7 EXAMPLE Writing an Equation of a Perpendicular Line

Write an equation of the line through each point and perpendicular to $y = \frac{3}{4}x + 2$. Graph all three lines.

a. $(0, 4)$

$m = -\left(\frac{1}{\frac{3}{4}}\right) = -\frac{4}{3}$ Find the negative reciprocal of $\frac{3}{4}$.

$y = mx + b$ Use slope-intercept form.

$y = -\frac{4}{3}x + 4$ Substitute: $m = -\frac{4}{3}$ and $b = 4$.

b. $(6, 1)$

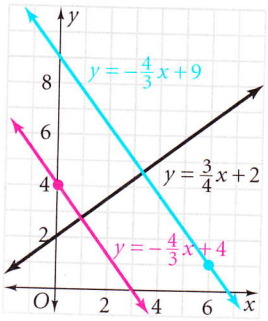
$y = -\frac{4}{3}x + b$ Slope is $-\frac{4}{3}$.

$1 = -\frac{4}{3}(6) + b$ Substitute (6, 1) for (x, y).

$1 = -8 + b$ Simplify.

$9 = b$ Solve for b.

$y = -\frac{4}{3}x + 9$ Write the equation.



Check Understanding 7 Write an equation for each line. Then graph the line. a–c. See margin p. 66.

a. through $(-1, 3)$ and perpendicular to the line $y = 5x - 3$

b. through $(2, 1)$ and parallel to the line $y = \frac{2}{3}x + \frac{5}{8}$

c. vertical and through $(5, -3)$

EXERCISES

Practice and Problem Solving

For more practice, see *Extra Practice*.

Practice by Example

Example 1 (page 62)

Graph each equation. Check your work. 1–8. See back of book.

1. $y = 2x$ **2.** $y = -3x - 1$ **3.** $y = 3x - 2$ **4.** $y = -4x + 5$

5. $5x - 2y = -4$ **6.** $-2x + 5y = -10$ **7.** $y - 3 = -2x$ **8.** $y + 4 = -3x$

Example 2 (page 63)

9. Cost Analysis The equation $y - 0.23x = 0$ relates the cost of operating a car to the number of miles driven, where x is the number of miles driven and y is the cost. a–b. See margin.

a. Graph the equation and determine the domain and range.

b. Explain what the x- and y-intercepts represent.

c. Explain what 0.23 represents.

0.23 represents a cost of $.23 per mile driven.

10. Fund-Raising The school glee club needs a total of $4500 for a trip to Omaha, Nebraska. To make money, members are selling baseball caps for $4.50 and sweatshirts for $12.50. a–b. See back of book.

a. Graph the equation $4.5x + 12.5y = 4500$, where x is the number of baseball caps and y is the number of sweatshirts sold.

b. Explain the meaning of the x- and y-intercepts in terms of the fund-raising.

Example 3 (page 64)

Find the slope of the line through each pair of points.

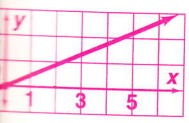
11. $(1, 6)$ and $(8, -1)$ -1 **12.** $(-3, 9)$ and $(0, 3)$ -2 **13.** $(0, 0)$ and $(2, 6)$ 3

14. $(-4, -3)$ and $(7, 1)$ $\frac{4}{11}$ **15.** $(-2, -1)$ and $(8, -3)$ $-\frac{1}{5}$ **16.** $(1, 2)$ and $(2, 3)$ 1

undefined **17.** $\left(\frac{2}{3}, \frac{4}{7}\right)$ and $\left(\frac{2}{3}, \frac{11}{7}\right)$ **18.** $(-3, 5)$ and $(4, 5)$ 0 **19.** $(-5, -7)$ and $(0, 10)$ $\frac{17}{5}$

0 0 −1 6

67–70 Exercises



$y = 0.23x$
domain $\{x \mid x \geq 0\}$
range $\{y \mid y \geq 0\}$

b. *x*-intercept (0, 0), *y*-intercept (0, 0); when no miles have been driven, there is no cost.

