y \\ 7y-2 &= -16 \\ 7y-2+2 &= -16+2 \\ 7y &= -14 \\ \frac{7y}{7} &= \frac{-14}{7} \\ y &= -2 \end{aligned}$$
The solution is –2.

98.
$$\begin{aligned} 0.2b+3 &= 0.5b+12 \\ 0.2b-0.5b+3 &= 0.5b-0.5b+12 \\ -0.3b+3 &= 12 \\ -0.3b+3-3 &= 12-3 \\ -0.3b &= 9 \\ \frac{-0.3b}{-0.3} &= \frac{9}{-0.3} \\ b &= -30 \end{aligned}$$
The solution is –30.

99.
$$\begin{aligned} m+0.4 &= 3m+0.8 \\ m-3m+0.4 &= 3m-3m+0.8 \\ -2m+0.4 &= 0.8 \\ -2m+0.4-0.4 &= 0.8-0.4 \\ -2m &= 0.4 \\ \frac{-2m}{-2} &= \frac{0.4}{-2} \\ m &= -0.2 \end{aligned}$$
The solution is –0.2.

100.
$$\begin{aligned} 4y-8 &= y-8 \\ 4y-y-8 &= y-y-8 \\ 3y-8 &= -8 \\ 3y-8+8 &= -8+8 \\ 3y &= 0 \\ \frac{3y}{3} &= \frac{0}{3} \\ y &= 0 \end{aligned}$$
The solution is 0.

101.
$$\begin{aligned} 5a+7 &= 2a+7 \\ 5a-2a+7 &= 2a-2a+7 \\ 3a+7 &= 7 \\ 3a+7-7 &= 7-7 \\ 3a &= 0 \\ \frac{3a}{3} &= \frac{0}{3} \\ a &= 0 \end{aligned}$$
The solution is 0.

102.
$$\begin{aligned} 6-5x &= 8-3x \\ 6-5x+3x &= 8-3x+3x \\ 6-2x &= 8 \\ 6-6-2x &= 8-6 \\ -2x &= 2 \\ \frac{-2x}{-2} &= \frac{2}{-2} \\ x &= -1 \end{aligned}$$
The solution is –1.

103.
$$\begin{aligned} 10-4n &= 16-n \\ 10-4n+n &= 16-n+n \\ 10-3n &= 16 \\ 10-10-3n &= 16-10 \\ -3n &= 6 \\ \frac{-3n}{-3} &= \frac{6}{-3} \\ n &= -2 \end{aligned}$$
The solution is –2.

104.
$$\begin{aligned} 5+7x &= 11+9x \\ 5+7x-9x &= 11+9x-9x \\ 5-2x &= 11 \\ 5-5-2x &= 11-5 \\ -2x &= 6 \\ \frac{-2x}{-2} &= \frac{6}{-2} \\ x &= -3 \end{aligned}$$
The solution is –3.

105.
$$\begin{aligned} 3-2y &= 15+4y \\ 3-2y-4y &= 15+4y-4y \\ 3-6y &= 15 \\ 3-3-6y &= 15-3 \\ -6y &= 12 \\ \frac{-6y}{-6} &= \frac{12}{-6} \\ y &= -2 \end{aligned}$$
The solution is –2.

106.
$$\begin{aligned} 2x-4 &= 6x \\ 2x-2x-4 &= 6x-2x \\ -4 &= 4x \\ \frac{-4}{4} &= \frac{4x}{4} \\ -1 &= x \end{aligned}$$
The solution is –1.

107.
$$\begin{aligned} 2b-10 &= 7b \\ 2b-2b-10 &= 7b-2b \\ -10 &= 5b \\ \frac{-10}{5} &= \frac{5b}{5} \\ -2 &= b \end{aligned}$$
The solution is –2.

108.
$$\begin{aligned} 8m &= 3m+20 \\ 8m-3m &= 3m-3m+20 \\ 5m &= 20 \\ \frac{5m}{5} &= \frac{20}{5} \\ m &= 4 \end{aligned}$$
The solution is 4.

109.
$$\begin{aligned} 9y &= 5y+16 \\ 9y-5y &= 5y-5y+16 \\ 4y &= 16 \\ \frac{4y}{4} &= \frac{16}{4} \\ y &= 4 \end{aligned}$$
The solution is 4.

110.
$$\begin{aligned} 8b+5 &= 5b+7 \\ 8b-5b+5 &= 5b-5b+7 \\ 3b+5 &= 7 \\ 3b+5-5 &= 7-5 \\ 3b &= 2 \\ \frac{3b}{3} &= \frac{2}{3} \\ b &= \frac{2}{3} \end{aligned}$$
The solution is $\frac{2}{3}$.

111.
$$\begin{aligned} 6y-1 &= 2y+2 \\ 6y-2y-1 &= 2y-2y+2 \\ 4y-1 &= 2 \\ 4y-1+1 &= 2+1 \\ 4y &= 3 \\ \frac{4y}{4} &= \frac{3}{4} \\ y &= \frac{3}{4} \end{aligned}$$
The solution is $\frac{3}{4}$.

112.
$$\begin{aligned} 7x-8 &= x-3 \\ 7x-x-8 &= x-x-3 \\ 6x-8 &= -3 \\ 6x-8+8 &= -3+8 \\ 6x &= 5 \\ \frac{6x}{6} &= \frac{5}{6} \\ x &= \frac{5}{6} \end{aligned}$$
The solution is $\frac{5}{6}$.

113.
$$\begin{aligned} 2y-7 &= -1-2y \\ 2y+2y-7 &= -1-2y+2y \\ 4y-7 &= -1 \\ 4y-7+7 &= -1+7 \\ 4y &= 6 \\ \frac{4y}{4} &= \frac{6}{4} \\ y &= \frac{3}{2} \end{aligned}$$
The solution is $\frac{3}{2}$.

114. $2m - 1 = -6m + 5$
$2m + 6m - 1 = -6m + 6m + 5$
$8m - 1 = 5$
$8m - 1 + 1 = 5 + 1$
$8m = 6$
$\frac{8m}{8} = \frac{6}{8}$
$m = \frac{3}{4}$

The solution is $\frac{3}{4}$.

115. $5x = 3x - 8$
$5x - 3x = 3x - 3x - 8$
$2x = -8$
$\frac{2x}{2} = \frac{-8}{2}$
$x = -4$

$4x + 2$
$= 4(-4) + 2$
$= -16 + 2$
$= -14$

The answer is –14.

116. $7x + 3 = 5x - 7$
$7x - 5x + 3 = 5x - 5x - 7$
$2x + 3 = -7$
$2x + 3 - 3 = -7 - 3$
$2x = -10$
$\frac{2x}{2} = \frac{-10}{2}$
$x = -5$

$3x - 2$
$= 3(-5) - 2$
$= -15 - 2$
$= -17$

The answer is –17.

117. $2 - 6a = 5 - 3a$
$2 - 6a + 3a = 5 - 3a + 3a$
$2 - 3a = 5$
$2 - 2 - 3a = 5 - 2$
$-3a = 3$
$\frac{-3a}{-3} = \frac{3}{-3}$
$a = -1$

$4a^2 - 2a + 1$
$= 4(-1)^2 - 2(-1) + 1$
$= 4(1) - 2(-1) + 1$
$= 4 + 2 + 1$
$= 6 + 1$
$= 7$

The answer is 7.

118. $1 - 5c = 4 - 4c$
$1 - 5c + 4c = 4 - 4c + 4c$
$1 - c = 4$
$1 - 1 - c = 4 - 1$
$-c = 3$
$-1(-c) = -1(3)$
$c = -3$

$3c^2 - 4c + 2$
$= 3(-3)^2 - 4(-3) + 2$
$= 3(9) - 4(-3) + 2$
$= 27 + 12 + 2$
$= 39 + 2$
$= 41$

The answer is 41.

Objective C Exercises

119. (ii)

120. $5x + 2(x + 1) = 23$
$5x + 2x + 2 = 23$
$7x + 2 = 23$
$7x + 2 - 2 = 23 - 2$
$7x = 21$
$\frac{7x}{7} = \frac{21}{7}$
$x = 3$

The solution is 3.

121. $6y + 2(2y + 3) = 16$
$6y + 4y + 6 = 16$
$10y + 6 = 16$
$10y + 6 - 6 = 16 - 6$
$10y = 10$
$\frac{10y}{10} = \frac{10}{10}$
$y = 1$

The solution is 1.

122. $9n - 3(2n - 1) = 15$
$9n - 6n + 3 = 15$
$3n + 3 = 15$
$3n + 3 - 3 = 15 - 3$
$3n = 12$
$\frac{3n}{3} = \frac{12}{3}$
$n = 4$

The solution is 4.

123. $12x - 2(4x - 6) = 28$
$12x - 8x + 12 = 28$
$4x + 12 = 28$
$4x + 12 - 12 = 28 - 12$
$4x = 16$
$\frac{4x}{4} = \frac{16}{4}$
$x = 4$

The solution is 4.

124. $7a - (3a - 4) = 12$
$7a - 3a + 4 = 12$
$4a + 4 = 12$
$4a + 4 - 4 = 12 - 4$
$4a = 8$
$\frac{4a}{4} = \frac{8}{4}$
$a = 2$

The solution is 2.

125. $9m - 4(2m - 3) = 11$
$9m - 8m + 12 = 11$
$m + 12 = 11$
$m + 12 - 12 = 11 - 12$
$m = -1$
The solution is –1.

126. $5(3 - 2y) + 4y = 3$
$15 - 10y + 4y = 3$
$15 - 6y = 3$
$15 - 15 - 6y = 3 - 15$
$-6y = -12$
$\frac{-6y}{-6} = \frac{-12}{-6}$
$y = 2$
The solution is 2.

127. $4(1 - 3x) + 7x = 9$
$4 - 12x + 7x = 9$
$4 - 5x = 9$
$4 - 4 - 5x = 9 - 4$
$-5x = 5$
$\frac{-5x}{-5} = \frac{5}{-5}$
$x = -1$
The solution is –1.

128. $5y - 3 = 7 + 4(y - 2)$
$5y - 3 = 7 + 4y - 8$
$5y - 3 = -1 + 4y$
$5y - 4y - 3 = -1 + 4y - 4y$
$y - 3 = -1$
$y - 3 + 3 = -1 + 3$
$y = 2$
The solution is 2.

129. $0.22(x + 6) = 0.2x + 1.8$
$0.22x + 1.32 = 0.2x + 1.8$
$0.22x - 0.2x + 1.32 = 0.2x - 0.2x + 1.8$
$0.02x + 1.32 = 1.8$
$0.02x + 1.32 - 1.32 = 1.8 - 1.32$
$0.02x = 0.48$
$\frac{0.02x}{0.02} = \frac{0.48}{0.02}$
$x = 24$
The solution is 24.

130. $0.05(4 - x) + 0.1x = 0.32$
$0.2 - 0.05x + 0.1x = 0.32$
$0.2 + 0.05x = 0.32$
$0.2 - 0.2 + 0.05x = 0.32 - 0.2$
$0.05x = 0.12$
$\frac{0.05x}{0.05} = \frac{0.12}{0.05}$
$x = 2.4$
The solution is 2.4.

131. $0.3x + 0.3(x + 10) = 300$
$0.3x + 0.3x + 3 = 300$
$0.6x + 3 = 300$
$0.6x + 3 - 3 = 300 - 3$
$0.6x = 297$
$\frac{0.6x}{0.6} = \frac{297}{0.6}$
$x = 495$
The solution is 495.

132. $2a - 5 = 4(3a + 1) - 2$
$2a - 5 = 12a + 4 - 2$
$2a - 5 = 12a + 2$
$2a - 12a - 5 = 12a - 12a + 2$
$-10a - 5 = 2$
$-10a - 5 + 5 = 2 + 5$
$-10a = 7$
$\frac{-10a}{-10} = \frac{7}{-10}$
$a = -\frac{7}{10}$
The solution is $-\frac{7}{10}$.

133. $5 - (9 - 6x) = 2x - 2$
$5 - 9 + 6x = 2x - 2$
$-4 + 6x = 2x - 2$
$-4 + 6x - 2x = 2x - 2x - 2$
$-4 + 4x = -2$
$-4 + 4 + 4x = -2 + 4$
$4x = 2$
$\frac{4x}{4} = \frac{2}{4}$
$x = \frac{1}{2}$
The solution is $\frac{1}{2}$.

134. $7-(5-8x)=4x+3$

$7-5+8x=4x+3$

$2+8x=4x+3$

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

$2+4x=3$

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

$4x=1$

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

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

The solution is $\frac{1}{4}$.

135. $3\,2-4(y-1)=3(2y+8)$

$3\,2-4y+4=6y+24$

$3\,6-4y=6y+24$

$18-12y=6y+24$

$18-12y-6y=6y-6y+24$

$18-18y=24$

$18-18-18y=24-18$

$-18y=6$

$\frac{-18y}{-18}=\frac{6}{-18}$

$y=-\frac{1}{3}$

The solution is $-\frac{1}{3}$.

136. $5\,2-(2x-4)=2(5-3x)$

$5\,2-2x+4=10-6x$

$5\,6-2x=10-6x$

$30-10x=10-6x$

$30-10x+6x=10-6x+6x$

$30-4x=10$

$30-30-4x=10-30$

$-4x=-20$

$\frac{-4x}{-4}=\frac{-20}{-4}$

$x=5$

The solution is 5.

137. $3a+2\,2+3(a-1)=2(3a+4)$

$3a+2\,2+3a-3=6a+8$

$3a+2-1+3a=6a+8$

$3a-2+6a=6a+8$

$9a-2=6a+8$

$9a-6a-2=6a-6a+8$

$3a-2=8$

$3a-2+2=8+2$

$3a=10$

$\frac{3a}{3}=\frac{10}{3}$

$a=\frac{10}{3}$

The solution is $\frac{10}{3}$.

138. $5+3\,1+2(2x-3)=6(x+5)$

$5+3\,1+4x-6=6x+30$

$5+3-5+4x=6x+30$

$5-15+12x=6x+30$

$-10+12x=6x+30$

$-10+12x-6x=6x-6x+30$

$-10+6x=30$

$-10+10+6x=30+10$

$6x=40$

$\frac{6x}{6}=\frac{40}{6}$

$x=\frac{20}{3}$

The solution is $\frac{20}{3}$.

139. $-2\,4-(3b+2)=5-2(3b+6)$

$-2\,4-3b-2=5-6b-12$

$-2\,2-3b=-7-6b$

$-4+6b=-7-6b$

$-4+6b+6b=-7-6b+6b$

$-4+12b=-7$

$-4+4+12b=-7+4$

$12b=-3$

$\frac{12b}{12}=\frac{-3}{12}$

$b=-\frac{1}{4}$

The solution is $-\frac{1}{4}$.

140. $-4x-2(2x-3)+1=2x-3$

$-4x-4x+6+1=2x-3$

$-4-3x+6+1=2x-3$

$12x-24+1=2x-3$

$12x-23=2x-3$

$12x-2x-23=2x-2x-3$

$10x-23=-3$

$10x-23+23=-3+23$

$10x=20$

$\frac{10x}{10}=\frac{20}{10}$

$x=2$

The solution is 2.

141. $4-3a=7-2(2a+5)$

$4-3a=7-4a-10$

$4-3a=-3-4a$

$4-3a+4a=-3-4a+4a$

$4+a=-3$

$4-4+a=-3-4$

$a=-7$

a^2+7a

$=(-7)^2+(7)(-7)$

$=49+(7)(-7)$

$=49-49$

$=0$

The answer is 0.

142. $9-5x=12-(6x+7)$

$9-5x=12-6x-7$

$9-5x=5-6x$

$9-5x+6x=5-6x+6x$

$9+x=5$

$9-9+x=5-9$

$x=-4$

x^2-3x-2

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

$=16-3(-4)-2$

$=16+12-2$

$=28-2$

$=26$

The answer is 26.

Objective D Exercises

143. **Strategy** $F=14$

Unknown: m

Solution

$F=2.5+2.3(m-1)$

$14=2.5+2.3m-2.3$

$14=0.2+2.3m$

$14-0.2=0.2-0.2+2.3m$

$13.98=2.3m$

$\frac{13.98}{2.3}=\frac{2.3m}{2.3}$

$6.08\approx m$

The customer drove 6 mi.

144. **Strategy** $F=20.9$

Unknown: m

Solution

$F=2.5+2.3(m-1)$

$20.9=2.5+2.3m-2.3$

$20.9=0.2+2.3m$

$20.9-0.2=0.2-0.2+2.3m$

$20.7=2.3m$

$\frac{20.7}{2.3}=\frac{2.3m}{2.3}$

$9=m$

The customer drove 9 mi.

145. (a) 8 – 3 = 5 ft

(b) The person who is 3 ft away.

(c) No

146. **Strategy** To find the force when the system balances, replace the variables F_1, x, and d in the lever system equation by the given values and solve for F_2.

Solution

$F_1x=F_2(d-x)$

$1002=F_2(10-2)$

$1002=F_2\cdot 8$

$200=8F_2$

$\frac{200}{8}=\frac{8F_2}{8}$

$25=F_2$

A 25-lb force must be applied to the other end.

147. **Solution** To find the location of the fulcrum when the system balances, replace the variables F_1, F_2, and d in the lever system equation by the given values and solve for x.

Solution

$F_1x=F_2(d-x)$

$70x=175(14-x)$

$70x=2450-175x$

$70x+175x=2450-175x+175x$

$245x=2450$

$\frac{245x}{245}=\frac{2450}{245}$

$x=10$

The fulcrum is 10 ft from the child.

148. **Strategy** To find the location of the fulcrum when the system balances, replace the variables $F_1, F_2,$ and d in the lever system equation by the given values and solve for x.

Solution

$$\begin{aligned} F_1x &= F_2(d-x)\\ 180x &= 120(15-x)\\ 180x &= 1800-120x\\ 180x+120x &= 1800\\ 300x &= 1800\\ \frac{300x}{300} &= \frac{1800}{300}\\ x &= 6 \end{aligned}$$

The fulcrum is 6 ft from the 180-lb person.

149. **Strategy** To find the location of the fulcrum when the system balances, replace the variables $F_1, F_2,$ and d in the lever system equation by the given values and solve for x.

Solution

$$\begin{aligned} F_1x &= F_2(d-x)\\ 90x &= 60(12-x)\\ 90x &= 720-60x\\ 90x+60x &= 720\\ 150x &= 720\\ \frac{150x}{150} &= \frac{720}{150}\\ x &= 4.8 \end{aligned}$$

The fulcrum is 4.8 ft from the 90-lb child.

150. **Strategy** To find the location of the fulcrum when the system balanced, replaces the variables $F_1, F_2,$ and d in the lever system equation by the given values and solve for x.

Solution

$$\begin{aligned} F_1x &= F_2(d-x)\\ 128x &= 160(18-x)\\ 128x &= 2880-160x\\ 128x+160x &= 2880-160x+160x\\ 288x &= 2880\\ \frac{288x}{288} &= \frac{2880}{288}\\ x &= 10 \end{aligned}$$

The fulcrum is 10 ft from the 128–lb acrobat.

151. **Strategy** To find the force when the system balances, replace the variables $F_2, x,$ and d in the lever system equation by the given values and solve for F_1.

Solution

$$\begin{aligned} F_1x &= F_2(d-x)\\ F_1\cdot 0.15 &= 30(9-0.15)\\ F_1\cdot 0.15 &= 30(8.85)\\ 0.15F_1 &= 2655\\ \frac{0.15F_1}{0.15} &= \frac{2655}{0.15}\\ F_1 &= 17\,70 \end{aligned}$$

A 1770-lb force is applied to the other end.

152. **Strategy** To find the break-even point, replace the variables P, C, and F in the cost equation by the given values and solve for x.

Solution

$$\begin{aligned} Px &= Cx+F\\ 1600x &= 950x+211,250\\ 1600-950x &= 211,250\\ 650x &= 211,250\\ x &= 325 \end{aligned}$$

The break-even point is 325 laser printers.

153. **Strategy** To find the break-even point, replace the variables P, C, and F in the cost equation by the given values and solve for x.

Solution

$$\begin{aligned} Px &= Cx+F\\ 325x &= 175x+39,000\\ 325x-175x &= 39,000\\ 150x &= 39,000\\ \frac{150x}{150} &= \frac{39,000}{150}\\ x &= 260 \end{aligned}$$

The break-even point is 260 barbecues.

154. **Strategy** To find the break-even point, replace the variables P, C, and F in the cost equation by the given values and solve for x.

Solution

$$\begin{aligned} Px &= Cx + F \\ 99x &= 38x + 24{,}400 \\ 99x - 38x &= 24{,}400 \\ 61x &= 24{,}400 \\ \frac{61x}{61} &= \frac{24{,}400}{61} \\ x &= 400 \end{aligned}$$

The break-even point is 400 headphones.

155. **Strategy** To find the break-even point, replace the variables P, C, and F in the cost equation by the given values and solve for x.

Solution

$$\begin{aligned} Px &= Cx + F \\ 49x &= 12x + 19{,}240 \\ 49x - 12x &= 19{,}240 \\ 37x &= 19{,}240 \\ \frac{37x}{37} &= \frac{19{,}240}{37} \\ x &= 520 \end{aligned}$$

The break-even point is 520 recorders.

156. **Strategy** $m = 10.4$ Unknown: C

Solution

$$\begin{aligned} m &= \frac{1}{6}(C-5) \\ 10.4 &= \frac{1}{6}(C-5) \\ 10.4 &= \frac{1}{6}C - \frac{5}{6} \\ 6 \cdot 10.4 &= 6 \cdot \frac{1}{6}C - 6 \cdot \frac{5}{6} \\ 62.4 &= C - 5 \\ 62.4 + 5 &= C - 5 + 5 \\ 67.4 &= C \end{aligned}$$

The mammal consumes 67.4 ml/min.

157. **Strategy** $m = 8.3$ Unknown: C

Solution

$$\begin{aligned} m &= \frac{1}{6}(C-5) \\ 8.3 &= \frac{1}{6}(C-5) \\ 8.3 &= \frac{1}{6}C - \frac{5}{6} \\ 6 \cdot 8.3 &= 6 \cdot \frac{1}{6}C - 6 \cdot \frac{5}{6} \\ 49.8 &= C - 5 \\ 49.8 + 5 &= C - 5 + 5 \\ 54.8 &= C \end{aligned}$$

The mammal consumes 54.8 ml/min.

Critical Thinking

158. $3(2x-1) - (6x-4) = -9$

$$\begin{aligned} 6x - 3 - 6x + 4 &= -9 \\ 1 &= -9 \end{aligned}$$

No solution

159. $\frac{1}{5}(25 - 10b) + 4 = \frac{1}{3}(9b - 15) - 6$

$$\begin{aligned} 5 - 2b + 4 &= 3b - 5 - 6 \\ 9 - 2b &= 3b - 11 \\ 9 - 2b - 3b &= 3b - 3b - 11 \\ 9 - 5b &= -11 \\ 9 - 9 - 5b &= -11 - 9 \\ -5b &= -20 \\ \frac{-5b}{-5} &= \frac{-20}{-5} \\ b &= 4 \end{aligned}$$

The solution is 4.

160. $3\left[4(w+2) - (w+1)\right] = 5(2+w)$

$$\begin{aligned} 3[4w + 8 - w - 1] &= 10 + 5w \\ 3[3w + 7] &= 10 + 5w \\ 9w + 21 &= 10 + 5w \\ 9w - 5w + 21 &= 10 + 5w - 5w \\ 4w + 21 &= 10 \\ 4w + 21 - 21 &= 10 - 21 \\ 4w &= -11 \\ \frac{4w}{4} &= \frac{-11}{4} \\ w &= -\frac{11}{4} \end{aligned}$$

The solution is $-\frac{11}{4}$.

161. $\dfrac{2(5x-6)-3(x-4)}{7}=x+2$

$$\frac{10x-12-3x+12}{7}=x+2$$
$$\frac{7x}{7}=x+2$$
$$x=x+2$$
$$x-x=x-x+2$$
$$0=2$$

No solution

162. **Strategy** Let x = the number.

One-half the number: $\frac{1}{2}x$

Two-thirds the number: $\frac{2}{3}x$

Solution

$$\frac{1}{2}x=\frac{2}{3}x$$
$$\frac{1}{2}x-\frac{2}{3}x=\frac{2}{3}x-\frac{2}{3}x$$
$$\frac{3}{6}x-\frac{4}{6}x=0$$
$$-\frac{1}{6}x=0$$
$$-6\cdot\left(-\frac{1}{6}x\right)=-6\cdot 0$$
$$x=0$$

The number is 0.

