Quick Review P.1

1. List the positive integers between -3 and 7.
2. List the integers between -3 and 7.
3. List all negative integers greater than -4.
4. List all positive integers less than 5.

In Exercises 5 and 6, use a calculator to evaluate the expression. Round the value to two decimal places.

5. **(a)** $4(-3.1)^3 - (-4.2)^5$ **(b)** $\dfrac{2(-5.5) - 6}{7.4 - 3.8}$
6. **(a)** $5[3(-1.1)^2 - 4(-0.5)^3]$ **(b)** $5^{-2} + 2^{-4}$

In Exercises 7 and 8, evaluate the algebraic expression for the given values of the variables.

7. $x^3 - 2x + 1, x = -2, 1.5$
8. $a^2 + ab + b^2, a = -3, b = 2$
9. List the possible remainders when the positive integer n is divided by 7.
10. List the possible remainders when the positive integer n is divided by 13.

Section P.1 Exercises

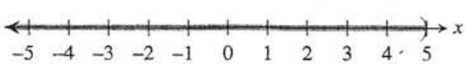
In Exercises 1–4, find the decimal form for the rational number. State whether it repeats or terminates.

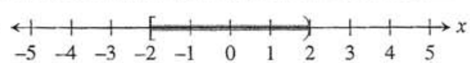
1. $-37/8$
2. $15/99$
3. $-13/6$
4. $5/37$

In Exercise 5–10, graph the interval of real numbers.

5. $x \leq 2$
6. $-2 \leq x < 5$
7. $(-\infty, 7)$
8. $[-3, 3]$
9. x is negative
10. x is greater than or equal to 2 and less than or equal to 6.

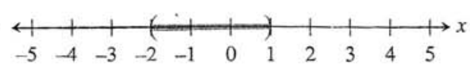
In Exercises 11–16, use an inequality to describe the interval of real numbers.

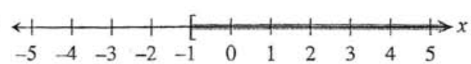
11. $[-1, 1)$
12. $(-\infty, 4]$
13. 

14. 

15. x is between -1 and 2.
16. x is greater than or equal to 5.

In Exercises 17–22, use interval notation to describe the interval of real numbers.

17. $x > -3$
18. $-7 < x < -2$
19. 

20. 

21. x is greater than -3 and less than or equal to 4.
22. x is positive.

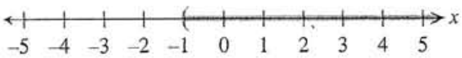
In Exercises 23–28, use words to describe the interval of real numbers.

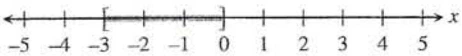
23. $4 < x \le 9$

24. $x \ge -1$

25. $[-3, \infty)$

26. $(-5, 7)$

27.


28.


In Exercises 29–32, find the endpoints and state whether the interval is bounded or unbounded, and its type.

29. $(-3, 4]$

30. $(-3, -1)$

31. $(-\infty, 5)$

32. $[-6, \infty)$

In Exercises 33–36, use both inequality and interval notation to describe the set of numbers. State the meaning of any variables you use.

33. Writing to Learn Bill is at least 29 years old.

34. Writing to Learn No item at Sarah's Variety Store costs more than \$2.00

35. Writing to Learn The price of a gallon of gasoline varies from \$1.099 to \$1.399.

36. Writing to Learn Salary raises at the State University of California at Chico will average between 2% and 6.5%

In Exercises 37 and 38, use the distributive property to write the expanded form of the expression.

37. $a(x^2 + b)$

38. $(y - z^3)c$

In Exercises 39 and 40, use the distributive property to write the factored form of the expression.

39. $ax^2 + dx^2$

40. $a^3z + a^3w$

In Exercises 41 and 42, find the additive inverse of the number.

41. $6 - \pi$

42. -7

43. Group Activity Discuss which algebraic property or properties are illustrated by the equation. Try to reach a consensus.

(a) $(3x)y = 3(xy)$

(b) $a^2b = ba^2$

(c) $a^2b + (-a^2b) = 0$

(d) $(x + 3)^2 + 0 = (x + 3)^2$

(e) $a(x + y) = ax + ay$

44. Group Activity Discuss which algebraic property or properties are illustrated by the equation. Try to reach a consensus.

(a) $(x + 2)\dfrac{1}{x + 2} = 1$

(b) $1 \cdot (x + y) = x + y$

(c) $2(x - y) = 2x - 2y$

(d) $2x + (y - z) = 2x + (y + (-z)) = (2x + y) + (-z) = (2x + y) - z$

(e) $\dfrac{1}{a}(ab) = \left(\dfrac{1}{a}a\right)b = 1 \cdot b = b$

Explorations

45. Investigating Exponents For positive integers m and n, we can use the definition to show that $a^m a^n = a^{m+n}$.

(a) Examine the equation $a^m a^n = a^{m+n}$ for $n = 0$ and explain why it is reasonable to define $a^0 = 1$ for $a \ne 0$.