3. Practice

Assignment Guide

1 Objective

A B Core 1–19, 42–50, 63–65, 69–70

C Extension 79–80

2 Objective

A B Core 20–41, 51–62, 66–68, 71–78

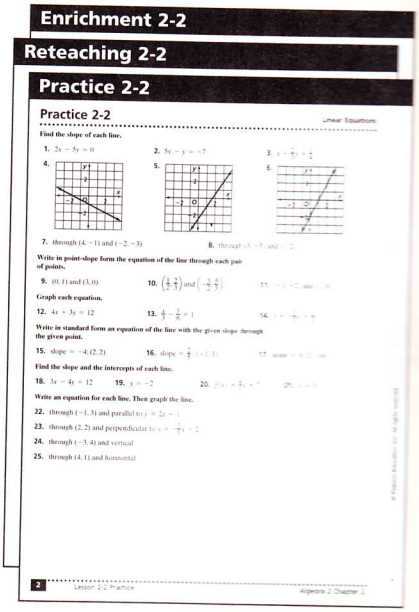
C Extension 81–84

Standardized Test Prep 85–90

Mixed Review 91–98

Error Prevention

Exercises 11–19 Remind students to subtract the *x*-coordinates in the same order as they subtract the *y*-coordinates and to be careful when subtracting negative numbers.



rcises 35, 36 In their answers, lents should note any rictions on A, B, and C.

rcises 48–50 Remind students it is a good idea to first tiply each side of the equation he LCD of all fractions in the ation to clear the equation of tions.

th Tip

rcises 75–77 Even though ndard form of a linear ation uniquely determines e, be careful to realize a line does not have a ue standard form.

Example 4 (page 65)

Write in standard form the equation of each line. 20–22. See margin.

20. slope $= 3$; $(1, 5)$

21. slope $= \frac{5}{6}$; $(22, 12)$

22. slope $= -\frac{3}{5}$; $(-4, 0)$

23. slope $= 0$; $(4, -2)$ $y = -2$

24. slope $= -1$; $(-3, 5)$ $x + y = 2$

25. slope $= 5$; $(0, 2)$ $5x - y = -2$

Example 5 (page 65)

Write in point-slope form the equation of the line through each pair of points. 26–28. See margin.

26. $(-10, 3)$ and $(-2, -5)$

27. $(1, 0)$ and $(5, 5)$

28. $(-4, 10)$ and $(-6, 15)$

29. $(0, -1)$ and $(3, -5)$ $y + 1 = -\frac{4}{3}(x - 0)$

30. $(7, 11)$ and $(13, 17)$ $y - 11 = 1(x - 7)$

31. $(1, 9)$ and $(6, 2)$ $y - 9 = -\frac{7}{5}(x - 1)$

Example 6 (page 66)

Find the slope of each line.

32. $5x + y = 4$ -5

33. $-3x + 2y = 7$ $\frac{3}{2}$

34. $-\frac{1}{2}x - y = \frac{3}{4}$ $-\frac{1}{2}$

35. $Ax + By = C$ $-\frac{A}{B}$

36. $Ax - By = C$ $\frac{A}{B}$

37. $y = 7$ 0

Example 7 (page 67)

Write an equation for each line. Then graph the line. 38–39. See margin.

38. through $(-2, 1)$ and parallel to $y = -3x + 1$

39. through $(-3, -1)$ and perpendicular to $y = -\frac{2}{5}x - 4$

40. through $(-7, 10)$ and horizontal 40–41. See back of book.

41. through $\left(1, -\frac{2}{7}\right)$ and vertical $x = 1$

B Apply Your Skills

Graph each equation. 42–50. See back of book.

42. $y = -\frac{3}{5}x - \frac{12}{5}$

43. $y = -2x + 3$

44. $y = -x + 7$

45. $3y - 2x = -12$

46. $4x + 5y = 20$

47. $4x - 3y = -6$

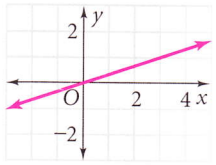
48. $\frac{2}{3}x + \frac{y}{3} = -\frac{1}{3}$

49. $\frac{3}{5}y - \frac{x}{5} = -\frac{6}{5}$

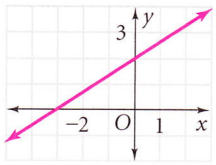
50. $\frac{4}{5} = -\frac{1}{3}x - \frac{3}{4}y$

Find the slope of each line.