163. $3x-4(x-1)$ is an expression, not an equation. There must be a equals sign to have an equation. You cannot solve an expression.

164. Many beginning algebra students do not differentiate between an equation that has no solution and an equation whose solution is zero. Students should explain that the solution of the equation $2x + 3 = 3$ is the (real) number zero. However, there is no solution of $x = x + 1$ because there is no (real) number that is equal to the number plus 1.

165. **Strategy** Let x be the number.

Subtract 4 from the number: $x - 4$

300% of the result: $3(x - 4)$

Solution

$$3(x-4)=x$$
$$3x-12=x$$
$$3x-3x-12=x-3x$$
$$-12=-2x$$
$$\frac{-12}{-2}=\frac{-2x}{-2}$$
$$6=x$$

The number is 6.

Projects and Group Activities

166. **Strategy** To find x;

- replace t with $x + 4$ in the equation $s = 3t - 1$
- replace s with the result in the equation $s = 5x - 3$
- solve for x

Solution

$$s=3t-1$$
$$s=3(x+4)-1$$
$$s=3x+12-1$$
$$s=3x+11$$

$$s=5x-3$$
$$3x+11=5x-3$$
$$3x-3x+11=5x-3x-3$$
$$11=2x-3$$
$$11+3=2x-3+3$$
$$14=2x$$
$$\frac{14}{2}=\frac{2x}{2}$$
$$7=x$$

The value of x is 7.

167. **Strategy** Let x be the population in 1990.
Population after 10,000 increase: $x + 10{,}000$
Population after 10% decrease:
$x + 10{,}000 - 0.1(x + 10{,}000)$
$x + 10{,}000 - 0.1x - 1000$
$0.9x + 9000$
6000 more than the beginning:
$0.9x + 9000 = x + 6000$

Solution

$$0.9x + 9000 = x + 6000$$
$$0.9x - 0.9x + 9000 = x - 0.9x + 6000$$
$$9000 = 0.1x + 6000$$
$$9000 - 6000 = 0.1x + 6000 - 6000$$
$$3000 = 0.1x$$
$$\frac{3000}{0.1} = \frac{0.1x}{0.1}$$
$$30{,}000 = x$$

The population in 1990 was 30,000.

Section 2.3

Concept Check

1. True

2. True

3. Ttue

4. **a.** $12 - x$

b. $12 - x$

5. equals

6. consecutive

7. 1; 2; 2

8. whole; low-fat;

Objective A Exercises

9. the unknown number: x

The difference between a number and 15	is	seven

$$x - 15 = 7$$
$$x - 15 + 15 = 7 + 15$$
$$x = 22$$

The number is 22.

10. the unknown number: x

The sum of five and a number	is	three

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

The number is –2.

11. the unknown number: x

The difference between nine and a number	is	seven

$$9 - x = 7$$
$$9 - 9 - x = 7 - 9$$
$$-x = -2$$
$$\frac{-1x}{-1} = \frac{-2}{-1}$$
$$x = 2$$

The number is 2.

12. the unknown number: x

Three-fifths of a number	is	negative thirty

$$\frac{3}{5}x = -30$$
$$\frac{5}{3}\left(\frac{3}{5}x\right) = \frac{5}{3}(-30)$$
$$x = -50$$

The number is –50.

13. the unknown number: x

The difference between five and twice a number	is	one

$$5 - 2x = 1$$
$$5 - 5 - 2x = 1 - 5$$
$$-2x = -4$$
$$\frac{-2x}{-2} = \frac{-4}{-2}$$
$$x = 2$$

The number is 2.

14. the unknown number: x

Four more than three times a number | is | thirteen

$$3x + 4 = 13$$
$$3x + 4 - 4 = 13 - 4$$
$$3x = 9$$
$$\frac{3x}{3} = \frac{9}{3}$$
$$x = 3$$

The number is 3.

15. the unknown number: x

The sum of twice a number and five | is | fifteen

$$2x + 5 = 15$$
$$2x + 5 - 5 = 15 - 5$$
$$2x = 10$$
$$\frac{2x}{2} = \frac{10}{2}$$
$$x = 5$$

The number is 5.

16. the unknown number: x

The difference between nine times a number and six | is | twelve

$$9x - 6 = 12$$
$$9x - 6 + 6 = 12 + 6$$
$$9x = 18$$
$$\frac{9x}{9} = \frac{18}{9}$$
$$x = 2$$

The number is 2.

17. the unknown number: x

Six less than four times a number | is | twenty-two

$$4x - 6 = 22$$
$$4x - 6 + 6 = 22 + 6$$
$$4x = 28$$
$$\frac{4x}{4} = \frac{28}{4}$$
$$x = 7$$

The number is 7.

18. the unknown number: x

Four times the sum of twice a number and three | is | twelve

$$4(2x + 3) = 12$$
$$8x + 12 = 12$$
$$8x + 12 - 12 = 12 - 12$$
$$8x = 0$$
$$\frac{8x}{8} = \frac{0}{8}$$
$$x = 0$$

The number is 0.

19. the unknown number: x

Three times the difference between four times a number and seven | is | fifteen

$$3(4x - 7) = 15$$
$$12x - 21 = 15$$
$$12x - 21 + 21 = 15 + 21$$
$$12x = 36$$
$$\frac{12x}{12} = \frac{36}{12}$$
$$x = 3$$

The number is 3.

20. the unknown number: x

Twice the difference between a number and twenty-five | is | three times the number

$$2(x - 25) = 3x$$
$$2x - 50 = 3x$$
$$2x - 2x - 50 = 3x - 2x$$
$$-50 = x$$

The number is –50.

21. the smaller number: x
the larger number: $20 - x$

Three times the smaller | is equal to | two times the larger

$$3x = 2(20 - x)$$
$$3x = 40 - 2x$$
$$3x + 2x = 40 - 2x + 2x$$
$$5x = 40$$
$$\frac{5x}{5} = \frac{40}{5}$$
$$x = 8$$

$20 - x = 20 - 8 = 12$

The smaller number is 8.

The larger number is 12.

22. the smaller number: x
the larger number: $15 - x$

One less than three times the smaller	is equal to	the larger

$$\begin{aligned} 3x - 1 &= 15 - x \\ 3x + x - 1 &= 15 - x + x \\ 4x - 1 &= 15 \\ 4x - 1 + 1 &= 15 + 1 \\ 4x &= 16 \\ \frac{4x}{4} &= \frac{16}{4} \\ x &= 4 \end{aligned}$$

$15 - x = 15 - 4 = 11$
The smaller number is 4.
The larger number is 11.

23. the smaller number: x
the larger number: $14 - x$

The difference between two times the smaller and the larger	is	one

$$\begin{aligned} 2x - (14 - x) &= 1 \\ 2x - 14 + x &= 1 \\ 3x - 14 &= 1 \\ 3x &= 15 \\ \frac{3x}{3} &= \frac{15}{3} \\ x &= 5 \end{aligned}$$

$14 - x = 14 - 5 = 9$
The smaller number is 5.
The larger number is 9.

24. the smaller number: x
the larger number: $18 - x$

The total of three times the smaller and twice the larger	is	forty-four

$$\begin{aligned} 3x + 2(18 - x) &= 44 \\ 3x + 36 - 2x &= 44 \\ x + 36 &= 44 \\ x + 36 - 36 &= 44 - 36 \\ x &= 8 \end{aligned}$$

$18 - x = 18 - 8 = 10$
The smaller number is 8.
The larger number is 10.

25. First odd integer: n
Second odd integer: $n + 2$
Third odd integer: $n + 4$
The sum of the three integers is 51.

$$\begin{aligned} n + (n + 2) + (n + 4) &= 51 \\ 3n + 6 &= 51 \\ 3n &= 45 \\ n &= 15 \\ n + 2 &= 15 + 2 = 17 \\ n + 4 &= 15 + 4 = 19 \end{aligned}$$

The three integers are 15, 17, and 19.

26. First even integer: n
Second even integer: $n + 2$
Third even integer: $n + 4$
The sum of the three integers is –18.

$$\begin{aligned} n + (n + 2) + (n + 4) &= -18 \\ 3n + 6 &= -18 \\ 3n &= -24 \\ n &= -8 \\ n + 2 &= -8 + 2 = -6 \\ n + 4 &= -8 + 4 = -4 \end{aligned}$$

The three integers are –8, –6, and –4.

27. First odd integer: n
Second odd integer: $n + 2$
Third odd integer: $n + 4$
Three times the second number is one more than the sum of the first and third numbers.

$$\begin{aligned} 3(n + 2) &= 1 + n + (n + 4) \\ 3n + 6 &= 5 + 2n \\ n + 6 &= 5 \\ n &= -1 \\ n + 2 &= -1 + 2 = 1 \\ n + 4 &= -1 + 4 = 3 \end{aligned}$$

The three integers are –1, 1, and 3.

28. First odd integer: n
Second odd integer: $n + 2$
Third odd integer: $n + 4$
Twice the first number equals seven more than the largest number.

$$\begin{aligned} 2n &= 7 + (n + 4) \\ 2n &= 11 + n \\ n &= 11 \\ n + 2 &= 11 + 2 = 13 \\ n + 4 &= 11 + 4 = 15 \end{aligned}$$

The three integers are 11, 13, and 15.

29. First even integer: n
Second even integer: $n + 2$
Three times the first integer equals twice the second integer.

$$3n = 2(n + 2)$$
$$3n = 2n + 4$$
$$n = 4$$
$$n + 2 = 4 + 2 = 6$$

The integers are 4 and 6.

30. First even integer: n
Second even integer: $n + 2$
Four times the first equals three times the second.

$$4n = 3(n + 2)$$
$$4n = 3n + 6$$
$$n = 6$$
$$n + 2 = 6 + 2 = 8$$

The integers are 6 and 8.

31. (iii)

Objective B Exercises

32.

19,200	is	three-fifths of the original number

$$19200 = \frac{3}{5}x$$
$$\frac{5}{3} \cdot 19200 = \frac{5}{3} \cdot \frac{3}{5}x$$
$$32000 = x$$

The original value was \$32,000.

33.

320	is	one-fourth of the length of the Golden Gate Bridge

$$320 = \frac{1}{4}x$$
$$4 \cdot 320 = 4 \cdot \frac{1}{4}x$$
$$1280 = x$$

The Golden Gate Bridge is 1280 ft.

34.

Orange	has	one-fifth of 290 calories

$$x = \frac{1}{5} \cdot 290$$
$$x = 58$$

An orange has 58 calories.

35.

\$1400 million	was	one-sixty-fifth of gross national product

$$1400 = \frac{1}{65}x$$
$$65 \cdot 1400 = 65 \cdot \frac{1}{65}x$$
$$91{,}000$$

91,000 million = 91 billion

The gross national product was \$91 billion.

36. Strategy Let x = amount of iron

15x = amount of mulch

2x = amount of potassium

The total is 18

Solution

$$x + 15x + 2x = 18$$
$$18x = 18$$
$$\frac{18x}{18} = \frac{18}{18}$$
$$x = 1$$

x = 1 lb iron

15x = 15(1) = 15 lb mulch

There are 15 lb of mulch.

37. Strategy To find the length of the sides of the triangle, write and solve an equation using x to represent the length of an equal side.

Solution

Perimeter of 23 ft	is	x ft + x ft + $(2x-1)$ ft

$$23 = x + x + (2x - 1)$$
$$23 = 4x - 1$$
$$24 = 4x$$
$$\frac{24}{4} = x$$
$$6 = x$$
$$2x - 1 = 12 - 1 = 11$$

The length of the sides are 6 ft, 6 ft and 11 ft.

38. Strategy To find the lengths of the sides of the triangle, write and solve an equation using x to represent the length of each equal side is then 3x + 2.

Solution

Perimeter of 46 m	is	$(3x+2)$ m + $(3x+2)$ m+ x m

$$46 = 3x + 2 + 3x + 2 + x$$
$$46 = 7x + 4$$
$$42 = 7x$$
$$\frac{42}{7} = x$$
$$6 = x$$
$$3x + 2 = 3(6) + 2 = 20$$

The lengths of the sides are 20 m, 20 m, and 6 m.

39. **Strategy** Level of tv = 70
Blender = 70 + 20 = 90
Jet engine = 2(90) – 40

Solution
2(90) – 40 = 180 – 40 = 140
The jet engine is 140 decibels.

40.

\$64,000	is	103 times company's yearly maintenance

$$64000 = 103x$$
$$\frac{64000}{103} = \frac{103x}{103}$$
$$621.36 \approx x$$

The company's yearly cost for a robot was \$600.

41. the area of Iceland: x
the area of Greenland: $21x$

The combined area	is	880,000 mi^2

$$x + 21x = 880{,}000$$
$$22x = 880{,}000$$
$$\frac{22x}{22} = \frac{880{,}000}{22}$$
$$x = 40{,}000$$

21(40,000) = 840,000
The area of Greenland is 840,000 mi^2.

42. hours of labor: x

\$820	is	\$375 and \$89 per hour

$$820 = 375 + 89x$$
$$820 - 375 = 375 - 375 + 89x$$
$$445 = 89x$$
$$\frac{445}{89} = \frac{89x}{89}$$
$$5 = x$$

5 h of labor were required.

43. **Strategy** To find the number of kilowatt hours, write and solve an equation using x to represent the number of kilowatt hours over 300.

Solution

The total cost	is	\$51.95

$$0.08(300) + 0.13x = 51.95$$
$$24 + 0.13x = 51.95$$
$$0.13x = 51.95 - 24$$
$$0.13x = 27.95$$
$$x = \frac{27.95}{0.13}$$
$$x = 215$$

The total number of kilowatt hours is 300 + 215 = 515.
The family used 515 kWh.

44. **Strategy** To find the number of hours worked, write and solve an equation using h to represent the number of hours worked.

Solution

\$4.00 plus \$0.25 for each hour worked	is	\$46.00

$$4 + 0.25h = 46$$
$$0.25h = 46 - 4$$
$$0.25h = 42$$
$$h = \frac{42}{0.25}$$
$$h = 168$$

The union member worked 168 h during March.

45. **Strategy** To find the amount of time that the phone was used, write and solve an equation using x to represent the amount of time.

Solution

\$80 plus \$0.40 per minute	is	\$100.40

$$80 + 0.40x = 100.40$$
$$0.40x = 100.40 - 80$$
$$0.40x = 20.40$$
$$x = \frac{20.40}{0.40}$$
$$x = 51$$

$900 + 51 = 951$

The business executive used the phone for 951 min.

46.

2.16 million tons	represents	four-fifths of plastic drink bottles

$$2.16 = \frac{4}{5}x$$
$$\frac{5}{4} \cdot 2.16 = \frac{5}{4} \cdot \frac{4}{5}x$$
$$2.7 = x$$

There were 2.7 million tons of plastic drink bottles stocked for sale.

47. \$.15

48. \$2.99

Critical Thinking

49. **Strategy** length of the shorter piece: x
perimeter of the shorter square: x
length of the longer piece: $12 - x$
perimeter of the longer piece: $12 - x$

Solution

perimeter of the larger square	is	twice the perimeter of the shorter square

$$12 - x = 2x$$
$$12 - x + x = 2x + x$$
$$12 = 3x$$
$$\frac{12}{3} = \frac{3x}{3}$$
$$4 = x$$

$12 - 4 = 8$

The perimeter of the larger square is 8 ft.

50. $\frac{1}{3}$

51. **Strategy** To find the time remaining:
- find the time to complete the whole trip
- subtract the time completed $\frac{1}{2}$ h from the whole trip to get the time remaining.

Solution

three-fifths of the trip	in	one-half hour

$$\frac{3}{5}t = \frac{1}{2}$$
$$\frac{5}{3} \cdot \frac{3}{5}t = \frac{5}{3} \cdot \frac{1}{2}$$
$$t = \frac{5}{6}$$
$$\frac{5}{6} - \frac{1}{2} = \frac{5}{6} - \frac{3}{6} = \frac{2}{6} = \frac{1}{3}$$

$\frac{1}{3}$ h is remaining.

52. money in cash drawer at beginning: x

one-half was used in the morning: $\frac{1}{2}x$

one-third of the remaining was used in the afternoon: $\frac{1}{3}\left(\frac{1}{2}x\right)=\frac{1}{6}x$

$$x-\frac{1}{2}x-\frac{1}{6}x=5$$
$$\frac{6}{6}x-\frac{3}{6}x-\frac{1}{6}x=5$$
$$\frac{2}{6}x=5$$
$$\frac{1}{3}x=5$$
$$3\cdot\frac{1}{3}x=3\cdot 5$$
$$x=15$$

There were \$15 in the cash drawer at the start of the day.

53. first number: n
second consecutive even number: $n+2$
third consecutive even number: $n+4$
fourth consecutive even number: $n+6$
The sum of the four number is -36.

$$n+n+2+n+4+n+6=-36$$
$$4n+12=-36$$
$$4n+12-12=-36-12$$
$$4n=-48$$
$$\frac{4n}{4}=\frac{-48}{4}$$
$$n=-12$$

$n+2=-12+2=-10$
$n+4=-12+4=-8$
$n+6=-12+6=-6$
The integers are -12, -10, -8, and -6.

54. first number: n
second consecutive odd number: $n+2$
third consecutive odd number: $n+4$
fourth consecutive odd number: $n+6$
The sum of the four number is -48.

$$n+n+2+n+4+n+6=-48$$
$$4n+12=-48$$
$$4n+12-12=-48-12$$
$$4n=-60$$
$$\frac{4n}{4}=\frac{-60}{4}$$
$$n=-15$$

$n+2=-15+2=-13$
$n+4=-15+4=-11$
$n+6=-15+6=-9$
The integers are -15, -13, -11 and -9.

55. first number: n
second consecutive odd number: $n+2$
third consecutive odd number: $n+4$
The sum of the first and the third is twice the second.

$$n+n+4=2(n+2)$$
$$2n+4=2n+4$$

Since an identity is true for all values, any three consecutive odd integers will make this true.

56. first number: n
second consecutive number: $n+1$
third consecutive number: $n+2$
fourth consecutive number: $n+3$
The sum of the first and the fourth is equal to the sum of the second and the third.

$$n+n+3=n+1+n+2$$
$$2n+2=2n+3$$

Since an identity is true for all values, any four consecutive even integers will make this true.

Projects or Group Activities

57. even

58. odd

59. even

60. even

61. even

62. even

63. even

64. odd

65. odd

66. odd

Check Your Progress: Chapter 2

1. $2a(a-1)=3a+3$

$2(3)(3-1)$	$3(3)+3$
$6(2)$	$9+3$
12	12

Yes

2. $x+7=-4$

$x+7-7=-4-7$

$x=-11$

The solution is –11.

3. $-3y=-27$

$\frac{-3y}{-3}=\frac{-27}{-3}$

$y=9$

The solution is 9.

4. $P\cdot B=A$

$0.45\cdot 160=A$

$72=A$

The 72 is 45% of 160.

5. $6-4a=-10$

$6-6-4a=-10-6$

$-4a=-16$

$\frac{-4a}{-4}=\frac{-16}{-4}$

$a=4$

The solution is 4.

6. $8t+1=-1$

$8\left(-\frac{1}{4}\right)+1$	-1
$-2+1$	-1
-1	-1

Yes

7. $\frac{1}{6}+b=-\frac{1}{3}$

$\frac{6}{1}\cdot\frac{1}{6}+6\cdot b=\frac{6}{1}\left(-\frac{1}{3}\right)$

$1+6b=-2$

$6b=-3$

$b=-\frac{1}{2}$

The solution is $-\frac{1}{2}$.

8. $5x-4(3-x)=2(x-1)-3$

$5x-12+4x=2x-2-3$

$9x-12=2x-5$

$9x-2x-12=2x-2x-5$

$7x-12=-5$

$7x-12+12=-5+12$

$7x=7$

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

$x=1$

The solution is 1.

9. **Strategy** Solve the equation $P\cdot B=A$ for B using $P=0.18$ and $A=27$.

Solution

$P\cdot B=A$

$0.18B=27$

$\frac{0.18B}{0.18}=\frac{27}{0.18}$

$B=150$

18% of 150 is 27.

10. $6y+5-8y=3-4y$

$-2y+5=3-4y$

$-2y+4y+5=3-4y+4y$

$2y+5=3$

$2y+5-5=3-5$

$2y=-2$

$\frac{2y}{2}=\frac{-2}{2}$

$y=-1$

The solution is –1.

11. $x(x+1) = x^2 + 5$

$4(4+1)$	4^2+5
$4(5)$	$16+5$
20	21

No

12. $84 = -16 + t$

$84 + 16 = -16 + 16 + t$

$100 = t$

The solution is 100.

13. $\frac{3}{4}c = \frac{3}{5}$

$\frac{4}{3}\cdot\frac{3}{4}c = \frac{4}{3}\cdot\frac{3}{5}$

$c = \frac{4}{5}$

The solution is $\frac{4}{5}$.

14. $9 = \frac{1}{2}d - 5$

$9 + 5 = \frac{1}{2}d - 5 + 5$

$14 = \frac{1}{2}d$

$2\cdot 14 = 2\cdot\frac{1}{2}d$

$28 = d$

The solution is 28.

15. **Strategy** Solve $P \cdot B = A$ for P using 170 for B and 42.5 for A.

Solution

$P \cdot B = A$

$P \cdot 170 = 42.5$

$\frac{P170}{170} = \frac{42.5}{170}$

$P = 0.25$

42.5 is 25% of 170.

16. $-\frac{8}{9} = -\frac{2}{3}y$

$-\frac{3}{2}\left(-\frac{8}{9}\right) = -\frac{3}{2}\left(-\frac{2}{3}y\right)$

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

The solution is $\frac{4}{3}$.

17. $3n + 2(n-4) = 7$

$3n + 2n - 8 = 7$

$5n - 8 = 7$

$5n - 8 + 8 = 7 + 8$

$5n = 15$

$\frac{5n}{5} = \frac{15}{5}$

$n = 3$

The solution is 3.

18. $3x - 8 = 5x + 6$

$3x - 3x - 8 = 5x - 3x + 6$

$-8 = 2x + 6$

$-8 - 6 = 2x + 6 - 6$

$-14 = 2x$

$\frac{-14}{2} = \frac{2x}{2}$

$-7 = x$

The solution is –7.

19. $2[3 - 5(x-1)] = 7x - 1$

$2[3 - 5x + 5] = 7x - 1$

$2[8 - 5x] = 7x - 1$

$16 - 10x = 7x - 1$

$16 - 10x - 7x = 7x - 7x - 1$

$16 - 17x = -1$

$16 - 16 - 17x = -1 - 16$

$-17x = -17$

$\frac{-17x}{-17} = \frac{-17}{-17}$

$x = 1$

The solution is 1.

20. $18 = 2t$

$\frac{18}{2} = \frac{2t}{2}$

$9 = t$

The solution is 9.

21. the unknown number: x

The quotient of fifteen and an unknown number	is	-3

$$\frac{15}{x} = -3$$
$$x\left(\frac{15}{x}\right) = x(-3)$$
$$15 = -3x$$
$$\frac{15}{-3} = \frac{-3x}{-3}$$
$$-5 = x$$

The number is –5.

22. First odd integer: x
Second odd integer: $x + 2$
Third odd integer: $x + 4$
Fourth odd integer: $x + 6$
The sum of the integers is 24.

$$x + x + 2 + x + 4 + x + 6 = 24$$
$$4x + 12 = 24$$
$$4x + 12 - 12 = 24 - 12$$
$$4x = 12$$
$$\frac{4x}{4} = \frac{12}{4}$$
$$x = 3$$

$x = 3$
$x + 2 = 5$
$x + 4 = 7$
$x + 6 = 9$
The integers are 3, 5, 7, and 9.

23. **Strategy** Solve the equation $B + BP = A$ for A using 1970 for B and 0.116 for P.
Solution

$$B + BP = A$$
$$1970 + 1970 \cdot 0.116 = A$$
$$1970 + 229 = A$$
$$2199 = A$$

The average consumption is 2199 calories.

24. **Strategy** To find the total time:
• find the time with the current to travel 24 mi (r = 10 + 2 = 12)
• find the time without the current to travel 24 mi (r = 10 – 2 = 8)
• add the two times and 1 hour to get the total trip

Solution

with the current:	without the current:
$rt = d$	$rt = d$
$12t = 24$	$8t = 24$
$\frac{12t}{12} = \frac{24}{12}$	$\frac{8t}{8} = \frac{24}{8}$
$t = 2$	$t = 3$

$2 + 3 + 1 = 6$
The total trip was 6 h.

25. **Strategy** Check the equation $F_1x = F_2(d - x)$ when $F_1 = 60$, $x = 3.5$, $F_2 = 50$, and $d = 8$.

