CHAPTER 4  SYSTEMS OF LINEAR EQUATIONS AND INEQUALITIES

Section 4.1  Solving Systems of Linear Equations by Graphing

Objective 1  Decide whether a given ordered pair is a solution of a system.

1. \((4, 1)\) 
   \[\begin{align*}
   x + 3y &= 6 \\
   2x - 7y &= 1
   \end{align*}\]

2. \((3, -2)\) 
   \[\begin{align*}
   2x + 3y &= 1 \\
   3x - 2y &= 10
   \end{align*}\]

3. \((4, 3)\) 
   \[\begin{align*}
   3x - 2y &= 6 \\
   x - 4y &= -8
   \end{align*}\]

4. \((4, -2)\) 
   \[\begin{align*}
   4x + 3y &= 10 \\
   x - 4y &= 12
   \end{align*}\]

5. \((-3, -5)\) 
   \[\begin{align*}
   x - y &= 2 \\
   4x + y &= 27
   \end{align*}\]

6. \((1, -5)\) 
   \[\begin{align*}
   x - 3y &= 16 \\
   4x - y &= 9
   \end{align*}\]

7. \((-5, -6)\) 
   \[\begin{align*}
   x - y &= 1 \\
   -2x + 3y &= -1
   \end{align*}\]

8. \((1, -2)\) 
   \[\begin{align*}
   -3x + y &= -5 \\
   4x - 3y &= 10
   \end{align*}\]

9. \((-2, -2)\) 
   \[\begin{align*}
   5x - 2y &= -5 \\
   y &= -3x - 8
   \end{align*}\]

10. \((-4, 8)\) 
    \[\begin{align*}
    3x + 2y &= 4 \\
    y &= -2x
    \end{align*}\]

11. \((3, 2)\) 
    \[\begin{align*}
    5x - y &= 13 \\
    2x - y &= 4
    \end{align*}\]

12. \((-1, -2)\) 
    \[\begin{align*}
    3x - 2y &= 12 \\
    x + 3y &= -7
    \end{align*}\]

13. \((-3, 8)\) 
    \[\begin{align*}
    x + 3 &= 0 \\
    y - 8 &= 0
    \end{align*}\]

14. \((2, 4)\) 
    \[\begin{align*}
    x + y &= 6 \\
    y &= 2x + 3
    \end{align*}\]

15. \((2, -8)\) 
    \[\begin{align*}
    3x - 2y &= 22 \\
    -x + y &= -10
    \end{align*}\]

Objective 2  Solve linear systems by graphing.

Solve the system by graphing both equations on the same axes.

16. \[\begin{align*}
   x + y &= 5 \\
   4x - y &= 5
   \end{align*}\]

17. \[\begin{align*}
   2x - y &= -6 \\
   3x + 2y &= -2
   \end{align*}\]

18. \[\begin{align*}
   4x - 3y &= 6 \\
   3x - 2y &= 3
   \end{align*}\]

19. \[\begin{align*}
   2x + 5y &= -5 \\
   5x &= 3y + 34
   \end{align*}\]

20. \[\begin{align*}
   3x - 2y &= 8 \\
   7x + 2y &= 12
   \end{align*}\]

21. \[\begin{align*}
   x - y &= 0 \\
   x + 8 &= 3y
   \end{align*}\]

22. \[\begin{align*}
   8x + 3y &= 24 \\
   2x - 3y &= -24
   \end{align*}\]

23. \[\begin{align*}
   6x - 5y &= -5 \\
   2x - 5y &= 15
   \end{align*}\]

24. \[\begin{align*}
   y - 2 &= 0 \\
   5x - 3y &= -26
   \end{align*}\]
25. \(2x = y\)  
\(7x - 2y = 0\)

26. \(3x - y = -4\)  
\(2x + y = -1\)

27. \(2x + 24 = 3y\)  
\(y + 2x = -8\)

28. \(2x + y = 8\)  
\(x + 3y = 14\)

29. \(3x + 4y = 12\)  
\(y = -x + 3\)

30. \(2x - y = -14\)  
\(x + 5 = 0\)

**Objective 3  Solve special systems by graphing.**

Solve the system of equations by graphing both equations on the same axes. If the two equations produce parallel lines, write no solution. If the two equations produce the same line, write infinite number of solutions.

