

Section 1.1 Exercises

1. $\Delta x = -2, \Delta y = -3$ 2. $\Delta x = 2, \Delta y = -4$
 Exercise numbers with a gray background indicate problems that the authors have designed to be solved *without a calculator*.

In Exercises 1–4, find the coordinate increments from A to B .

1. $A(1, 2), B(-1, -1)$ 2. $A(-3, 2), B(-1, -2)$
 3. $A(-3, 1), B(-8, 1)$ 4. $A(0, 4), B(0, -2)$
 $\Delta x = -5, \Delta y = 0$ $\Delta x = 0, \Delta y = -6$

In Exercises 5–8, let L be the line determined by points A and B .

- (a) Plot A and B . (b) Find the slope of L .
 (c) Draw the graph of L .

5. $A(1, -2), B(2, 1)$ (b) 3 6. $A(-2, -1), B(1, -2)$ (b) $-\frac{1}{3}$
 7. $A(2, 3), B(-1, 3)$ (b) 0 8. $A(1, 2), B(1, -3)$

In Exercises 9–12, you are given a point P on a line with slope m . Find the y -coordinate of the point with the given x -coordinate.

9. $P(3, 5)$ $m = 2$ $x = 4.5$ $y = 8$
 10. $P(-2, 1)$ $m = 3$ $x = 2$ $y = 13$
 11. $P(3, 2)$ $m = -3$ $x = 5$ $y = -4$
 12. $P(-1, -2)$ $m = 0.8$ $x = 1$ $y = -0.4$

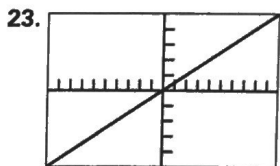
In Exercises 13–17, the position d of a bicyclist (measured in kilometers) is a linear function of time t (measured in minutes). At time $t = 6$ minutes, the position is $d = 5$ km. If the bicyclist travels 2 km for every 5 minutes, find the position of the bicyclist at each time t .

13. $t = 8$ minutes $d = 5.8$ km 14. $t = 3$ minutes $d = 3.8$ km
 15. $t = 12$ minutes $d = 7.4$ km 16. $t = 20$ minutes $d = 10.6$ km
 17. Find the linear equation that describes the position d of the bicyclist in Exercises 13–16 as a function of time t . $d = 0.4(t - 6) + 5$
 18. **Club Fees** A tennis club charges a monthly fee of \$65 and a rate of \$20 for each half-hour of court time. Find the linear equation that gives the total monthly fee F for a club member who accumulates t hours of court time during the month. $F = 65 + 40t$

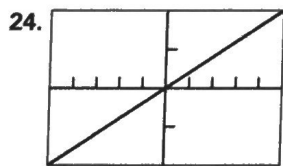
In Exercises 19–22, write the point-slope equation for the line through the point P with slope m .

19. $P(1, 1)$, $m = 1$ 20. $P(-1, 1)$, $m = -1$
 21. $P(0, 3)$, $m = 2$ 22. $P(-4, 0)$, $m = -2$

In Exercises 23 and 24, the line contains the origin and the point in the upper right corner of the grapher screen. Write an equation for the line.



$[-10, 10]$ by $[-25, 25]$ $y = \frac{5}{2}x$



$[-5, 5]$ by $[-2, 2]$ $y = \frac{5}{2}x$

19. $y = 1(x - 1) + 1$ 20. $y = -1(x + 1) + 1$
 21. $y = 2(x - 0) + 3$ 22. $y = -2(x + 4) + 0$
 29. (a) $y = -x$ (b) $y = x$ 30. (a) $y = -2x - 2$ (b) $y = \frac{1}{2}x + 3$
 31. (a) $x = -2$ (b) $y = 4$ 32. (a) $y = \frac{1}{2}$ (b) $x = -1$

In Exercises 25–28, find the (a) slope and (b) y -intercept, and (c) graph the line.