Solution

$F_1x = F_2(d - x)$	
$60 \cdot 3.5$	$50(8 - 3.5)$
210	$50(4.5)$
210	225

No

Section 2.4

Concept Check

1. $10.50

2. $600

3. $.76

4. 0.90; 225

5. 100

6. 1.5; 8.5

7. True

8. True

9. False

10. In the formula $V = AC$, V represents the value, A represents the amount, and C represents the cost. For example: there are 2 pounds of tomatoes that sell for $1.49 per pound. To find the value (V), multiply the amount (2) by the cost ($1.49).

$$V = AC$$
$$V = 2 \cdot 1.49$$
$$V = 2.98$$

The value of the tomatoes would be $2.98.

11. In the formula $Q = Ar$, Q represents the quantity, A represents the amount, and r represents the percent. For example: there are 2 ml of a 25% acid solution. To find the value (Q), multiply the amount (2) by the percent (0.25).

$Q = Ar$

$Q = 2 \cdot 0.25$

$Q = 0.5$

There is 0.5 ml of acid in the solution.

12. In the formula $d = rt$, d represents the distance, r represents the rate, and t represents the time.

Objective A Exercises

13. **Strategy**

- Amount of high-protein supplement: x

  Amount of vitamin supplement: $5 - x$

	Amount	Cost	Value
High-protein	x	6.75	$6.75x$
Vitamin	$5 - x$	3.25	$3.25(5 - x)$
Mixture	5	4.65	4.65(5)

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 6.75x + 3.25(5 - x) &= 4.65(5) \\ 6.75x + 16.25 - 3.25x &= 23.25 \\ 3.50x + 16.25 &= 23.25 \\ 3.50x + 16.25 - 16.25 &= 23.25 - 16.25 \\ 3.50x &= 7.00 \\ x &= \frac{7.00}{3.50} \\ x &= 2 \\ 5 - x &= 3 \end{aligned}$$

To make the mixture, 2 lb of the high protein supplement and 3 lb of the vitamin supplement were used.

14. **Strategy**

- Amount of alloy 1: x

  Amount of alloy 2: $200 - x$

	Amount	Cost	Value
Alloy 1	x	4.30	$4.30(x)$
Alloy 2	$200 - x$	1.80	$1.80(200 - x)$
Mixture	200	2.50	2.50(200)

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 4.30x + 1.80(200 - x) &= 2.50(200) \\ 4.30x + 360.00 - 1.80x &= 500.00 \\ 2.50x + 360 &= 500 \\ 2.50x + 360 - 360 &= 500 - 360 \\ 2.50x &= 140 \\ x &= \frac{140}{2.50} \\ x &= 56 \\ 200 - x &= 144 \end{aligned}$$

The amount of alloy 1 needed is 56 oz.

The amount of alloy 2 needed is 144 oz.

15. **Strategy**

- Amount of chamomile tea: x

  Amount of orange tea: 12

	Amount	Cost	Value
Chamomile	x	18.20	$18.20(x)$
Orange tea	12	12.25	12(12.25)
Mixture	$x + 12$	14.63	$14.63(x + 12)$

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 18.20x + 12(12.25) &= 14.63(x + 12) \\ 18.20x + 147 &= 14.63x + 175.56 \\ 18.20x - 14.63x + 147 &= 14.63x - 14.63x + 175.56 \\ 3.57x + 147 &= 175.56 \\ 3.57x + 147 - 147 &= 175.56 - 147 \\ 3.57x &= 28.56 \\ \frac{3.57x}{3.57} &= \frac{28.56}{3.57} \\ x &= 8 \end{aligned}$$

The amount of chamomile tea needed is 8 lb.

16. **Strategy**

- Amount of millet seed: 100

  Amount of sunflower seed: x

	Amount	Cost	Value
Millet seed	100	0.60	0.60(100)
Sunflower seed	x	1.10	$1.10x$
Mixture	$100 + x$	0.70	$0.70(100 + x)$

- The sum of the values before mixing equals the value after mixing.

Solution

$$60 + 1.10x = 0.70(100 + x)$$
$$60 + 1.10x = 70 + 0.70x$$
$$60 - 60 + 1.10x = 70 - 60 + 0.70x$$
$$1.10x = 10 + 0.70x$$
$$1.10x - 0.70x = 10 + 0.70x - 0.70x$$
$$0.40x = 10$$
$$\frac{0.40x}{0.40} = \frac{10}{0.40}$$
$$x = 25$$

The mixture will need 25 lb of sunflower seeds.

17. Strategy

•Cost of mixture: x

	Amount	Cost	Value
Expensive coffee	8	9.20	8(9.20)
Cheaper coffee	12	5.50	12(5.50)
Mixture	20	x	20(x)

- The sum of the values before mixing equals the value after mixing.

Solution

$$8(9.20) + 12(5.50) = 20x$$
$$73.60 + 66 = 20x$$
$$139.60 = 20x$$
$$\frac{139.60}{20} = \frac{20x}{20}$$
$$6.98 = x$$

The cost of the coffee mixture is \$6.98.

18. Strategy

•Cost of mixture: x

	Amount	Cost	Value
200 oz	200	7.50	7.5(200)
500 oz	500	4.00	4(500)
Mixture	700	x	700(x)

- The sum of the values before mixing equals the value after mixing.

Solution

$$7.5(200) + 4(500) = 700x$$
$$1500 + 2000 = 700x$$
$$3500 = 700x$$
$$\frac{3500}{700} = \frac{700x}{700}$$
$$5 = x$$

The cost of the perfume mixture is \$5.00 per ounce.

19. Strategy

- Amount of \$1 herb: x

	Amount	Cost	Value
\$2 herb	30	2	2(30)
\$1 herb	x	1	1x
Mixture	$30 + x$	1.60	1.6($30 + x$)

- The sum of the values before mixing equals the value after mixing.

Solution

$$2(30) + x = 1.6(30 + x)$$
$$60 + x = 48 + 1.6x$$
$$60 + x - x = 48 + 1.6x - x$$
$$60 = 48 + 0.6x$$
$$60 - 48 = 48 - 48 + 0.6x$$
$$12 = 0.6x$$
$$\frac{12}{0.6} = \frac{0.6x}{0.6}$$
$$20 = x$$

The amount of the \$1 herb is 20 oz.

20. Strategy

•Amount of popcorn: 5

Amount of caramel: x

	Amount	Cost	Value
Popcorn	5	0.80	0.80(5)
Caramel	x	2.40	2.40x
Mixture	$5 + x$	1.40	$1.40(5 + x)$

- The sum of the values before mixing equals the value after mixing.

Solution

$$4 + 2.40x = 1.40(5 + x)$$
$$4 + 2.40x = 7 + 1.40x$$
$$4 + 2.40x - 1.40x = 7 + 1.40x - 1.40x$$
$$4 + 1x = 7$$
$$4 - 4 + 1x = 7 - 4$$
$$x = 3$$

3 lb of caramel are needed to make the mixture.

21. Strategy

- Amount of pepper cheddar cheese: x
  Amount of Pennsylvania Jack: $5 - x$

	Amount	Cost	Value
Pepper cheddar	x	16	16x
Jack	$5 - x$	12	$12(5 - x)$
Mixture	5	13.20	13.20(5)

- The sum of the values before mixing equals the value after mixing.

Solution

$$16x + 12(5 - x) = 13.20(5)$$
$$16x + 60 - 12x = 66$$
$$4x + 60 - 60 = 66 - 60$$
$$4x = 6$$
$$\frac{4x}{4} = \frac{6}{4}$$
$$x = 1.5$$

$5 - 1.5 = 3.5$

The mixture needs 1.5 kg of pepper cheese and 3.5 kg of Pennsylvania Jack.

22. Strategy

- Amount of oak chips: x
  Amount of pine chips: $80 - x$

	Amount	Cost	Value
Oak chips	x	3.10	$3.10x$
Pine chips	$80 - x$	2.50	$2.50(80 - x)$
Mixture	80	2.65	2.65(80)

- The sum of the values before mixing equals the value after mixing.

Solution

$$3.10x + 2.50(80 - x) = 2.65(80)$$
$$3.10x + 200 - 2.50x = 212$$
$$0.60x + 200 - 200 = 212 - 200$$
$$0.60x = 12$$
$$\frac{0.60x}{0.60} = \frac{12}{0.60}$$
$$x = 20$$

$80 - 20 = 60$

The mixture needs 20 lb of oak chips and 60 lb of pine chips.

23. Strategy

- Amount of grain: 500
  Amount of meal: x

	Amount	Cost	Value
Grain	500	1.2	1.2(500)
Meal	x	0.8	$0.8x$
Mixture	$500 + x$	1.05	$1.05(500 + x)$

- The sum of the values before mixing equals the value after mixing.

Solution

$$1.2(500) + 0.8x = 1.05(500 + x)$$
$$600 + 0.8x = 525 + 1.05x$$
$$600 + 0.8x - 0.8x = 525 + 1.05x - 0.8x$$
$$600 = 525 + 0.25x$$
$$600 - 525 = 525 - 525 + 0.25x$$
$$75 = 0.25x$$
$$\frac{75}{0.25} = \frac{0.25x}{0.25}$$
$$300 = x$$

The mixture needs 300 lb of meal.

24. Strategy

- Amount of fruit juice: x
  Amount of ice cream: $100 - x$

	Amount	Cost	Value
Fruit juice	x	4.50	$4.50x$
Ice cream	$100 - x$	8.50	$8.50(100 - x)$
Mixture	100	5.50	100(5.50)

- The sum of the values before mixing equals the value after mixing.

Solution

$$4.50x + 8.50(100 - x) = 100(5.50)$$
$$4.50x + 850 - 8.50x = 550$$
$$-4x + 850 = 550$$
$$-4x + 850 - 850 = 550 - 850$$
$$-4x = -300$$
$$\frac{-4x}{-4} = \frac{-300}{-4}$$
$$x = 75$$

$100 - 75 = 25$

The punch needs 75 gal of fruit juice and 25 gal of ice cream.

25. Strategy

- Amount of almonds: x

  Amount of walnuts: $100 - x$

	Amount	Cost	Value
Almonds	x	6.50	$6.50(x)$
Walnuts	$100 - x$	5.50	$5.50(100 - x)$
Mixture	100	5.87	5.87(100)

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 6.50x + 5.50(100 - x) &= 5.87(100) \\ 6.50x + 550 - 5.50x &= 587 \\ x + 550 &= 587 \\ x + 550 - 550 &= 587 - 550 \\ x &= 37 \\ 100 - x &= 63 \end{aligned}$$

The amount of almonds is 37 lb.

The amount of walnuts is 63 lb.

26. Strategy

- cost of house blend coffee: x

	Amount	Cost	Value
Central Am.	12	8	12(8)
South Am.	30	4.50	30(4.50)
Mixture	42	x	$42x$

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 12(8) + 30(4.50) &= 42x \\ 96 + 135 &= 42x \\ 231 &= 42x \\ \frac{231}{42} &= \frac{42x}{42} \\ 5.5 &= x \end{aligned}$$

The house blend costs \$5.50.

27. Strategy

- Cost of mixture: x

	Amount	Cost	Value
Sugar	40	2.00	40(2.00)
Flakes	120	1.20	120(1.20)
Mixture	160	x	$160x$

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 40(2.00) + 120(1.20) &= 160x \\ 80 + 144 &= 160x \\ 224 &= 160x \\ \frac{224}{160} &= \frac{160x}{160} \\ 1.40 &= x \end{aligned}$$

The cost per pound of the sugar-coated cereal is \$1.40.

28. Strategy

- Amount of blue dye: x

	Amount	Cost	Value
Blue dye	x	1.60	1.60x
Anil	18	2.50	18(2.50)
Mixture	$18 + x$	1.90	$1.90(18 + x)$

- The sum of the values before mixing equals the value after mixing.

Solution

$$\begin{aligned} 1.6x + 18(2.50) &= 1.90(18 + x) \\ 1.6x + 45 &= 34.2 + 1.9x \\ 1.6x - 1.6x + 45 &= 34.2 + 1.9x - 1.6x \\ 45 &= 34.2 + 0.3x \\ 45 - 34.2 &= 34.2 - 34.2 + 0.3x \\ 10.8 &= 0.3x \\ \frac{10.8}{0.3} &= \frac{0.3x}{0.3} \\ 36 &= x \end{aligned}$$

The mixture needs 36 L of blue dye.

29. Strategy

- Number of bundles of seedlings: x

  Number of bundles of container-grown plants: $1720 - x$

	Amount	Cost	Value
Seedlings	x	17	$17(x)$
Contain-grown	$14 - x$	45	$45(14 - x)$
Mixture	14		406

- The sum of the values of the seedlings and container-grown plants must equal the total spent.

Solution

$$17x + 45(14 - x) = 406$$
$$17x + 630 - 45x = 406$$
$$-28x = -224$$
$$\frac{-28x}{-28} = \frac{-224}{-28}$$
$$x = 8$$
$$14 - x = 14 - 8 = 6$$

The Park's Department bought 8 bundles of seedlings and 6 bundles of container-grown plants.

30. **Strategy**

- cost per ounce of gold alloy: x

	Amount	Cost	Value
Pure gold	25	1282	25(1282)
alloy	40	900	40(900)
Mixture	65	x	$65x$

- The sum of the before mixing equals the value after mixing.

Solution

$$25(1282) + 40(900) = 65x$$
$$32050 + 36000 = 65x$$
$$68050 = 65x$$
$$\frac{68050}{65} = \frac{65x}{65}$$
$$1046.92 \approx x$$

The cost of the gold alloy is \$1046.92.

31. **Strategy**

- Amount of expensive lotion: 50
  Amount of supplement lotion: 100

	Amount	Cost	Value
Expensive lotion	50	4.00	4(50)
Supplement lotion	100	2.50	2.5(100)
Mixture	150	x	$150x$

- The sum of the values before mixing equals the value after mixing.

Solution

$$200 + 250 = 150x$$
$$450 = 150x$$
$$\frac{450}{150} = \frac{150x}{150}$$
$$3 = x$$

The sunscreen mixture will cost \$3.00.

32. iii, v, and vi

33. iv

Objective B Exercises

34. **Strategy**

- The percent concentration of the resulting alloy: x

	Amount	Percent	Quantity
30% gold alloy	40	0.30	0.30(40)
20% gold alloy	60	0.20	0.20(60)
Mixture	100	x	$100x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.30(40) + 0.20(60) = 100x$$
$$12 + 12 = 100x$$
$$24 = 100x$$
$$0.24 = x$$

The resulting alloy is 24% gold.

35. **Strategy**

- The percent concentration of tomato juice in the mixture: x

	Amount	Percent	Quantity
50% juice	100	0.50	0.50(100)
25% juice	200	0.25	0.25(200)
Mixture	300	x	$300x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.50(100) + 0.25(200) = 300x$$
$$50 + 50 = 300x$$
$$100 = 300x$$
$$\frac{1}{3} = x$$

The percent concentration of tomato juice in the mixture as $33\frac{1}{3}\%$.

36. Strategy

- Amount of 15% acid solution: x
- Mixture: $x + 5$

	Amount	Percent	Quantity
15% acid	x	0.15	$0.15x$
20% acid	5	0.20	$0.20(5)$
Mixture	$x + 5$	0.16	$0.16(x + 5)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.15x + 0.20(5) &= 0.16(x + 5) \\ 0.15x + 1 &= 0.16x + 0.8 \\ -0.01x &= -0.2 \\ x &= 20 \end{aligned}$$

20 gallons of 15% acid solution must be used.

37. Strategy

- Amount of 50% corn: x
- Amount of mixture: $x + 400$

	Amount	Percent	Quantity
50% corn	x	0.50	$0.50x$
80% corn	400	0.80	$0.80(400)$
Mixture	$x + 400$	0.75	$0.75(x + 400)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.50x + 0.80(400) &= 0.75(x + 400) \\ 0.50x + 320 &= 0.75x + 300 \\ -0.25x &= -20 \\ x &= 80 \end{aligned}$$

80 lbs of 50% corn must be used.

38. Strategy

- Amount of 25% wool yarn: x
- Amount of mixture: $x + 20$

	Amount	Percent	Quantity
25% wool yarn	x	0.25	$0.25x$
50% wool alloy	20	0.50	$0.50(20)$
Mixture	$x + 20$	0.35	$0.35(x + 20)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.25x + 0.50(20) &= 0.35(x + 20) \\ 0.25x + 10 &= 0.35x + 7 \\ -0.10x &= -3 \\ x &= 30 \end{aligned}$$

30 lbs of 25% wool yarn must be used.

39. Strategy

- Amount of dark green paint: x
- Amount of mixture: $x + 5$

	Amount	Percent	Quantity
Light green paint	x	0.40	$0.40x$
Dark green paint	5	0.20	$0.20(5)$
25% yellow paint	$x + 5$	0.25	$0.25(x + 5)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.40x + 0.20(5) &= 0.25(x + 5) \\ 0.40x + 1 &= 0.25x + 1.25 \\ 0.15x &= 0.25 \\ x &= 1\frac{2}{3} \end{aligned}$$

$1\frac{2}{3}$ gal of light green latex paint must be used.

40. Strategy

- Amount of 9% nitrogen food: x
- Amount of 25% nitrogen food: $10 - x$

	Amount	Percent	Quantity
9% nitrogen	x	0.09	$0.09x$
25% nitrogen	$10 - x$	0.25	$0.25(10 - x)$
15% nitrogen	10	0.15	$0.15(10)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.09x + 0.25(10 - x) &= 0.15(10) \\ 0.09x + 2.5 - 0.25x &= 1.5 \\ -0.16x + 2.5 &= 1.5 \\ -0.16x &= -1 \\ x &= 6.25 \end{aligned}$$

6.25 gal of the 9% nitrogen plant food must be used.

41. Strategy

- Amount of 13% acid solution: x
- Amount of 18% acid solution: $50 - x$

	Amount	Percent	Quantity
13% acid	x	0.13	$0.13x$
18% acid	$50 - x$	0.18	$0.18(50 - x)$
16% acid mixture	50	0.16	$0.16(50)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.13x + 0.18(50 - x) = 0.16(50)$$
$$0.13x + 9.00 - 0.18x = 8.00$$
$$-0.05x + 9.00 = 8.00$$
$$-0.05x = -1.00$$
$$x = 20$$
$$50 - x = 50 - 20 = 30$$

The amount of 13% solution is 20 ml.
The amount of 18% solution is 30 ml.

42. Strategy

- The percent concentration of sugar in the mixture: x

	Amount	Percent	Quantity
Sugar	5	1.00	1.00(5)
Cereal	45	0.10	0.10(45)
Mixture	50	x	$50x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.00(5) + 0.10(45) = 50x$$
$$5 + 4.5 = 50x$$
$$9.5 = 50x$$
$$0.19 = x$$

The percent concentration of sugar in the mixture is 19%.

43. Strategy

- Percent concentration of the resulting alloy: x

	Amount	Percent	Quantity
Pure silver	30	1.00	30
20% silver	50	0.20	0.20(50)
Resulting mixture	80	x	$80x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$30 + 10 = 80x$$
$$40 = 80x$$
$$0.50 = x$$

The percent concentration is 50%.

44. Strategy

- Amount of 60% lavender: x

	Amount	Percent	Quantity
80% lavender	70	0.80	0.80(70)
60% lavender	x	0.60	$0.60x$
74% mixture	$x + 70$	0.74	$0.74(x + 70)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.8(70) + 0.6x = 0.74(x + 70)$$
$$56 + 0.6x = 0.74x + 51.8$$
$$56 + 0.6x - 0.6x = 0.74x - 0.6x + 51.8$$
$$56 = 0.14x + 51.8$$
$$56 - 51.8 = 0.14x + 51.8 - 51.8$$
$$4.2 = 0.14x$$
$$\frac{4.2}{0.14} = \frac{0.14x}{0.14}$$
$$30 = x$$

30 oz of 60% should be used.

45. Strategy

- Amount of 40% mixture: x

	Amount	Percent	Quantity
Grass seed 1	x	0.40	$0.40x$
Grass seed 2	40	0.60	0.60(40)
60% mixture	$x + 40$	0.56	$0.56(x + 40)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.4x + 0.6(40) = 0.56(x + 40)$$
$$0.4x + 24 = 0.56x + 22.4$$
$$0.4x - 0.4x + 24 = 0.56x - 0.4x + 22.4$$
$$24 = 0.16x + 22.4$$
$$24 - 22.4 = 0.16x + 22.4 - 22.4$$
$$1.6 = 0.16x$$
$$\frac{1.6}{0.16} = \frac{0.16x}{0.16}$$
$$10 = x$$

10 lb of the 40% mixture must be used.

46. Strategy

- Amount of 7% hydrogen peroxide: x
- Amount of 4% hydrogen peroxide: $300 - x$

	Amount	Percent	Quantity
7% hydrogen peroxide	x	0.07	$0.07x$
4% hydrogen peroxide	$300 - x$	0.04	$0.04(300 - x)$
Mixture	300	0.05	0.05(300)

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.07x + 0.04(300 - x) = 0.05(300)$$
$$0.07x + 12 - 0.04x = 15$$
$$0.03x = 3$$
$$x = 100$$
$$300 - x = 200$$

100 ml of 7% hydrogen peroxide and 200 ml of 4% hydrogen peroxide are needed.

47. Strategy

- Amount of pure silk: x
- Amount of 85% silk: $75 - x$

	Amount	Percent	Quantity
Pure silk	x	1.00	x
85% silk	$75 - x$	0.84	$0.85(75 - x)$
Mixture	75	0.96	0.96(75)

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$x + 0.85(75 - x) = 0.96(75)$$
$$x + 63.75 - 0.85x = 72$$
$$0.15x + 63.75 - 63.75 = 72 - 63.75$$
$$0.15x = 8.25$$
$$x = 55$$

$75 - 55 = 20$

55 kg of pure silk and 20 kg of 85% silk are needed.

48. Strategy

- Percent concentration of the mixture: x

	Amount	Percent	Quantity
Pure aloe cream	40	1.00	40(1)
64% aloe	50	0.64	0.64(50)
mixture	90	x	$90x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$40 + 0.64(50) = 90x$$
$$40 + 32 = 90x$$
$$72 = 90x$$
$$\frac{72}{90} = \frac{90x}{90}$$
$$0.8 = x$$

The mixture is 80% aloe.

49. Strategy

- amount of pure ethanol: x

	Amount	Percent	Quantity
Pure ethanol	x	1.00	$1x$
E10	100	0.10	0.10(100)
mixture	$100 + x$	0.20	$0.20(100 + x)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$x + 0.1(100) = 0.2(100 + x)$$
$$x + 10 = 20 + 0.2x$$
$$x - 0.20x + 10 = 20 + 0.2x - 0.2x$$
$$0.8x + 10 = 20$$
$$0.8x + 10 - 10 = 20 - 10$$
$$0.8x = 10$$
$$\frac{0.8x}{0.8} = \frac{10}{0.8}$$
$$x = 12.5$$

12.5 gal of ethanol need to be added.

50. **Strategy**

- percent concentration of the mixture: x

	Amount	Percent	Quantity
20% conditioner	12	0.20	0.2(12)
shampoo	8	0.00	0(8)
mixture	20	x	$20x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.2(12) + 0(8) &= 20x \\ 2.4 &= 20x \\ 2.4 &= 20x \\ \frac{2.4}{20} &= x \\ 0.12 &= x \end{aligned}$$

The mixture is 12% conditioner.

51. **Strategy** • Amount of pure chocolate: x

	Amount	Percent	Quantity
50% chocolate	150	0.50	0.50(150)
Pure chocolate	x	1.00	$1.00x$
Mixture	$x + 150$	0.75	$0.75(x + 150)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 0.50(150) + 1.00x &= 0.75(150 + x) \\ 75 + x &= 112.5 + 0.75x \\ 0.25x &= 37.5 \\ x &= 150 \end{aligned}$$

150 oz of pure chocolate must be added.

52. **Strategy**

- percent concentration of wild rice in mixture: x

	Amount	Percent	Value
Pure wild rice	8	1.00	8(1)
20% wild rice	12	0.20	0.2(12)
mixture	20	x	$20x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\begin{aligned} 8(1) + 0.2(12) &= 20x \\ 8 + 2.4 &= 20x \\ 10.4 &= 20x \\ \frac{10.4}{20} &= \frac{20x}{20} \\ 0.52 &= x \end{aligned}$$

The mixture is 52% wild rice.

53. False

54. False

Objective C Exercises

55. **Strategy**

- Speed of first plane: r
- Speed of second plane: $r + 25$

	Rate	Time	Distance
First plane	r	2	$2r$
Second plane	$r + 25$	2	$2(r + 25)$

- In 2 h, the planes are 470 miles apart.