31. \(4x - 3y = 12\)  
\(6y - 8x = -24\)

32. \(2x + 2y = 8\)  
\(x = 4 - y\)

33. \(3x - 2y = 6\)  
\(-9x + 6y = 18\)

34. \(x + 2y = 4\)  
\(6x = -3y + 18\)

35. \(4x + y = 10\)  
\(y = -4x - 10\)

36. \(5x - 2y = 9\)  
\(4y - 10x = -18\)

37. \(3x - y = 2\)  
\(-6x + 2y = -4\)

38. \(-4x + y = 6\)  
\(12x - 3y = 12\)

39. \(x + y = 3\)  
\(-x - y = -1\)

40. \(x - \frac{1}{2} y = 5\)  
\(-2x + y = 1\)

41. \(2x + y = 5\)  
\(-4x - 2y = -10\)

42. \(x + y = 3\)  
\(2x + 2y = -6\)

**Objective 4  Identify special systems without graphing.**

Without graphing, answer the following questions for each linear system

(a) Is the system inconsistent, are the equations dependent, or neither?

(b) Is the graph a pair of intersecting lines, a pair of parallel lines, or one line?

(c) Does the system have one solution, no solution, or an infinite number of solutions?

43. \(x + y = 7\)  
\(x + y = 1\)

44. \(x - 2y = 5\)  
\(2x - 4y = 10\)

45. \(3x + y = 2\)  
\(6x + 2y = 6\)

46. \(2x + y = 11\)  
\(x - y = 5\)

47. \(x + 3y = 3\)  
\(4x + 12y = 12\)

48. \(y = 3x - 2\)  
\(3x - y = 4\)
49. \(2x - y = 4\) \(x + 3y = 2\) 

50. \(2x - y = 5\) \(2x = y + 3\) 

51. \(3x - 4y = 8\) \(x - 2y = 4\) 

52. \(2x - 6y = 4\) \(y = \frac{1}{3}x - \frac{2}{3}\) 

53. \(6x + 2y = 12\) \(y = -3x + 3\) 

54. \(4x + 3y = 8\) \(y = -\frac{4}{3}x + \frac{4}{3}\) 

Objective 5  Use a graphing calculator to solve a linear system. 

Use the graphing capabilities of your calculator to find the solutions to the given system.

55. \(5x + y = 12\) \(-5x + 2y = -6\) 

56. \(y = -2x\) \(2x - y = 16\) 

57. \(x + y = -2\) \(3x - 2y = 19\) 

58. \(5x - 4y = 3\) \(7x - 10y = -9\) 

59. \(2x - 3y = -9\) \(3x + y = 25\) 

60. \(5y = 2x\) \(8x - 5y = 30\) 

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

62. \(3x - 2y = 6\) \(\frac{3}{2}x - 3 = y\) 

63. \(6x - 2y = 8\) \(y = 3x - 4\) 

64. \(\frac{1}{3}x + y = 5\) \(-\frac{1}{3}x + 3 = y\) 

65. \(3x = -15\) \(9x - 4y = -41\) 

66. \(1 + 5x = \frac{1}{2}y\) \(1 + \frac{1}{4}y = 10x\) 

Mixed Exercises

Decide whether the given ordered pair is a solution of the given system.

67. \((-1, 2)\) \(3x - y = -5\) \(4x + y = -2\) 

68. \((3, -5)\) \(3x + 2y = 1\) \(2x + 5y = -19\) 

69. \((4, 0)\) \(3x - 2y = 12\) \(-x + 3y = -4\) 

70. \((0, -5)\) \(2x - y = 5\) \(3x + 2y = 10\) 

71. \((7, -2)\) \(3x + y = 19\) \(-2x + 3y = -7\) 

72. \(\left(\frac{3}{2}, -2\right)\) \(2x + 5y = -7\) \(3x + 4y = 13\)
Solve the system of equations by graphing both equations on the same axes. If the system is inconsistent or the equations are dependent, say so.

73. \( x + 3y = 9 \)  
\( 4x + 3y = -9 \)

74. \( 5x - 3y = 30 \)  
\( 10x - 6y = 60 \)

75. \( 2x + 3y = 6 \)  
\( x - 2y = 10 \)

76. \( 7x - 3y = -17 \)  
\( -14x + 6y = -24 \)

77. \( 3x - y = -4 \)  
\( 7x + 9y = 2 \)

78. \( x - 5y = 25 \)  
\( 2x - y = -4 \)

Without graphing, determine whether the system has one solution, no solution, or an infinite number of solutions.

