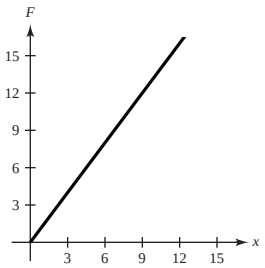
81. (a)

x	0	3	6	9	12
$\frac{4}{3}x$	0	4	8	12	16

(b)



(c) F doubles.

83. The scales on the y-axes are different. From graph (a) it appears that sales have not increased. From graph (b) it appears that sales have increased dramatically.

85. The graph of an equation is the set of all solutions of the equation plotted on a rectangular coordinate system.

87. To find the x-intercepts, let $y = 0$ and solve the equation for x. To find the y-intercepts, let $x = 0$ and solve the equation for y.

Example: $2x - y = 4$

$2x - 0 = 4$	$2(0) - y = 4$
$2x = 4$	$-y = 4$
$x = 2$ $(2, 0)$	$y = -4$ $(0, -4)$
x-intercept	y-intercept

89. (a) It is 6 miles from the person's home.

(b) For time $4 < t < 6$ the person is stopped since the graph is a constant line.

(c) The person's speed was greatest during $6 \le t \le 10$ because the graph is steepest there.

Section 2.3 Slope and Graphs of Linear Equations

1. $(0, 2)$ and $(6, 6)$

$$m = \frac{6 - 2}{6 - 0} = \frac{4}{6} = \frac{2}{3}$$

3. $(0, 8)$ and $(4, 0)$

$$m = \frac{0 - 8}{4 - 0} = \frac{-8}{4} = -2$$

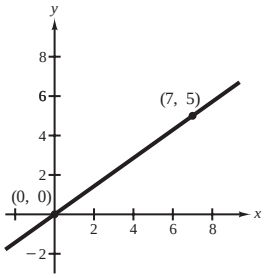
5. $(3, 0)$ and $(3, 8)$

$$m = \frac{8 - 0}{3 - 3} = \frac{8}{0} = \text{undefined}$$

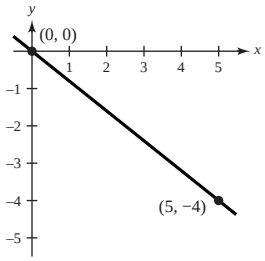
7. (a) $m = \frac{3}{4} \Rightarrow L_3$ (b) $m = 0 \Rightarrow L_2$

(c) $m = -3 \Rightarrow L_1$

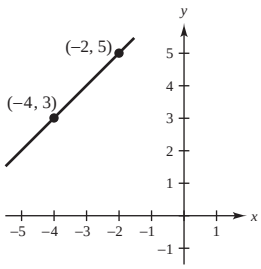
9. $m = \dfrac{5-0}{7-0} = \dfrac{5}{7}$ Line rises.



11. $m = \dfrac{-4-0}{5-0} = \dfrac{-4}{5}$ Line falls.

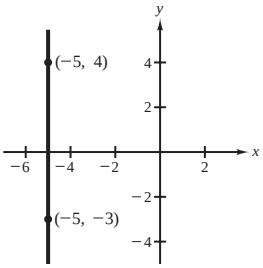


13. $m = \dfrac{3-5}{-4-(-2)} = \dfrac{-2}{-2} = 1$ Line rises.

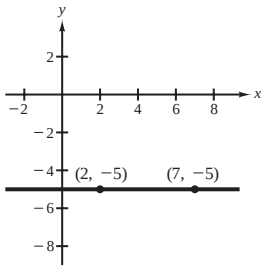


15. $m = \dfrac{4-(-3)}{-5-(-5)} = \dfrac{7}{0}$ = undefined

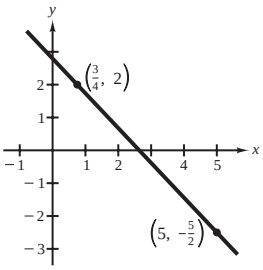
Line is vertical.



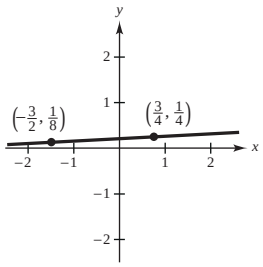
17. $m = \dfrac{-5-(-5)}{7-2} = \dfrac{0}{5} = 0$ Line is horizontal.



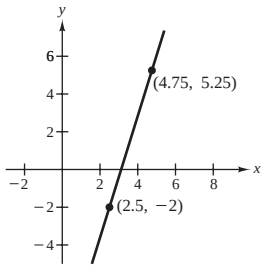
19. $m = \dfrac{2-\dfrac{-5}{2}}{\dfrac{3}{4}-5} \cdot \dfrac{4}{4} = \dfrac{8+10}{3-20} = \dfrac{18}{-17}$ Line falls.