Solution

$$\begin{aligned} 2r + 2(r + 25) &= 470 \\ 2r + 2r + 50 &= 470 \\ 4r &= 420 \\ r &= 105 \\ r + 25 &= 130 \end{aligned}$$

The first plane is flying at 105 mph and the second plane is flying at 130 mph.

56. **Strategy**

- Speed of first cyclist r
- Speed of second cyclist: $2r$

	Rate	Time	Distance
First plane	r	3	$3r$
Second	$2r$	3	$6r$

- In 3 h, the planes are 81 miles apart.

Solution

$$\begin{aligned} 3r + 6r &= 81 \\ 9r &= 81 \\ r &= 9 \\ 2r &= 18 \end{aligned}$$

The first cyclist is traveling at 9 mph and the second at 18 mph.

57. **Strategy** • Time for first skater: t

• Time for second skater: $t - 10$

	Rate	Time	Distance
First skater	8	t	$8t$
Second skater	10	$t - 10$	$10(t - 10)$

• The skaters travel the same distance.

Solution

$$8t = 10(t - 10)$$
$$8t = 10t - 100$$
$$8t - 10t = 10t - 10t - 100$$
$$-2t = -100$$
$$\frac{-2t}{-2} = \frac{-100}{-2}$$
$$t = 50$$

Time for second skater = 50 – 10 = 40
The second skater overtakes the first 40 s after the second skater starts.

58. **Strategy**

• Time for first runner: t

• Time for second runner: $t - \frac{1}{2}$

	Rate	Time	Distance
First runner	6	t	$6t$
Second runner	7	$t - \frac{1}{2}$	$7\left(t - \frac{1}{2}\right)$

• The second runner overtakes the first runner.

Solution

$$6t = 7\left(t - \frac{1}{2}\right)$$
$$6t = 7t - 3\frac{1}{2}$$
$$-1t = -3\frac{1}{2}$$
$$t = 3\frac{1}{2}$$
$$t - \frac{1}{2} = 3$$

The second runner will overtake the first runner in 3 h.

59. **Strategy**

• Time the motorboat travels: t

• Time the cabin cruiser travels: $t - 2$

	Rate	Time	Distance
Motorboat	9	t	$9t$
Cabin Cruiser	18	$t - 2$	$18(t - 2)$

• How many hours after the cabin cruiser leaves will the cabin cruiser meet up with the motorboat?

Solution

$$9t = 18(t - 2)$$
$$9t = 18t - 36$$
$$-9t = -36$$
$$t = 4$$
$$t - 2 = 2$$

The cabin cruiser will overtake the motorboat in 2 h.

60. **Strategy**

• Time for the jogger: t

• Time for the cyclist: $t - 1$

	Rate	Time	Distance
Jogger	6	t	$6t$
Cyclist	8	$t - 1$	$8(t - 1)$

• The jogger and cyclist traveled a total of 15 mi.

Solution

$$6t + 9(t - 1) = 15$$
$$6t + 9t - 9 = 15$$
$$15t - 9 = 15$$
$$15t - 9 + 9 = 15 + 9$$
$$15t = 24$$
$$\frac{15t}{15} = \frac{24}{15}$$
$$t = \frac{8}{5}$$

$\frac{8}{5}$ hr · 60 min = 96 min = 1 hr 36 min
1 hr 36 min after 8:00 A.M. = 9:36 A.M.
The two meet at 9:36 A.M..

61. Strategy

- Time to airport: t
- Time in flight: $3 - t$

	Rate	Time	Distance
To airport	30	t	$30t$
In flight	60	$3 - t$	$60(3 - t)$

- The total trip is 150 mi.

Solution

$$\begin{aligned} 30t + 60(3 - t) &= 150 \\ 30t + 180 - 60t &= 150 \\ 180 - 30t &= 150 \\ -30t &= -30 \\ t &= 1 \\ \text{Distance} &= 60(3 - t) = 60(3 - 1) \\ &= 60(2) = 120 \end{aligned}$$

The corporate offices are 120 mi from the airport.

62. Strategy

- Time traveling at 105 mph: t
- Time traveling at 115 mph: $25 - t$

	Rate	Time	Distance
At 105	105	t	$105t$
At 115	115	$5 - t$	$115(5 - t)$

- The total trip is 555 mi.

Solution

$$\begin{aligned} 105t + 115(5 - t) &= 555 \\ 105t + 575 - 115t &= 555 \\ 575 - 10t &= 555 \\ -10t &= -20 \\ t &= 2 \\ 5 - t &= 5 - 2 = 3 \end{aligned}$$

The plane travels at 105 mph for 2 h and at 115 mph for 3 h.

63. Strategy

- Speed for first 3 h: r
- Speed for second 3 h: $r - 5$

	Rate	Time	Distance
First 3h	r	3	$3r$
Second 3h	$r - 5$	3	$3(r - 5)$

- The total trip is 57 mi.

Solution

$$\begin{aligned} 3r + 3(r - 5) &= 57 \\ 3r + 3r - 15 &= 57 \\ 6r - 15 &= 57 \\ 6r &= 72 \\ r &= 12 \\ \text{Distance} &= 3r = 3(12) = 36 \end{aligned}$$

The sailboat traveled 36 mi in the first 3 h.

64. Strategy

- Time to site: t
- Time returning: $5 - t$

	Rate	Time	Distance
To site	150	t	$150t$
Returning	100	$5 - t$	$100(5 - t)$

- The two distances are the same.

Solution

$$\begin{aligned} 150t &= 100(5 - t) \\ 150t &= 500 - 100t \\ 150t + 100t &= 500 - 100t + 100t \\ 250t &= 500 \\ \frac{250t}{250} &= \frac{500}{250} \\ t &= 2 \end{aligned}$$

Distance = $150t = 150(2) = 300$ mi each way
The total distance was 600 mi.

65. Strategy

- Rate for freight train: r
- Rate for passenger train: $r + 20$

	Rate	Time	Distance
Freight	r	5	$5r$
Passenger	$r + 20$	3	$3(r + 20)$

- The trains travel the same distance.

Solution

$$\begin{aligned} 5r &= 3(r + 20) \\ 5r &= 3r + 60 \\ 2r &= 60 \\ r &= 30 \\ r + 20 &= 30 + 20 = 50 \end{aligned}$$

The freight train travels at 30 mph.
The passenger train travels at 50 mph.

66. Strategy

- The speed of the car: $2r$
- The speed of the bus: r

	Rate	Time	Distance
Car	$2r$	2	$4r$
Bus	r	2	$2r$

- In 2 h the car is 68 mi ahead of the bus.

Solution

$$\begin{aligned} 2r + 68 &= 4r \\ 68 &= 2r \\ 34 &= r \\ 2r &= 68 \end{aligned}$$

The car is traveling at 68 mph.

67. Strategy

- The time the first ship traveled: t
- The time the second ship traveled: $t - \frac{10}{25}$

	Rate	Time	Distance
First ship	25	t	$25t$
Second ship	35	$t - \frac{10}{25}$	$35\left(t - \frac{10}{25}\right)$

- The second ship catches up to the first ship.

Solution

$$\begin{aligned} 25t &= 35\left(t - \frac{10}{25}\right) \\ 25t &= 35t - 14 \\ -10t &= -14 \\ t &= 1.4 \\ t - \frac{10}{25} &= 1.4 - 0.4 = 1 \end{aligned}$$

The second ship catches up to the first ship in 1 h.

68. Strategy

- Time the first plane traveled: t
- Time the second plane traveled: $t - 1$

	Rate	Time	Distance
First plane	500	t	$500t$
Second plane	500	$t - 1$	$500(t - 1)$

- The planes pass each other.

Solution

$$\begin{aligned} 500t + 500(t-1) &= 3000 \\ 500t + 500t - 500 &= 3000 \\ 1000t &= 2500 \\ t &= 2\frac{1}{2} \end{aligned}$$

The planes will pass each other after 2.5 h.

69. Strategy

- Rate of the second car: r
- Rate of the first car: $r + 10$
- 12 min $\div$ 60 $= \frac{1}{5}$ hr

	Rate	Time	Distance
First car	$r + 10$	$\frac{1}{5}$	$\frac{1}{5}(r + 10)$
Second car	r	$\frac{1}{5}$	$\frac{1}{5}r$

- The total distance traveled by the two cars is 36.

Solution

$$\begin{aligned} \frac{1}{5}(r+10) + \frac{1}{5}r &= 36 \\ \frac{1}{5}r + 2 + \frac{1}{5}r &= 36 \\ \frac{5}{1}\cdot\frac{1}{5}r + 5\cdot 2 + \frac{5}{1}\cdot\frac{1}{5}r &= 5\cdot 36 \\ r + 10 + r &= 180 \\ 2r + 10 - 10 &= 180 - 10 \\ 2r &= 170 \\ \frac{2r}{2} &= \frac{170}{2} \\ r &= 85 \end{aligned}$$

85 + 10 = 95

The faster car is traveling 95 km/h.

70. Strategy

- Time the first train traveled: t
- Time the second train traveled: $t - 1$

	Rate	Time	Distance
First train	60	t	$60t$
Second train	50	$t - 1$	$50(t - 1)$

- The two trains pass each other.

Solution

$$\begin{aligned} 60t + 50(t-1) &= 500 \\ 60t + 50t - 50 &= 500 \\ 110t &= 550 \\ t &= 5 \\ t - 1 &= 4 \end{aligned}$$

The trains pass each other 4 h after the second train leaves Charleston.

71. Strategy

- Time for first car: t
- Time for second car: $t - \frac{1}{4}$

	Rate	Time	Distance
First driver	90	t	$90t$
Second driver	120	$t - \frac{1}{4}$	$120\left(t - \frac{1}{4}\right)$

- The second car will overtake the first when the distances are equal.

Solution

$$\begin{aligned} 90t &= 120\left(t - \frac{1}{4}\right) \\ 90t &= 120t - 30 \\ 90t - 120t &= 120t - 120t - 30 \\ -30t &= -30 \\ \frac{-30t}{-30} &= \frac{-30}{-30} \\ t &= 1 \end{aligned}$$

Distance = $90t = 90(1) = 90$ mi

The track is on 50 mi, so the second will not overtake the first.

72. Strategy

- Rate traveled on winding road: r
- Rate traveled on straight road: $t + 20$

	Rate	Time	Distance
Straight road	$r + 20$	2	$2(r + 20)$
Winding road	r	3	$3(r)$

- The total distance traveled was 210 mi.

Solution

$$\begin{aligned} 2(r+20) + 3(r) &= 210 \\ 2r + 40 + 3r &= 210 \\ 5r + 40 &= 210 \\ 5r + 40 - 40 &= 210 - 40 \\ 5r &= 170 \\ \frac{5r}{5} &= \frac{170}{5} \\ r &= 34 \end{aligned}$$

The average speed on the winding road was 34 mph.

73. Strategy

- Time the car traveled: t
- Time the bus traveled: $t - 1$

	Rate	Time	Distance
Car	45	t	$45t$
Bus	60	$t - 1$	$60(t - 1)$

- The bus overtakes the car.

Solution

$$\begin{aligned} 45t &= 60(t-1) \\ 45t &= 60t - 60 \\ -15t &= -60 \\ t &= 4 \\ 45t &= 180 \end{aligned}$$

The bus overtakes the car 180 mi from the starting point.

74. Strategy

- Time for car: t
- Time for cyclist: $t + 3$

	Rate	Time	Distance
Car	48	t	$48t$
Cyclist	12	$t + 3$	$12(t + 3)$

- The two vehicles travel the same distance.

Solution

$$\begin{aligned} 48t &= 12(t+3) \\ 48t &= 12t + 36 \\ 36t &= 36 \\ t &= 1 \\ \text{Distance} &= 48t = 48(1) = 48 \end{aligned}$$

The car overtakes the cyclist 48 mi from the starting point.

75. **Strategy**

- Time for the first part of the trip: t
- Time for the second part of the trip: $5 - t$

	Rate	Time	Distance
First part of trip	115	t	$115t$
Remainder of trip	125	$5 - t$	$125(5 - t)$

- The total distance traveled was 605 mi.

Solution

$$115t + 125(5 - t) = 605$$
$$115t + 625 - 125t = 605$$
$$-10t + 625 - 625 = 605 - 625$$
$$-10t = -20$$
$$\frac{-10t}{-10} = \frac{-20}{-10}$$
$$t = 2$$

$5 - 2 = 3$

The plane traveled 2 h at 115 mph and 3 h at 125 mph.

Critical Thinking

76. **Strategy**

- Cost of the mixture: x

	Amount	Cost	Value
\$4.50 alloy	30	4.50	4.50(30)
\$3.50 alloy	40	3.50	3.50(40)
\$3.00 alloy	30	3.00	3.00(30)
Resulting mixture	100	x	$100x$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$4.50(30) + 3.50(40) + 3.00(30) = 100x$$
$$135 + 140 + 90 = 100x$$
$$365 = 100x$$
$$\frac{365}{100} = \frac{100x}{100}$$
$$3.65 = x$$

The mixture costs \$3.65 per ounce.

77. **Strategy**

- Amount of Walnuts: x
- Amount of Cashews: $50 - 20 - x = 30 - x$

	Amount	Cost	Value
Walnuts	x	5.60	$5.60(x)$
Cashews	$30 - x$	7.50	$7.50(30 - x)$
Peanuts	20	4.00	4.00(20)
Mixture	50	5.72	5.72(50)

- The sum of the values before mixing equals the value after mixing.

Solution

$$5.60(x) + 7.50(30 - x) + 4.00(20) = 5.72(50)$$
$$5.6x + 225 - 7.5x + 80 = 286$$
$$-1.9x + 305 = 286$$
$$-1.9x + 305 - 305 = 286 - 305$$
$$-1.9x = -19$$
$$\frac{-1.9x}{-1.9} = \frac{-19}{-1.9}$$
$$x = 10$$

$30 - 10 = 20$

The amount of walnuts is 10 lb.

The amount of cashews is 20 lb.

78. **Strategy**

- Amount of water evaporated: x

	Amount	Percent	Quantity
Water	x	0	$0(x)$
12% salt	50	0.12	0.12(50)
15% salt	$50 - x$	0.15	$0.15(50 - x)$

- The difference between the quantities before and after evaporation is equal to the quantity before evaporation.

Solution

$$0.12(50) - 0x = 0.15(50 - x)$$
$$6 = 7.5 - 0.15x$$
$$-1.5 = -0.15x$$
$$10 = x$$

10 oz of water should be evaporated.

79. **Strategy**

- Amount of pure acid: x
- Amount of water: $10 - x$

	Amount	Percent	Quantity
Pure acid	x	1.00	$1.00x$
Water	$10 - x$	0	$0(10 - x)$
Mixture	10	0.30	$0.30(10)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.00x + 0(10 - x) = 0.30(10)$$
$$x = 3$$

$10 - 3 = 7$

3 L of pure acid and 7 L of water are mixed.

80. **Strategy**

- Amount of pure acid: x
- Amount of water: $50 - x$

	Amount	Percent	Quantity
Pure acid	50	1.00	1.00(50)
Water	x	0	$0(x)$
Mixture	$50 + x$	0.40	$0.40(50 + x)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.00(50) + 0(x) = 0.40(50 + x)$$
$$50 = 20 + 0.4x$$
$$50 - 20 = 20 - 20 + 0.4x$$
$$30 = 0.4x$$
$$\frac{30}{0.4} = \frac{0.4x}{0.4}$$
$$75 = x$$

75 g of pure water must be added.

81. **Strategy**

- Number of adult tickets: x
- Number of child tickets: $120 - x$

	Amount	Cost	Value
Adult tickets	x	5.50	$5.50(x)$
Child tickets	$120 - x$	2.75	$2.75(120 - x)$

- The sum of the values must equal \$563.75.

Solution

$$5.50x + 2.75(120 - x) = 563.75$$
$$5.50x + 330 - 2.75x = 563.75$$
$$2.75x + 330 = 563.75$$
$$2.75x + 330 - 330 = 563.75 - 330$$
$$2.75x = 233.75$$
$$\frac{2.75x}{2.75} = \frac{233.75}{2.75}$$
$$x = 85$$

$120 - 85 = 35$

85 adult tickets and 35 child tickets were sold.

82. **Strategy**

- Speed for the car: $3r + 5$
- Speed for the cyclist: r

	Rate	Time	Distance
Car	$3r + 5$	1.5	$1.5(3r + 5)$
Cyclist	r	1.5	$1.5r$

- The distance for the car is 46.5 more than the distance for the cyclist.

Solution

$$1.5(3r + 5) = 1.5r + 46.5$$
$$4.5r + 7.5 = 1.5r + 46.5$$
$$4.5r - 1.5r + 7.5 = 1.5r - 1.5r + 46.5$$
$$3r + 7.5 = 46.5$$
$$3r + 7.5 - 7.5 = 46.5 - 7.5$$
$$3r = 39$$
$$\frac{3r}{3} = \frac{39}{3}$$
$$r = 13$$

The cyclist is traveling 13 mph.

83. **Strategy**

- Time downstream: t
- Time upstream: $1 - t$

	Rate	Time	Distance
Downstream	12	t	$12t$
Upstream	4	$1 - t$	$4(1 - t)$

- The distance downstream is equal to the distance upstream.

Solution

$$12t = 4(1-t)$$
$$12t = 4 - 4t$$
$$12t + 4t = 4 - 4t + 4t$$
$$16t = 4$$
$$\frac{16t}{16} = \frac{4}{16}$$
$$t = \frac{1}{4}$$

$\frac{1}{4} \cdot 60 \text{ min} = 15 \text{ min}$

10:00 + 0:15 = 10:15

The campers turned around at 10:15 A.M.

84. **Strategy**

- Time for the truck: t
- Time for the van: $t - 1$

	Rate	Time	Distance
Truck	45	t	$45t$
Van	65	$t - 1$	$65(t - 1)$

- The van overtakes the truck when the distances are equal.

Solution

$$45t = 65(t-1)$$
$$45t = 65t - 65$$
$$45t - 65t = 65t - 65t - 65$$
$$-20t = -65$$
$$\frac{-20t}{-20} = \frac{-65}{-20}$$
$$t = \frac{13}{4}$$
$$t = 3\frac{1}{4}$$

$3\frac{1}{4}$ h = 3 h 15 min

11 A.M. + 3 h 15 min = 2:15 P.M.

The van overtake the truck at 2:15 P.M.

Projects and Group Activities

85. **Strategy**

- Amount to be drained and pure to be added: x
- Amount of 20%: $15 - x$

	Amount	Percent	Quantity
Pure antifreeze	x	1.00	$1.00x$
20%	$15 - x$	0.20	$0.20(15 - x)$
Mixture	15	0.40	0.40(15)

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.00x + 0.20(15 - x) = 0.40(15)$$
$$x + 3 - 0.2x = 6$$
$$0.8x + 3 = 6$$
$$0.8x + 3 - 3 = 6 - 3$$
$$0.8x = 3$$
$$\frac{0.8x}{0.8} = \frac{3}{0.8}$$
$$x = 3.75$$

3 .75 gal should be drained and replaced with antifreeze.

86. **Strategy** To find the amount of acid in the beginning. $\left(33\frac{1}{3}\% = \frac{1}{3}; 50\% = \frac{1}{2}\right)$

- Amount acid: x

After the 5 oz of water are added:

	Amount	Percent	Quantity
Solution	$x + 5$	$\frac{1}{3}$	$\frac{1}{3}(x+5)$
Acid	5	1.00	1.00(5)
Mixture	$x + 10$	$\frac{1}{2}$	$\frac{1}{2}(x+10)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$\frac{1}{3}(x+5)+1.00(5)=\frac{1}{2}(x+10)$$
$$\frac{1}{3}x+\frac{5}{3}+5=\frac{1}{2}x+5$$
$$\frac{6}{1}\cdot\frac{1}{3}x+\frac{6}{1}\cdot\frac{5}{3}+6\cdot5=\frac{6}{1}\cdot\frac{1}{2}x+6\cdot5$$
$$2x+10+30=3x+30$$
$$2x+40=3x+30$$
$$2x-2x+40=3x-2x+30$$
$$40=x+30$$
$$40-30=x+30-30$$
$$10=x$$

Strategy Find the percent of the acid at the beginning.

- Percent of acid: x

	Amount	Percent	Quantity
Beginning	10	x	$10x$
Water	5	0	0(5)
Mixture	15	$\frac{1}{3}$	$\frac{1}{3}(15)$

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$10x+0(5)=\frac{1}{3}(15)$$
$$10x=5$$
$$\frac{10x}{10}=\frac{5}{10}$$
$$x=0.5$$

The original mixture was 50%.

87. Strategy

- Find the total distance traveled and the total time.
- Divide the total distance by the total time to determine the average speed.

	Rate	Time	Distance
Leaving	10	2	10(2) = 20
Returning	20	$\frac{20}{20}=1$	20(1) = 20
Total		3	40

Solution

Average speed $=\frac{40}{3}=13\frac{1}{3}$

The bicyclist's average speed is $13\frac{1}{3}$ mph.

88. Strategy • The rate for 2nd mi: r

	Rate	Time	Distance
First mile	30	$\frac{1}{30}$	1
Second mile	r	$\frac{1}{r}$	1
Both miles	60	$\frac{2}{60}=\frac{1}{30}$	2

- The time traveled during the first mile plus the time traveled during the second mile is equal to the total time traveled during both miles.

Solution

$$\frac{1}{30}+\frac{1}{r}=\frac{1}{30}$$
$$\frac{1}{r}=0$$
$$r=0$$

There is no solution to this problem. It is not possible to increase the speed enough to average 60 mph.

89. Strategy

- Time to ascend: t
- Time to descend: $12-t$

	Rate	Time	Distance
Ascend	0.5	t	$0.5t$
Descend	1	$12-t$	$1(12-t)$

- The distances are the same.

Solution

$$0.5t=1(12-t)$$
$$0.5t=12-t$$
$$0.5t+t=12-t+t$$
$$1.5t=12$$
$$\frac{1.5t}{1.5}=\frac{12}{1.5}$$
$$t=8$$

Distance: $0.5t = 0.5(8) = 4$ mi each way
The total distance was 8 mi.

90. We look for patterns in mathematics to help us solve different types of problems. If we notice that the amount times the cost is equal to the value it helps us see the relationship holds for all value problems. If we notice that the amount times the percent gives us the volume it helps us to see the relationship for all percent volume problems. We could see that the amount times the cost gives us the value, we can see that problem 81 is a type of mixture problem.

Section 2.5

Concept Check

1. The Addition Property of Inequalities states that the same number can be added to each side of an inequality without changing the solution set of the inequality.
Examples will vary. For instance:

$$\begin{array}{c} 8 > 6 \\ 8 + 7 > 6 + 7 \\ 15 > 13 \end{array} \quad \text{and} \quad \begin{array}{c} -5 < -1 \\ -5 + (-2) < -1 + (-2) \\ -7 < -3 \end{array}$$

2. The Multiplication Property of Inequalities:
Rule 1: Each side of an inequality can be multiplied by the same positive constant without changing the solution set of the inequality.
Rule 2: If each side of an inequality is multiplied by the same negative constant and the inequality symbol is reversed, then the solution set of the inequality is not changed.
Examples will vary. For instance:

$$\begin{array}{c} 8 > 6 \\ 2 \cdot 8 > 2 \cdot 6 \\ 18 > 12 \end{array} \quad \text{and} \quad \begin{array}{c} 8 > 6 \\ (-2) \cdot 8 > (-2) \cdot 6 \\ -16 < -12 \end{array}$$

3. Replace x with each value to determine if the inequality holds.
i) $-17 + 7 \le -3$; $-10 \le -3$; solution
ii) $8 + 7 \le -3$; $15 \le -3$; not a solution
iii) $-10 + 7 \le -3$; $-3 \le -3$; solution
iv) $0 + 7 \le -3$; $7 \le -3$; not a solution

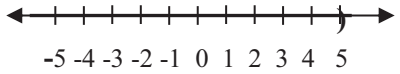
4. Replace x with each value to determine if the inequality holds.
i) $2(6) - 1 > 5$; $12 - 1 > 5$; $11 > 5$; solution
ii) $2(-4) - 1 > 5$; $-8 - 1 > 5$; $-9 > 5$; not a solution
iii) $2(3) - 1 > 5$; $6 - 1 > 5$; $5 > 5$; not a solution
iv) $2(5) - 1 > 5$; $10 - 1 > 5$; $9 > 5$; solution

5. <

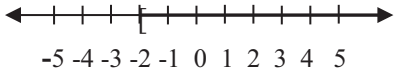
6. a. When a compound inequality is combined with *or* the set operation union is used.
b. When a compound inequality is combined with *and* the set operation intersection is used.