79. \( 2x + 5y = -5 \)  
\( -2x = 5y + 30 \)

80. \( x - y = -5 \)  
\( 5x + 2y = 2 \)

81. \( x - y = 0 \)  
\( 2x + 3y = 10 \)

82. \( x + 6y = -33 \)  
\( 9x - 5y = -2 \)

83. \( 6x + 15y = -48 \)  
\( -2x - 5y = 16 \)

84. \( y - 2 = 0 \)  
\( 3x - 2y = -16 \)

85. \( 2x = y \)  
\( 5x + 3y = 0 \)

86. \( 3y + 1 = x \)  
\( \frac{1}{3}x - y = \frac{1}{3} \)

87. \( y = 5x \)  
\( \frac{1}{5}y - \frac{2}{5} = x \)

88. \( y = 4 \)  
\( x - 3 = 0 \)

89. \( 5x + 2y = 7 \)  
\( 10x + 7 = -4y \)

90. \( 3x - y = 12 \)  
\( x = 4 - y \)

91. \( y - 2 = 0 \)  
\( x + 4 = 0 \)

92. \( 4x - 3y = 18 \)  
\( 6y - 8x = -36 \)

93. \( 3x + 3y = 12 \)  
\( x = 4 - y \)

94. \( x = y - 4 \)  
\( 8x = 13 - 7y \)

95. \( 5x + 7y = 9 \)  
\( 8x + y = 45 \)

96. \( \frac{1}{2}x - \frac{1}{4}y = 5 \)  
\( -2x + y = 4 \)

Writing/Conceptual Exercises

97. A student solved a linear system and found the solutions to be \((5, 2)\) and \((6, 6)\). What is wrong with this?

98. Why is the graphing method not the best method for solving a linear system?
99. One student found that a point in the first quadrant had coordinates which were a solution of a linear system. A second student found a similar point in the second quadrant. Both students were correct. What does this tell you about the system?

100. Find a system of equations with the solution \((-4, 2)\) and show the graph.

Section 4.2 Solving Systems of Linear Equations by Substitution

Objective 1 Solve linear systems by substitution.

Solve the system by the substitution method. Check your solution.

101. \[x + y = 10\]
    \[y = 4\]

102. \[3x + 2y = 9\]
    \[y = x + 2\]

103. \[3x + y = 0\]
    \[y = -x\]

104. \[x - 2y = 8\]
    \[x = 1 - 5y\]

105. \[y + 4x = 0\]
    \[x = -11 - 3y\]

106. \[5x + 2y = -7\]
    \[y = 2x + 10\]

107. \[x + y = 5\]
    \[5x - 2y = 4\]

108. \[x - 4y = 1\]
    \[3x - 4y = -13\]

109. \[-8x + 5y = -9\]
    \[x - y = 3\]

110. \[3x - 2 = -y\]
    \[y + 2x = -2\]

111. \[5x + 3y = 18\]
    \[x + y = 4\]

112. \[3x - 2y = -13\]
    \[x - 5y = -26\]

Objective 2 Solve special systems by substitution.

Solve the system by the substitution method.

113. \[3x - 2y = 7\]
    \[6x - 4y = 9\]

114. \[x + y = 6\]
    \[-x - y = -6\]

115. \[4x - 8y = 12\]
    \[x - 2y = 3\]

116. \[8x - 2y = 7\]
    \[4x - y = 7\]

117. \[6x + 2y = 10\]
    \[3x + y = 4\]

118. \[36x + 20y = 12\]
    \[-27x - 15y = -9\]

119. \[5x + 2y = -6\]
    \[10x + 4y = 4\]

120. \[48x - 56y = 32\]
    \[21y - 18x = -12\]

121. \[12x - 18y = 24\]
    \[4x - 6y = 6\]

122. \[72x - 60y = -24\]
    \[25y - 30x = 10\]

123. \[x + y = 8\]
    \[\frac{x}{2} + \frac{y}{2} = 4\]

124. \[3x - 5y = 10\]
    \[x - \frac{5}{3}y = 3\]
Objective 3   Solve linear systems with fractions.

In the given systems, begin by clearing fractions and then solve the system by substitution.

125. \[
\frac{x}{4} + \frac{y}{6} = 1 \\
\frac{x}{2} + \frac{y}{3} = -1
\]

126. \[
\frac{7}{3}x + y = 5 \\
2x + \frac{3}{2}y = 3
\]

127. \[
\frac{7}{6}x - y = 9 \\
\frac{2}{3}x + \frac{14}{3}y = 14
\]

128. \[
x + \frac{5}{3}y = 11 \\
\frac{5}{6}x + \frac{2}{3}y = \frac{29}{6}
\]

129. \[
\frac{x}{5} - \frac{7}{5}y = \frac{6}{5} \\
\frac{1}{4}x - \frac{1}{2}y = \frac{1}{6}
\]

130. \[
\frac{4}{3}x + y = 1 \\
\frac{5}{6}x + y = -2
\]

131. \[
\frac{x}{2} - \frac{2y}{3} = \frac{4}{3} \\
4x + 8 = \frac{3}{3}
\]

132. \[
\frac{1}{20}x + \frac{1}{15}y = -\frac{1}{6} \\
\frac{1}{6}x + 1 = 0
\]

133. \[
\frac{1}{3}x + \frac{5}{6}y = 1 \\
\frac{1}{2}x + \frac{3}{4}y = \frac{3}{2}
\]

134. \[
\frac{5}{8}x - \frac{1}{4}y = -2 \\
\frac{1}{2}x - \frac{2}{3}y = -\frac{2}{3}
\]

Mixed Exercises

Solve the system by the substitution method.