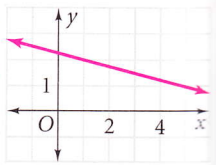
51. $\frac{1}{3}$



52. $\frac{2}{3}$



53. $-\frac{1}{4}$



Find the slope and the intercepts of each line. 54–62. See margin.

54. $f(x) = \frac{2}{3}x + 4$

55. $y = -x + 1000$

56. $-Rx + Sy = -T$

57. $g(x) = 54x - 1$

58. $x = -3$

59. $y = 0$

60. $-\frac{1}{3}x - \frac{2}{3}y = \frac{5}{3}$

61. $y = 0.4 - 0.8x$

62. $\frac{A}{D}x + \frac{B}{D}y = \frac{C}{D}$

Find the slope of the line through each pair of points.

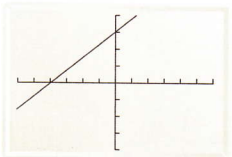
63. $\left(\frac{3}{2}, -\frac{1}{2}\right)$ and $\left(-\frac{2}{3}, \frac{1}{3}\right)$ $\frac{5}{13}$

64. $\left(-\frac{1}{2}, -\frac{1}{2}\right)$ and $(-3, -4)$ $\frac{7}{5}$

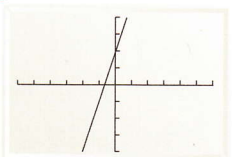
65. $\left(0, \frac{1}{2}\right)$ and $\left(\frac{5}{7}, 0\right)$ $-\frac{7}{10}$

Write an equation for each line. Each interval is 1 unit.

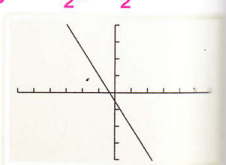
66. $y = \frac{3}{4}x + 3$



67. $y = 3x + 2$



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



es 67–70 Exercises

$3x - y = -2$

$\frac{5}{6}x - y = \frac{19}{3}$

$\frac{3}{5}x + y = -\frac{12}{5}$

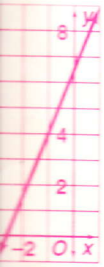
$y - 3 = -1(x + 10)$

$y - 0 = \frac{5}{4}(x - 1)$

$y - 10 = -\frac{5}{2}(x + 4)$

$y = -3x - 5$

$y = \frac{5}{2}x + \frac{13}{2}$



54. $\frac{2}{3}$; (0, 4), (−6, 0)

55. −1; (0, 1000), (1000, 0)

56. $\frac{R}{S}$; $\left(0, -\frac{T}{S}\right)$, $\left(\frac{T}{R}, 0\right)$

57. 5; (0, −1), $\left(\frac{1}{5}, 0\right)$

58. undefined slope; no y-intercept, (−3, 0)

59. 0; (0, 0), all pts. on x-axis

60. $-\frac{1}{2}$; $\left(0, -\frac{5}{2}\right)$, (−5, 0)

61. −0.8; (0, 0.4), (0.5, 0)

62. $-\frac{A}{B}$; $\left(0, \frac{C}{B}\right)$, $\left(\frac{C}{A}, 0\right)$

Connection

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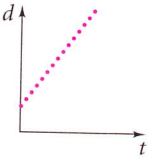
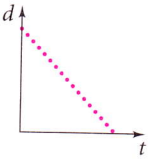
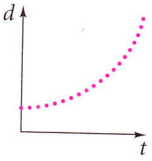
69. Data Analysis Three students moved away from or toward a motion detector, one at a time. Each graph shows distance from the detector as a function of time.

I. 

II. 

III. 

a. Which student(s) moved at a constant rate? Which student(s) did not? Justify your reasoning. **See left.**

b. Which student(s) moved away from the motion detector? **I and III**

c. Which student started farthest from the motion detector? **II**

70. Critical Thinking Most graphing calculators are designed to graph equations that are solved for y. What lines could not be graphed with this method? **Vertical lines cannot be graphed by this method.**

Write an equation for each line. Then graph the line. 71–74. See margin.