Objective A Exercises

7. $x - 3 < 2$
$x < 5$
$\{x \mid x < 5\}$



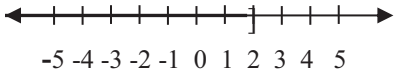
8. $x + 4 \ge 2$
$x \ge -2$
$\{x \mid x \ge -2\}$



9. $4x \le 8$

$$\frac{4x}{4} \le \frac{8}{4}$$

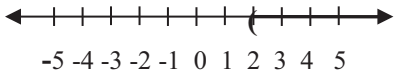
$x \le 2$
$\{x \mid x \le 2\}$



10. $6x > 12$

$$\frac{6x}{6} > \frac{12}{6}$$

$x > 2$
$\{x \mid x > 2\}$

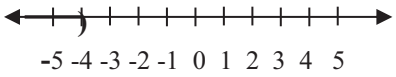


11. $-2x > 8$

$$\frac{-2x}{-2} < \frac{8}{-2}$$

$$x < -4$$

$\{x \mid x < -4\}$

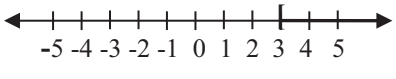


12. $-3x \leq -9$

$$\frac{-3x}{-3} \geq \frac{-9}{-3}$$

$$x \geq 3$$

$\{x \mid x \geq 3\}$



13. $3x - 1 > 2x + 2$

$$x - 1 > 2$$

$$x > 3$$

The solution set is $\{x \mid x > 3\}$.

14. $5x + 2 \geq 4x - 1$

$$x + 2 \geq -1$$

$$x \geq -3$$

The solution set is $\{x \mid x \geq -3\}$.

15. $2x - 1 > 7$

$$2x > 8$$

$$\frac{2x}{2} > \frac{8}{2}$$

$$x > 4$$

The solution set is $\{x \mid x > 4\}$.

16. $3x + 2 < 8$

$$3x < 6$$

$$\frac{3x}{3} < \frac{6}{3}$$

$$x < 2$$

The solution set is $\{x \mid x < 2\}$.

17. $5x - 2 \leq 8$

$$5x \leq 10$$

$$\frac{5x}{5} \leq \frac{10}{5}$$

$$x \leq 2$$

The solution set is $\{x \mid x \leq 2\}$.

18. $4x + 3 \leq -1$

$$4x \leq -4$$

$$\frac{4x}{4} \leq \frac{-4}{4}$$

$$x \leq -1$$

The solution set is $\{x \mid x \leq -1\}$.

19. $6x + 3 > 4x - 1$

$$6x > 4x - 4$$

$$2x > -4$$

$$\frac{2x}{2} > \frac{-4}{2}$$

$$x > -2$$

The solution set is $\{x \mid x > -2\}$.

20. $7x + 4 < 2x - 6$

$$5x + 4 < -6$$

$$5x < -10$$

$$\frac{5x}{5} < \frac{-10}{5}$$

$$x < -2$$

The solution set is $\{x \mid x < -2\}$.

21. $8x + 1 \geq 2x + 13$

$$6x + 1 \geq 13$$

$$6x \geq 12$$

$$\frac{6x}{6} \geq \frac{12}{6}$$

$$x \geq 2$$

The solution set is $\{x \mid x \geq 2\}$.

22. $5x - 4 < 2x + 5$

$$3x - 4 < 5$$

$$3x < 9$$

$$\frac{3x}{3} < \frac{9}{3}$$

$$x < 3$$

The solution set is $\{x \mid x < 3\}$.

23. $4 - 3x < 10$

$$-3x < 6$$

$$\frac{-3x}{-3} > \frac{6}{-3}$$

$$x > -2$$

The solution set is $\{x \mid x > -2\}$.

24. $2 - 5x > 7$
$-5x > 5$
$\frac{-5x}{-5} < \frac{5}{-5}$
$x < -1$
The solution set is $\{x \mid x < -1\}$.

25. $7 - 2x \geq 1$
$-2x \geq -6$
$\frac{-2x}{-2} \leq \frac{-6}{-2}$
$x \leq 3$
The solution set is $\{x \mid x \leq 3\}$.

26. $3 - 5x \leq 18$
$-5x \leq 15$
$\frac{-5x}{-5} \geq \frac{15}{-5}$
$x \geq -3$
The solution set is $\{x \mid x \geq -3\}$.

27. $-3 - 4x > -11$
$-4x > -8$
$\frac{-4x}{-4} < \frac{-8}{-4}$
$x < 2$
The solution set is $\{x \mid x < 2\}$.

28. $-2 - x < 7$
$-x < 9$
$(-1)(-x) > (-1)(9)$
$x > -9$
The solution set is $\{x \mid x > -9\}$.

29. $4x - 2 < x - 11$
$3x - 2 < -11$
$3x < -9$
$\frac{3x}{3} < \frac{-9}{3}$
$x < -3$
The solution set is $\{x \mid x < -3\}$.

30. $6x + 5 \leq x - 10$
$5x + 5 \leq -10$
$5x \leq -15$
$\frac{5x}{5} \leq \frac{-15}{5}$
$x \leq -3$
The solution set is $\{x \mid x \leq -3\}$.

31. $x + 7 \geq 4x - 8$
$-3x + 7 \geq -8$
$-3x \geq -15$
$\frac{-3x}{-3} \leq \frac{-15}{-3}$
$x \leq 5$
The solution set is $\{x \mid x \leq 5\}$.

32. $3x + 1 \leq 7x - 15$
$-4x + 1 \leq -15$
$-4x \leq -16$
$\frac{-4x}{-4} \geq \frac{-16}{-4}$
$x \geq 4$
The solution set is $\{x \mid x \geq 4\}$.

33. $3x + 2 \leq 7x + 4$
$-4x + 2 \leq 4$
$-4x \leq 2$
$\frac{-4x}{-4} \geq \frac{2}{-4}$
$x \geq -\frac{1}{2}$
The solution set is $\{x \mid x \geq -\frac{1}{2}\}$.

34. The solution to the inequality $x + n > a$, where both n and a are positive and $n < a$ contains only positive numbers.

35. The solution to the inequality $nx > a$, where both n and a are negative contains both positive and negative numbers.

36. The solution to the inequality $nx > a$, where n is negative and a is positive contains only negative numbers.

37. The solution to the inequality $x - n > -a$, where both n and a are positive and $n < a$ contains both positive and negative numbers.

38. $3x - 5 \geq -2x + 5$
$5x - 5 \geq 5$
$5x \geq 10$
$\frac{5x}{5} \geq \frac{10}{5}$
$x \geq 2$
The solution is $[2,\infty)$.

39. $7x+3<4x+1$
$7x+3-3<4x+1-3$
$7x<4x-2$
$7x-4x<4x-4x-2$
$3x<-2$
$\frac{3x}{3}<\frac{-2}{3}$
$x<-\frac{2}{3}$
The solution is $\left(-\infty,-\frac{2}{3}\right)$.

40. $5x-7\leq x-9$
$5x-7+7\leq x-9+7$
$5x\leq x-2$
$5x-x\leq x-x-2$
$4x\leq -2$
$\frac{4x}{4}\leq\frac{-2}{4}$
$x\leq -\frac{1}{2}$
The solution is $\left(-\infty,-\frac{1}{2}\right]$.

41. $\frac{2}{3}x-\frac{3}{2}<\frac{7}{6}-\frac{1}{3}x$
$6\left(\frac{2}{3}x-\frac{3}{2}\right)<6\left(\frac{7}{6}-\frac{1}{3}x\right)$
$4x-9<7-2x$
$6x-9<7$
$6x<16$
$\frac{6x}{6}<\frac{16}{6}$
$x<\frac{8}{3}$
The solution is $\left(-\infty,\frac{8}{3}\right)$.

42. $\frac{7}{12}x-\frac{3}{2}<\frac{2}{3}x+\frac{5}{6}$
$12\left(\frac{7}{12}x-\frac{3}{2}\right)<12\left(\frac{2}{3}x+\frac{5}{6}\right)$
$7x-18<8x+10$
$-x-18<10$
$-x<28$
$(-1)(-x)>(-1)(28)$
$x>-28$
The solution is $(-28, \infty)$.

43. $\frac{1}{2}x-\frac{3}{4}<\frac{7}{4}x-2$
$4\left(\frac{1}{2}x-\frac{3}{4}\right)<4\left(\frac{7}{4}x-2\right)$
$2x-3<7x-8$
$-5x-3<-8$
$-5x<-5$
$\frac{-5x}{-5}>\frac{-5}{-5}$
$x>1$
The solution is $(1, \infty)$.

44. $6 - 2(x - 4) \le 2x + 10$
$6 - 2x + 8 \le 2x + 10$
$14 - 2x \le 2x + 10$
$14 - 4x \le 10$
$-4x \le -4$
$\frac{-4x}{-4} \ge \frac{-4}{-4}$
$x \ge 1$
The solution is $[1, \infty)$.

45. $4(2x - 1) > 3x - 2(3x - 5)$
$8x - 4 > 3x - 6x + 10$
$8x - 4 > -3x + 10$
$11x - 4 > 10$
$11x > 14$
$\frac{11x}{11} > \frac{14}{11}$
$x > \frac{14}{11}$
The solution is $\left(\frac{14}{11}, \infty\right)$.

46. $2(1 - 3x) - 4 > 10 + 3(1 - x)$
$2 - 6x - 4 > 10 + 3 - 3x$
$-6x - 2 > 13 - 3x$
$-3x - 2 > 13$
$-3x > 15$
$\frac{-3x}{-3} < \frac{15}{-3}$
$x < -5$
The solution is $(-\infty, -5)$.

47. $2 - 5(x + 1) \ge 3(x - 1) - 8$
$2 - 5x - 5 \ge 3x - 3 - 8$
$-3 - 5x \ge 3x - 11$
$-5x \ge 3x - 8$
$-8x \ge -8$
$\frac{-8x}{-8} \le \frac{-8}{-8}$
$x \le 1$
The solution is $(-\infty, 1]$.

48. $2 - 2(7 - 2x) < 3(3 - x)$
$2 - 14 + 4x < 9 - 3x$
$-12 + 4x < 9 - 3x$
$4x < 21 - 3x$
$7x < 21$
$x < 3$
The solution is $(-\infty, 3)$.

49. $3 + 2(x + 5) \ge x + 5(x + 1) + 1$
$3 + 2x + 10 \ge x + 5x + 5 + 1$
$2x + 13 \ge 6x + 6$
$-4x + 13 \ge 6$
$-4x \ge -7$
$\frac{-4x}{-4} \le \frac{-7}{-4}$
$x \le \frac{7}{4}$
The solution is $\left(-\infty, \frac{7}{4}\right]$.

50. $10 - 13(2 - x) < 5(3x - 2)$
$10 - 26 + 13x < 15x - 10$
$-16 + 13x < 15x - 10$
$13x < 15x + 6$
$-2x < 6$
$\frac{-2x}{-2} > \frac{6}{-2}$
$x > -3$
The solution is $(-3, \infty)$.

51. $3 - 4(x + 2) \le 6 + 4(2x + 1)$
$3 - 4x - 8 \le 6 + 8x + 4$
$-4x - 5 \le 10 + 8x$
$-12x - 5 \le 10$
$-12x \le 15$
$\frac{-12x}{-12} \ge \frac{15}{-12}$
$x \ge -\frac{5}{4}$
The solution is $\left[-\frac{5}{4}, \infty\right)$.

52. $3x - 2(3x - 5) \le 2 - 5(x - 4)$
$3x - 6x + 10 \le 2 - 5x + 20$
$-3x + 10 \le 22 - 5x$
$2x + 10 \le 22$
$2x \le 12$
$\frac{2x}{2} \le \frac{12}{2}$
$x \le 6$
The solution is $(-\infty, 6]$.

53. $12 - 2(3x - 2) \geq 5x - 2(5 - x)$
$12 - 6x + 4 \geq 5x - 10 + 2x$
$16 - 6x \geq 7x - 10$
$-6x \geq 7x - 26$
$-13x \geq -26$
$\frac{-13x}{-13} \leq \frac{-26}{-13}$
$x \leq 2$
The solution is $(-\infty, 2]$.

Objective B Exercises

54. $3x < 6$ and $x + 2 > 1$
$x < 2$ $x > -1$
$\{x \mid x < 2\}$ $\{x \mid x > -1\}$
$\{x \mid x < 2\} \cap \{x \mid x > -1\} = (-1, 2)$

55. $x - 3 \leq 1$ and $2x \geq -4$
$x \leq 4$ $x \geq -2$
$\{x \mid x \leq 4\}$ $\{x \mid x \geq -2\}$
$\{x \mid x \leq 4\} \cap \{x \mid x \geq -2\} = [-2, 4]$

56. $x + 2 \geq 5$ or $3x \leq 3$
$x \geq 3$ $x \leq 1$
$\{x \mid x \geq 3\}$ $\{x \mid x \leq 1\}$
$\{x \mid x \geq 3\} \cup \{x \mid x \leq 1\} = (-\infty, 1] \cup [3, \infty)$

57. $2x < 6$ or $x - 4 > 1$
$x < 3$ $x > 5$
$\{x \mid x < 3\}$ $\{x \mid x > 5\}$
$\{x \mid x < 3\} \cup \{x \mid x > 5\} = (-\infty, 3) \cup (5, \infty)$

58. $-2x > -8$ and $-3x < 6$
$x < 4$ $x > -2$
$\{x \mid x < 4\}$ $\{x \mid x > -2\}$
$\{x \mid x < 4\} \cap \{x \mid x > -2\} = (-2, 4)$

59. $\frac{1}{2}x > -2$ and $5x < 10$
$x > -4$ $x < 2$
$\{x \mid x > -4\}$ $\{x \mid x < 2\}$
$\{x \mid x > -4\} \cap \{x \mid x < 2\} = (-4, 2)$

60. $\frac{1}{3}x < -1$ or $2x > 0$
$x < -3$ $x > 0$
$\{x \mid x < -3\}$ $\{x \mid x > 0\}$
$\{x \mid x < -3\} \cup \{x \mid x > 0\} = (-\infty, -3) \cup (0, \infty)$

61. $\frac{2}{3}x > 4$ or $2x < -8$
$x > 6$ $x < -4$
$\{x \mid x > 6\}$ $\{x \mid x < -4\}$
$\{x \mid x > 6\} \cup \{x \mid x < -4\} = (-\infty, -4) \cup (6, \infty)$

62. $x + 4 \geq 5$ and $2x \geq 6$
$x \geq 1$ $x \geq 3$
$\{x \mid x \geq 1\}$ $\{x \mid x \geq 3\}$
$\{x \mid x \geq 1\} \cap \{x \mid x \geq 3\} = [3, \infty)$

63. $3x < -9$ and $x - 2 < 2$
$x < -3$ $x < 4$
$\{x \mid x < -3\}$ $\{x \mid x < 4\}$
$\{x \mid x < -3\} \cap \{x \mid x < 4\} = (-\infty, -3)$

64. $-5x > 10$ and $x + 1 > 6$
$x < -2$ $x > 5$
$\{x \mid x < -2\}$ $\{x \mid x > 5\}$
$\{x \mid x < -2\} \cap \{x \mid x > 5\} = \emptyset$

65. $2x - 3 > 1$ and $3x - 1 < 2$
$2x > 4$ $3x < 3$
$x > 2$ $x < 1$
$\{x \mid x > 2\}$ $\{x \mid x < 1\}$
$\{x \mid x > 2\} \cap \{x \mid x < 1\} = \emptyset$

66. $7x < 14$ and $1 - x < 4$
$x < 2$ $-x < 3$
$x > -3$
$\{x \mid x < 2\}$ $\{x \mid x > -3\}$
$\{x \mid x < 2\} \cap \{x \mid x > -3\} = (-3, 2)$

67. $4x + 1 < 5$ and $4x + 7 > -1$
$4x < 4$ $4x > -8$
$x < 1$ $x > -2$
$\{x \mid x < 1\}$ $\{x \mid x > -2\}$
$\{x \mid x < 1\} \cap \{x \mid x > -2\} = (-2, 1)$

68. The inequality $x > -3$ and $x > 2$ describes one interval of real numbers.

69. The inequality $x > -3$ or $x < 2$ describes all real numbers.

70. The inequality $x < -3$ and $x > 2$ describes the empty set.

71. The inequality $x < -3$ or $x > 2$ describes two intervals of real numbers.

72. $3x + 7 < 10$ or $2x - 1 > 5$

$3x < 3$ $\qquad$ $2x > 6$

$x < 1$ $\qquad$ $x > 3$

$\{x \mid x < 1\}$ $\qquad$ $\{x \mid x > 3\}$

$\{x \mid x < 1\} \cup \{x \mid x > 3\} = \{x \mid x < 1 \text{ or } x > 3\}$

73. $6x - 2 < -14$ or $5x + 1 > 11$

$6x < -12$ $\qquad$ $5x > 10$

$x < -2$ $\qquad$ $x > 2$

$\{x \mid x < -2\}$ $\qquad$ $\{x \mid x > 2\}$

$\{x \mid x < -2\} \cup \{x \mid x > 2\} = \{x \mid x < -2 \text{ or } x > 2\}$

74. $-5 < 3x + 4 < 16$

$-5 + (-4) < 3x + 4 + (-4) < 16 + (-4)$

$-9 < 3x < 12$

$$\frac{-9}{3} < \frac{3x}{3} < \frac{12}{3}$$

$-3 < x < 4$

$\{x \mid -3 < x < 4\}$

75. $5 < 4x - 3 < 21$

$5 + 3 < 4x - 3 + 3 < 21 + 3$

$8 < 4x < 24$

$$\frac{8}{4} < \frac{4x}{4} < \frac{24}{4}$$

$2 < x < 6$

$\{x \mid 2 < x < 6\}$

76. $0 < 2x - 6 < 4$

$0 + 6 < 2x - 6 + 6 < 4 + 6$

$6 < 2x < 10$

$$\frac{6}{2} < \frac{2x}{2} < \frac{10}{2}$$

$3 < x < 5$

$\{x \mid 3 < x < 5\}$

77. $-2 < 3x + 7 < 1$

$-2 + (-7) < 3x + 7 + (-7) < 1 + (-7)$

$-9 < 3x < -6$

$$\frac{-9}{3} < \frac{3x}{3} < \frac{-6}{3}$$

$-3 < x < -2$

$\{x \mid -3 < x < -2\}$

78. $4x - 1 > 11$ or $4x - 1 \le -11$

$4x > 12$ $\qquad$ $4x \le -10$

$x > 3$ $\qquad$ $x \le -\frac{5}{2}$

$\{x \mid x > 3\}$ $\qquad$ $\{x \mid x \le -\frac{5}{2}\}$

$\{x \mid x > 3\} \cup \{x \mid x \le -\frac{5}{2}\} = \{x \mid x > 3 \text{ or } x \le -\frac{5}{2}\}$

79. $3x - 5 > 10$ or $3x - 5 < -10$

$3x > 15$ $\qquad$ $3x < -5$

$x > 5$ $\qquad$ $x < -\frac{5}{3}$

$\{x \mid x > 5\}$ $\qquad$ $\{x \mid x < -\frac{5}{3}\}$

$\{x \mid x > 5\} \cup \{x \mid x < -\frac{5}{3}\} = \{x \mid x > 5 \text{ or } x < -\frac{5}{3}\}$

80. $9x - 2 < 7$ and $3x - 5 > 10$

$9x < 9$ $\qquad$ $3x > 15$

$x < 1$ $\qquad$ $x > 5$

$\{x \mid x < 1\}$ $\qquad$ $\{x \mid x > 5\}$

$\{x \mid x < 1\} \cap \{x \mid x > 5\} = \emptyset$

81. $8x + 2 \le -14$ and $4x - 2 > 10$

$8x \le -16$ $\qquad$ $4x > 12$

$x \le -2$ $\qquad$ $x > 3$

$\{x \mid x \le -2\}$ $\qquad$ $\{x \mid x > 3\}$

$\{x \mid x \le -2\} \cap \{x \mid x > 3\} = \emptyset$

82. $3x - 11 < 4$ or $4x + 9 \ge 1$

$3x < 15$ $\qquad$ $4x \ge -8$

$x < 5$ $\qquad$ $x \ge -2$

$\{x \mid x < 5\}$ $\qquad$ $\{x \mid x \ge -2\}$

$\{x \mid x < 5\} \cup \{x \mid x \ge -2\}$ = the set of real numbers

83. $5x + 12 \ge 2$ or $7x - 1 \le 13$

$5x \ge -10$ $\qquad$ $7x \le 14$

$x \ge -2$ $\qquad$ $x \le 2$

$\{x \mid x \ge -2\}$ $\qquad$ $\{x \mid x \le 2\}$

$\{x \mid x \ge -2\} \cup \{x \mid x \le 2\}$ = the set of real numbers

84. $-6 \le 5x + 14 \le 24$
$-6 + (-14) \le 5x + 14 + (-14) \le 24 + (-14)$
$-20 \le 5x \le 10$
$\frac{-20}{5} \le \frac{5x}{5} \le \frac{10}{5}$
$-4 \le x \le 2$
$\{x \mid -4 \le x \le 2\}$

85. $3 \le 7x - 14 \le 31$
$3 + 14 \le 7x - 14 + 14 \le 31 + 14$
$17 \le 7x \le 45$
$\frac{17}{7} \le \frac{7x}{7} \le \frac{45}{7}$
$\frac{17}{7} \le x \le \frac{45}{7}$
$\{x \mid \frac{17}{7} \le x \le \frac{45}{7}\}$

86. $3 - 2x > 7$ and $5x + 2 > -18$
$-2x > 4$ $5x > -20$
$x < -2$ $x > -4$
$\{x \mid x < -2\}$ $\{x \mid x > -4\}$
$\{x \mid x < -2\} \cap \{x \mid x > -4\} = \{x \mid -4 < x < -2\}$

87. $1 - 3x < 16$ and $1 - 3x > -16$
$-3x < 15$ $-3x > -17$
$x > -5$ $x < \frac{-17}{-3}$
$\{x \mid x > -5\}$ $\{x \mid x < \frac{17}{3}\}$
$\{x \mid x > -5\} \cap \{x \mid x < \frac{17}{3}\} = \{x \mid -5 < x < \frac{17}{3}\}$

88. $5 - 4x > 21$ or $7x - 2 > 19$
$-4x > 16$ $7x > 21$
$x < -4$ $x > 3$
$\{x \mid x < -4\}$ $\{x \mid x > 3\}$
$\{x \mid x < -4\} \cup \{x \mid x > 3\} = \{x \mid x < -4 \text{ or } x > 3\}$

89. $6x + 5 < -1$ or $1 - 2x < 7$
$6x < -6$ $-2x < 6$
$x < -1$ $x > -3$
$\{x \mid x < -1\}$ $\{x \mid x > -3\}$
$\{x \mid x < -1\} \cup \{x \mid x > -3\}$ = The set of real numbers.

90. $3 - 7x \le 31$ and $5 - 4x > 1$
$-7x \le 28$ $-4x > -4$
$x \ge -4$ $x < 1$
$\{x \mid x \ge -4\}$ $\{x \mid x < 1\}$
$\{x \mid x \ge -4\} \cap \{x \mid x < 1\} = \{x \mid -4 \le x < 1\}$

91. $9 - x \ge 7$ and $9 - 2x < 3$
$-x \ge -2$ $-2x < -6$
$x \le 2$ $x > 3$
$\{x \mid x \le 2\}$ $\{x \mid x > 3\}$
$\{x \mid x \le 2\} \cap \{x \mid x > 3\} = \emptyset$

Objective C Exercises

92. The low temperature was 21°F can be written as $t \ge 21$.

93. The temperature did not go above 42°F can be written as $t \le 42$.

94. The temperature ranged from 21°F to 42°F can be written as $21 \le t \le 42$.

95. The high temperature was 42°F can be written as $t \le 42$.

96. Strategy: Let W represent the width of the rectangle.
The length of the rectangle is $4W + 2$.
To find the maximum width solve the inequality $2L + 2W < 34$.

Solution:
$2L + 2W < 34$
$2(4W + 2) + 2W < 34$
$8W + 4 + 2W < 34$
$10W + 4 < 34$
$10W < 30$
$W < 3$
The maximum width of the rectangle is 2 ft.

97. Strategy: Let x represent the width of the rectangle.
The length of the rectangle is $2x - 5$.
To find the maximum width solve the inequality $2L + 2W < 60$.