135. \[
2x - 3y = -1 \\
2x + 9y = -13
\]

136. \[
3x - 2y = 6 \\
x - 6 = 0
\]

137. \[
5x + 2y = 16 \\
y + 2 = 0
\]

138. \[
6x + 5y = 8 \\
x + 7 = 0
\]

139. \[
3x - 6y = 12 \\
x = 2y + 4
\]

140. \[
6x + 8y = 14 \\
4y = 17 - 3x
\]
141. \(4x + 3y = 10\)  
\(3x + 5y = 2\)  
142. \(2x - 5y = 11\)  
\(3x - 4y = 6\)  
143. \(y = 3x + 2\)  
\(2x - y = -3\)

144. \(22x - 10y = 0\)  
\(5y - 11x = 0\)  
145. \(15x - 10y = 5\)  
\(-12x + 8y = -4\)  
146. \(15 + 8x = 6y\)  
\(30 + 12y = 16x\)

147. \(14x - 42y = 0\)  
\(x = 3y\)  
148. \(9x - 15y = 21\)  
\(-12x + 20y = 28\)  
149. \(3x - 7y = 12\)  
\(-9x + 21y = 36\)

150. \(6x = 2y - 10\)  
\(5y = 25 + 15x\)  
151. \(3x - 8y = 9\)  
\(x = \frac{8}{3}y + 3\)  
152. \(2x + y = -10\)  
\(x + \frac{1}{2}y = -5\)

153. \(\frac{x - y}{2} = \frac{1}{3}\)  
\(\frac{x}{4} - \frac{y}{12} = \frac{3}{4}\)  
154. \(\frac{1}{4}x + \frac{1}{2}y = -9\)  
\(\frac{1}{9}x - \frac{1}{6}y = \frac{2}{3}\)  
155. \(\frac{9}{2}x - \frac{3}{4}y = 3\)  
\(-\frac{3}{4}x + \frac{1}{8}y = -\frac{1}{2}\)

156. \(\frac{5}{7}x + \frac{4}{3}y = -3\)  
\(\frac{1}{7}x + \frac{1}{6}y = 0\)  
157. \(\frac{1}{2}x + \frac{1}{3}y = -1\)  
\(\frac{3}{2}x - \frac{2}{3}y = 17\)  
158. \(x - \frac{3}{4}y = -5\)  
\(2x - \frac{1}{2}y = -2\)

Solve each equation in the system for \(y\). Then use the intersection feature on your graphing calculator to find the coordinates of the point of intersection.

159. \(3x - 2y = -4\)  
\(7x - 4y = -2\)  
160. \(9x + 2y = -10\)  
\(-7x + 3y = 26\)

161. \(x + y = -10\)  
\(3x + 2y = -25\)  
162. \(17x - 12y = -13\)  
\(16x - 12y = -14\)
Writing/Conceptual Exercises

In Exercises 163 through 166, which variable would be easier to solve for in the first step of the substitution method? In which equation would you solve for it? Why?

163. \( 3x + y = 10 \) 
    \( 4x - 7y = 9 \)

164. \( 7x - y = 12 \) 
    \( 2x + 3y = 8 \)

165. \( 5x - 9y = 14 \) 
    \( x - 5y = 7 \)

166. \( 9x + 7y = 6 \) 
    \( 2x + 4y = -14 \)

Section 4.3 Solving Systems of Linear Equations by Elimination

Objective 1 Solve linear systems by elimination.

Solve the system by the addition method. Check your answers.

167. \( x + y = 4 \) 
    \( x - y = 2 \)

168. \( x - y = 7 \) 
    \( 2x + y = 8 \)

169. \( 7x - y = 4 \) 
    \( -3x + y = 4 \)

170. \( x + 2y = -7 \) 
    \( -x - 3y = 14 \)

171. \( 2x + 5y = -35 \) 
    \( -2x + 3y = -5 \)

172. \( 3x - 4y = 8 \) 
    \( x + 4y = -2 \)

173. \( -9x + 2y = -13 \) 
    \( 3x - 2y = -5 \)

174. \( 7x + 3y = 19 \) 
    \( 2x - 3y = -10 \)

175. \( x - 3y = -1 \) 
    \( -x + 4y = 3 \)

176. \( 3x - 5y = -16 \) 
    \( x + 5y = 8 \)

177. \( -3x + 8y = -35 \) 
    \( -5x - 8y = 27 \)

178. \( 2x + 5y = -32 \) 
    \( -2x + y = 8 \)

Objective 2 Multiply when using the elimination method.