71. $m = 0$, through $(5, -1)$

72. $m = 2$, through $(1, 3)$

73. $m = \frac{5}{6}$, through $(-4, 0)$

74. $m = -\frac{3}{2}$, through $(0, -1)$

Write each equation in standard form.

75. $y = \frac{3}{2}x - 1$ **$3x - 2y = 2$**

76. $x + \frac{1}{3}y = \frac{2}{9}$ **$9x + 3y = 2$**

77. $-\left(\frac{1}{2}x + 2y\right) = \frac{2}{3}$ **$3x + 12y = -4$**

78. a. Open-Ended Write an equation of a line.

b. Write an equation of the line parallel to the line you wrote in part (a) passing through the point $(0.5, 0.6)$. **a–e. Check students' work.**

c. Write an equation of the line perpendicular to the line you wrote in part (a) passing through the point $\left(\frac{5}{3}, 2\right)$.

d. Write an equation of the line parallel to the line you wrote in part (c) passing through the point $(-3, 1)$.

e. Geometry Graph the lines from parts (a), (b), (c), and (d). If they form a polygon, describe it. **The polygon is a rectangle.**

Points that are on the same line are *collinear*. Use the definition of slope to determine whether the given points are collinear.

79. $(-2, 6), (0, 2), (1, 0)$ **yes**

80. $(3, -5), (-3, 3), (0, 2)$ **no**

81. a. Graph $y = 3x + 1$. **See back of book.**

b. Write an equation of the line through point $(-1, 3)$ that is parallel to the line from part (a). Graph the line on the same set of axes. **$y = 3x + 6$**

c. Write an equation of the line through point $(-1, 3)$ that is perpendicular to the line from part (a). Graph the line on the same set of axes. **$y = -\frac{1}{3}x + \frac{8}{3}$**

d. What is true about the lines from parts (b) and (c)? Explain. **They are perpendicular.**

82. Geometry Prove that the triangle with vertices $(3, 5), (-2, 6)$, and $(1, 3)$ is a right triangle. **See back of book.**

83. Geometry Prove that the quadrilateral with vertices $(2, 5), (4, 8), (7, 6)$, and $(5, 3)$ is a rectangle. **See back of book.**

84. Critical Thinking Lines p, q, and r all pass through point $(-3, 4)$. Line p has slope 4 and is perpendicular to line q. Line r passes through Quadrants I and II only. Write an equation for each line. Then graph the three lines on the same coordinate plane. **See back of book.**

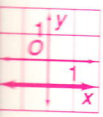
4. Assess

Lesson Quiz 2-2

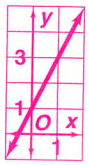
1. Find the slope of the line through the points $(-5, -1)$ and $(2, 3)$. $\frac{4}{7}$
2. Write an equation in standard form for the line with slope 3 through $(9, -4)$. $3x - y = 31$
3. Write in point-slope form an equation of the line through the points $(-3, 8)$ and $(7, 6)$. Use $(-3, 8)$ as the point for the equation. $y - 8 = -\frac{1}{5}(x + 3)$
4. Write the equation $3x - 12y = 6$ in slope-intercept form. $y = \frac{1}{4}x - \frac{1}{2}$
5. What is the slope of a line perpendicular to $y = \frac{2}{3}x - 7$? What is the slope of a line parallel to $y = \frac{2}{3}x - 7$? $-\frac{3}{2}; \frac{2}{3}$

Alternative Assessment

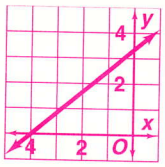
Have students work in pairs. Students use a Geoboard to create a coordinate system by using two red rubberbands, one for the x-axis and one for the y-axis. Each pin along each axis represents one unit. Rubberbands are thought of as representing lines not line segments. One student makes a non-vertical line using a yellow rubberband. The other student names two points on the line, the slope, and the y-intercept, writes an equation of the line perpendicular to the given line at its y-intercept, and graphs this new line using a blue rubberband. Students switch roles and repeat.



72. $y = 2x + 1$



73. $y = \frac{5}{6}x + \frac{10}{3}$



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