CHAPTER 3  LINEAR EQUATIONS AND INEQUALITIES IN TWO VARIABLES; FUNCTIONS

Section 3.1  Reading Graphs; Linear Equations in Two Variables

Objective 1  Interpret graphs.

The pie chart below shows how the Pratt family used its income in 2007. The total family income was $78,000. Use this chart to answer the questions in Exercise 1 – 3.

1. What percentage of the family’s income was spent on the combination of the following expenses: mortgage payments, college tuition, and travel?

2. How much money was spent on college tuition?

3. How much more money was spent on mortgage payments than went into savings?

Use the bar graph below to answer the questions in Exercises 4 – 6.

4. In which year were auto retail sales the highest?

5. Between what two years did auto retail sales decrease?

6. Between what two years did auto retail sales increase by the largest amount?
The line graph below shows the rate of inflation during recent years in the United States. Use this graph to answer the questions in Exercises 7 – 9.

7. What is the highest inflation rate shown on the graph? When did it occur?

8. What is the lowest inflation rate shown on the graph? When did it occur?

9. During which quarter did the greatest increase in inflation rate occur?

The line graph below shows crime rates per one million people in the areas in and around certain American cities. Use this graph to answer the questions in Exercises 10 – 12.

10. Which city showed a decline in its crime rate from 2000 to 2006?

11. Which city had the greatest crime rate in 2006?

12. Which city had about the same crime rate throughout the period 2000 – 2006?
Objective 2  Write a solution as an ordered pair.

Write the solution as an ordered pair. Assume that the pairs must be written in alphabetic order.

13. \(x = 5\) and \(y = 2\)
14. \(x = 6\) and \(y = -3\)
15. \(a = -5\) and \(b = 3\)
16. \(a = 2\) and \(b = 3\)
17. \(p = \frac{1}{5}\) and \(q = -1\)
18. \(p = -2\) and \(q = -11\)
19. \(r = 0\) and \(s = -7\)
20. \(s = \frac{1}{3}\) and \(r = 3\)
21. \(m = 0.2\) and \(n = 0.3\)
22. \(n = -19\) and \(m = 6\)

Objective 3  Decide whether a given ordered pair is a solution of a given equation.

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

23. \(x + y = 6;\) \((1,5)\)
24. \(2a - b = 6;\) \((2, -2)\)
25. \(4m - 3n = 6;\) \((1,2)\)
26. \(5a - 3b = 1;\) \((0, \frac{1}{3})\)
27. \(x = -6y;\) \((0,0)\)
28. \(m = 4n;\) \((2,8)\)
29. \(y + 4 = 0;\) \((0, -4)\)
30. \(x = -7;\) \((-7, 0)\)
31. \(x - 6 = 2;\) \((8,3)\)
32. \(x = 1 - 3y;\) \((0, -\frac{1}{3})\)
Objective 4  Complete ordered pairs for a given equation.

Complete the ordered pairs beneath the equation.

33. \( y = 3x - 1 \)  
   (a) \((4, \quad )\)  
   (b) \((0, \quad )\)  
   (c) \((\quad , 2)\)  
   (d) \((\quad , -10)\)  
   (e) \((\quad , 11)\)

34. \( y = -4x + 6 \)  
   (a) \((1, \quad )\)  
   (b) \((-3, \quad )\)  
   (c) \((\quad , 6)\)  
   (d) \((\quad , 22)\)  
   (e) \((\quad , -10)\)

35. \( y = 4 - 2x \)  
   (a) \((-2, \quad )\)  
   (b) \((4, \quad )\)  
   (c) \((\quad , 0)\)  
   (d) \((-1, \quad )\)  
   (e) \((\quad , -8)\)

36. \( 5x + 2y = 3 \)  
   (a) \((1, \quad )\)  
   (b) \((-7, \quad )\)  
   (c) \((\quad , -6)\)  
   (d) \((0, \quad )\)  
   (e) \((\quad , 0)\)

37. \( x = -3 \)  
   (a) \((-3, \quad )\)  
   (b) \((0, \quad )\)  
   (c) \((\quad , 0)\)  
   (d) \((-4, \quad )\)  
   (e) \((\quad , -\frac{4}{3})\)

38. \( y = 7 \)  
   (a) \((3, \quad )\)  
   (b) \((0, \quad )\)  
   (c) \((\quad , 7)\)  
   (d) \((-4, \quad )\)  
   (e) \((\quad , 0.75)\)

Objective 5  Complete a table of values.

Complete the table of values.