Solve the system by the addition method. Check your answers.

179. \( 6x + 5y = -7 \) 
    \( 2x - 4y = -8 \)

180. \( 8x + 6y = 22 \) 
    \( 4x - y = -1 \)

181. \( 4x - 3y = 24 \) 
    \( 3x - 2y = 16 \)

182. \( 3x + 8y = -3 \) 
    \( 2x + 5y = -3 \)

183. \( x - 4y = 12 \) 
    \( x + 6y = -8 \)

184. \( 3x - 4y = 4 \) 
    \( 6x - y = 22 \)
185. \[4x - y = -8\] \[x - y = -5\]  
186. \[4x - 5y = -17\] \[3x + 2y = -7\]  
187. \[3x + y = 23\] \[x + 4y = 15\]  
188. \[4x - 8y = 8\] \[7x + 5y = -5\]  
189. \[2x + 2y = 4\] \[3x - 5y = -2\]  
190. \[x - 9y = 41\] \[3x + 5y = -5\]  

**Objective 3  Use an alternative method to find the second value in a solution.**

Solve the system by using the addition method twice. Check your answer.

191. \[2x - y = 6\] \[x + 2y = 8\]  
192. \[4x + y = 25\] \[3x + y = 20\]  
193. \[2x + 3y = 35\] \[3x - 2y = -6\]  
194. \[6x - 5y = -22\] \[9x + 2y = 5\]  
195. \[x - 6y = -3\] \[2x - 3y = 4\]  
196. \[4x - 3y = 5\] \[x + 3y = 0\]  
197. \[2x + 3y = 5\] \[3x - 2y = -4\]  
198. \[x + 2y = 0\] \[2x - y = -1\]  
199. \[5x - 6y = 2\] \[x + 3y = 2\]  
200. \[2x - 5y = -6\] \[3x - y = -1\]  
201. \[x - 4y = 2\] \[x - 5y = 1\]  
202. \[3x + 2y = -1\] \[5x + 4y = -1\]  

**Objective 4  Use the elimination method to solve special systems.**

Solve the system by the addition method.

203. \[3x - 2y = 4\] \[6x - 4y = 7\]  
204. \[x + y = 5\] \[x - y = -5\]  
205. \[4x - 8y = 20\] \[x - 2y = 5\]  
206. \[8x - 2y = 3\] \[4x - y = 3\]  
207. \[6x + 2y = 12\] \[3x + y = -6\]  
208. \[24x - 15y = 33\] \[-16x + 10y = -22\]  
209. \[5x + 2y = -8\] \[10x + 4y = 16\]  
210. \[48x - 56y = 32\] \[21y - 18x = -12\]  
211. \[12x - 18y = 25\] \[4x - 6y = 7\]  
212. \[72x - 60y = -12\] \[25y - 30x = 5\]  
213. \[10x - 14y = 0\] \[7y - 5x = 0\]  
214. \[15x - 10y = 15\] \[-12x + 8y = 12\]
Mixed Exercises

Solve the system by the addition method. Check your answers.

215. \[2x + 3y = 5\]
    \[x + 3y = -2\]
216. \[3x + y = 9\]
    \[2x + y = 5\]
217. \[-8x + 3y = -1\]
    \[2x - 7y = -31\]
218. \[x - 2y = -4\]
    \[3x + 2y = 20\]
219. \[13x - 39y = 0\]
    \[x = 3y\]
220. \[9x - 15y = 27\]
    \[-12x + 20y = 36\]
221. \[14x - 5y = 2\]
    \[-11x + 8y = -26\]
222. \[3x = 37 + 5y\]
    \[x - y = 9\]
223. \[4x - 4y = 1\]
    \[5x - 4y = 4\]
224. \[5x = 5 - 4y\]
    \[5y = 7 - 6x\]
225. \[6x = 2y - 6\]
    \[5y = 15 + 15x\]
226. \[2x - 3y = -2\]
    \[x + 4y = 3\]
227. \[x + y = -15\]
    \[3x - y = -5\]
228. \[x - y = 5\]
    \[x + y = 7\]
229. \[x + y = -3\]
    \[8x + y = 4\]
230. \[5x - 6y = 9\]
    \[3x + 6y = 7\]
231. \[3x + y = 2\]
    \[6x - y = -5\]
232. \[15x - 3y = 8\]
    \[21x + 3y = 10\]
233. \[-x - 2y = 5\]
    \[-x - 2y = -6\]
234. \[6x - 4y = 4\]
    \[12x + 8y = 12\]
235. \[3x - 4y = 12\]
    \[-6x + 8y = -9\]
236. \[5x - 7y = 10\]
    \[3x + 5y = 6\]
237. \[3x - 4y = 8\]
    \[4x + 5y = -10\]
238. \[7x + 4y = -8\]
    \[6x + 5y = -10\]
239. \[6x + 5y = 17\]
    \[y = -x + 2\]
240. \[5x - y = 19\]
    \[7x - 2y = 29\]
241. \[5x - 7y = 17\]
    \[3x - 12 = 6y\]
242. \[6x + 25 = 7y\]
    \[5y + 7 = -4x\]
243. \[3x - 4 = -3y - 1\]
    \[2x + y = -1\]
244. \[x - 2y = 8\]
    \[-\frac{1}{2}x + y = -4\]
Writing/Conceptual Exercises