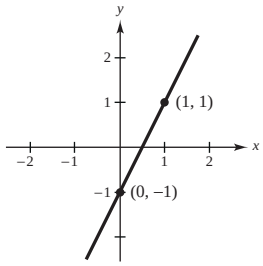
21. $m = \dfrac{\frac{1}{4} - \frac{1}{8}}{\frac{3}{4} - \frac{-3}{2}} \cdot \dfrac{8}{8} = \dfrac{2 - 1}{6 + 12} = \dfrac{1}{18}$ Line rises.



23. $m = \dfrac{5.25 - (-2)}{4.75 - 2.5} = \dfrac{7.25}{2.25} = \dfrac{725}{225} = \dfrac{29}{9}$ Line rises.



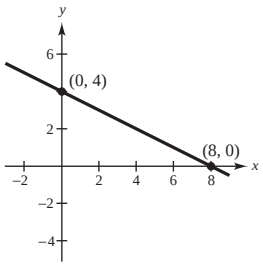
25.



x	-1	0	1
$y = 2x - 1$	-3	-1	1
Solution	$(-1, -3)$	$(0, -1)$	$(1, 1)$

$$m = \frac{1 - (-1)}{1 - 0} = \frac{2}{1} = 2$$

27.

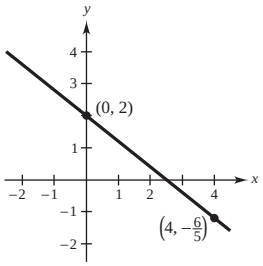


x	-1	0	1
$y = -\frac{1}{2}x + 4$	$\frac{9}{2}$	4	$\frac{7}{2}$
Solution	$\left(-1, \frac{9}{2}\right)$	$(0, 4)$	$\left(1, \frac{7}{2}\right)$

$$m = \frac{\frac{7}{2} - 4}{1 - 0} = \frac{7}{2} - \frac{8}{2}$$

$$= -\frac{1}{2}$$

29.



x	-1	0	1
$y = -\frac{4}{5}x + 10$	$\frac{14}{5}$	2	$\frac{6}{5}$
Solution	$\left(-1, \frac{14}{5}\right)$	$(0, 2)$	$\left(1, \frac{6}{5}\right)$

$$4x + 5y = 10$$

$$5y = -4x + 10$$

$$y = -\frac{4}{5}x + 2$$

$$m = \frac{\frac{6}{5} - 2}{1 - 0} = \frac{6}{5} - \frac{10}{5}$$

$$= -\frac{4}{5}$$

31. $\dfrac{-2}{3} = \dfrac{7-5}{x-4}$

$-2(x-4) = 6$

$-2x + 8 = 6$

$-2x = -2$

$x = 1$

33. $\dfrac{3}{2} = \dfrac{3-y}{9-(-3)}$

$3(12) = 2(3-y)$

$36 = 6 - 2y$

$30 = -2y$

$-15 = y$

35. $0 = \dfrac{y-2}{x-5}$

Horizontal line: (1, 2), (0, 2), (3, 2)

Any points with a y-coordinate of 2

37. $3 = \dfrac{y+4}{x-3}$

$(4, -1), (5, 2)$

let $x = 4$, solve for y:

$3 = \dfrac{y+4}{4-3}$

$3 = y + 4$

$-1 = y$

let $x = 5$, solve for y:

$3 = \dfrac{y+4}{5-3}$

$6 = y + 4$

$2 = y$

39. $-1 = \dfrac{y-3}{x-0}$

$(1, 2), (2, 1)$

let $x = 1$, solve for y:

$-1 = \dfrac{y-3}{1-0}$

$-1 = y - 3$

$2 = y$

let $x = 2$, solve for y:

$-1 = \dfrac{y-3}{2-0}$

$-2 = y - 3$

$1 = y$

41. $\dfrac{4}{3} = \dfrac{y-0}{x+5}$

$(-2, 4), (1, 8)$

let $x = -2$, solve for y:

$\dfrac{4}{3} = \dfrac{y}{-2+5}$

$4 = y$

let $x = 1$, solve for y:

$\dfrac{4}{3} = \dfrac{y}{1+5}$

$8 = y$

43. $6x - 3y = 9$

$-3y = -6x + 9$

$\dfrac{-3y}{-3} = \dfrac{-6x}{-3} + \dfrac{9}{-3}$

$y = 2x - 3$

45. $4y - x = -4$

$4y = x - 4$

$\dfrac{4y}{4} = \dfrac{x}{4} - \dfrac{4}{4}$

$y = \dfrac{1}{4}x - 1$

47. $2x + 5y - 3 = 0$

$5y = -2x + 3$

$\dfrac{5y}{5} = \dfrac{-2x}{5} + \dfrac{3}{5}$

$y = \dfrac{-2}{5}x + \dfrac{3}{5}$

49. $y = \frac{1}{2}x + 2$

51. $y = 3x - 2$

$m = 3; (0, -2)$

53. $3y - 2x = 3$

$3y = 2x + 3$

$y = \frac{2}{3}x + 1$

$m = \frac{2}{3}; (0, 1)$

55. $5x + 3y - 2 = 0$

$3y = -5x + 2$

$y = \dfrac{-5}{3}x + \dfrac{2}{3}$

$m = \dfrac{-5}{3}; \left(0, \dfrac{2}{3}\right)$

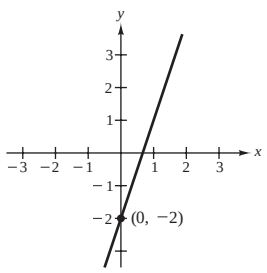
57. $3x - y - 2 = 0$

$-y = -3x + 2$

$y = 3x - 2$

slope $= 3$

y-intercept $= -2$

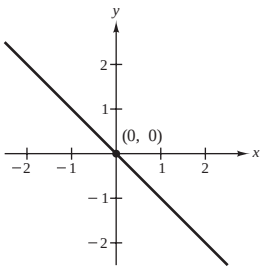


59. $x + y = 0$

$y = -x + 0$

slope $= -1$

y-intercept $= 0$



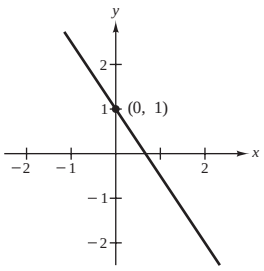
61. $3x + 2y - 2 = 0$

$2y = -3x + 2$

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

slope $= \frac{-3}{2}$

y-intercept $= 1$



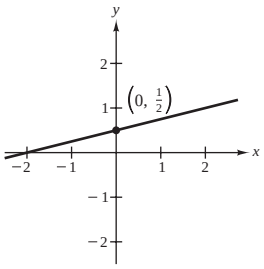
63. $x - 4y + 2 = 0$

$-4y = -x - 2$

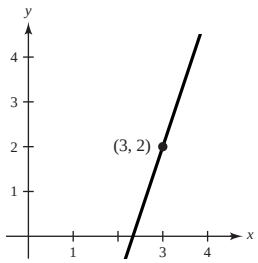
$y = \frac{1}{4}x + \frac{1}{2}$

slope $= \frac{1}{4}$

y-intercept $= \frac{1}{2}$



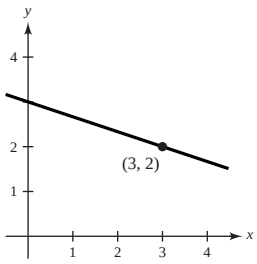
65.



Locate a second point with the slope of 3.

$m = \frac{3}{1} = \frac{\text{Change in } y}{\text{Change in } x}$

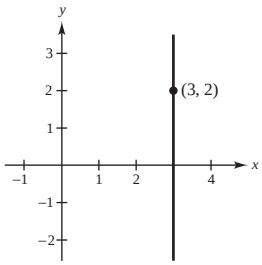
67.



Locate a second point with the slope of $\frac{-1}{3}$.

$m = \frac{-1}{3} = \frac{\text{Change in } y}{\text{Change in } x}$

69.



m is undefined so the line is vertical.

71. $2x - y + 4 = 0$

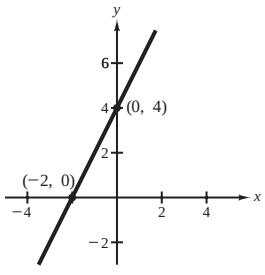
$2(0) - y + 4 = 0$

$4 = y \quad (0, 4)$

$2x - 0 + 4 = 0$

$2x = -4$

$x = -2 \quad (-2, 0)$



73. $-5x + 2y - 20 = 0$

$-5(0) + 2y - 20 = 0$

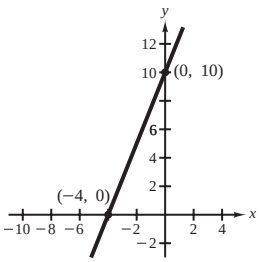
$2y = 20$

$y = 10 \quad (0, 10)$

$-5x + 2(0) - 20 = 0$

$-5x = 20$

$x = -4 \quad (-4, 0)$



75. $L_1: y = \frac{1}{2}x - 2$

$L_2: y = \frac{1}{2}x + 3$

$m_1 = \frac{1}{2}$ and $m_2 = \frac{1}{2}$

$L_1 = m_2$ so the lines are parallel.