25. $3x + 4y = 12$ (a) $-\frac{3}{4}$ (b) 3 26. $x + y = 2$ (a) -1 (b) 2
 27. $\frac{x}{3} + \frac{y}{4} = 1$ (a) $-\frac{4}{3}$ (b) 4 28. $y = 2x + 4$ (a) 2 (b) 4

In Exercises 29–32, write an equation for the line through P that is (a) parallel to L , and (b) perpendicular to L .

29. $P(0, 0)$, $L: y = -x + 2$ 30. $P(-2, 2)$, $L: 2x + y = 4$
 31. $P(-2, 4)$, $L: x = 5$ 32. $P(-1, 1/2)$, $L: y = 3$

In Exercises 33–38, find the unique pair (x, y) that satisfies both equations simultaneously.

33. $x - 2y = 13$ and $3x + y = 4$ (3, -5)
 34. $2x + y = 11$ and $6x - y = 5$ (2, 7)
 35. $20x + 7y = 22$ and $y - 5x = 11$ (-1, 6)
 36. $2y - 5x = 0$ and $4x + y = 26$ (4, 10)
 37. $4x - y = 4$ and $14x + 3y = 1$ (1/2, -2)
 38. $3x + 2y = 4$ and $12x - 5y = 3$ (2/3, 1)

39. **Unit Pricing** If 5 burgers and 4 orders of fries cost \$30.76, while 8 burgers and 6 orders of fries cost \$48.28, what is the cost of a burger and what is the cost of an order of fries? A burger costs \$4.28 and an order of fries costs \$2.34.

40. Writing to Learn x - and y -intercepts

(a) Explain why c and d are the x -intercept and y -intercept, respectively, of the line

$$\frac{x}{c} + \frac{y}{d} = 1.$$

(b) How are the x -intercept and y -intercept related to c and d in the line

$$\frac{x}{c} + \frac{y}{d} = 2?$$

41. **Parallel and Perpendicular Lines** For what value of k are the two lines $2x + ky = 3$ and $x + y = 1$ (a) parallel? $k = 2$ (b) perpendicular? $k = -2$

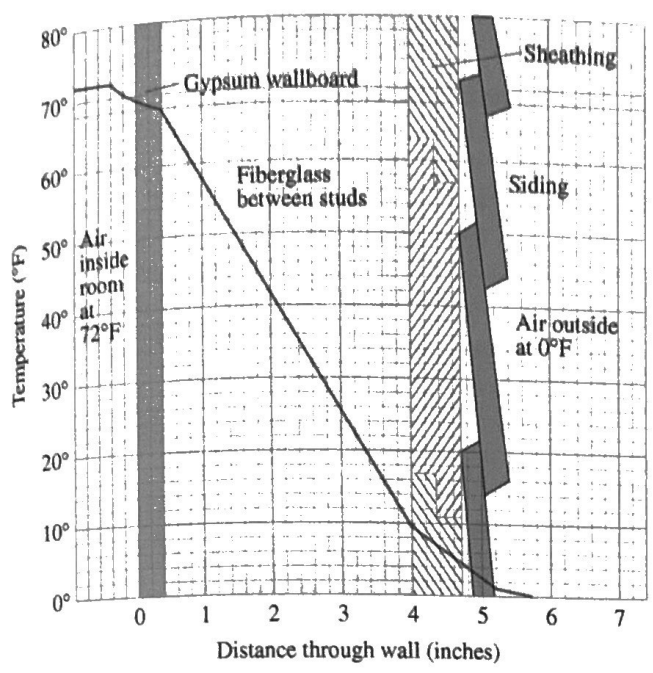
Group Activity In Exercises 42–44, work in groups of two or three to solve the problem.

42. **Insulation** By measuring slopes in the figure below, find the temperature change in degrees per inch for the following materials.

- (a) gypsum wallboard
 (b) fiberglass insulation
 (c) wood sheathing

40. (a) When $y = 0$, $x = c$; when $x = 0$, $y = d$.
 (b) The x -intercept is $2c$ and the y -intercept is $2d$.
 42. (a) -3.75 degrees/inch (b) -16.1 degrees/inch (c) -7.1 degrees/inch
 (d) Best: fiberglass; poorest: gypsum wallboard. The best insulator will have the largest temperature change per inch, because that will allow larger temperature differences on opposite sides of thinner layers.