245. Only one of the following systems does not require that we multiply one or both equations by a constant in order to solve the system by the addition method. Which one is it?

(a) \[4x + y = 7 \quad 2x - 3y = 6\]
(b) \[-7x + 3y = 6 \quad 4x - 3y = 5\]
(c) \[3x + 2y = 5 \quad 2x - 3y = 9\]
(d) \[x + y = 5 \quad 2x - 2y = 10\]

246. For the system

\[4x + 10y = 3\]
\[5x - 25y = 18\]

if we were to multiply the first (top) equation by \(-5\), by what number would we have to multiply the second (bottom) equation in order to:

(a) Eliminate the \(x\) terms when solving by the addition method?
(b) Eliminate the \(y\) terms when solving by the addition method?

247. Without actually solving the system, explain why

\[x - y = 6\]
\[x - y = 11\]

can have no solution.

248. On an algebra quiz, Libby and Margie solved the following system by the addition method:

\[5x + 3y = 12\]
\[x - y = -4\]

After multiplying the second equation by 3 and adding the result to the first equation, both of them obtained the equation \(8x = 0\). Libby wrote down that the system has no solution, while Margie wrote on her paper that the system has an infinite number of solutions. Who is correct? Explain?
Section 4.4 Applications of Linear Systems

Objective 1 Solve problems about unknown numbers.

Use a system of equations to solve the problem.

249. The sum of two numbers is 73. Their difference is 21. Find the numbers.

250. Find two numbers whose sum is –103 and whose difference is 53.

251. The difference between two numbers is 9. If the larger is one more than two times the smaller, find the numbers.

252. The sum of two numbers is 12. If two times the larger is added to three times the smaller, the result is 27. Find the numbers.

253. The difference between two numbers is 11. If two times the smaller is added to one-half the larger, the result is 33. Find the numbers.

254. Two neighboring towns, Rockville and Clinton, have a combined population of 8085. There are 1243 more people living in Rockville than in Clinton. Find the population in each town.

255. There are a total of 57 students in the two second grade classes at Greencastle School. If Mrs. Ferrari has 5 more students in her class than Mrs. Baylies, find the number of students in each class.

256. A rope 54 meters long is cut into two pieces with one piece three times as long as the other. Find the length of each piece.

257. The perimeter of a rectangular room is 40 feet. The length is 4 feet less than three times the width. Find the dimensions of the room.

258. The perimeter of a triangular pennant is 98 inches. If two sides are of equal length, and the third side is 20 inches longer than each of the equal sides, what are the lengths of the three sides?
Objective 2  Solve problems about quantities and their costs.

Use a system of equations to solve the problem.

259. Admission prices at a football game were $8 for adults and $4 for children. The total receipts for the game were $56,000. Tickets were sold to 8000 people. How many adults and how many children attended the game?

260. The receipts from a concert were $2450. The price for a regular ticket was $7 and the student tickets were half the regular price. If 400 tickets were sold, how many of each type where there?

261. The cashier at JR’s Drug Store has some $10 bills and some $20 bills. The total value of the money is $1310. If there is a total of 77 bills, how many of each type are there?

262. A postal clerk has 1250 stamps in his drawer that are worth a total of $427.50. If there are only 39¢ stamps and 15¢ stamps, how many of each kind are there?

263. There were 404 tickets sold for a soccer game, some for students and some for non-students. Student tickets cost $1.25 and non-student tickets cost $3.50 each. The total receipts were $739. How many of each type were sold?

264. The cashier at Taco World has some $5 bills and some $20 bills. The total value of the money is $1575. If the number of twenties is equal to twice the number of fives, how many of each type are there?

265. The total receipts for a basketball game were $2432.50. There were 423 tickets sold, some for children and some for adults. If the adult tickets cost $7.50 and the children’s tickets cost $5, how many of each type were there?

266. Twice as many general admission tickets to a basketball game were sold as reserved seat tickets. General admission tickets cost $10 and reserved seat tickets cost $15. If the total value of both kinds of tickets was $29,750, how many tickets of each kind were sold?

