The following two characteristics of lines are useful:

1. **Parallel lines have the same slope.**

   For example, the lines $y = 2x + 1$ and $y = 2x - 3$ are parallel because they have the same slope, 2.

2. **Perpendicular lines have slopes that are negative reciprocals of each other.** For instance, the lines $y = \frac{2}{3}x + 1$ and $y = -\frac{3}{2}x + 5$ are perpendicular because their slopes are negative reciprocals. Note that the product of their slopes is $\frac{2}{3}\left(-\frac{3}{2}\right) = -1$.

0.5 EXERCISES

PRACTICE

In Exercises 1–5, determine the slope of the line through the two given points.

1. $(3, 8), (-9, 4)$

2. $(8, 14), (10, 64)$

3. $(-3, -1), (2, 14)$

4. $(1.5, 6), (-2.5, -2)$

5. $(6.5, -3.1), (-2, 3.3)$

In Exercises 6–10, determine if the line given contains the specified point.

6. $2x + 3y = 17$; $(2, 3)$

7. $y = 6x - 3$; $(10, 44)$

8. $y = -6x - 4$; $(8, -52)$

9. $y = 23x - 3$; $(2, 63)$

10. $7x - 5y = 20$; $(-30, -46)$

For each line described in Exercises 11–15, write the equation of the line in the specified form.

11. Passing through $(-1, 0)$ with slope $\frac{7}{2}$; standard form

12. Passing through $(4, -1)$ and $(-2, 3)$; standard form

13. Passing through $(0, 3)$ and $(-3, 1)$; slope-intercept form

14. Passing through $(5, 2)$ and $(-3, 6)$; point-slope form

15. Passing through $(-3, 4)$ and $(2, 2)$; standard form

In Exercises 16–21, write each equation in slope-intercept form, if possible. Identify the slope and *y*-intercept; then draw the graph.

16. $x - 2y = 6$

17. $x + 5y = 10$

18. $4x - 7 = 0$

19. $4x + 2y = 11$

20. $3x + 4y = 8$

21. $5x - 6y = 12$

In Exercises 22–26, determine if the lines $\overleftrightarrow{AB}$ and $\overleftrightarrow{BC}$ are the same line.

22. $A = (0, 0), B = (3, 8), C = (6, 16)$

23. $A = (1, -1), B = (3, 2), C = (6, 16)$

24. $A = (1, 1), B = (2, 4), C = (6, 16)$

25. $A = (-6, 2), B = (0, 2), C = (5, 8)$

26. $A = (1, 3), B = (-1, -1), C = (0, 2)$

In Exercises 27–36, determine if the two lines given are parallel, perpendicular, or neither. Explain why.

27. $y = 4x - 1$ and $y = 0.25x + 6$

28. $y = 11x + 4$ and $y = 11x - 4$

29. $2x + 3y = 17$ and $2x + 3y = 0$

30. $4x + 6y = 4$ and $3x - 2y = 4$

31. $45x + 5y = 20$ and $y = \frac{1}{9}x + 3$

32. $y = 5x + 7$ and $10x - 2y = 9$

33. $3x - y = 12$ and $-x + 3y = 36$

34. $y = \frac{1}{2}x + 8$ and $2x - 4y = 3$

35. $y = x - 15$ and $3x + 3y = 15$

36. $y = 6x - 6$ and $4x + 24y = 4$

In Exercises 37–42, find an equation for the line satisfying the given conditions.

37. Parallel to $x + 3y = 4$ and passing through $(3, 1)$

38. Parallel to $2x + 3y = 5$ and passing through $(-2, 4)$

39. Parallel to $7x - 5y = 2$ and passing through $(-1, 2)$

40. Perpendicular to $5x + 2y = 3$ and passing through $(-4, -1)$

41. Perpendicular to $3x - 4y = 4$ and passing through $(3, 3)$

42. Perpendicular to $x - 6y = 4$ and passing through $(-2, 7)$

43. Given that the lines $y = 2x + b_1$ and $y = -3x + b_2$ intersect at $(12, 24)$, find b_1 and b_2 and sketch both of the lines together on the same graph.

APPLICATIONS

44. Water freezes at 32° Fahrenheit and at 0° Celsius. Water boils at 212° Fahrenheit and at 100° Celsius. Determine a linear relation (equation) for a temperature F (for Fahrenheit) in terms of the temperature C (for Celsius).

45. The owner of a gift shop has determined that if the price for a plush toy is \$12, the store will sell 100 plush toys per month. However, only 80 plush toys are sold if the price is raised to \$14. Assuming a linear relationship between x, the number of plush toys sold, and y, the price of a plush toy, write an equation relating x and y.

46. Suppose a vendor of hot dogs at high school baseball games profits \$100 on the sale of 300 hot dogs and \$130 on the sale of 360 hot dogs. Write a linear equation relating x, the number of hot dogs sold, and y, the profit.

47. Suppose a roadside produce stand will sell 250 pounds of tomatoes for \$562.50 and 70 pounds for \$157.50. Assuming a linear relationship between weight and price, how much would 100 pounds cost?

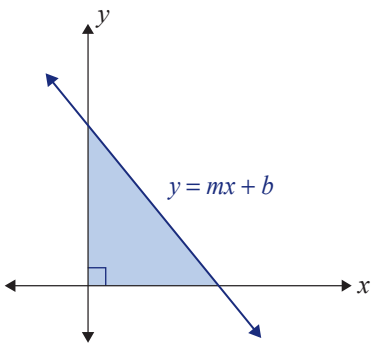
48. A seafood distributor sold large sea scallops for a price of \$325 per gallon last January. Six months later, the price was \$355 per gallon. If there was a linear relationship between the month (where January = 1, February = 2, etc.) and the price during this time period, what was the price in April?

49. The Castle Promotions Company sells 12 dozen magnets with a college logo to college bookstores for \$308, and 15 dozen for \$380. Assuming a linear relationship between cost and quantity, how much would 20 dozen magnets cost?

WRITING & THINKING

50. Sketch the lines $y = 3x - 4$ and $y = -3x + 2$ together on the same graph. Draw a horizontal line through their common point. What can be said about this horizontal line?

51. Every line that does not pass through the origin determines a right triangle with the right angle at the origin. The three sides of the triangle lie on part of the line and the two axes (as shown in the graph). Write a formula for the area of this triangle if the line is given by $y = mx + b$.



52. Suppose (c_1, d_1) and (c_2, d_2) are points on the graph of $y = mx + b$. Then $m = \dfrac{d_2 - d_1}{c_2 - c_1}$. Find an expression for b in terms of the c's and d's.