Solution:
$$\begin{aligned} 2L + 2W &< 60 \\ 2(2x - 5) + 2x &< 60 \\ 4x - 10 + 2x &< 60 \\ 6x - 10 &< 60 \\ 6x &< 70 \\ x &< \frac{70}{6} = 11\frac{2}{3} \end{aligned}$$

The maximum width of the rectangle is 11 cm.

98. a) the total length of the fish is
$2 + 3(1) + 3(1.75) + 5(1) = 15.25$ in
b) Strategy: Let n represent the number of 2-in hatchet fish.
To find the maximum number of hatchet fish that can be added solve the inequality $288 \geq 12(15.25 + 2n)$.

Solution:
$$\begin{aligned} 288 &\geq 12(15.25 + 2n) \\ 288 &\geq 183 + 24n \\ 105 &\geq 24n \\ \frac{105}{24} &\geq n \\ 4\frac{3}{8} &\geq n \end{aligned}$$

You can add a maximum of 4 hatchet fish.

99. Strategy: Let d represent the number of days to run advertisement.
To find the maximum number of days the advertisement can run on the website solve the inequality $250 + 12d \leq 1500$.

Solution:
$$\begin{aligned} 250 + 12d &\leq 1500 \\ 12d &\leq 1250 \\ d &\leq \frac{1250}{12} \\ d &\leq 104\frac{1}{6} \end{aligned}$$

You can run the advertisement for 104 days.

100. Strategy: Let t represent the number of additional tickets.
To find the maximum number of tickets Alisha can purchase solve the inequality $25 + 1.50t \leq 45$.

Solution:
$$\begin{aligned} 25 + 1.5t &\leq 45 \\ 1.5t &\leq 20 \\ t &\leq \frac{20}{1.5} \\ t &\leq 13\frac{1}{3} \end{aligned}$$

Alisha can buy an additional 13 tickets.

101. Strategy: Let x represent the cost of a gallon of paint.
Since a gallon of paint covers 100 square feet and the room is 320 square feet the homeowner will need to buy 4 gallons of paint.
To find the maximum cost per gallon solve the inequality $24 + 4x \leq 100$.

Solution:
$$\begin{aligned} 24 + 4x &\leq 100 \\ 4x &\leq 76 \\ x &\leq 19 \end{aligned}$$

The maximum that the homeowner can pay for a gallon of paint is \$19.

102. Strategy: To find the temperature range in Celsius degrees solve the compound inequality $14 < \frac{9}{5}C + 32 < 77$.

Solution:
$$14 < \frac{9}{5}C + 32 < 77$$
$$14 + (-32) < \frac{9}{5}C + 32 + (-32) < 77 + (-32)$$
$$-18 < \frac{9}{5}C < 45$$
$$\frac{5}{9}(-18) < \frac{5}{9}\left(\frac{9C}{5}\right) < \frac{5}{9}(45)$$
$$-10^\circ < C < 25^\circ$$

103. Strategy: To find the temperature range in Fahrenheit degrees solve the compound inequality $0 < \frac{5(F-32)}{9} < 30$.

Solution: $0 < \frac{5(F-32)}{9} < 30$

$$\frac{9}{5}(0) < \frac{9}{5}\left(\frac{5(F-32)}{9}\right) < \frac{9}{5}(30)$$

$$0 < F - 32 < 54$$

$$0 + 32 < F - 32 + 32 < 54 + 32$$

$$32^\circ < F < 86^\circ$$

104. Strategy: Let N represent the amount of sales.
To find the minimum amount of sales solve the inequality $1200 + 0.06N \geq 6000$.

Solution: $1200 + 0.06N \geq 6000$

$0.06N \geq 4800$

$N \geq 80{,}000$

The executive's amount of sales must be \$80,000 or more per month.

105. Strategy: Let N represent the amount of sales.
To find the minimum amount of sales solve the inequality $1000 + 0.05N \geq 3200$.

Solution: $1000 + 0.05N \geq 3200$

$0.05N \geq 2200$

$N \geq 44{,}000$

George's amount of sales must be \$44,000 or more per month.

106. Strategy: Divide the total number of students (70) and the number of professors (10) by 12.
Solve the inequality $N > \frac{70+10}{12}$.

Solution

$N > \frac{70+10}{12}$

$N > \frac{80}{12}$

$N > 6.67$

The minimum number of busses is 7.

107. Let x represent the number of gallons needed in the first month. To find the minimum, solve the inequality $x + (x+400) + (x+800) + (x+1200) + (x+1600) \geq 8500$.

Solution

$x + x + 400 + (x+800) + (x+1200) + (x+1600) \leq 8500$

$5x + 4000 \leq 8500$

$5x + 4000 - 4000 \leq 8500 - 4000$

$5x \leq 4500$

$x \leq 900$

The company must make a minimum of 900 gal the first month.

108. Strategy: Let N represent the score on the last test.
To find the range of scores solve the inequality $90 \leq \frac{95+89+81+N}{4} \leq 100$.

Solution:

$$90 \leq \frac{95+89+81+N}{4} \leq 100$$

$$90 \leq \frac{265+N}{4} \leq 100$$

$$4(90) \leq 4 \cdot \frac{265+N}{4} \leq 4(100)$$

$$360 \leq 265 + N \leq 400$$

$$360 - 265 \leq 265 - 265 + N \leq 400 - 265$$

$$95 \leq N \leq 135$$

Since 100 is the maximum core, the range of scores needed to receive an A grade is $95 \leq N \leq 100$.

109. Strategy: Let n represent the score on the last test.
To find the range of scores solve the inequality

$$70 \le \frac{56+91+83+62+n}{5} \le 79.$$

Solution:

$$70 \le \frac{56+91+83+62+n}{5} \le 79$$

$$70 \le \frac{292+n}{5} \le 79$$

$$5(70) \le 5 \cdot \frac{292+n}{5} \le 5(79)$$

$$350 \le 292 + n \le 395$$

$$350 - 292 \le 292 - 292 + n \le 395 - 292$$

$$58 \le n \le 103$$

Since 100 is the maximum core, the range of scores needed to receive an C grade is $58 \le n \le 100$.

110. Strategy: Let n number of miles on a full tank. To find the range of miles, solve the inequality $\frac{112}{3.5} \le n \le \frac{112}{5}$.

Solution:

$$112(3.5) \le n \le 112(5)$$

$$392 \le n \le 560$$

The range of miles on a full tank is between 392 mi and 560 mi.

Critical Thinking

111. a) $a \le 2x + 1 \le b$

$a - 1 \le 2x \le b - 1$

Since $-2 \le x \le 4$ we have $-4 \le 2x \le 6$

$a - 1 \le 2x$

$a - 1 \le -4$

$a \le -3$

The largest possible value of a is -3.

b) $2x \le b - 1$

$6 \le b - 1$

$7 \le b$

The smallest possible value of b is 7.

112. False

113. True

114. True

115. True

Projects or Group Activities

116. a) Always true
b) Sometimes true
c) Sometimes true
d) Sometimes true
e) Always true

Section 2.6

Concept Check

1. $|2 - 8| = 6$

$|-6| = 6$

$6 = 6$

Yes, 2 is a solution.

2. $|2(-2) - 5| = 9$

$|-4 - 5| = 9$

$|-9| = 9$

$9 = 9$

Yes, -2 is a solution.

3. $|3(-1) - 4| = 7$

$|-3 - 4| = 7$

$|-7| = 7$

$7 = 7$

Yes, -1 is a solution.

4. $|6(1) - 1| = -5$

$|6 - 1| = -5$

$|5| = -5$

$5 \ne -5$

No, 1 is not a solution.

5. $|x| = 7$

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

The solutions are 7 and -7.

6. $|a| = 2$

$a = 2$ or $a = -2$

The solutions are 2 and -2.

7. $|-y| = 6$
$-y = 6$ or $-y = -6$
$y = -6$ or $y = 6$
The solutions are 6 and – 6.

8. $|-t| = 3$
$-t = 3$ or $-t = -3$
$t = -3$ or $t = 3$
The solutions are 3 and – 3.

9. $|x| = -4$
There is no solution to this equation because the absolute value of a number must be nonnegative.

10. $|y| = -3$
There is no solution to this equation because the absolute value of a number must be nonnegative.

11. $|-t| = -3$
There is no solution to this equation because the absolute value of a number must be nonnegative.

12. $|-y| = -2$
There is no solution to this equation because the absolute value of a number must be nonnegative.

13. $|x| > 3$
$x > 3$ or $x < -3$
$\{x \mid x > 3\}$ $\{x \mid x < -3\}$
$\{x \mid x > 3\} \cup \{x \mid x < -3\} = \{x \mid x > 3 \text{ or } x < -3\}$

14. $|x| < 5$
$-5 < x < 5$
$\{x \mid -5 < x < 5\}$

15. $|x - 2| < 5$

16. $|x - 4| > 3$

Objective A Exercises

17. $|x + 2| = 3$
$x + 2 = 3$ or $x + 2 = -3$
$x = 1$ $x = -5$
The solutions are 1 and – 5.

18. $|x + 5| = 2$
$x + 5 = 2$ or $x + 5 = -2$
$x = -3$ $x = -7$
The solutions are – 3 and – 7.

19. $|y - 5| = 3$
$y - 5 = 3$ or $y - 5 = -3$
$y = 8$ $y = 2$
The solutions are 2 and 8.

20. $|y - 8| = 4$
$y - 8 = 4$ or $y - 8 = -4$
$y = 12$ $y = 4$
The solutions are 4 and 12.

21. $|a - 2| = 0$
$a - 2 = 0$
$a = 2$
The solution is 2.

22. $|a + 7| = 0$
$a + 7 = 0$
$a = -7$
The solution is −7.

23. $|x - 2| = -4$
There is no solution to this equation because the absolute value of a number must be nonnegative.

24. $|x + 8| = -2$
There is no solution to this equation because the absolute value of a number must be nonnegative.

25. $|3 - 4x| = 9$

$3 - 4x = 9$ or $3 - 4x = -9$

$-4x = 6$ $\quad -4x = -12$

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

The solutions are 3 and $-\frac{3}{2}$.

26. $|2 - 5x| = 3$

$2 - 5x = 3$ or $2 - 5x = -3$

$-5x = 1$ $\quad -5x = -5$

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

The solutions are 1 and $-\frac{1}{5}$.

27. $|2x - 3| = 0$

$2x - 3 = 0$

$2x = 3$

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

The solution is $\frac{3}{2}$.

28. $|5x + 5| = 0$

$5x + 5 = 0$

$5x = -5$

$x = -1$

The solution is -1.

29. $|3x - 2| = -4$

There is no solution to this equation because the absolute value of a number must be nonnegative.

30. $|2x + 5| = -2$

There is no solution to this equation because the absolute value of a number must be nonnegative.

31. $|x - 2| - 2 = 3$

$|x - 2| = 5$

$x - 2 = 5$ or $x - 2 = -5$

$x = 7$ $\quad x = -3$

The solutions are 7 and -3.

32. $|x - 9| - 3 = 2$

$|x - 9| = 5$

$x - 9 = 5$ or $x - 9 = -5$

$x = 14$ $\quad x = 4$

The solutions are 4 and 14.

33. $|3a + 2| - 4 = 4$

$|3a + 2| = 8$

$3a + 2 = 8$ or $3a + 2 = -8$

$3a = 6$ $\quad 3a = -10$

$a = 2$ $\quad a = -\frac{10}{3}$

The solutions are 2 and $-\frac{10}{3}$.

34. $|2a + 9| + 4 = 5$

$|2a + 9| = 1$

$2a + 9 = 1$ or $2a + 9 = -1$

$2a = -8$ $\quad 2a = -10$

$a = -4$ $\quad a = -5$

The solutions are -4 and -5.

35. $|2 - y| + 3 = 4$

$|2 - y| = 1$

$2 - y = 1$ or $2 - y = -1$

$-y = -1$ $\quad -y = -3$

$y = 1$ $\quad y = 3$

The solutions are 1 and 3.

36. $|8 - y| - 3 = 1$

$|8 - y| = 4$

$8 - y = 4$ or $8 - y = -4$

$-y = -4$ $\quad -y = -12$

$y = 4$ $\quad y = 12$

The solutions are 4 and 12.

37. $|2x - 3| + 3 = 3$

$|2x - 3| = 0$

$2x - 3 = 0$

$2x = 3$

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

The solution is $\frac{3}{2}$.

38. $|4x - 7| - 5 = -5$
$|4x - 7| = 0$
$4x - 7 = 0$
$4x = 7$
$x = \frac{7}{4}$
The solution is $\frac{7}{4}$.

39. $|2x - 3| + 4 = -4$
$|2x - 3| = -8$
There is no solution to this equation because the absolute value of a number must be nonnegative.

40. $|3x - 2| + 1 = -1$
$|3x - 2| = -2$
There is no solution to this equation because the absolute value of a number must be nonnegative.

41. $|6x - 5| - 2 = 4$
$|6x - 5| = 6$
$6x - 5 = 6$ or $6x - 5 = -6$
$6x = 11$ $6x = -1$
$x = \frac{11}{6}$ $x = -\frac{1}{6}$
The solutions are $\frac{11}{6}$ and $-\frac{1}{6}$.

42. $|4b + 3| - 2 = 7$
$|4b + 3| = 9$
$4b + 3 = 9$ or $4b + 3 = -9$
$4b = 6$ $4b = -12$
$b = \frac{3}{2}$ $b = -3$
The solutions are $\frac{3}{2}$ and -3.

43. $|3t + 2| + 3 = 4$
$|3t + 2| = 1$
$3t + 2 = 1$ or $3t + 2 = -1$
$3t = -1$ $3t = -3$
$t = -\frac{1}{3}$ $t = -1$
he solutions are $-\frac{1}{3}$ and -1.

44. $|5x - 2| + 5 = 7$
$|5x - 2| = 2$
$5x - 2 = 2$ or $5x - 2 = -2$
$5x = 4$ $5x = 0$
$x = \frac{4}{5}$ $x = 0$
The solutions are $\frac{4}{5}$ and 0.

45. $3 - |x - 4| = 5$
$-|x - 4| = 2$
$|x - 4| = -2$
There is no solution to this equation because the absolute value of a number must be nonnegative.

46. $2 - |x - 5| = 4$
$-|x - 5| = 2$
$|x - 5| = -2$
There is no solution to this equation because the absolute value of a number must be nonnegative.

47. $8 - |2x - 3| = 5$
$-|2x - 3| = -3$
$|2x - 3| = 3$
$2x - 3 = 3$ or $2x - 3 = -3$
$2x = 6$ $2x = 0$
$x = 3$ $x = 0$
The solutions are 3 and 0.

48. $8 - |3x + 2| = 3$
$-|3x + 2| = -5$
$|3x + 2| = 5$
$3x + 2 = 5$ or $3x + 2 = -5$
$3x = 3$ $3x = -7$
$x = 1$ $x = -\frac{7}{3}$
The solutions are 1 and $-\frac{7}{3}$.

49. $|2 - 3x| + 7 = 2$
$|2 - 3x| = -5$
There is no solution to this equation because the absolute value of a number must be nonnegative.

50. $|1 - 5a| + 2 = 3$

$|1 - 5a| = 1$

$1 - 5a = 1$ or $1 - 5a = -1$

$-5a = 0$ $\quad -5a = -2$

$a = 0$ $\quad a = \frac{2}{5}$

The solutions are 0 and $\frac{2}{5}$.

51. $|8 - 3x| - 3 = 2$

$|8 - 3x| = 5$

$8 - 3x = 5$ or $8 - 3x = -5$

$-3x = -3$ $\quad -3x = -13$

$x = 1$ $\quad x = \frac{13}{3}$

The solutions are 1 and $\frac{13}{3}$.

52. $|6 - 5b| - 4 = 3$

$|6 - 5b| = 7$

$6 - 5b = 7$ or $6 - 5b = -7$

$-5b = 1$ $\quad -5b = -13$

$b = -\frac{1}{5}$ $\quad b = \frac{13}{5}$

The solutions are $-\frac{1}{5}$ and $\frac{13}{5}$.

53. $|2x - 8| + 12 = 2$

$|2x - 8| = -10$

There is no solution to this equation because the absolute value of a number must be nonnegative.

54. $|3x - 4| + 8 = 3$

$|3x - 4| = -5$

There is no solution to this equation because the absolute value of a number must be nonnegative.

55. $2 + |3x - 4| = 5$

$|3x - 4| = 3$

$3x - 4 = 3$ or $3x - 4 = -3$

$3x = 7$ $\quad 3x = 1$

$x = \frac{7}{3}$ $\quad x = \frac{1}{3}$

The solutions are $\frac{7}{3}$ and $\frac{1}{3}$.

56. $5 + |2x + 1| = 8$

$|2x + 1| = 3$

$2x + 1 = 3$ or $2x + 1 = -3$

$2x = 2$ $\quad 2x = -4$

$x = 1$ $\quad x = -2$

The solutions are 1 and −2.

57. $5 - |2x + 1| = 5$

$-|2x + 1| = 0$

$2x + 1 = 0$

$2x = -1$

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

The solution is $-\frac{1}{2}$.

58. $3 - |5x + 3| = 3$

$-|5x + 3| = 0$

$5x + 3 = 0$

$5x = -3$

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

The solution is $-\frac{3}{5}$.

59. $6 - |2x + 4| = 3$

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

$|2x + 4| = 3$

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

$2x = -1$ $\quad 2x = -7$

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

The solutions are $-\frac{1}{2}$ and $-\frac{7}{2}$.

60. $8 - |3x - 2| = 5$

$-|3x - 2| = -3$

$|3x - 2| = 3$

$3x - 2 = 3$ $\quad 3x - 2 = -3$

$3x = 5$ or $3x = -1$

$x = \frac{5}{3}$ $\quad x = -\frac{1}{3}$

The solutions are $\frac{5}{3}$ and $-\frac{1}{3}$.

61. $8-|1-3x|=-1$

$-|1-3x|=-9$

$|1-3x|=9$

$1-3x=9 \qquad 1-3x=-9$

$-3x=8 \quad \text{or} \quad -3x=-10$

$x=-\frac{8}{3} \qquad x=\frac{10}{3}$

The solutions are $-\frac{8}{3}$ and $\frac{10}{3}$.

62. $3-|3-5x|=-2$

$-|3-5x|=-5$

$|3-5x|=5$

$3-5x=5 \qquad 3-5x=-5$

$-5x=2 \quad \text{or} \quad -5x=-8$

$x=-\frac{2}{5} \qquad x=\frac{8}{5}$

The solutions are $-\frac{2}{5}$ and $\frac{8}{5}$.

63. $5+|2-x|=3$

$|2-x|=-2$

There is no solution to this equation because the absolute value of a number must be nonnegative.

64. $6+|3-2x|=2$

$|3-2x|=-4$

There is no solution to this equation because the absolute value of a number must be nonnegative.

65. Two positive solutions.

66. No solution.

67. Two negative solutions.

68. One positive and one negative solution.

Objective B Exercises

69. $|x+1|>2$

$x+1>2 \qquad \text{or} \qquad x+1<-2$

$x>1 \qquad\qquad x<-3$

$\{x \mid x>1\} \qquad \{x \mid x<-3\}$

$\{x \mid x>1\} \cup \{x \mid x<-3\} = \{x \mid x>1 \text{ or } x<-3\}$

70. $|x-2|>1$

$x-2>1 \qquad \text{or} \qquad x-2<-1$

$x>3 \qquad\qquad x<1$

$\{x \mid x>3\} \qquad \{x \mid x<1\}$

$\{x \mid x>3\} \cup \{x \mid x<1\} = \{x \mid x>3 \text{ or } x<1\}$

71. $|x-5| \le 1$

$-1 \le x-5 \le 1$

$-1+5 \le x-5+5 \le 1+5$

$4 \le x \le 6$

$\{x \mid 4 \le x \le 6\}$

72. $|x-4| \le 3$

$-3 \le x-4 \le 3$

$-3+4 \le x-4+4 \le 3+4$

$1 \le x \le 7$

$\{x \mid 1 \le x \le 7\}$

73. $|2-x| \ge 3$

$2-x \ge 3 \qquad \text{or} \qquad 2-x \le -3$

$-x \ge 1 \qquad\qquad -x \le -5$

$x \le -1 \qquad\qquad x \ge 5$

$\{x \mid x \le -1\} \qquad \{x \mid x \ge 5\}$

$\{x \mid x \le -1\} \cup \{x \mid x \ge 5\} = \{x \mid x \le -1 \text{ or } x \ge 5\}$

74. $|3-x| \ge 2$

$3-x \ge 2 \qquad \text{or} \qquad 3-x \le -2$

$-x \ge -1 \qquad\qquad -x \le -5$

$x \le 1 \qquad\qquad x \ge 5$

$\{x \mid x \le 1\} \qquad \{x \mid x \ge 5\}$

$\{x \mid x \le 1\} \cup \{x \mid x \ge 5\} = \{x \mid x \le 1 \text{ or } x \ge 5\}$

75. $|2x+1|<5$

$-5<2x+1<5$

$-5-1<2x+1-1<5-1$

$-6<2x<4$

$-3<x<2$

$\{x \mid -3<x<2\}$

76. $|3x - 2| < 4$

$-4 < 3x - 2 < 4$

$-4 + 2 < 3x - 2 + 2 < 4 + 2$

$-2 < 3x < 6$

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

$\{x \mid -\frac{2}{3} < x < 2\}$

77. $|5x + 2| > 12$

$5x + 2 > 12$ or $5x + 2 < -12$

$5x > 10$ $\quad$ $5x < -14$

$x > 2$ $\quad$ $x < -\frac{14}{5}$

$\{x \mid x > 2\}$ $\quad$ $\{x \mid x < -\frac{14}{5}\}$

$\{x \mid x > 2\} \cup \{x \mid x < -\frac{14}{5}\}$

$= \{x \mid x > 2 \text{ or } x < -\frac{14}{5}\}$

78. $|7x - 1| > 13$

$7x - 1 > 13$ or $7x - 1 < -13$

$7x > 14$ $\quad$ $7x < -12$

$x > 2$ $\quad$ $x < -\frac{12}{7}$

$\{x \mid x > 2\}$ $\quad$ $\{x \mid x < -\frac{12}{7}\}$

$\{x \mid x > 2\} \cup \{x \mid x < -\frac{12}{7}\}$

$= \{x \mid x > 2 \text{ or } x < -\frac{12}{7}\}$

79. $|4x - 3| \leq -2$

The absolute value of a number must be nonnegative. The solution set is the empty set $\emptyset$.

80. $|5x + 1| \leq -4$

The absolute value of a number must be nonnegative. The solution set is the empty set $\emptyset$.

81. $|2x + 7| > -5$

$2x + 7 > -5$ or $2x + 7 < 5$

$2x > -12$ $\quad$ $2x < -2$

$x > -6$ $\quad$ $x < -1$

$\{x \mid x > -6\}$ $\quad$ $\{x \mid x < -1\}$

$\{x \mid x > -6\} \cup \{x \mid x < -1\}$ = The set of all real numbers.

82. $|3x - 1| > -4$

$3x - 1 > -4$ or $3x - 1 < 4$

$3x > -3$ $\quad$ $3x < 5$

$x > -1$ $\quad$ $x < \frac{5}{3}$

$\{x \mid x > -1\}$ $\quad$ $\{x \mid x < \frac{5}{3}\}$

$\{x \mid x > -1\} \cup \{x \mid x < \frac{5}{3}\}$ = The set of all real numbers.

83. $|4 - 3x| \geq 5$

$4 - 3x \geq 5$ or $4 - 3x \leq -5$

$-3x \geq 1$ $\quad$ $-3x \leq -9$

$x \leq -\frac{1}{3}$ $\quad$ $x \geq 3$

$\{x \mid x \leq -\frac{1}{3}\}$ $\quad$ $\{x \mid x \geq 3\}$

$\{x \mid x \leq -\frac{1}{3}\} \cup \{x \mid x \geq 3\}$

$= \{x \mid x \leq -\frac{1}{3} \text{ or } x \geq 3\}$

84. $|7 - 2x| > 9$

$7 - 2x > 9$ or $7 - 2x < -9$

$-2x > 2$ $\quad$ $-2x < -16$

$x < -1$ $\quad$ $x > 8$

$\{x \mid x < -1\}$ $\quad$ $\{x \mid x > 8\}$

$\{x \mid x < -1\} \cup \{x \mid x > 8\}$

$= \{x \mid x < -1 \text{ or } x > 8\}$

85. $|5 - 4x| \leq 13$

$-13 \leq 5 - 4x \leq 13$

$-13 + (-5) \leq 5 + (-5) - 4x \leq 13 + (-5)$

$-18 \leq -4x \leq 8$

$\frac{18}{4} \geq x \geq -2$

$\{x \mid -2 \leq x \leq \frac{9}{2}\}$

86. $|3 - 7x| < 17$

$-17 < 3 - 7x < 17$

$-17 + (-3) < 3 + (-3) - 7x < 17 + (-3)$

$-20 < -7x < 14$

$\frac{20}{7} > x > -2$

$\{x \mid -2 < x < \frac{20}{7}\}$

87. $|6 - 3x| \le 0$

$0 \le 6 - 3x \le 0$

$-6 \le -3x \le -6$

$2 \le x \le 2$

$2 \le x \le 2 = \{x \mid x = 2\}$

88. $|10 - 5x| \ge 0$

$10 - 5x \ge 0$ or $10 - 5x \le 0$

$-5x \ge -10$ $-5x \le -10$

$x \le 2$ $x \ge 2$

$\{x \mid x \le 2\}$ $\{x \mid x \ge 2\}$

$\{x \mid x \le 2\} \cup \{x \mid x \ge 2\}$ = The set of all real numbers.