39. \( x + 2y = 4 \)  
   \[
   \begin{array}{cc}
   x & 2 \\
   y & 4 \\
   \end{array}
   \]

40. \(-3x = y\)  
   \[
   \begin{array}{cc}
   x & 2 \\
   y & -9 \\
   \end{array}
   \]

41. \( 3x + 2y = 6 \)  
   \[
   \begin{array}{cc}
   x & 0 \\
   y & -4 \\
   \end{array}
   \]

42. \( y = 2x - 1 \)  
   \[
   \begin{array}{cc}
   x & 0 \\
   y & -3 \\
   \end{array}
   \]

43. \( 4m - n = 8 \)  
   \[
   \begin{array}{cc}
   m & 0 \\
   n & -2 \\
   \end{array}
   \]

44. \( 3s - 4t = 12 \)  
   \[
   \begin{array}{cc}
   s & 0 \\
   t & 12 \\
   \end{array}
   \]
45. \( x = -5 \)

\[
\begin{array}{c|c|c|c}
\hline
x & 0 & 4 & -5 \\
\hline
y & \multicolumn{3}{c|}{\text{---}} \\
\hline
\end{array}
\]

46. \( y = 0 \)

\[
\begin{array}{c|c|c|c}
\hline
x & -5 & 0 & -1 \\
\hline
y & \multicolumn{3}{c|}{\text{---}} \\
\hline
\end{array}
\]

47. \( x - 10 = 0 \)

\[
\begin{array}{c|c|c|c}
\hline
x & \multicolumn{3}{c|}{\text{---}} \\
\hline
y & -8 & 0 & 8 \\
\hline
\end{array}
\]

48. \( y + 6 = 0 \)

\[
\begin{array}{c|c|c|c}
\hline
x & -6 & 0 & 6 \\
\hline
y & \multicolumn{3}{c|}{\text{---}} \\
\hline
\end{array}
\]

**Objective 6  Plot ordered pairs.**

Plot the ordered pair on a coordinate system.

49. \((6,1)\)  50. \((-2,4)\)  51. \((5,3)\)  52. \((-2,-5)\)

53. \((4,-2)\)  54. \((-4,3)\)  55. \((1,0)\)  56. \((0,-4)\)

57. \((-5,0)\)  58. \((0,4)\)  59. \((0,0)\)  60. \((2,-5)\)

Without plotting the given point, name the quadrant in which it lies or the axis on which it lies.

61. \((1,2)\)  62. \((5,-8)\)  63. \((-7,1)\)  64. \((-10,-1)\)

65. \(\left(-\frac{1}{2}, \frac{3}{5}\right)\)  66. \((0,-11)\)  67. \((-5,0)\)  68. \((0,0)\)

**Mixed Exercises**

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

69. \(3x + y = 8; \ (4,0)\)  70. \(2x + y = 5; \ (2,1)\)

71. \(y = 5x; \ (5,1)\)  72. \(3x + y = -8; \ (0,-8)\)

73. \(x = 2y; \ (6,3)\)  74. \(x - 4 = 0; \ (0,4)\)
Complete the given ordered pairs for the equation.

75. \(y = -2x + 5\)  
   \(6, \quad \left(-\frac{1}{2}, \quad \right)(, \, 0)\)

76. \(3x - 6y = 18\)  
   \(0, \quad )\)(,0)(2, \, )

77. \(-x + y = 2\)  
   \(3, \quad )\)(,5)(-5.2, \)\)

78. \(y - 4 = -1\)  
   \(0, \quad )\)(-1, \, )\)(70, \)

Complete the table of values.

79. \(-2x + y = 8\)  
   \[
   \begin{array}{|c|c|}
   \hline
   x & 4 & -2 \\
   y & 0 & \\
   \hline
   \end{array}
   \]

80. \(2r - 5s = 10\)  
   \[
   \begin{array}{|c|c|}
   \hline
   r & 0 & -3 \\
   s & 0 & \\
   \hline
   \end{array}
   \]

81. \(x + 4 = -1\)  
   \[
   \begin{array}{|c|c|}
   \hline
   x & \\
   y & -5 & 0 & 1 \\
   \hline
   \end{array}
   \]

82. \(4u + 7v = 28\)  
   \[
   \begin{array}{|c|c|}
   \hline
   u & 0 & 4 \\
   v & 0 & \\
   \hline
   \end{array}
   \]

Without plotting the given point, name the quadrant in which it lies or the axis on which it lies.

83. \((-5, \frac{3}{4})\)  
84. (7,13)  
85. \((-8.5,0)\)

86. \((-\frac{2}{3}, \frac{-1}{4})\)  
87. (3,\(-6)\)  
88. (0,\(2)\)
The line graph below shows industrial production of three countries. Use this graph to answer the questions in Exercises 89 – 92.

89. Which country had the smallest change in industrial production over the entire period?

90. Which country showed a decline in industrial production during a certain period?

91. Which country showed the greatest increase over production during a certain period?

92. Which country showed the most steady rate of growth in industrial production over the entire period?

Writing/Conceptual Exercises

93. Do (−4, 7) and (7, −4) represent the same ordered pair? Explain.

94. Do the ordered pairs (−2, 0) and (0, −2) correspond to the same point?

95. The ordered pair (4, −1) is a solution of the equation \(3x + 2y = \square\).

96. The ordered pair (−1, ____) is a solution of the equation \(y = −x\).

97. The ordered pair (___, −3) is a solution of the equation \(x = 3\).

98. The ordered pair (5, ___) is a solution of the equation \(y = −6\).

99. The point whose graph has coordinates (0, −6) lies along the ____-axis.

100. The point whose graph has coordinates (0, −7) lies along the ____-axis.
Section 3.2  Graphing Linear Equations in Two Variables

Objective 1  Graph linear equations by plotting ordered pairs.

Complete the ordered pairs using the given equation. Then graph the equation by plotting the points and drawing a line through them.