77. $L_1: y = \frac{3}{4}x - 3$

$L_2: y = \frac{-4}{3}x + 1$

$m_1 = \frac{3}{4}$ and $m_2 = \frac{-4}{3}$

$m_1 \cdot m_2 = -1$ so the lines are perpendicular.

79. $-\frac{12}{100} = \frac{-2000}{x}$

$-12x = -200{,}000$

$x \approx 16{,}667$

The change in horizontal position is 16,667 feet.

81. $\frac{3}{4} = \frac{h}{15}$

$45 = 4h$

$\frac{45}{4} = h$

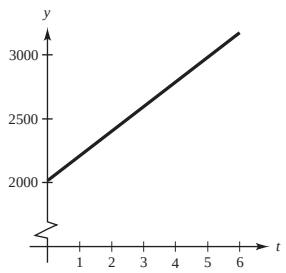
The maximum height in the attic is $\frac{45}{4}$ feet $= 11.25$ feet.

83. $y = 192.64t + 2015.79$

(a)

t	0	1	2	3	4	5	6
y	\$2015.79	\$2208.43	\$2401.07	\$2593.71	\$2786.35	\$2978.99	\$3171.63

(b)

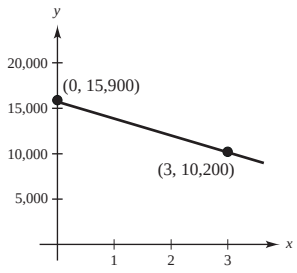


(c) On the average, tuition and fees increased \$192.64 each year from 1990 to 1996. The increase is the slope of the graph.

(d) for 2005, $t = 15$ so $y = 192.64(15) + 2015.79$

$= \$4905.39$

85. (a)



(b) $m = \frac{15{,}900 - 10{,}200}{0 - 3} = -1900$

(c) The slope is the annual depreciation.

87. Negative slope: line falls to the right.

Zero slope: line is horizontal

Positive slope: line rises to the right

89. In the form $y = mx + b$, m represents the slope and b represents the y-intercept.

91. No, it is not possible for two lines with positive slopes to be perpendicular to each other. Their slopes must be negative reciprocals of each other.

Mid-Chapter Quiz for Chapter 2

1. Quadrants I or II. Since x can be any real number and y is 4, the point $(x, 4)$ can only be located in quadrants in which the y coordinate is positive.

2. $(10, -3)$

3. $4x - 3y = 10$

(a) $(2, 1)$ $\quad 4(2) - 3(1) \stackrel{?}{=} 10$

$8 - 3 \stackrel{?}{=} 10$

$5 \neq 10$ not a solution

(b) $(1, -2)$ $\quad 4(1) - 3(-2) \stackrel{?}{=} 10$

$4 + 6 \stackrel{?}{=} 10$

$10 = 10$ solution

(c) $(2.5, 0)$ $\quad 4(2.5) - 3(0) \stackrel{?}{=} 10$

$10 - 0 \stackrel{?}{=} 10$

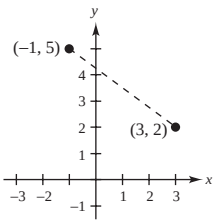
$10 = 10$ solution

(d) $\left(2, -\frac{2}{3}\right)$ $\quad 4(2) - 3\left(-\frac{2}{3}\right) \stackrel{?}{=} 10$

$8 + 2 \stackrel{?}{=} 10$

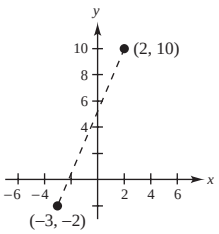
$10 = 10$ solution

4.



$$d = \sqrt{(-1 - 3)^2 + (5 - 2)^2}$$
$$= \sqrt{16 + 9}$$
$$= \sqrt{25}$$
$$= 5$$

5.



$$d = \sqrt{(-3 - 2)^2 + (-2 - 10)^2}$$
$$= \sqrt{25 + 144}$$
$$= \sqrt{169}$$
$$= 13$$

6. $6x - 8y + 48 = 0$

x-intercept: $6x - 8(0) + 48 = 0$

$6x = -48$

$x = -8$ $\quad (-8, 0)$

y-intercept: $6(0) - 8y + 48 = 0$

$-8y = -48$

$y = 6$ $\quad (0, 6)$

7. $y = 2x - 3$

$y = 2(0) - 3$

$= -3$ $\quad (0, -3)$

$0 = 2x - 3$

$3 = 2x$

$\frac{3}{2} = x$ $\quad \left(\frac{3}{2}, 0\right)$

$y = 2(2) - 3$

$= 1$ $\quad (2, 1)$