(d) **Writing to Learn** Which of the materials in (a)–(c) is the best insulator? the poorest? Explain.



43. **For the Birds** The level of seed in Bruce's bird feeder declines linearly over time. If the feeder is filled to the 12-inch level at 10:00 AM and is at the 7-inch level at 2:00 PM the same day, at approximately what time will the seed be completely gone? 7:36 PM
44. **Modeling Distance Traveled** A car starts from point P at time $t = 0$ and travels at 45 mph.
- Write an expression $d(t)$ for the distance the car travels from P . $d(t) = 45t$
 - Graph $y = d(t)$.
 - What is the slope of the graph in (b)? What does it have to do with the car? Slope is 45, which is the speed in miles per hour.
 - Writing to Learn** Create a scenario in which t could have negative values.
 - Writing to Learn** Create a scenario in which the y -intercept of $y = d(t)$ could be 30.

Standardized Test Questions

45. **True or False** The slope of a vertical line is zero. Justify your answer. False. A vertical line has no slope.
46. **True or False** The slope of a line perpendicular to the line $y = mx + b$ is $1/m$. Justify your answer. False. The slope is $-1/m$.
47. **Multiple Choice** Which of the following is an equation of the line through $(-3, 4)$ with slope $1/2$? A
- $y - 4 = \frac{1}{2}(x + 3)$
 - $y + 3 = \frac{1}{2}(x - 4)$
 - $y - 4 = -2(x + 3)$
 - $y - 4 = 2(x + 3)$
 - $y + 3 = 2(x - 4)$
44. (d) Suppose the car has been traveling 45 mph for several hours when it is first observed at point P at time $t = 0$.
- (e) The car starts at time $t = 0$ at a point 30 miles past P .

48. **Multiple Choice** Which of the following is an equation of the vertical line through $(-2, 4)$? E
- $y = 4$
 - $x = 2$
 - $y = -4$
 - $x = 0$
 - $x = -2$
49. **Multiple Choice** Which of the following is the x -intercept of the line $y = 2x - 5$? D
- $x = -5$
 - $x = 5$
 - $x = 0$
 - $x = 5/2$
 - $x = -5/2$
50. **Multiple Choice** Which of the following is an equation of the line through $(-2, -1)$ parallel to the line $y = -3x + 1$? B
- $y = -3x + 5$
 - $y = -3x - 7$
 - $y = \frac{1}{3}x - \frac{1}{3}$
 - $y = -3x + 1$
 - $y = -3x - 4$

Extending the Ideas

51. **Tangent to a Circle** A circle with radius 5 centered at the origin passes through the point $(3, 4)$. Find an equation for the line that is tangent to the circle at that point.
52. **Knowing Your Rights** The vertices of triangle ABC have coordinates $A(-3, 10)$, $B(1, 3)$, and $C(15, 11)$. Prove that it is a right triangle. Which side is the hypotenuse?
53. **Simultaneous Linear Equations Revisited** The two linear equations shown below are said to be *dependent and inconsistent*:
- $$3x - 5y = 3$$
- $$-9x + 15y = 8$$
- Solve the equations simultaneously by an algebraic method, either substitution or elimination. What is your conclusion?
 - What happens if you use a graphical method?
 - Writing to Learn** Explain in algebraic and graphical terms what happens when two linear equations are dependent and inconsistent. Answers on page 12.
54. **Simultaneous Linear Equations Revisited Again** The two linear equations shown below are said to be *dependent and consistent*:
- $$2x - 5y = 3$$
- $$6x - 15y = 9$$
- Solve the equations simultaneously by an algebraic method, either substitution or elimination. What is your conclusion?
 - What happens if you use a graphical method?
 - Writing to Learn** Explain in algebraic and graphical terms what happens when two linear equations are dependent and consistent. Answers on page 12.

51. $y - 4 = -\frac{3}{4}(x - 3)$ (Notice that the radius has slope $4/3$, and the tangent is perpendicular to the radius.)
52. Segment AB has slope $-7/4$ and segment BC has slope $4/7$. Thus $AB \perp BC$ and the segment AC is the hypotenuse.