101. \( x + y = 3 \)  
    (0, )  
    ( ,0)  
    (−2, )

102. \( x + y = −3 \)  
    (0, )  
    ( ,0)  
    (−2, −5)

103. \( x − y = 4 \)  
    (0, )  
    ( ,0)  
    (−2, )

104. \( x − y = −1 \)  
    (0, )  
    ( ,0)  
    (−4, )

105. \( y = x + 5 \)  
    (0, )  
    ( ,0)  
    (−1, )

106. \( y + 4 = x \)  
    (0, )  
    ( ,0)  
    (−2, )

107. \( y = 3x − 2 \)  
    (0, )  
    ( ,0)  
    (2, )

108. \( y = 3x + 6 \)  
    (0, )  
    ( ,0)  
    (−3, )

109. \( y + 4 = 0 \)  
    (0, )  
    ( ,0)  
    (−3, )

110. \( x − 4 = 0 \)  
    ( ,0)  
    ( ,−2)  
    ( ,3)

111. \( x = −2y + 4 \)  
    (0, )  
    ( ,0)  
    (−2, )

112. \( 2x + 3y = 6 \)  
    (0, )  
    ( ,0)  
    (−3, )

Objective 2  Find intercepts.

Find the intercepts for the graph of the equation.

113. \( 2x + 6y = 12 \)  
114. \( 3x − 2y = 12 \)

115. \( 3x + y = 0 \)  
116. \( 4x − 7y = −8 \)

117. \( 5x − 3y = 12 \)  
118. \( 4x + 3y = 9 \)

119. \( 3x − 2y = 8 \)  
120. \( 5x + 3y = 15 \)

121. \( 2x − 7y = −7 \)  
122. \( 3x + 5y = 9 \)
Find the intercepts for the equation. Then graph the equation.

123. \(2x + y = 4\)  
124. \(3x - y = 3\)

125. \(3x + 4y = -12\)  
126. \(-x + 2y = 4\)

127. \(6x + 5y = 15\)  
128. \(2x - 3y = 6\)

129. \(5x - 2y = -10\)  
130. \(2x - y = 5\)

131. \(x + 2y = -3\)  
132. \(6x + 5y = -30\)

**Objective 3**  
Graph linear equations of the form \(Ax + By = 0\).

Graph the equation.

133. \(3x - y = 0\)  
134. \(x + 4y = 0\)

135. \(x - y = 0\)  
136. \(2x + y = 0\)

137. \(x - 2y = 0\)  
138. \(3x + y = 0\)

139. \(2x - 3y = 0\)  
140. \(5x + 2y = 0\)

141. \(3x + 4y = 0\)  
142. \(-4x + 5y = 0\)

**Objective 4**  
Graph linear equations of the form \(y = k\) or \(x = k\).

Graph the equation.

143. \(x = 4\)  
144. \(y = 5\)

145. \(y = -5\)  
146. \(x = -4\)

147. \(x - 4 = 0\)  
148. \(y + 5 = 0\)

149. \(x - 6 = 0\)  
150. \(y + 2 = 0\)

151. \(x = 0\)  
152. \(y = 0\)
Objective 5 Use a linear equation to model data.

For the business week of March 4 – 8, 2007, the conversion rate between the US dollar and the Japanese yen could be modeled by the linear equation

\[ y = 0.2225x + 202.25 \]

where \( x = 0 \) represents March 4\(^{\text{th}}\), \( x = 1 \) represents March 5\(^{\text{th}}\), and so on. (Source: The Wall Street Journal.)

153. Use the equation to approximate the number of Japanese yen that correspond to one US dollar on March 7.

154. Approximate the number of Japanese yen that correspond to one US dollar on March 5\(^{\text{th}}\).

From 2004 – 2007, the conversion rate between the US dollar and the Venezuelan Bolivar could be modeled by the linear equation

\[ y = 74.87x + 1920.0 \]

where \( x = 0 \) represents 2004, \( x = 1 \) represents 2005, and so on. (Source: The Wall Street Journal.)

155. Approximate the number of bolivar that corresponded to one US dollar in 2007.

156. If the growth rate remains constant, project the number of bolivar that will correspond to one US dollar in 2011.

According to the US Bureau of Census, the US population grew from 248,709,873 in 1990 to 281,421,906 in 2000 (Source: http://www.census.com.) This growth can be approximated by the linear equation

\[ y = 3.27x + 248.7 \]

where \( x = 0 \) represents 1990, \( x = 10 \) represents 2000, and so on.

157. What was the approximate population in 1996?

158. What was the approximate population in 1992?

159. Presuming that this model will remain accurate for the foreseeable future, what will the approximate population be in 2008?
Mixed Exercises

Complete the ordered pairs for the equation. Then graph the equation by plotting the points and drawing a line through them.

