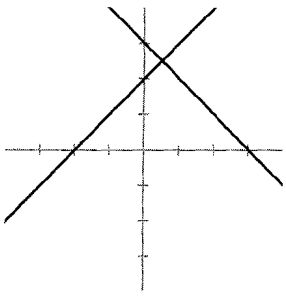


[−4, 4] by [−4, 4]

1.33 Support: Checking screen coordinates suggests that the point of intersection of the graphs of $y_1 = x + 2$ and $y_2 = -x + 3$ is (0.5, 2.5).

We can now obtain the y-coordinate by substituting $x = 1/2$ in the equation for either line. We choose $y = x + 2$ arbitrarily and find

$$y = \frac{1}{2} + 2 = \frac{5}{2}.$$

The coordinates of Q are $(1/2, 5/2)$, which is supported by the graphs of the two lines in a square viewing window (Fig. 1.33).

STEP 3: We calculate the distance between $P(2, 1)$ and $Q(1/2, 5/2)$:

$$d = \sqrt{\left(2 - \frac{1}{2}\right)^2 + \left(1 - \frac{5}{2}\right)^2} = \sqrt{\left(\frac{3}{2}\right)^2 + \left(-\frac{3}{2}\right)^2} = \sqrt{\frac{18}{4}} = \frac{3}{2}\sqrt{2}.$$

The distance from P to L is $(3/2)\sqrt{2}$, or 2.121 to three decimal places. ∎

Exercises 1.2

In Exercises 1–4, compute the rise (Δy) and the run (Δx) for the line segment AB.

1. $A(1, 2), B(-1, -1)$ **2.** $A(-3, 2), B(-1, -2)$

3. $A(-3, 1), B(-8, 1)$ **4.** $A(0, 4), B(0, -2)$

Plot the points A and B in Exercises 5–8. Then find the slope (if any) of the line they determine. Also find the slope (if any) of the lines perpendicular to line AB.

5. $A(1, -2), B(2, 1)$ **6.** $A(-2, -1), B(1, -2)$

7. $A(2, 3), B(-1, 3)$ **8.** $A(1, 2), B(1, -3)$

In Exercises 9–14, find the distance between the given points.

9. (1, 0) and (0, 1) **10.** (2, 4) and (−1, 0)

11. $(2\sqrt{3}, 4)$ and $(-\sqrt{3}, 1)$ **12.** (2, 1) and (1, −1/3)

13. (a, b) and (0, 0) **14.** $(0, y)$ and $(x, 0)$

Find the absolute values in Exercises 15–20.

15. $|-3|$ **16.** $|2 - 7|$

17. $|-2 + 7|$ **18.** $|1.1 - 5.2|$

19. $|(-2)3|$ **20.** $\left|\frac{2}{-7}\right|$

In Exercises 21–24, find an equation for (a) the vertical line and (b) the horizontal line through the given point.

21. (2, 3) **22.** (−1, 4/3)

23. $(0, -\sqrt{2})$ **24.** $(-\pi, 0)$

In Exercises 25–30, write an equation for the line that passes through the point P and has slope m.

25. $P(1, 1), m = 1$ **26.** $P(1, -1), m = -1$

27. $P(-1, 1), m = 1$ **28.** $P(-1, 1), m = -1$

29. $P(0, b), m = 2$ **30.** $P(a, 0), m = -2$

In Exercises 31–36, find an equation for the line through the two points.

31. (0, 0), (2, 3) **32.** (1, 1), (2, 1)

33. (1, 1), (1, 2) **34.** (−2, 0), (−2, −2)

35. (−2, 1), (2, −2) **36.** (1, 3), (3, 1)

In Exercises 37–42, write an equation for the line with the given slope m and y-intercept b. Draw a complete graph.

37. $m = 3, b = -2$ **38.** $m = -1, b = 2$

39. $m = 1, b = \sqrt{2}$ **40.** $m = -1/2, b = -3$

41. $m = -5, b = 2.5$ **42.** $m = 1/3, b = -1$

In Exercises 43–48, find the x- and y-intercepts of the line. Then use the intercepts to sketch a complete graph of the line. Support your sketch with a graphing utility.

43. $3x + 4y = 12$ **44.** $x + y = 2$

45. $4x - 3y = 12$ **46.** $2x - y = 4$

47. $y = 2x + 4$ **48.** $x + 2y = -4$

In Exercises 49 and 50, find the x- and y-intercepts of the line. Draw a complete graph of the line.

49. $\frac{x}{3} + \frac{y}{4} = 1$ **50.** $\frac{x}{-2} + \frac{y}{3} = 1$

In Exercises 51 and 52, find the x- and y-intercepts of the line.

51. $\frac{x}{a} + \frac{y}{b} = 1$ **52.** $\frac{x}{a} + \frac{y}{b} = 2$

In Exercises 53–58, find an equation for the line through P perpendicular to L. Graph each pair of lines in a square viewing window. Then find the distance from P to L.