267. Maxine has $15,000 to invest, part at 5% and part at 8%. She wants the income from simple interest on the two investments to total $1080 annually. How much should she invest at each rate?

268. Mrs. Pratt has $12,000 to invest at 7% and 9%. She wants the income from simple interest on the two investments to total $1000 yearly. How much should she invest at each rate?
Objective 3   Solve problems about mixtures.

Use a system of equations to solve the problem.

269. A merchant wishes to mix coffee worth $6 a pound with coffee worth $3 a pound to get 48 pounds of a mixture worth $4 a pound. How many pounds of the $6 and the $3 coffee will be needed?

270. A grocer wishes to blend candy selling for $1.60 a pound with candy selling for $2.50 a pound to get a mixture that will be sold for $1.90 a pound. How many pounds of the $1.60 and the $2.50 candy should be used to get 30 pounds of the mixture?

271. How many barrels of olives worth $40 a barrel must be mixed with olives worth $65 a barrel to get 50 barrels worth $56 a barrel?

272. How many pounds of $4.20 a pound candy should be mixed with candy worth $3.50 a pound to get 21 pounds of candy worth $3.90 a pound?

273. Homefront Candy sells caramels that cost $3.65 per pound mixed with creams that cost $3.25 per pound. How much of each kind of candy is in a pound of the mixture if it costs $3.49?

274. How many liters of 35% solution should be mixed with a 55% solution to get 60 liters of a 43% solution?

275. A 95% antifreeze solution is to be mixed with a 70% solution to make 40 liters of an 80% solution. How many liters of the 95% and 70% solution should be used?

276. A pharmacist needs 15 liters of 20% alcohol solution. He has only 15% alcohol solution and 30% alcohol on hand to make the mixture. How many liters of each should be combine to make the mixture?

277. A 10% solution of hydrochloric acid is mixed with a 40% solution of hydrochloric acid to get 100 liters of 22% solution. How many liters of each solution are needed?

278. A 20% sodium hydroxide solution is mixed with a 45% sodium hydroxide solution to get 70 liters of a 30% alcohol solution. How many liters of each solution are used?
Objective 4  Solve problems about distance, rate (or speed), and time.

Use a system of equations to solve the problem.

279. Two cars start from positions 300 miles apart and race toward each other. They meet after 3 hours. Find the average speed of each car if one car travels 10 miles per hour faster than the other.

280. Two trains start from positions 500 miles apart and travel toward each other. They meet after 2 ½ hours. Find the average speed of each train if one train travels 20 miles per hour faster than the other.

281. At the beginning of a bicycle fund raiser, Brad and Dustin are 60 miles apart. If they leave at the same time and travel in the same direction, Brad would overtake Dustin in 15 hours. If they traveled toward each other, they would meet in 3 hours. What are their speeds?

282. Two cars leave from the same place and travel in the same direction. One car travels $\frac{5}{2}$ times as fast as the other. After 3 hours they are 66 miles apart. Find the speed of each car.

283. Antonio left Somerset traveling to Akron 230 miles away at the same time as Katie left Akron traveling to Somerset. They met after 2 hours. If Katie was traveling 1.3 times as fast as Antonio, what were their speeds?

284. Mr. Hoffman left Indianapolis at noon on the same day that Mr. Diekhans left Indianapolis at 1 P.M. Both were traveling in the same direction. At 5 P.M., Mr. Diekhans was 62 miles behind Mr. Hoffman. If Mr. Hoffman was traveling 2 miles per hour faster than Mr. Diekhans, what were their speeds?

285. It takes a boat 2 hours to go 28 miles downstream and 7 hours to return. Find the speed of the current and the speed of the boat in still water.

286. A plane can travel 300 miles per hour with the wind and 230 miles per hour against the wind. Find the speed of the wind and the speed of the plane in still air.

287. It takes a canoe 1 ½ hours to go 24 miles downstream and 3 hours to return. Find the speed of the current and the speed of the canoe in still water.

288. Two planes left Terre Haute traveling in opposite directions. Plane A left 15 minutes before plane B. After plane B had been flying for 1 hour, the planes were 860 miles apart. What were the speeds of the two planes if plane A was flying 40 miles per hour faster than plane B?
Mixed Exercises

289. The perimeter of a rectangle is 56 centimeters. The length is 7 centimeters more than twice the width. Find the dimensions of the rectangle.

290. Cathy plans to buy 10 sweaters with exactly $141. If some sweaters cost $12, and the others cost $15, how many of each price should she buy?

291. Emily has 20 bills in her wallet worth $155 together. If the wallet contains only $5 and $10 bills, how many of each denomination does she have?

292. Two airplanes start out together and travel in opposite directions. At the end of 4 hours, they are 4240 kilometers apart. If one plane travels 60 kilometers per hour faster than the other, what are their speeds?