160. \( y - 3 = x \)
    
    \[ (0, \ ) \quad (0, \ ) \quad (0, \ ) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]

161. \( x = 2y + 4 \)
    
    \[ (0, \ ) \quad (0, \ ) \quad (0, \ ) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]

162. \( 3y = x + 6 \)
    
    \[ (0, \ ) \quad (0, \ ) \quad (0, \ ) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]

163. \( 2x = y + 6 \)
    
    \[ (0, \ ) \quad (3, \ ) \quad (0, \ ) \]
    \[ (0, 0) \quad (3, 0) \quad (0, 0) \]
    \[ (0, 0) \quad (3, 0) \quad (0, 0) \]

164. \( x = 4y - 1 \)
    
    \[ (3, \ ) \quad (0, \ ) \quad (5, \ ) \]
    \[ (3, 0) \quad (0, 0) \quad (5, 0) \]
    \[ (3, 0) \quad (0, 0) \quad (5, 0) \]

165. \( 5y = -4x + 5 \)
    
    \[ (0, \ ) \quad (0, \ ) \quad (0, \ ) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]
    \[ (0, 0) \quad (0, 0) \quad (0, 0) \]

Find the intercepts for the graph of the equation.

166. \( 4x - y = -4 \)
    
    \[ 6x + 4y = -24 \]
    \[ 167. \]

168. \( 4x - 3y = 12 \)
    
    \[ -4x + 7y = 8 \]
    \[ 169. \]

170. \( 3x - 2y = -6 \)
    
    \[ x - 4y = 8 \]
    \[ 171. \]

172. \( x - 3y = 0 \)
    
    \[ 6x - 7y = 3 \]
    \[ 173. \]

Find the intercepts for the graph of the equation. Then graph the equation.

174. \( -3x + 2y = 12 \)
    
    \[ 4x - 7y = -8 \]
    \[ 175. \]

176. \( 4x - 3y = 0 \)
    
    \[ 3x + 5y = 0 \]
    \[ 177. \]

178. \( 4x + 3y = 6 \)
    
    \[ 3x - 5y = 15 \]
    \[ 179. \]

180. \( 3x - y = 0 \)
    
    \[ 3x - 5y = 0 \]
    \[ 181. \]

182. \( y + 3 = 0 \)
    
    \[ x - 2 = 0 \]
    \[ 183. \]
Writing/Conceptual Exercises

184. The graph of the equation $3x - 7y = 0$ goes through the ________.

185. The graph of the equation $x + 4 = 0$ is a ________ line.

186. The graph of the equation $y - 1 = 0$ is a ________ line.

187. The graph of the equation $x = 0$ is the _____-axis.

188. The graph of the equation $y = 0$ is the _____-axis.

189. If a line has no $y$-intercept, it must be a ________ line.

Section 3.3 The Slope of a Line

Objective 1 Find the slope of a line, given two points.

Find the slope of the line.

190. Through $(1, 2)$ and $(3, 5)$

191. Through $(2, 1)$ and $(4, 4)$

192. Through $(-3, 1)$ and $(5, 4)$

193. Through $(5, -6)$ and $(2, 3)$

194. Through $(-2, 1)$ and $(5, -4)$

195. Through $(5, 4)$ and $(-8, 4)$

196. Through $(1, 3)$ and $(5, 2)$

197. Through $(-3, -2)$ and $(1, 3)$

198. Through $(-3, -4)$ and $(-2, -5)$

199. Through $(0, 0)$ and $(6, -8)$

200. Through $(-3, -2)$ and $(-3, 6)$

201. Through $(-3, 4)$ and $(3, -4)$

Objective 2 Find the slope from the equation of a line.

Find the slope of the line.

202. $y = -\frac{11}{3}x + 12$

203. $3y = x + 9$

204. $5y = 2x - 10$

205. $2x + 4y = 7$

206. $8y - 2x = 11$

207. $3x + 5y = 0$

208. $y = 5$

209. $x = -3$

210. $18x = 12y$
Objective 3  Use slopes to determine whether two lines are parallel, perpendicular, or neither.

For the pair of equations, give the slopes of the lines, and then determine whether the two lines are parallel, perpendicular, or neither.

211.  
\[ y = 7x - 2 \]
\[ y = 7x + 11 \]

212.  
\[ y = 2x + 7 \]
\[ y = 8 - \frac{1}{2}x \]

213.  
\[ x + y = -3 \]
\[ x - y = 7 \]

214.  
\[ 3x + y = 6 \]
\[ x - 3y = 13 \]

215.  
\[ 5x + y = 10 \]
\[ x + 5y = -5 \]

216.  
\[ 9x + 3y = 7 \]
\[ x - 3y = 4 \]

217.  
\[ 4x + 5y = 9 \]
\[ 5x + 4y = 13 \]

218.  
\[ 8x + 2y = 5 \]
\[ 4x = 1 - y \]

219.  
\[ y - 4 = 0 \]
\[ y + 1 = 0 \]

220.  
\[ y = 2 \]
\[ x = -3 \]

221.  
\[ 3x - y = 8 \]
\[ 3x - y = 3 \]

222.  
\[ 6x + 5y = 28 \]
\[ 6x - 5y = 7 \]

Mixed Exercises

Find the slope of the line.

223. Through (3,1) and (5,4)  
224. Through (4,11) and (−6,1)

225. Through (1,−3) and (4,2)  
226. Through (−4,5) and (1,3)

227. Through (0,3) and (0,−3)  
228. Through (6,−2) and (−6,−2)

229. Through (−1,4) and (0,0)  
230. Through \( \left( 2, -\frac{1}{2} \right) \) and (5,4)

231.  
\[ y = \frac{1}{3}x - 9 \]

232.  
\[ y = -\frac{3}{5}x + 7 \]
233. \(6x - 3y = 24\)  
234. \(x = -13\)

235. \(x = 4y\)  
236. \(3x + 3y = 13\)

237. \(y + 6 = 0\)  
238. \(3x - 4y = 24\)

For the pair of equations, give the slopes of the lines, and then determine whether the two lines are parallel, perpendicular, or neither.