53. $P(0, 0), L: y = -x + 2$

54. $P(0, 0), L: x + \sqrt{3}y = 3$

55. $P(1, 2), L : x + 2y = 3$

56. $P(-2, 2), L : 2x + y = 4$

57. $P(3, 6), L : x + y = 3$

58. $P(-2, 4), L : x = 5$

In Exercises 59–62, find an equation for the line through P parallel to L. Draw a complete graph of each pair of lines.

59. $P(2, 1), L : y = x + 2$

60. $P(0, 0), L : y = 3x - 5$

61. $P(1, 0), L : 2x + y = -2$

62. $P(1, 1), L : x + y = 1$

Coordinates of points on a number line are specified in Exercises 63 and 64. Use absolute value notation, and write an expression for the distance between the points.

63. **a)** x and 3 **b)** x and -2

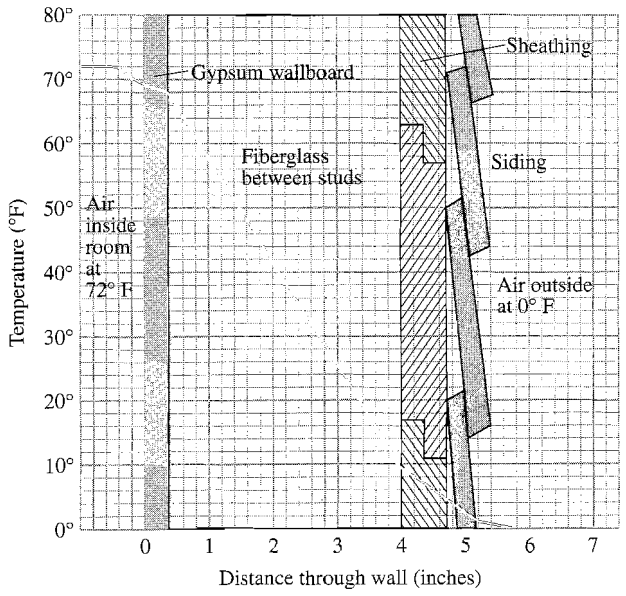
64. **a)** y and -1.3 **b)** y and 5.5

In Exercises 65 and 66, write a sentence involving distance which is equivalent to the given algebraic sentence.

65. $|x - 5| = 1$ **66.** $|x + 3| = 5$

67. Do not fall into the trap $|-a| = a$. This equation does not hold for all values of a.
a) Find a value of a for which $|-a| \neq a$.
b) For what values of a does the equation $|-a| = a$ hold?

68. For what values of x does $|1 - x|$ equal $1 - x$? For what values of x does it equal $x - 1$?



1.34 The temperature changes in the wall in Exercise 69. (Source: *Differentiation*, by W. U. Walton et al., Project CALC, Education Development Center, Inc., Newton, Mass. (1975), p. 25.)

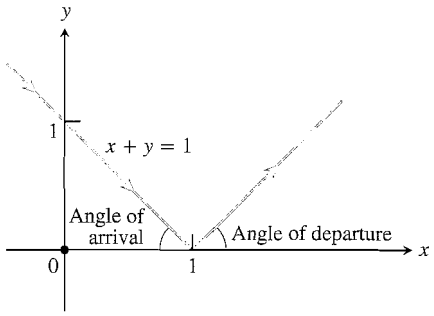
Applications

69. *Insulation.* By measuring slopes in Fig. 1.34, find the temperature change in degrees per inch for the following:
a) gypsum wall board
b) fiberglass insulation
c) wood sheathing

70. *Insulation.* Which of the materials listed in Exercise 69 is the best insulator? The poorest? Explain.

71. *Pressure under water.* The pressure p experienced by a diver under water is related to the diver's depth d by an equation of the form $p = kd + 1$ (k a constant). When $d = 0$ meters, the pressure is 1 atmosphere. The pressure at 100 meters is about 10.94 atmospheres. Find the pressure at 50 meters.

72. *Reflected light.* A ray of light comes in along the line $x + y = 1$ above the x-axis and reflects off the x-axis. The angle of departure is equal to the angle of arrival. Write an equation of the line along which the departing light travels.



73. *Fahrenheit versus Celsius.* We found a relationship between Fahrenheit temperature and Celsius temperature in Example 4.
a) Is there a temperature at which a Fahrenheit thermometer and a Celsius thermometer give the same reading? If so, what is it?
b) GRAPH $y_1 = (9/5)x + 32$, $y_2 = x$, and $y_3 = (5/9)(x - 32)$ in the same viewing window. Explain what you see in the window and how this is related to part (a).

74. *The Mt. Washington Cog Railway.* The steepest part of the Mt. Washington Cog Railway in New Hampshire has a phenomenal 37.1% grade. At this point, the passengers in the front of the car are 14 ft above those in the rear. About how far apart are the front and rear rows of seats?

75. A car starts from point P at time $t = 0$ and travels at 45 mph.
a) Write an algebraic expression $d(t)$ for the distance the car travels from P.
b) Graph $y = d(t)$.
c) What is the slope of the graph in part (b)? What does it have to do with the car?