

## Section 4.2 Slope of a Line and Rate of Change

### Section 4.2 Practice Exercises

1. (a) slope;  $\frac{y_2 - y_1}{x_2 - x_1}$

(b) parallel

(c) right

(d)  $-1$

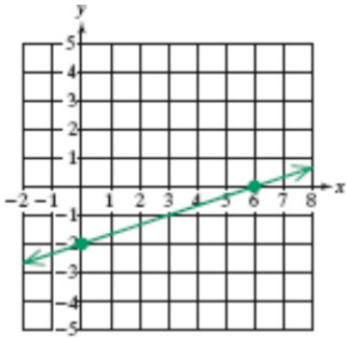
(e) undefined; horizontal

3.  $x$ -intercept     $y$ -intercept

$$x - 3(0) = 6 \quad 0 - 3y = 6$$

$$x = 6 \quad y = -2$$

$(6, 0)$   $(0, -2)$

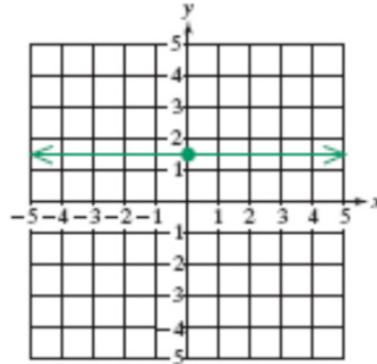


5.  $x$ -intercept     $y$ -intercept

none     $2y - 3 = 0$

$$y = \frac{3}{2}$$

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



7.  $m = \frac{8}{24} = \frac{1}{3}$

9.  $m = \frac{3}{5.5} = \frac{3(2)}{5.5(2)} = \frac{6}{11}$

11. Undefined

13. Positive

15. Slope is negative because the line falls from left to right

17. Slope is zero because the line is horizontal

19. Slope is undefined because the line is vertical

21. Slope is positive because the line rises from left to right

23. Slope is negative because the line falls from left to right

25. (0, 1) and (2, 2) are on the line.

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

27. (0, 0) and (1, -3) are on the line.

$$m = \frac{-3-0}{1-0} = \frac{-3}{1} = -3$$

29. (0, -3) and (1, -3) are on the line.

$$m = \frac{-3-(-3)}{1-0} = \frac{-3+3}{1} = \frac{0}{1} = 0$$

31. (-2, 0) and (-2, 1) are on the line.

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

The slope is undefined.

33.  $m = \frac{2-4}{-4-2} = \frac{-2}{-6} = \frac{1}{3}$

35.  $m = \frac{-6-3}{1-(-2)} = \frac{-9}{3} = -3$

37.  $m = \frac{2-5}{(-4)-1} = \frac{-3}{-5} = \frac{3}{5}$

39.  $m = \frac{3-3}{-2-5} = \frac{0}{-7} = 0$

41.  $m = \frac{5-(-7)}{2-2} = \frac{12}{0}$  is undefined

43.  $m = \frac{\frac{4}{5} - \frac{3}{5}}{\frac{1}{4} - \frac{1}{2}} = \frac{\frac{1}{5}}{-\frac{1}{4}} = \frac{28}{5}$

45.  $m = \frac{6-(-1)}{-5-3} = \frac{7}{-8} = -\frac{7}{8}$

47.  $m = \frac{1.1-(-3.4)}{-3.2-6.8} = \frac{4.5}{-10} = -0.45$  or  $-\frac{9}{20}$

49.  $m = \frac{2.6-3.5}{2000-1994} = \frac{-0.9}{6}$   
 $= -0.15$  or  $-\frac{3}{20}$

51. (a)  $m = -2$

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

53. (a)  $m = 0$

(b)  $m = -\frac{1}{0}$  is undefined

55. (a)  $m = \frac{4}{5}$

(b)  $m = -\frac{1}{\frac{4}{5}} = -\frac{5}{4}$

57.  $m_1 m_2 = -2 \left( \frac{1}{2} \right) = -1$

The lines are perpendicular.

59.  $m_1 = m_2 = 1$

The two lines are parallel.

61.  $m_1 = \frac{2}{7} \neq m_2 = -\frac{2}{7}$

$$m_1 m_2 = \frac{2}{7} \left( -\frac{2}{7} \right) = -\frac{4}{49} \neq -1$$

The lines are neither parallel nor perpendicular.

63.  $m_1 = \frac{-2-4}{-1-2} = \frac{-6}{-3} = 2$

$$m_2 = \frac{5-7}{0-1} = \frac{-2}{-1} = 2$$

Since  $m_1 = m_2 = 2$ , the two lines are parallel.

65.  $m_1 = \frac{4-9}{0-1} = \frac{-5}{-1} = 5$

$$m_2 = \frac{1-2}{10-5} = \frac{-1}{5}$$

$$m_1 m_2 = 5 \left( -\frac{1}{5} \right) = -1$$

The two lines are perpendicular.