239. \(4x + 7y = 2\)  
\(7x - 4y = 5\)

240. \(8x - 9y = 2\)  
\(9x + 8y = 11\)

241. \(x = 19\)  
\(y = 4\)

242. \(y = 6\)  
\(y + 2 = 9\)

243. \(8x - 3y = 11\)  
\(-8x + 3y = 1\)

244. \(7x - 11y = 9\)  
\(7x + 11y = 2\)

245. \(3x - 2y = 4\)  
\(-9x + 6y = 14\)

246. \(3x - 2y = 0\)  
\(2x + 3y = 0\)

In Exercises 247 – 251, two views of the same line are shown in the accompanying calculator screen, along with the coordinates of two points displayed at the bottom. Find the slope of the line.

247.

248.
249.

250.

251.

Writing/Conceptual Exercises

Tell whether each statement is true or false. If the statement is false, show how it can be changed to a correct statement.

252. A line with negative slope rises from left to right.

253. Horizontal lines have undefined slope.

254. If two lines are perpendicular, their slopes are reciprocals.

For the line shown, decide whether (a) the slope is positive, negative, or zero, and (b) the y-value of the y-intercept is positive, negative, or zero.

255.

256.
Section 3.4  Equations of a line

Objective 1  Write an equation of a line by using its slope and \( y \)-intercept.

Write an equation in slope-intercept form for the line.

261.  \( m = 5; \ b = -1 \)  
262.  \( m = -3; \ b = 0 \)

263.  \( m = \frac{1}{2}; \ b = -\frac{1}{2} \)  
264.  \( m = \frac{2}{3}; \ b = 4 \)

265.  \( m = -1; \ b = 1 \)  
266.  \( m = 0; \ b = 3 \)

267.  Slope 2; y-intercept (0, –3)  
268.  Slope \( \frac{3}{4} \); y-intercept \( (0, -\frac{1}{3}) \)

269.  Slope –6; y-intercept (0, 0)  
270.  Slope –1; y-intercept (0, 1)

271.  Slope 0; y-intercept (0, –2)  
272.  Slope 1; y-intercept \( (0, \frac{5}{2}) \)
Objective 2  Graph a line by using its slope and a point on the line.

Graph the line passing through the given point and having the given slope.

273.  \((2,3); \; m = \frac{1}{3}\)  
274.  \((-1,3); \; m = 2\)

275.  \((3,1); \; m = -\frac{1}{4}\)  
276.  \((4,-3); \; m = -3\)

277.  \((4,-2); \; m = -1\)  
278.  \((-5,-2); \; m = \frac{2}{3}\)

279.  \((-2,4); \; \text{undefined slope}\)  
280.  \((-4,3) \; m = 1\)

281.  \((2,-5); \; m = -\frac{5}{2}\)  
282.  \((-3,-3); \; m = 0\)

Objective 3  Write an equation of a line by using its slope and any point on the line.

Write an equation for the line passing through the given point and having the given slope. Write the equation in the form \(Ax + By = C\).

283.  \((3,2); \; m = 4\)  
284.  \((-4,1); \; m = 1\)

285.  \((-4,-1); \; m = -\frac{1}{3}\)  
286.  \((1,-2); \; m = -5\)

287.  \((2,-7); \; m = -4\)  
288.  \((-5,-2); \; m = \frac{1}{4}\)

289.  \((-5,2); \; m = -\frac{2}{5}\)  
290.  \((0,0); \; m = 0\)

291.  \((-3,2); \; m = -\frac{2}{5}\)  
292.  \((-3,-5); \; \text{undefined slope}\)

293.  \((3,-4); \; m = \frac{5}{3}\)  
294.  \((1,-5); \; m = -1\)

295.  \(\left(\frac{3}{2},-3\right); \; m = -\frac{1}{2}\)  
296.  \((4,2); \; m = \frac{5}{4}\)
Objective 4  Write an equation of a line by using two points on the line.

Write an equation for the line passing through the given pair of points. Write the equation in the form $Ax + By = C$.

297. $(1, 4)$ and $(5, 2)$  
298. $(5, 1)$ and $(4, -2)$  
299. $(-3, 2)$ and $(2, 0)$  
300. $(-3, -5)$ and $(-2, 4)$  
301. $(2, -3)$ and $(5, 2)$  
302. $(-3, 5)$ and $(-3, -2)$  
303. $(2, -1)$ and $(3, 5)$  
304. $(-2, 3)$ and $(2, 7)$  
305. $(3, 6)$ and $(-2, -3)$  
306. $(3, -1)$ and $(4, -2)$  
307. $(1, 7)$ and $(-3, -2)$  
308. $(2, -6)$ and $(6, -4)$  
309. $\left(\frac{1}{2}, -\frac{2}{3}\right)$ and $\left(\frac{3}{2}, 1\right)$  
310. $\left(-\frac{4}{5}, \frac{1}{8}\right)$ and $\left(-\frac{8}{5}, -\frac{3}{8}\right)$

Objective 5  Find an equation of a line that fits a data set.