89. $|2 - 9x| > 20$

$2 - 9x > 20$ or $2 - 9x < -20$

$-9x > 18$ $-9x < -22$

$x < -2$ $x > \frac{22}{9}$

$\{x \mid x < -2\}$ $\{x \mid x > \frac{22}{9}\}$

$\{x \mid x < -2\} \cup \{x \mid x > \frac{22}{9}\}$

$= \{x \mid x < -2 \text{ or } x > \frac{22}{9}\}$

90. $|5x - 1| < 16$

$-16 < 5x - 1 < 16$

$-16 + 1 < 5x - 1 + 1 < 16 + 1$

$-15 < 5x < 17$

$-3 < x < \frac{17}{5}$

$\{x \mid -3 < x < \frac{17}{5}\}$

91. $|2x - 3| + 2 < 8$

$|2x - 3| < 6$

$-6 < 2x - 3 < 6$

$-6 + 3 < 2x - 3 + 3 < 6 + 3$

$-3 < 2x < 9$

$-\frac{3}{2} < x < \frac{9}{2}$

$\{x \mid -\frac{3}{2} < x < \frac{9}{2}\}$

92. $|3x - 5| + 1 < 7$

$|3x - 5| < 6$

$-6 < 3x - 5 < 6$

$-6 + 5 < 3x - 5 + 5 < 6 + 5$

$-1 < 3x < 11$

$-\frac{1}{3} < x < \frac{11}{3}$

$\{x \mid -\frac{1}{3} < x < \frac{11}{3}\}$

93. $|2 - 5x| - 4 > -2$

$|2 - 5x| > 2$

$2 - 5x > 2$ or $2 - 5x < -2$

$-5x > 0$ $-5x < -4$

$x < 0$ $x > \frac{4}{5}$

$\{x \mid x < 0\}$ $\{x \mid x > \frac{4}{5}\}$

$\{x \mid x < 0\} \cup \{x \mid x > \frac{4}{5}\} = \{x \mid x < 0 \text{ or } x > \frac{4}{5}\}$

94. $|4 - 2x| - 9 > -3$

$|4 - 2x| > 6$

$4 - 2x > 6$ or $4 - 2x < -6$

$-2x > 2$ $-2x < -10$

$x < -1$ $x > 5$

$\{x \mid x < -1\}$ $\{x \mid x > 5\}$

$\{x \mid x < -1\} \cup \{x \mid x > 5\}$

$= \{x \mid x < -1 \text{ or } x > 5\}$

95. $8 - |2x - 5| < 3$

$-|2x - 5| < -5$

$|2x - 5| > 5$

$2x - 5 < -5$ or $2x - 5 > 5$

$2x < 0$ $2x > 10$

$x < 0$ $x > 5$

$\{x \mid x < 0\}$ $\{x \mid x > 5\}$

$\{x \mid x < 0\} \cup \{x \mid x > 5\} = \{x \mid x < 0 \text{ or } x > 5\}$

96. $12 - |3x - 4| > 7$

$-|3x - 4| > -5$

$|3x - 4| < 5$

$-5 < 3x - 4 < 5$

$-5 + 4 < 3x - 4 + 4 < 5 + 4$

$-1 < 3x < 9$

$-\frac{1}{3} < x < 3$

$\{x \mid -\frac{1}{3} < x < 3\}$

97. All negative solutions.

98. Both positive and negative solutions.

Objective C Exercises

99. The desired dosage is 3 ml. The tolerance is 0.2 ml.

100. The desired diameter of the piston is 5 in. The actual diameter can vary from the desired diameter by 0.01 in.

101. Strategy: Let d represent the diameter of the bushing, T the tolerance and x the lower and upper limits of the diameter. Solve the absolute value inequality $|x - d| \le T$.

Solution: $|x - d| \le T$

$|x - 1.75| \le 0.008$

$-0.008 \le x - 1.75 \le 0.008$

$-0.008 + 1.75 \le x - 1.75 + 1.75 \le 0.008 + 1.75$

$1.742 \le x \le 1.758$

The lower and upper limits of the diameter of the bushing are 1.742 in. and 1.758 in.

102. Strategy: Let d represent the diameter of the bushing, T the tolerance and x the lower and upper limits of the diameter. Solve the absolute value inequality $|x - d| \le T$.

Solution: $|x - d| \le T$

$|x - 3.48| \le 0.004$

$-0.004 \le x - 3.48 \le 0.004$

$-0.004 + 3.48 \le x - 3.48 + 3.48 \le 0.004 + 3.48$

$3.476 \le x \le 3.484$

The lower and upper limits of the diameter of the bushing are 3.476 in. and 3.484 in.

103. Strategy: Let L represent the length of the piston. Solve the absolute value inequality $|L - 9\frac{5}{8}| \le \frac{1}{32}$.

Solution: $|L - 9\frac{5}{8}| \le \frac{1}{32}$

$-\frac{1}{32} \le L - 9\frac{5}{8} \le \frac{1}{32}$

$-\frac{1}{32} + 9\frac{5}{8} \le L - 9\frac{5}{8} + 9\frac{5}{8} \le \frac{1}{32} + 9\frac{5}{8}$

$9\frac{19}{32} \le L \le 9\frac{21}{32}$

The upper and lower limits of the length of the piston are $9\frac{19}{32}$ in. and $9\frac{21}{32}$ in.

104. a) Strategy: Let x represent the range in the girth of an NCAA football. Solve the absolute value inequality $|x - 21| \le \frac{1}{4}$.

Solution: $|x - 21| \le \frac{1}{4}$

$-\frac{1}{4} \le x - 21 \le \frac{1}{4}$

$-\frac{1}{4} + 21 \le x - 21 + 21 \le \frac{1}{4} + 21$

$20\frac{3}{4} \le x \le 21\frac{1}{4}$

The lower and upper limits of the girth of an NCAA football are $20\frac{3}{4}$ in. and $21\frac{1}{4}$ in.

b) Strategy: Let x represent the range of the circumference of an NCAA football. Solve the absolute value inequality

$$|x - 28\frac{1}{8}| \le \frac{3}{8}.$$

Solution: $|x - 28\frac{1}{8}| \le \frac{3}{8}$

$$-\frac{3}{8} \le x - 28\frac{1}{8} \le \frac{3}{8}$$

$$-\frac{3}{8} + 28\frac{1}{8} \le x - 28\frac{1}{8} + 28\frac{1}{8} \le \frac{3}{8} + 28\frac{1}{8}$$

$$27\frac{3}{4} \le x \le 28\frac{1}{2}$$

The lower and upper limits of the circumference of an NCAA football are $27\frac{3}{4}$ in. and $28\frac{1}{2}$ in.

c) Strategy: Let x represent the range of the length of an NCAA football. Solve the absolute value inequality $|x - 11\frac{1}{32}| \le \frac{5}{32}$.

Solution: $|x - 11\frac{1}{32}| \le \frac{5}{32}$

$$-\frac{5}{12} \le x - 11\frac{1}{32} \le \frac{5}{32}$$

$$-\frac{5}{12} + 11\frac{1}{32} \le x - 11\frac{1}{32} + 11\frac{1}{32} \le \frac{5}{32} + 11\frac{1}{32}$$

$$10\frac{7}{8} \le x \le 11\frac{3}{16}$$

The upper and lower limits of the length of an NCAA football are $10\frac{7}{8}$ and $11\frac{3}{16}$ in.

105. Strategy: Let x represent the percent of American voters who felt the economy is an important issue.
Solve the absolute value inequality $|x - 41| \le 3$.

Solution: $|x - 41| \le 3$

$$-3 \le x - 41 \le 3$$

$$-3 + 41 \le x - 41 + 41 \le 3 + 41$$

$$38 \le x \le 44$$

The lower and upper limits of American voters who felt the economy is an important issue 38% and 44%.

106. a) Strategy: Let x represent the temperature range for gold sword tail.
Solve the absolute value inequality $|x - 73| \le 9$.

Solution: $|x - 73| \le 9$

$$-9 \le x - 73 \le 9$$

$$-9 + 73 \le x - 73 + 73 \le 9 + 73$$

$$64 \le x \le 82$$

The lower and upper limits of temperature requirements for the gold swordtail are 64°F and 82°F.

b) Strategy: Let x represent the pH levels for gold sword tail.
Solve the absolute value inequality $|x - 7.65| \le 0.65$.

Solution: $|x - 7.65| \le 0.65$

$$-0.65 \le x - 7.65 \le 0.65$$

$$-0.65 + 7.65 \le x - 7.65 + 7.65 \le 0.65 + 7.65$$

$$7.0 \le x \le 8.3$$

The lower and upper limits of the range in pH levels for the gold swordtail are 7.0 and 8.3.

107. Strategy: Let M represent the range, in ohms, for a resistor.
Let T represent the tolerance of the resistor.
Solve the absolute value inequality $|M - 29{,}000| \le T$.

Solution: $T = (0.02)(29{,}000)$

$= 580$ ohm

$|M - 29{,}000| \le 580$

$$-580 \le M - 29{,}000 \le 580$$

$$-580 + 29{,}000 \le M - 29{,}000 + 29{,}000 \le 580 + 29{,}000$$

$$28{,}420 \le M \le 29{,}580$$

The upper and lower limits of the resistor are 28,420 ohms and 29,580 ohms.

108. Strategy: Let M represent the range, in ohms, for a resistor.
Let T represent the tolerance of the resistor.
Solve the absolute value inequality $|M - 15{,}000| \le T$.

Solution: $T = (0.10)(15{,}000)$
$= 1500$ ohms

$$|M - 15{,}000| \le 1500$$
$$-1500 \le M - 15{,}000 \le 1500$$
$$-1500 + 15{,}000 \le M - 15{,}000 + 15{,}000 \le 1500 + 15{,}000$$
$$13{,}500 \le M \le 16{,}500$$

The upper and lower limits of the resistor are 13,500 ohms and 16,500 ohms.

Critical Thinking

109. a) The equation $|x + 3| = x + 3$ is true for all x for which $x + 3 \ge 0$.

$$x + 3 \ge 0$$
$$x \ge -3$$
$$\{x \mid x \ge -3\}$$

b) The equation $|a - 4| = 4 - a$ is true for all a for which $4 - a \ge 0$.

$$4 - a \ge 0$$
$$-a \ge -4$$
$$a \le 4$$
$$\{a \mid a \le 4\}$$

110. a) $|x + y| \le |x| + |y|$
b) $|x - y| \ge |x| - |y|$
c) $||x| - |y|| \ge |x| - |y|$
d) $|xy| = |x||y|$

111. $-2 \le x \le 2$
$-a \le 3x - 2 \le a, \ a \ge 0$
For $x = 2$ we have $3x - 2 = 4$ and $3x - 2 < 4$ for $-2 \le x \le 2$.
For $3x - 2 \le a$ to be true a must be greater than or equal to 4. The smallest possible value of a is 4.

Projects or Group Activities

112. $|4x + 3| = 2x + 10$

$$4x + 3 = 2x + 10$$
$$4x - 2x + 3 = 2x - 2x + 10$$
$$2x + 3 = 10$$
$$2x + 3 - 3 = 10 - 3$$
$$2x = 7$$
$$\frac{2x}{2} = \frac{7}{2}$$
$$x = \frac{7}{2}$$

or

$$4x + 3 = -(2x + 10)$$
$$4x + 3 = -2x - 10$$
$$4x + 2x + 3 = -2x + 2x - 10$$
$$6x + 3 = 10$$
$$6x + 3 - 3 = -10 - 3$$
$$6x = -13$$
$$\frac{6x}{6} = \frac{-13}{6}$$
$$x = \frac{-13}{6}$$

The solutions are $\frac{7}{2}$ and $-\frac{13}{6}$.

113. $|3x - 4| = 2x + 10$

$$3x - 4 = 2x + 10$$
$$3x - 2x - 4 = 2x - 2x + 10$$
$$x - 4 = 10$$
$$x - 4 + 4 = 10 + 4$$
$$x = 14$$

or

$$3x - 4 = -(2x + 10)$$
$$3x - 4 = -2x - 10$$
$$3x + 2x - 4 = -2x + 2x - 10$$
$$5x - 4 = -10$$
$$5x - 4 + 4 = -10 + 4$$
$$5x = -6$$
$$\frac{5x}{5} = \frac{-6}{5}$$
$$x = -\frac{6}{5}$$

The solutions are 14 and $-\frac{6}{5}$.

114. $|x+3|=2x-1$

$x+3=2x-1$

$x-2x+3=2x-2x-1$

$-x+3=-1$

$-x+3-3=-1-3$

$-x=-4$

$x=4$

or

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

$x+3=-2x+1$

$x+2x+3=-2x+2x+1$

$3x+3=1$

$3x+3-3=1-3$

$3x=-2$

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

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

x cannot equal $-\frac{2}{3}$ since

$\left|-\frac{2}{3}+3\right|$ is positive and

$3\left(-\frac{2}{3}\right)-1=-2-1=-3$. The solution is 4.

115. $|3x+1|=2x-5$

$3x+1=2x-5$

$3x-2x+1=2x-2x-5$

$x+1=-5$

$x+1-1=-5-1$

$x=-6$

or

$3x+1=-(2x-5)$

$3x+1=-2x+5$

$3x+2x+1=-2x+2x+5$

$5x+1=5$

$5x+1-1=5-1$

$5x=4$

$\frac{5x}{5}=\frac{4}{5}$

$x=\frac{4}{5}$

Since $2x-5=2(-6)-5=-12-5=-17$

and $2x-5=2\left(-\frac{6}{5}\right)-5=-\frac{12}{5}-\frac{25}{5}=-\frac{37}{5}$,

there is no solution.

Chapter 2 Review Exercises

1. $x+3=24$

$x=24-3$

$x=21$

The solution is 21.

2. $x+5(3x-20)=10(x-4)$

$x+15x-100=10x-40$

$16x-100=10x-40$

$6x=60$

$\frac{6x}{6}=\frac{60}{6}$

$x=10$

The solution is 10.

3. $5x-6=29$

$5x=29+6$

$5x=35$

$\frac{5x}{5}=\frac{35}{5}$

$x=7$

The solution is 7.

4.

$5x-2=4x+5$	
$5(3)-2$	$4(3)+5$
$15-2$	$12+5$
$13\neq 17$	

No, 3 is not a solution.

5. $\frac{3}{5}a=12$

$a=12\cdot\frac{5}{3}$

$a=20$

The solution is 20.

6. $3x-7>-2$

$3x-7+7>-2+7$

$3x>5$

$\frac{3x}{3}>\frac{5}{3}$

$x>\frac{5}{3}$

The solution is $\left(\frac{5}{3},\infty\right)$.

7. $P(12)=30$

$\frac{P(12)}{12}=\frac{30}{12}$

$P=2.5$

The percent is 250%.

8. $5x+3=10x-17$

$3+17=10x-5x$

$20=5x$

$4=x$

The solution is 4.

9. $7-\left[4+2(x-3)\right]=11(x+2)$

$7-\left[4+2x-6\right]=11x+22$

$7-\left[-2+2x\right]=11x+22$

$7+2-2x=11x+22$

$9-2x=11x+22$

$9-22=11x+2x$

$-13=13x$

$-1=x$

The solution is -1.

10. $6+|3x-3|=2$

$6-6+|3x-3|=2-6$

$|3x-3|=-4$

There is no solution to this equation because the absolute value of a number must be non-negative.

11. $|2x-5|<3$

$-3<2x-5<3$

$-3+5<2x-5+5<3+5$

$2<2x<8$

$\frac{2}{2}<\frac{2x}{2}<\frac{8}{2}$

$1<x<4$

The solution set is $\{x\,|\,1<x<4\}$.

12. $3x<4$

$\frac{3x}{3}<\frac{4}{3}$

$x<\frac{4}{3}$

and

$x+2>-1$

$x+2-2>-1-2$

$x>-3$

$\left\{x\,|\,x<\frac{4}{3}\right\}\cup\{x\,|\,x>-3\}=\left\{x\,|\,-3<x<\frac{4}{3}\right\}$

The solution is set is $\left\{x\,|\,-3<x<\frac{4}{3}\right\}$.

13. $3x-2>x-4$

$3x-x-2>x-x-4$

$2x-2>-4$

$2x-2+2>-4+2$

$2x>-2$

$\frac{2x}{2}>\frac{-2}{2}$

$x>-1$

or

$7x-5<3x+3$

$7x-3x-5<3x-3x+3$

$4x-5<3$

$4x-5+5<3+5$

$4x<8$

$\frac{4x}{4}<\frac{8}{4}$

$x<2$

$\{x\,|\,x>-1\}\cup\{x\,|\,x<2\}$

$=\{x\,|\,x \text{ is any real number}\}$

The interval is $(-\infty,\infty)$.

14. $4x-5\geq 3$

$4x-5+5\geq 3+5$

$4x\geq 8$

$\frac{4x}{4}\geq\frac{8}{4}$

$x\geq 2$

and

$4x-5\leq -3$

$4x-5+5\leq -3+5$

$4x\leq 2$

$\frac{4x}{4}\leq\frac{2}{4}$

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

The solution set is $\{x\,|\,x\geq 2\}\cup\left\{x\,|\,x\leq\frac{1}{2}\right\}$.

15. $3y-5=3-2y$

$3y+2y-5=3-2y+2y$

$5y-5=3$

$5y-5+5=3+5$

$5y=8$

$\frac{5y}{5}=\frac{8}{5}$

$y=\frac{8}{5}$

The solution is $\frac{8}{5}$.

16. $4x-5+x=6x-8$

$5x-5=6x-8$

$5x-6x-5=6x-6x-8$

$-x-5=-8$

$-x-5+5=-8+5$

$-x=-3$

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

$x=3$

The solution is 3.

17. $3(x-4)=-5(6-x)$

$3x-12=-30+5x$

$3x-5x-12=-30+5x-5x$

$-2x-12=-30$

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

$-2x=-18$

$\frac{-2x}{-2}=\frac{-18}{-2}$

$x=9$

The solution is 9.

18. $\frac{3x-2}{4}+1=\frac{2x-3}{2}$

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

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

$3x+2=4x-6$

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

$-x+2=-6$

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

$-x=-8$

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

$x=8$

The solution is 8.

19. $|5x+8|=0$

$5x+8=0$

$5x+8-8=0-8$

$5x=-8$

$\frac{5x}{5}=\frac{-8}{5}$

$x=-\frac{8}{5}$

The solution is $-\frac{8}{5}$.

20. $|5x-4|<-2$

There is no solution to this equation because the absolute value of a number must be non-negative.

21. **Strategy** Given: $F_1 = 120$, $x = 2$,
$d - x = 12 - 2 = 10$
Unknown: F_2

Solution

$F_1x=F_2(d-x)$

$120(2)=F_2(10)$

$240=10F_2$

$24=F_2$

The force is 24 lb.

22. **Strategy**

- Speed on winding road: r
- Speed on level road: $r + 20$

	Rate	Time	Distance
Winding road	r	3	$3r$
Level road	$r + 20$	2	$2(r+20)$

- The total trip was 200 mi.

Solution

$3r+2(r+20)=200$

$3r+2r+40=200$

$5r+40=200$

$5r=160$

$r=32$

The average speed on the winding road was 32 mph.

23. **Strategy**

- Amount of cranberry juice: x
- Amount of apple juice: $10 - x$

	Amount	Cost	Value
Cranberry juice	x	1.79	$1.79(x)$
Apple juice	$10 - x$	1.19	$1.19(10 - x)$
Mixture	10	1.61	1.61(10)

- The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.79x + 1.19(10 - x) = 1.61(10)$$
$$1.79x + 11.90 - 1.19x = 16.10$$
$$0.60x = 4.2$$
$$x = 7$$
$$10 - x = 10 - 3 = 7$$

The amount of cranberry juice was 7 qt. The amount of apple juice was 3 qt.

24. **Strategy** • First integer: n
• Second integer: $n + 1$
• Third integer: $n + 2$
• Four times the second integer equals the sum of the first and third integer.

Solution

$$4(n+1) = n + n + 2$$
$$4n + 4 = 2n + 2$$
$$2n = -2$$
$$n = -1$$

The integers are −1, 0, and 1.

25. The unknown number is x.

Four less than five times a number	is	sixteen

$$5x - 4 = 16$$
$$5x - 4 + 4 = 16 + 4$$
$$5x = 20$$
$$\frac{5x}{5} = \frac{20}{5}$$
$$x = 4$$

The number is 4.

26. The height of the Eiffel Tower: x

1472	is	654 less than twice the height of the Eiffel Tower

$$1472 = 2x - 654$$
$$2126 = 2x$$
$$1063 = x$$

The Eiffel Tower is 1063 feet tall.

27. **Strategy**
• Time for jet plane: t
• Time for propeller-driven plane: $t + 2$

	Rate	Time	Distance
Jet	600	t	$600t$
Propeller	200	$t + 2$	$200(t + 2)$

• The two traveled the same distance.

Solution

$$600t = 200(t + 2)$$
$$600t = 200t + 400$$
$$400t = 400$$
$$t = 1$$

Distance = 600t = 600(1) = 600
The jet overtakes the propeller-driven plane 600 mi from the starting point.

28. **Strategy** • Let b represent the diameter of the bushing, T the tolerance, and d the lower and upper limits of diameter. Solve the absolute value inequality $|d - b| \le T$ for d.

Solution

$$|d - b| \le T$$
$$-0.003 < d - 2.75 \le 0.003$$
$$-0.003 < d - 2.75 \le 0.003$$
$$-0.003 + 2.75 \le d - 2.75 + 2.75 \le 0.003 + 2.75$$
$$2.747 \le d \le 2.753$$

The lower limit of the bushing is 2.747 in. and the upper limit is 2.753 in.

29. **Strategy**
• Amount of butter fat in the mixture: x

	Amount	Percent	Quantity
Cream	5	0.30	0.3(5)
Milk	8	0.04	0.04(8)
Mixture	13	x	$13x$

• The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.30(5) + 0.04(8) = 13x$$
$$1.5 + 0.32 = 13x$$
$$1.82 = 13x$$
$$0.14 = x$$

The mixture is 14% butterfat.

30. **Strategy**

- Time to island: t
- Time to return: $2\frac{1}{3} - t = \frac{7}{3} - t$

	Rate	Time	Distance
To island	16	t	$16t$
Return	12	$\frac{7}{3} - t$	$12\left(\frac{7}{3} - t\right)$

- The distance to the island equals the distance to return.

Solution

$$16t = 12\left(\frac{7}{3} - t\right)$$
$$16t = 28 - 12t$$
$$16t + 12t = 28 - 12t + 12t$$
$$28t = 28$$
$$\frac{28t}{28} = \frac{28}{28}$$
$$t = 1$$

$16t = 16(1) = 16$

The distance from the island to the dock is 16 mi.

Chapter 2 Test

1.
$$3x - 2 = 5x + 8$$
$$3x - 3x - 2 = 5x - 3x + 8$$
$$-2 - 8 = 2x + 8 - 8$$
$$-10 = 2x$$
$$\frac{-10}{2} = \frac{2x}{2}$$
$$-5 = x$$

The solution is −5.

2.
$$x - 3 = -8$$
$$x - 3 + 3 = -8 + 3$$
$$x = -5$$

The solution is –5.

3.
$$3x - 5 = -14$$
$$3x - 5 + 5 = -14 + 5$$
$$3x = -9$$
$$\frac{3x}{3} = \frac{-9}{3}$$
$$x = -3$$

The solution is –3

4.
$$4 - 2(3 - 2x) = 2(5 - x)$$
$$4 - 6 + 4x = 10 - 2x$$
$$-2 + 4x = 10 - 2x$$
$$-2 + 2 + 4x + 2x = 10 + 2 - 2x + 2x$$
$$6x = 12$$
$$\frac{6x}{6} = \frac{12}{6}$$
$$x = 2$$

The solution is 2.