67.  $m_1 = \frac{3-4}{0-4} = \frac{1}{4}$

$$m_2 = \frac{-1-7}{-1-1} = \frac{-8}{-2} = 4$$

$$m_1 \neq m_2$$

$$m_1 m_2 = \frac{1}{4}(4) = 1 \neq -1$$

The lines are neither parallel nor perpendicular.

$$69. m = \frac{32,000 - 29,600}{0 - 15} = \frac{2400}{-15} = 160$$

The average rate of change is \$160 per year.

71. (a) We use the ordered pairs (1985, 539) and (2010, 1714) to find the slope.

$$m = \frac{1714 - 539}{2010 - 1985} = \frac{1175}{25} = 47$$

(b) The number of male prisoners increased at a rate of 47 thousand per year during this time period.

$$73. (a) d = 0.2t = 0.2(5 \text{ sec}) = 1 \text{ mi}$$

$$(b) d = 0.2t = 0.2(10 \text{ sec}) = 2 \text{ mi}$$

$$(c) d = 0.2t = 0.2(15 \text{ sec}) = 3 \text{ mi}$$

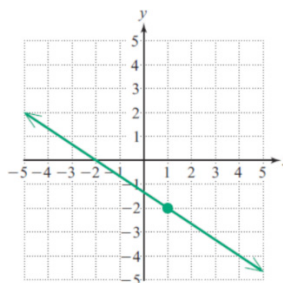
$$(d) m = \frac{(2 \text{ miles}) - (1 \text{ mile})}{(10 \text{ sec}) - (5 \text{ sec})} = \frac{1}{5} = 0.2$$

The slope  $m = 0.2$  means that the distance between a lightning strike and an observer increases by 0.2 miles for every additional second between seeing lightning and hearing thunder.

$$75. m = \frac{3 \text{ units up}}{4 \text{ units right}} = \frac{3}{4}$$

$$77. m = \frac{0 \text{ units up}}{5 \text{ units right}} = \frac{0}{5} = 0$$

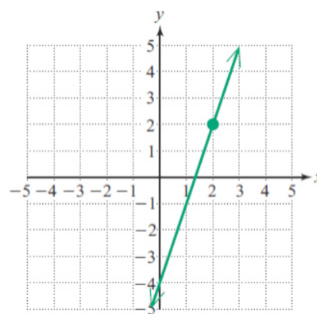
79.



For example: (4, -4) and (-2, 0)

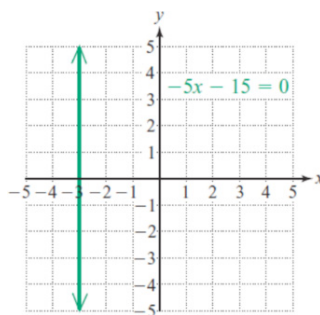
For example: (5, -1) and (-3, 5)

81.



For example: (3, 5) and (1, -1)

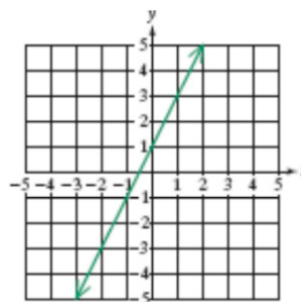
83.



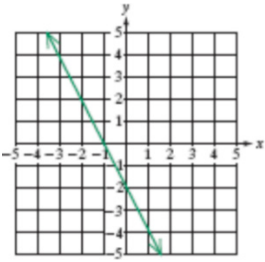
For example: (-3, 1) and (-3, 4)

For Exercises 85-89, answers will vary.

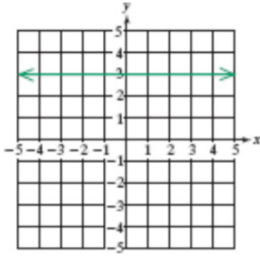
85.



87.



89.



91. Label the points.

$$(x_1, y_1) = (a + b, 4m - n)$$

$$(x_2, y_2) = (a - b, m + 2n)$$

Now substitute into the slope formula.

$$\begin{aligned} &= \frac{m - 4m + 2n + n}{a - a - b - b} \\ &= \frac{-3m + 3n}{-2b} \text{ or } \frac{3m - 2n}{2b} \\ m &= \frac{(m + 2n) - (4m - n)}{(a - b) - (a + b)} \\ &= \frac{m + 2n - 4m + n}{a - b - a - b} \end{aligned}$$

93. To find the  $x$ -intercept, substitute  $y = 0$ .

$$ax + b(0) = c$$

$$ax = c \Rightarrow x = \frac{c}{a}$$

$$\left( \frac{c}{a}, 0 \right)$$

95. From  $(2, -1)$  going 2 units up and 5 units to the right yields the point  $(7, 1)$ . Or, going 2 units down and 5 units to the left yields the point  $(-3, -3)$ .