The total expenditures (in millions of dollars) for the purchase of antiques and collectibles is given below. Use the information in the chart to answer questions 311 – 314.

<table>
<thead>
<tr>
<th>Year</th>
<th>$x$</th>
<th>Millions of dollars ($y$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>0</td>
<td>84</td>
</tr>
<tr>
<td>2002</td>
<td>1</td>
<td>101</td>
</tr>
<tr>
<td>2003</td>
<td>2</td>
<td>123</td>
</tr>
<tr>
<td>2004</td>
<td>3</td>
<td>136</td>
</tr>
<tr>
<td>2005</td>
<td>4</td>
<td>160</td>
</tr>
<tr>
<td>2006</td>
<td>5</td>
<td>181</td>
</tr>
<tr>
<td>2007</td>
<td>6</td>
<td>196</td>
</tr>
</tbody>
</table>

311. Use the data from 2002 and 2007 to find the slope of the line that approximates this information. Then use the slope to find the equation of the line in slope-intercept form.

312. To see how well the equation in exercise #311 approximates the ordered pairs $(x, y)$ in the table, let $x = 4$ (for 2005) and find $y$.

313. Use the data from 2003 and 2006 to find the slope of the line that approximates this information. Then use the slope to find the equation of the line in slope-intercept form.
314. To see how well the equation in exercise #313 approximates the ordered pairs \((x, y)\) in the table of data, let \(x = 3\) (for 2004) and find \(y\).

**Mixed Exercises**

Write an equation in slope-intercept form for the line.

315. Slope \(-2\); \(y\)-intercept \((0,3)\)  
316. \(m = -4\); \(b = 5\)

317. Slope \(\frac{1}{2}\); \(y\)-intercept \(0, -\frac{2}{3}\)  
318. \(m = 0\); \(b = -3\)

319. Slope \(1\); \(y\)-intercept \(0, -4\)  
320. Slope \(\frac{3}{4}\); \(y\)-intercept \(0, -\frac{4}{3}\)

321. Slope \(-\frac{2}{3}\); \(y\)-intercept \((0,5)\)  
322. Slope \(-3\); \(y\)-intercept \(0, \frac{3}{5}\)

Graph the line passing through the given point and having the given slope.

323. \((4, -3); m = -2\)  
324. \((0,3); m = \frac{3}{4}\)

325. \((-2, -3); m = 4\)  
326. \((5, 2); m = -\frac{1}{3}\)

327. \((-4,3); m = 0\)  
328. \((-3, -4); \text{ undefined slope}\)

Write an equation in the form \(Ax + By = C\) for the line.

329. Through \((3, -2); m = \frac{1}{3}\)  
330. Through \((5, 7)\) and \((3, 6)\)

331. Through \((-7, -5); m = 0\)  
332. Through \((-1, -4)\) and \((0, 4)\)

333. Through \((3, -9); m = -3\)  
334. Through \((3, 6)\) and \((3, -6)\)

335. Through \((2, -5); m = -\frac{1}{3}\)  
336. Through \((4, -7)\) and \((-2, -2)\)

337. Through \((-12, 20); m = -\frac{3}{4}\)  
338. Through \((0, 6)\) and \((-15, 0)\)
In Exercises 339 – 343, two views of the same line are shown on a calculator screen. Use the displays at the bottom of the screen to find the equation of the form \( y = mx + b \) for the line. Then graph the line on your own calculator to support your answer. Use the standard viewing window.

339.

340.

341.

342.

343.
Writing/Conceptual Exercises

Matching the equation with the graph that would *most closely resemble* its graph.

344. \( y = -2x + 4 \)  
345. \( y = 2x + 4 \)  
346. \( y = 2x - 4 \)

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

350. \( y = 4 \)  
351. \( y = -\frac{1}{2}x + 4 \)  
352. \( y = -\frac{1}{2}x - 4 \)

A.  
B.  
C.  

D.  
E.  
F.  

G.  
H.  
I.
Section 3.5  Graphing Linear Inequalities in Two Variables

Objective 1  Graph $\leq$ or $\geq$ linear inequalities.

Graph the linear inequality.

353. $y \geq x + 5$  
354. $y \leq x - 3$

355. $y \geq 3x$  
356. $y \leq -\frac{2}{5}x + 2$

357. $x + y \geq 3$  
358. $x - y \geq 3$

359. $y \geq -3$  
360. $2x + 5y \leq -8$

361. $2x - 3y \geq 6$  
362. $x + 1 \leq -2$

Objective 2  Graph $<$ or $>$ linear inequalities.

Graph the linear inequality.

363. $y < x - 3$  
364. $y < -2x + 4$

365. $x < 2y + 6$  
366. $x + 4y < 4$

367. $2x + 5y < -10$  
368. $2x - 3y < 6$

369. $5x + 4y > 20$  
370. $3x - 2y > 6$

371. $6 - 3y > 2x$  
372. $5x - 2y + 10 < 0$

Objective 3  Graph inequalities with a boundary through the origin.

Graph the linear inequality.