5.
$$x^2 - 3x = 2x - 6$$

$(-2)^2 - 3(-2)$	$2(-2) - 6$
$4 - 3(-2)$	$-4 - 6$
$4 + 6$	-10

$$10 \neq -10$$

No, –2 is not a solution.

6.
$$7 - 4x = -13$$
$$7 - 7 - 4x = -13 - 7$$
$$-4x = -20$$
$$\frac{-4x}{-4} = \frac{-20}{-4}$$
$$x = 5$$

The solution is 5.

7.
$$P \cdot B = A$$
$$0.005(8) = A$$
$$0.04 = A$$

0.5% of 8 is 0.04.

8.
$$5x - 2(4x - 3) = 6x + 9$$
$$5x - 8x + 6 = 6x + 9$$
$$-3x + 6 = 6x + 9$$
$$-3x + 3x + 6 - 9 = 6x + 3x + 9 - 9$$
$$-3 = 9x$$
$$\frac{-3}{9} = \frac{9x}{9}$$
$$-\frac{1}{3} = x$$

The solution is $-\frac{1}{3}$.

9.
$$\begin{aligned} 5x+3-7x &= 2x-5 \\ -2x+3 &= 2x-5 \\ -2x+2x+3+5 &= 2x+2x-5+5 \\ 8 &= 4x \\ \frac{8}{4} &= \frac{4x}{4} \\ 2 &= x \end{aligned}$$

The solution is 2.

10.
$$\begin{aligned} \frac{3}{4}x &= -9 \\ \frac{4}{3}\left(\frac{3}{4}x\right) &= -9\left(\frac{4}{3}\right) \\ x &= -12 \end{aligned}$$

The solution is –12.

11.
$$\begin{aligned} 4-3(x+2) &< 2(2x+3)-1 \\ 4-3x-6 &< 4x+6-1 \\ -2-3x &> 4x+5 \\ -2+2-3x-4x &< 4x-4x+5+2 \\ -7x &< 7 \\ \frac{-7x}{-7} &> \frac{7}{-7} \\ x &> -1 \end{aligned}$$

The solution is $(-1, \infty)$.

12.
$$\begin{aligned} 4x-1 &> 5 \\ 4x-1+1 &> 5+1 \\ 4x &> 6 \\ \frac{4x}{4} &> \frac{6}{4} \\ x &> \frac{3}{2} \end{aligned}$$
or
$$\begin{aligned} 2-3x &< 8 \\ 2-2-3x &< 8-2 \\ -3x &< 6 \\ \frac{-3x}{-3} &> \frac{6}{-3} \\ x &> -2 \end{aligned}$$

$$\left\{x \mid x > \frac{3}{2}\right\} \cup \{x \mid x > -2\} = \{x \mid x > -2\}$$

The solution set is $\{x \mid x > -2\}$.

13.
$$\begin{aligned} 4-3x &\geq 7 \\ 4-4-3x &\geq 7-4 \\ -3x &\geq 3 \\ \frac{-3x}{-3} &\leq \frac{3}{-3} \\ x &\leq -1 \end{aligned}$$
and
$$\begin{aligned} 2x+3 &\geq 7 \\ 2x+3-3 &\geq 7-3 \\ 2x &\geq 4 \\ \frac{2x}{2} &\geq \frac{4}{2} \\ x &\geq 2 \end{aligned}$$

$$\{x \mid x \leq -1\} \cap \{x \mid x \geq 2\} = \varnothing$$

There is no solution.

14. $|3-5x| = 12$

$$\begin{aligned} 3-5x &= 12 \\ 3-3-5x &= 12-3 \\ -5x &= 9 \\ \frac{-5x}{-5} &= \frac{9}{-5} \\ x &= -\frac{9}{5} \end{aligned}$$
$$\begin{aligned} 3-5x &= -12 \\ 3-3-5x &= -12-3 \\ -5x &= -15 \\ \frac{-5x}{-5} &= \frac{-15}{-5} \\ x &= 3 \end{aligned}$$

The solutions are $-\frac{9}{5}$ and 3.

15.
$$\begin{aligned} 2-|2x-5| &= -7 \\ 2-2-|2x-5| &= -7-2 \\ -|2x-5| &= -9 \\ \frac{-|2x-5|}{-1} &= \frac{-9}{-1} \\ |2x-5| &= 9 \end{aligned}$$
$$\begin{aligned} 2x-5 &= 9 \\ 2x-5+5 &= 9+5 \\ 2x &= 14 \\ \frac{2x}{2} &= \frac{14}{2} \\ x &= 7 \end{aligned}$$
$$\begin{aligned} 2x-5 &= -9 \\ 2x-5+5 &= -9+5 \\ 2x &= -4 \\ \frac{2x}{2} &= \frac{-4}{2} \\ x &= -2 \end{aligned}$$

The solutions are –2 and 7.

16.
$$\begin{aligned} |3x-5| &\leq 4 \\ -4 &\leq 3x-5 \leq 4 \\ -4+5 &\leq 3x-5+5 \leq 4+5 \\ 1 &\leq 3x \leq 9 \\ \frac{1}{3} &\leq \frac{3x}{3} \leq \frac{9}{3} \\ \frac{1}{3} &\leq x \leq 3 \end{aligned}$$

The solution set is $\left\{x \mid \frac{1}{3} \leq x \leq 3\right\}$.

17. **Strategy** • Amount rye flour: x

• Amount wheat flour: $15 - x$

	Amount	Percent	Quantity
Rye	x	0.70	$0.70(x)$
Wheat	$15 - x$	0.40	$0.40(15 - x)$
Mixture	15	0.60	$15(0.60)$

• The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.70x + 0.40(15 - x) = 0.60(5)$$
$$0.70x + 6 - 0.40x = 9$$
$$0.30x + 6 = 9$$
$$0.30x = 3$$
$$x = 10$$
$$15 - x = 15 - 10 = 5$$

The amount of rye flour is 10 lb.
The amount of wheat flour is 5 lb.

18. **Strategy** • First even integer: n

• Second even integer: $n + 2$

• Third even integer: $n + 4$

• The sum of the integers is 36.

Solution

$$n + n + 2 + n + 4 = 36$$
$$3n + 6 = 36$$
$$3n + 6 - 6 = 36 - 6$$
$$3n = 30$$
$$\frac{3n}{3} = \frac{30}{3}$$
$$n = 10$$

$n + 2 = 10 + 2 = 12$

$n + 4 = 10 + 4 = 14$

The integers are 10, 12, and 14.

19. **Strategy • Amount pure water:** x

	Amount	Percent	Quantity
Water	x	0.00	$0.00(x)$
20% solution	5	0.20	$0.20(5)$
Mixture	$x + 5$	0.16	$0.16(x + 5)$

• The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$0.00x + 0.20(5) = 0.16(x + 5)$$
$$1 = 0.16x + 0.8$$
$$0.2 = 0.16x$$
$$1.25 = x$$

1.25 gal of water must be added.

20. The number: x

The three times the number: $3x$

The difference between 3 times the number and 15	is	27

$$3x - 15 = 27$$
$$3x - 15 + 15 = 27 + 15$$
$$3x = 42$$
$$\frac{3x}{3} = \frac{42}{3}$$
$$x = 14$$

The number is 14.

21. **Strategy**

• Rate of the skier: x

• Rate of the snowmobile: $x + 4$

	Rate	Time	Distance
Skier	x	3	$3x$
Snowmobile	$x + 4$	1	$1(x + 4)$

• The two traveled the same distance.

Solution

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

The rate of the snowmobile is 6 mph.

22. **Strategy** Write and solve an equation letting x represent the number of LCD flat panel TVs and $140 - x$ represent the LCD rear projection TVs.

Solution

$$3(140 - x) = x - 20$$
$$420 - 3x = x - 20$$
$$440 = 4x$$
$$110 = x$$

The company makes 110 LCD flat panel TVs each day.

23. **Strategy** • The smaller number: x

• The larger number: $18 - x$

Solution

$$4x - 7 = 2(18 - x) + 5$$
$$4x - 7 = 36 - 2x + 5$$
$$4x - 7 = 41 - 2x$$
$$6x = 48$$
$$x = 8$$
$$18 - x = 18 - 8 = 10$$

The smaller number is 8.
The larger number is 10.

24. **Strategy**

• Time for flight out: t

• Time for flight in: $7 - t$

	Rate	Time	Distance
Flight out	90	t	$90t$
Flight in	120	$7 - t$	$120(7 - t)$

• The distance traveled is the same.

Solution

$$90t = 120(7 - t)$$
$$90t = 840 - 120t$$
$$210t = 840$$
$$t = 4$$

Distance = $90t = 90(4) = 360$
The distance to the airport is 360 mi.

25. **Strategy** Given: $m_1 = 100$, $T_1 = 80$, $m_2 = 50$, and $T_2 = 20$
Unknown: T

Solution

$$m_1(T_1 - T) = m_2(T - T_2)$$
$$100(80 - T) = 50(T - 20)$$
$$8000 - 100T = 50T - 1000$$
$$-150T = -9000$$
$$T = 60$$

The final temperature is 60° C.

26. **Strategy** To find the number of miles, write and solve an inequality using N to represent the number of miles.

Solution

cost of Gambelli < cost of McDougal

$$40 + 0.25N < 58$$
$$40 - 40 + 0.25N < 58 - 40$$
$$0.25N < 18$$
$$\frac{0.18N}{0.18} < \frac{18}{0.25}$$
$$N < 72$$

Gambelli will cost less if you drive less the 72 mi.

27. **Strategy** • Let b represent the diameter of the bushing, T the tolerance, and d the lower and upper limits of diameter. Solve the absolute value inequality $|d - b| \le T$ for d.

Solution

$$|d - b| \le T$$
$$|d - 2.65| < 0.002$$
$$-0.002 < d - 2.65 \le 0.002$$
$$-0.002 + 2.65 \le d - 2.65 + 2.65 \le 0.002 + 2.65$$
$$2.648 \le d \le 2.652$$

The lower limit of the bushing is 2.648 in. and the upper limit is 2.652 in.

Cumulative Review Exercises

1. $-6 - (-20) - 8 = -6 + 20 - 8 = 14 - 8 = 6$

2. $(-2)(-6)(-4) = 12(-4) = -48$

3. $-\frac{5}{6}-\left(-\frac{7}{16}\right)=-\frac{40}{48}-\left(-\frac{21}{48}\right)=\frac{-40-(-21)}{48}=\frac{-40+21}{48}$
$=-\frac{19}{48}$

4. $-\frac{7}{3}\div\frac{7}{6}=-\frac{7}{3}\cdot\frac{6}{7}=-\frac{7\cdot 6}{3\cdot 7}=-2$

5. $-4^2\cdot\left(-\frac{3}{2}\right)^3=-(4)(4)\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)$
$=-16\left(-\frac{27}{8}\right)=54$

6. $25-3\frac{(5-2)^2}{2^3+1}+2=25-3\frac{(3)^2}{8+1}+2$
$=25-3\frac{9}{9}+2$
$=25-3+2$
$=22+2=24$

7. $3(a-c)-2ab$
$=3\left[2-(-4)\right]-2(2)(3)=3\left[2+4\right]-2(2)(3)$
$=3\left[6\right]-2(2)(3)=18-2(2)(3)=18-4(3)$
$=18-12=6$

8. $3x-8x+(-12x)=-5x+(-12x)$
$=-5x-12x=-17x$

9. $2a-(-b)-7a-5b=2a+b-7a-5b$
$=(2a-7a)+(b-5b)$
$=-5a+(-4b)=-5a-4b$

10. $(16x)\left(\frac{1}{8}\right)=\frac{1}{8}(16x)=\left(\frac{1}{8}\cdot 16\right)x=2x$

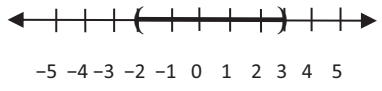
11. $-4(-9y)=4(9y)=(4\cdot 9)y=36y$

12. $-2\left(-x^2-3x+2\right)=-2\left(-x^2\right)+(-2)(-3x)+(-2)(2)$
$=2x^2+6x-4$

13. $-3\,2x-4(x-3)+2=-3\,2x-4x+12+2$
$=-3-2x+12+2=6x-36+2$
$=6x-34$

14. $A\cap B=\{-4,\ -2,\ 0,\ 2\}\cap\{-4,\ 0,\ 4,\ 8\}=\{-4,\ 0\}$

15. $\{x\mid x<3\}\cap\{x\mid x>-2\}$



16.

x^2+6x+9	=	$x+3$
$(-3)^2+6(-3)+9$	|	$-3+3$
$9-18+9$	|	0
$-9+9$	|	0
$0=0$		

Yes, –3 is a solution.

17. Percent · Base = Amount
$32\%\cdot 60=A$
$0.32\cdot 60=A$
$19.2=A$

32% of 60 is 19.2

18. $\frac{3}{5}x=-15$
$\frac{5}{3}\cdot\frac{3}{5}x=\frac{5}{3}\cdot(-15)$
$1\cdot x=-25$
$x=-25$

The solution is −25.

19. $7x-8=-29$
$7x-8+8=-29+8$
$7x=-21$
$\frac{7x}{7}=\frac{-21}{7}$
$x=-3$

The solution is −3.

20. $13-9x=-14$
$13-13-9x=-14-13$
$-9x=-27$
$\frac{-9x}{-9}=\frac{-27}{-9}$
$x=3$

The solution is 3.

21. $8x-3(4x-5)=-2x-11$
$8x-12x+15=-2x-11$
$-4x+15=-2x-11$
$-2x=-26$
$x=13$

The solution is 13.

22. Percent · Base = Amount
$25\%\cdot B=30$
$0.25B=30$
$\frac{0.25B}{0.25}=\frac{30}{0.25}$
$B=120$

25% of 120 is 30.

23.
$$\begin{aligned} 5x-8 &= 12x+13 \\ 5x-12x-8 &= 5x-5x+13 \\ -7x-8 &= 13 \\ -7x-8+8 &= 13+8 \\ -7x &= 21 \\ \frac{-7x}{-7} &= \frac{21}{-7} \\ x &= -3 \end{aligned}$$

The solution is –3.

24.
$$\begin{aligned} 11-4x &= 2x+8 \\ 11-4x-2x &= 2x-2x+8 \\ 11-6x &= 8 \\ 11-11-6x &= 8-11 \\ -6x &= -3 \\ \frac{-6x}{-6} &= \frac{-3}{-6} \\ x &= \frac{1}{2} \end{aligned}$$

The solution is $\frac{1}{2}$.

25.
$$\begin{aligned} 3-2(2x-1) &\ge 3(2x-2)+1 \\ 3-4x+2 &\ge 6x-6+1 \\ -4x+5 &\ge 6x-5 \\ -4x-6x+5 &\ge -5 \\ -10x+5 &\ge -5 \\ -10x+5-5 &\ge -5-5 \\ -10x &\ge -10 \\ \frac{-10x}{-10} &\le \frac{-10}{-10} \\ x &\le 1 \end{aligned}$$

The solution set is $\{x \mid x \le 1\}$.

26.
$$\begin{aligned} 3x+2 &\le 5 \\ 3x+2-2 &\le 5-2 \\ 3x &\le 3 \\ \frac{3x}{3} &\le \frac{3}{3} \\ x &\le 1 \end{aligned}$$

and

$$\begin{aligned} x+5 &\ge 1 \\ x+5-5 &\ge 1-5 \\ x &\ge -4 \end{aligned}$$

$$\{x \mid x \le 1\} \cap \{x \mid x \ge -4\} = \{x \mid -4 \le x \le 1\}$$

The solution set is $\{x \mid -4 \le x \le 1\}$.

27. $|3-2x| = 5$

$$\begin{aligned} 3-2x &= 5 \\ 3-3-2x &= 5-3 \\ -2x &= 2 \\ \frac{-2x}{-2} &= \frac{2}{-2} \\ x &= -1 \end{aligned}$$

$$\begin{aligned} 3-2x &= -5 \\ 3-3-2x &= -5-3 \\ -2x &= -8 \\ \frac{-2x}{-2} &= \frac{-8}{-2} \\ x &= 4 \end{aligned}$$

The solutions are –1 and 4.

28. $|3x-1| > 5$

$$\begin{aligned} 3x-1 &< -5 \\ 3x-1+1 &< -5+1 \\ 3x &< -4 \\ \frac{3x}{3} &< \frac{-4}{3} \\ x &< -\frac{4}{3} \end{aligned}$$

or

$$\begin{aligned} 3x-1 &> 5 \\ 3x-1+1 &> 5+1 \\ 3x &> 6 \\ \frac{3x}{3} &> \frac{6}{3} \\ x &> 2 \end{aligned}$$

$$\left\{x \mid x < -\frac{4}{3}\right\} \cup \{x \mid x > 2\} = \left\{x \mid x > 2 \text{ or } x < -\frac{4}{3}\right\}$$

The solution set is $\left\{x \mid x > 2 \text{ or } x < -\frac{4}{3}\right\}$.

27.
$$55\% = 55\left(\frac{1}{100}\right) = \frac{55}{100} = \frac{11}{20}$$

30.
$$1.03 = 1.03(100\%) = 103\%$$

31. **Strategy** Given: $m_1 = 300$, $T_1 = 750$, $m_2 = 100$, and $T_2 = 15$
Unknown: T

Solution

$$\begin{aligned} m_1(T_1 - T) &= m_2(T - T_2) \\ 300(75 - T) &= 100(T - 15) \\ 22{,}500 - 300T &= 100T - 1500 \\ -400T &= -24{,}000 \\ T &= 60 \end{aligned}$$

The final temperature is 60° C.

32. The unknown number: x

The difference between 12and the product of 3 and a number	is	–18

$$\begin{aligned} 12-5x &= -18 \\ -5x &= -30 \\ x &= 6 \end{aligned}$$

The number is 6.

33. To find the area of the garage, let x = the area.

200 ft^2 more than three times the area of the garage	is	2000 ft^2

$$3x + 200 = 2000$$
$$3x = 1800$$
$$x = 600$$

The area of th4e garage is 600 ft^2.

34. **Strategy** • Amount of oat flour: x

	Amount	Cost	Quantity
Oat	x	0.80	$0.80x$
Wheat	40	0.50	$0.50(40)$
Mixture	$x + 40$	0.60	$0.60(x + 40)$

Solution

$$0.80x + 0.50(40) = 0.60(x + 40)$$
$$0.80x + 20 = 0.60x + 24$$
$$0.20x = 4$$
$$x = 20$$

20 lb of oat flour are needed for the mixture.

35. **Strategy** • Amount pure gold: x

	Amount	Percent	Quantity
Pure gold	x	1.00	$1.00x$
Alloy	100	0.20	$0.20(100)$
Mixture	$x + 100$	0.36	$0.36(x + 100)$

• The sum of the quantities before mixing is equal to the quantity after mixing.

Solution

$$1.00x + 0.20(100) = 0.36(x + 100)$$
$$1.00x + 20 = 0.36x + 36$$
$$0.64x = 16$$
$$x = 25$$

25 g of pure gold must be added.

36. **Strategy**

• Time running: t

•Time jogging: $55 - t$

	Rate	Time	Distance
Running	8	t	$8t$
Jogging	3	$55 - t$	$3(55 - t)$

• The distance traveled is the same.

Solution

$$8t = 3(55 - t)$$
$$8t = 165 - 3t$$
$$11t = 165$$
$$t = 15$$

Distance = 8t = 8(15) = 120

The length of the track is 120 m.

Chapter 3: Geometry

Prep Test

1. $2(18)+2(10)=36+20=56$

2. $x+47=90$
$x=43$

3. $32+97+x=180$
$129+x=180$
$x=51$

4. abc
$(2)(3.14)(9)=6.28(9)=56.52$

5. xyz^3
$\left(\frac{4}{3}\right)(3.14)\left(3^3\right)=\frac{4}{3}(3.14)27=113.04$

6. $\frac{1}{2}a(b+c)$
$=\frac{1}{2}(6)(25+15)=\frac{1}{2}(6)(40)=3(40)=120$

Section 3.1

Concept Check

1. 12; 5; x; 4

2. 113°; 180°

3. 160°; 140°; 360°

4. $3x$; 90°

5. a; b

6. b; c

7. c; d; 180°

8. a; c

9. **a.** $\angle a$, $\angle b$, and $\angle c$

b. $\angle y$ and $\angle z$

c. $\angle x$

10. **a.** $\angle b$; $\angle c$

b. $\angle y$; $\angle z$

Objective A Exercises

11. The measure of the given angle is 40°. The measure of the angle is between 0° and 90°, so the angle is acute.

12. The measure of the given angle is 69°. The measure of the angle is between 0° and 90°, so the angle is acute.

13. The measure of the given angle is 115°. The measure of the angle is between 90° and 180°, so the angle is obtuse.

14. The measure of the given angle is 122°. The measure of the angle is between 90° and 180°, so the angle is obtuse.

15. The measure of the given angle is 90°. The angle is right.

16. The measure of the given angle is 20°. The measure of the angle is between 0° and 90°, so the angle is acute.

17. **Strategy** Complementary angles are two angles whose sum is 90°. To find the complement, let x represent the complement of a 62° angle. Write an equation and solve for x.

Solution
$x+62°=90°$
$x=28°$
The complement of a 62° angle is a 28° angle.

18. **Strategy** Complementary angles are two angles whose sum is 90°. To find the complement, let x represent the complement of a 31° angle. Write an equation and solve for x.

Solution
$x+31°=90°$
$x=59°$
The complement of a 31° angle is a 59° angle.

19. **Strategy** Supplementary angles are two angles whose sum is 180°. To find the supplement, let x represent the supplement of a 162° angle. Write an equation and solve for x.

Solution

$$x + 162° = 180°$$
$$x = 18°$$

The supplement of a 162° angle is an 18° angle.

20. **Strategy** Supplementary angles are two angles whose sum is 180°. To find the supplement, let x represent the supplement of a 72° angle. Write an equation and solve for x.

Solution

$$x + 72° = 180°$$
$$x = 108°$$

The supplement of a 72° angle is a 108° angle.

21.
$$AB + BC + CD = AD$$
$$12 + BC + 9 = 35$$
$$21 + BC = 35$$
$$BC = 14$$
$$BC = 14 \text{ cm}$$

22.
$$AB + BC + CD = AD$$
$$21 + 14 + CD = 54$$
$$35 + CD = 54$$
$$CD = 19$$
$$CD = 19 \text{ mm}$$

23.
$$QR + RS = QS$$
$$QR + 3(QR) = QS$$
$$7 + 3 \cdot 7 = QS$$
$$7 + 21 = QS$$
$$28 = QS$$
$$QS = 28 \text{ ft}$$

24.
$$QR + RS = QS$$
$$QR + 2(QR) = QS$$
$$15 + 2(15) = QS$$
$$15 + 30 = QS$$
$$45 = QS$$
$$QS = 45 \text{ in.}$$

25.
$$EF + FG = EG$$
$$EF + \frac{1}{2}(EF) = EG$$
$$20 + \frac{1}{2}(20) = EG$$
$$20 + 10 = EG$$
$$30 = EG$$
$$EG = 30 \text{ m}$$

26.
$$EF + FG = EG$$
$$EF + \frac{1}{3}(EF) = EG$$
$$18 + \frac{1}{3}(18) = EG$$
$$18 + 6 = EG$$
$$24 = EG$$
$$EG = 24 \text{ cm}$$

27.
$$\angle LOM + \angle MON = \angle LON$$
$$53° + \angle MON = 139°$$
$$\angle MON = 139° - 53° = 86°$$

The measure of $\angle MON$ is 86°.

28.
$$\angle LOM + \angle MON = \angle LON$$
$$\angle LOM + 38° + = 85°$$
$$\angle LOM = 85° - 38° = 47°$$

The measure of $\angle LON$ is 47°.

29. **Strategy** To find the measure of $\angle x$, write an equation using the fact that the sum of the measures of $\angle x$ and $\angle 2x$ is 90°. Solve for $\angle x$.

Solution

$$x + 2x = 90°$$
$$3x = 90°$$
$$x = 30°$$

The measure of $\angle x$ is 30°.

30. **Strategy** To find the measure of $\angle x$, write an equation using the fact that the sum of the measures of $\angle x$ and $\angle 4x$ is 90°. Solve for $\angle x$.

Solution

$$x + 4x = 90°$$
$$5x = 90°$$
$$x = 18°$$

The measure of $\angle x$ is 18°.