293. A 30% acid solution is to be mixed with a 50% acid solution to get 120 milliliters of a 35% acid solution. How many milliliters of 30% solution are needed?

294. Dale invested $50,000 in two accounts last year. One account earned 6% and the other earned 7% annual interest. If the total income last year from these accounts was $3360, how much was invested in each account?

295. It takes Carla’s boat ½ hour to go 8 miles downstream and 1 hour to make the return trip upstream. Find the speed of the current and the speed of Carla’s boat in still water.

296. A merchant wishes to make 160 pounds of coffee blend that can be sold for $5 per pound. The blend will be a mixture of coffee worth $8 per pound and coffee worth $3 per pound. How many pounds of each kind of coffee should be used in the mixture?

297. Andy leaves Bainbridge, driving by car to Seymore, which is 168 kilometers away. At the same time, Ralph, riding his bicycle, leaves Seymore cycling toward Bainbridge. Andy is traveling 40 kilometers per hour faster than Ralph. They pass each other 1 ½ hours later. What are their speeds?

298. How many liters of water should be added to a 25% antifreeze solution to get 50 liters of a 20% solution?

299. The sum of two numbers is –21. If one number is two less than five times the other, find the numbers.

300. The sum of two numbers is –3. If one number is tripled, the result is 23 more than the other number. Find the original numbers.

301. Two angles are complementary. The larger angle measures 5° less than twice the smaller. Find the measures of the angles.
302. Two angles are supplementary. The difference between their measures is 26°. Find the measures of the angles.

303. A bank teller has 78 bills of $1 and $5 denominations. How many of each type does he have if the total value of the money is $210?

304. The box office is selling reserved seat tickets and general admission tickets for $10 and $5, respectively. The total value of the tickets sold is $630. If there were 103 tickets sold, how many of each type are there?

305. Mr. Sommerville has twice as much money invested at 14% as he has at 11%. If his yearly income from the investment is $2145, how much does he have invested at each rate?

306. Mr. Howe has half as much money invested at 9% as he has at 12%. If his yearly income from the two investments is $1980, how much does he have invested at each rate?

307. Two cars leave the same town at the same time traveling in opposite directions. After 5 hours, they are 505 miles apart. Find the average speed of each car if the average speed of one is 5 miles per hour greater than the average speed of the other.

308. John hiked up to Lookout Point from the ranger station in 2 hours. The trip down along the same route took him 1 ½ hours. Find the distance from the ranger station to Lookout Point if his average speed going up was 5 miles per hour less than twice his average returning speed.

309. A freight train leaves a station traveling west. One hour later a passenger train leaves the same station traveling in the same direction. The passenger train overtakes the freight train in three hours. Find the average speed of the passenger train if the average speed of the passenger train is 15 miles per hour more than the average speed of the freight train.

310. Geoff has a coin collection containing pennies, nickels, and dimes. He has 400 coins altogether. The total value of the coins is $30.48. If he has the same number of pennies as nickels, how many coins of each denomination does he have?

311. Traveling with the current, a boat can travel the same distance in 2 hours as it can traveling against the current in 5 hours. If the average speed of the boat in still water is 4 miles per hour more than the speed of the current, find the average speed of the boat in still water.

312. Eugene and Rao live 468 miles apart. They start driving toward each other at the same time and meet in 4 hours. Rao’s average speed is 5 miles per hour more than Eugene’s average speed. Find Eugene’s average speed.
### Section 4.5 Solving Systems of Linear Inequalities

**Objective 1 and 2** Solve systems of linear inequalities by graphing. Use a graphing calculator to solve a system of linear inequalities.

Graph the solutions of each system of linear inequalities. Then use the graphing capacity of your calculator to verify your answers.

<table>
<thead>
<tr>
<th>313.</th>
<th>$y \leq -1$</th>
<th>314.</th>
<th>$3x + 5y \geq 15$</th>
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<th>$x + y \leq 3$</th>
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<td></td>
<td>$-3x + 4y \leq 2$</td>
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<td>$y \geq x - 2$</td>
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<td></td>
<td>$x - 2y \leq 4$</td>
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<td>$4x + y \leq -6$</td>
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<td></td>
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<td></td>
<td>$y \geq 0$</td>
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Writing/Conceptual Exercises

337. Explain the difference between infinitely many solutions to a system of linear inequalities and any ordered pair being a solution.

338. What determines whether to draw a solid boundary line or a dashed boundary line in solving a system of linear inequalities?

339. Can a system of linear inequalities have solutions in all quadrants? If so, graph the solution of such a system.

340. Can a system of linear inequalities have solutions in only one quadrant? If so, graph the solution of such a system.