373. $y \leq -3x$  
374. $y \geq 4x$

375. $x > 4y$  
376. $x > 2y$
377. \( x > -2y \)
378. \( x < -3y \)

379. \( y \leq \frac{3}{4}x \)
380. \( y \geq \frac{1}{3}x \)

381. \( 3x - 4y \geq 0 \)
382. \( 4x - 5y < 0 \)

### Mixed Exercises

Graph the linear inequality

383. \( y \geq -x + 5 \)
384. \( y < 3x - 2 \)

385. \( x \leq -5 \)
386. \( y > 3 \)

387. \( 3x + 2y \leq -6 \)
388. \( y \geq -\frac{1}{3}x \)

389. \( x > \frac{1}{3}y \)
390. \( -5x + 3y > 15 \)

391. \( x - 4 > 0 \)
392. \( y \leq -\frac{1}{2}x + 6 \)

393. \( y + 2 \geq 0 \)
394. \( 3x + 4y - 12 > 0 \)

395. \( 3x \leq 2y \)
396. \( y > \frac{2}{3}x - 5 \)

397. \( 3x - 2y \geq 12 \)
398. \( 2x + 5y < 10 \)

399. \( 3x - y < 0 \)
400. \( 8x + y \geq 4 \)
In Exercises 401 – 404, a graphics calculator was used to generate the shaded graphs in choices A, B, C, and D. Match the inequality with the appropriate choice.

401. \( y \leq -2x + 5 \)
402. \( y \geq -2x + 5 \)
403. \( y \leq 2x - 5 \)
404. \( y \geq 2x - 5 \)

In Exercises 405 – 408, a graphics calculator was used to generate the shaded graphs in choices A, B, C, and D. Match the inequality with the appropriate choice.

405. \( y \leq x - 2 \)
406. \( y \geq x - 2 \)
407. \( y \leq -x + 2 \)
408. \( y \geq -x + 2 \)
Section 3.6 Introduction to Functions

Objectives 1 and 2 Understand the definition of a relation. Understand the definition of a function.

Decide whether the relation is a function.

409. \( \{(1,3),(2,4),(4,7),(3,9)\} \)

410. \( \{(1,-4),(2,-4),(3,-4),(4,-4)\} \)

411. \( \left\{\left(\frac{3}{2},4\right),(6,9),(2,7)\right\} \)

412. \( \{(6,8),(7,9),(8,10)\} \)

413.

414.

415.

416.

417.

418.
Objective 3  Decide whether an equation defines a function.

Decide whether the equation or inequality defines $y$ as a function of $x$.

419. $y = 2x - 4$  
420. $y = 3 - 7x$

421. $6x - 7y = 5$  
422. $5x + 11y = 2$

423. $y = x^2 + 7x + 6$  
424. $y = 2 - x^2$

425. $x = y^2 - 1$  
426. $y = -\sqrt{x + 1}$

427. $6x - y < 1$  
428. $3x > 2y$

429. $y = \frac{1}{x - 1}$  
430. $y = \frac{-2}{3x + 1}$

431. $y = |x - 1|$  
432. $y = -|3 - x|$ 

433. $y = -x^3$  
434. $x = |y|$

435. $y < x$  
436. $x = y^4$

437. $x^2 + y^2 = 36$  
438. $5x - 4y = 20$

Objective 4  Find domains and ranges.

Find the domain and the range for the function.

439. $y = 2x - 5$  
440. $y = 9 - x$

441. $y = x^3 + 2$  
442. $y = x^3 - 4$

443. $y = 7 - x^2$  
444. $y = 8$

445. $y = (x + 3)^2$  
446. $y = x^3$

447. $y = |x| + 9$  
448. $y = |x - 4|$
Objective 5  Use function notation.

For the function \(f\), find (a) \(f(2)\) and (b) \(f(-1)\).

449. \(f(x) = 8x - 3\)  
450. \(f(x) = 9x + 10\)

451. \(f(x) = 6 - 3x\)  
452. \(f(x) = 8 - 5x\)

453. \(f(x) = x^2 + 1\)  
454. \(f(x) = 3x^2 - 3\)

455. \(f(x) = -x^2 + 8x - 2\)  
456. \(f(x) = -x + x^2\)

457. \(f(x) = (x + 2)^2\)  
458. \(f(x) = 9x^2 - 6x + 2\)

459. \(f(x) = -(2x - 1)^2\)  
460. \(f(x) = -(x - 2)^2\)

461. \(f(x) = |x - 7|\)  
462. \(f(x) = -|2 - x|\)

For the polynomial function \(P\), find (a) \(P(0)\), (b) \(P(-2)\), and (c) \(P(3)\).

463. \(P(x) = 2x^2 + 3x\)  
464. \(P(x) = x^2 - x - 8\)

465. \(P(x) = -x^3\)  
466. \(P(x) = x^3 + 2x - 3\)

467. \(P(x) = x^4 - 16\)  
468. \(P(x) = 2x^3 + x^2 - 2x + 1\)

Objective 6  Apply the function concept in an application.

The following table gives the Nielsen television rating information for five random programs during the week of March 5 – 11, 2007. Use the table to answer questions 469 – 475 on the next page.

<table>
<thead>
<tr>
<th>Program</th>
<th>Share ((x))</th>
<th>Audience in millions ((y))</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Idol</td>
<td>26.0</td>
<td>18.6</td>
</tr>
<tr>
<td>House</td>
<td>22.0</td>
<td>15.7</td>
</tr>
<tr>
<td>Without a Trace</td>
<td>18.0</td>
<td>12.2</td>
</tr>
<tr>
<td>Cold Case</td>
<td>15.0</td>
<td>10.5</td>
</tr>
<tr>
<td>CSI: NY</td>
<td>13.0</td>
<td>8.8</td>
</tr>
</tbody>
</table>

http://ytv.yahoo.com/nielsen/
469. Use the table to write a set of ordered pairs that define a function $f$.

470. What is the domain of $f$?

471. What is the range of $f$?

472. Find $f(22.0)$ and $f(13.0)$.

473. For what $x$-value does $f(x)$ equal 12.2?

474. For what $x$-value does $f(x)$ equal 10.5?

475. American Idol drew an audience of 18.6. Translate this into actual numbers of viewers.

**Mixed Exercises**

Decide whether the relation is a function. Give the domain and range.

476. $\{(1,3),(1,4),(2,-1),(3,7)\}$\hspace{1cm}477. $\{(-1,5),(0,2),(1,-2)\}$

478. $\{(-2,2),(-3,3),(-4,4)\}$\hspace{1cm}479. $\{(6,-3),(4,-2),(2,-1),(0,0)\}$

480. $\{(0,4),(3,2),(0,0),(3,6)\}$\hspace{1cm}481. $\{(1,1),(1,2),(1,6),(1,0)\}$

Decide whether the equation or inequality defines $y$ as a function of $x$. If so, give the domain and the range for the function.

482. $y + x = 3$\hspace{1cm}483. $x^2 + y^2 = 4$

484. $y \geq 8x - 4$\hspace{1cm}485. $y = \frac{1}{x}$

486. $y = 4x - 3$\hspace{1cm}487. $y = -x^2 + 1$

488. $y = |x + 2|$\hspace{1cm}489. $y = -3$
For the function $f$, find (a) $f(-2)$ and (b) $f(4)$.

490. $f(x) = 2x + 11$  
491. $f(x) = 5 - 2x$  
492. $f(x) = -3x^2$  
493. $f(x) = x^2 - 2x$  
494. $f(x) = \frac{4}{x^2 + 1}$  
495. $f(x) = \frac{2x + 1}{-5}$

In Exercises 496 – 503, a calculator-generated graph of a relation is shown. Describe whether the relation is a function.

496.  
497.  
498.  
499.  
500.  
501.  
502.  
503.
In Exercises 504 – 508, the table shown was generated by a calculator. The expression $y_i$ represents $f(x)$. The points represented in the table line on a straight line.

### 504.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>1.5</td>
</tr>
<tr>
<td>-2.5</td>
<td>1.4</td>
</tr>
<tr>
<td>-2</td>
<td>1.3</td>
</tr>
<tr>
<td>-1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>-1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

(a) What is $f(1)$?
(b) Find the value of $x$ if $f(x) = 25$.
(c) Write the function in the form $y = mx + b$.

### 505.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-1.3</td>
</tr>
<tr>
<td>-2.5</td>
<td>-1.19</td>
</tr>
<tr>
<td>-2</td>
<td>-1.19</td>
</tr>
<tr>
<td>-1.5</td>
<td>-1.19</td>
</tr>
<tr>
<td>-1</td>
<td>-1.19</td>
</tr>
</tbody>
</table>

(a) What is $f(3)$?
(b) Find the value of $x$ if $f(x) = -19$.
(c) Write the function in the form $y = mx + b$.

### 506.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4</td>
<td>11.4</td>
</tr>
<tr>
<td>-3.5</td>
<td>11.7</td>
</tr>
<tr>
<td>-3</td>
<td>12</td>
</tr>
<tr>
<td>-2.5</td>
<td>12.4</td>
</tr>
<tr>
<td>-2</td>
<td>12.8</td>
</tr>
</tbody>
</table>

(a) What is $f(6)$?
(b) Find the value of $x$ if $f(x) = 11$.
(c) Write the function in the form $y = mx + b$.

### 507.

<table>
<thead>
<tr>
<th>$X$</th>
<th>$Y_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>-12</td>
<td>-5</td>
</tr>
<tr>
<td>-11.5</td>
<td>-5.3</td>
</tr>
<tr>
<td>-11</td>
<td>-5.6</td>
</tr>
<tr>
<td>-10.5</td>
<td>-6</td>
</tr>
<tr>
<td>-10</td>
<td>-6.3</td>
</tr>
</tbody>
</table>

(a) What is $f(6)$?
(b) Find the value of $x$ if $f(x) = -5$.
(c) Write the function in the form $y = mx + b$. 
508. \( \begin{array}{|c|c|}
\hline
x & y \\
\hline
-3 & 9 \\
0 & 0 \\
3 & -8 \\
6 & 2 \\
9 & 6 \\
12 & -11 \\
15 & 0 \\
\hline
\end{array} \)

(a) What is \( f(6) \)?
(b) Find the value of \( x \) if \( f(x) = 6 \).
(c) Write the function in the form \( y = mx + b \).

Writing/Conceptual Exercises

509. In your own words, explain the difference between a relation and a function.

510. In your own words, explain the idea of a function.

511. How can you tell from its graph whether a relation is a function?