(b) Examine the equation $a^m a^n = a^{m+n}$ for $n = -m$ and explain why it is reasonable to define $a^{-m} = 1/a^m$ for $a \ne 0$.

46. Decimal Forms of Rational Numbers Here is the third step when we divide 1 by 17. (The first two steps are not shown, because the quotient is 0 in both cases.)

$$\begin{array}{r} 0.05 \\ 17\overline{)1.00} \\ \underline{85} \\ 15 \end{array}$$

By convention we say that 1 is the first remainder in the long division process, 10 is the second, and 15 is the third remainder.

(a) Continue this long division process until a remainder is repeated, and complete the following table:

Step	Quotient	Remainder
1	0	1
2	0	10
3	5	15
⋮	⋮	⋮

(b) Explain why the digits that occur in the quotient between the pair of repeating remainders determine the infinitely repeating portion of the decimal representation. In this case

$$\frac{1}{17} = 0.\overline{0588235294117647}.$$

(c) Explain why this procedure will always determine the infinitely repeating portion of a rational number whose decimal representation does not terminate. ■

In Exercises 47–52, simplify the expression. Assume that the variables in the denominators are nonzero.

47. $\dfrac{x^4y^3}{x^2y^5}$

48. $\dfrac{(3x^2)^2y^4}{3y^2}$

49. $\left(\dfrac{4}{x^2}\right)^2$

50. $\left(\dfrac{2}{xy}\right)^{-3}$

51. $\dfrac{(x^{-3}y^2)^{-4}}{(y^6x^{-4})^{-2}}$

52. $\left(\dfrac{4a^3b}{a^2b^3}\right)\left(\dfrac{3b^2}{2a^2b^4}\right)$

The data in Table P.1 give details about the year 2000 budget for education in President Clinton's budget proposal.

Table P.1 Department of Education

Budget Item	Amount ($)
Eisenhower Professional Development Program	335 million
Goals 2000	491 million
Title I	7.9 billion
Safe, Drug Free Schools	591 million
Charter Schools	130 million
America Reads Challenge	286 million
Bilingual, Immigrant Education	415 million
Special Education	5.1 billion

Source: National Science Teachers Association, NSTA Reports, April 1999, Vol. 10, No. 5, p 3.

In Exercises 53–56, write the amount of the budget item in Table P.1 in scientific notation.

53. Goals 2000

54. Title I

55. Charter Schools

56. America Reads Challenge

In Exercises 57 and 58, write the number in scientific notation.

57. The mean distance from Jupiter to the sun is about 483,900,000 miles.

58. The electric charge, in coulombs, of an electron is about $-0.000\ 000\ 000\ 000\ 000\ 000\ 16$.

In Exercises 59–62, write the number in decimal form.

59. 3.33×10^{-8}

60. 6.73×10^{11}

61. The distance that light travels in 1 year (*one light-year*) is about 5.87×10^{12} mi.

62. The mass of a neutron is about 1.6747×10^{-24} g.

In Exercises 63 and 64, use scientific notation to simplify.

63. $\dfrac{(1.35 \times 10^{-7})(2.41 \times 10^{8})}{1.25 \times 10^{9}}$

64. $\dfrac{(3.7 \times 10^{-7})(4.3 \times 10^{6})}{2.5 \times 10^{7}}$

Extending the Ideas

The **magnitude** of a real number is its distance from the origin.

65. List the whole numbers whose magnitudes are less than 7.

66. List the natural numbers whose magnitudes are less than 7.

67. List the integers whose magnitudes are less than 7.

P.2 Cartesian Coordinate System

Cartesian Plane • Absolute Value of a Real Number • Distance Formulas • Midpoint Formulas • Equations of Circles

Cartesian Plane

The points in a plane correspond to ordered pairs of real numbers, just as the points on a line can be associated with individual real numbers. This correspondence creates the **Cartesian plane**, or the **rectangular coordinate system** in the plane.

To construct a rectangular coordinate system, or a Cartesian plane, draw a pair of perpendicular real number lines, one horizontal and the other vertical, with the lines intersecting at their respective 0-points (Figure P.6). The horizontal line is usually the ***x*-axis** and the vertical line is usually the ***y*-axis**. The positive direction on the x-axis is to the right, and the positive direction on the y-axis is up. Their point of intersection, O, is the **origin of the Cartesian plane**.

Each point P of the plane is associated with an **ordered pair (x, y)** of real numbers, the **(Cartesian) coordinates of the point**. The ***x*-coordinate** represents the intersection of the x-axis with the perpendicular from P, and the ***y*-coordinate** represents the intersection of the y-axis with the perpendicular from P. Figure P.6 shows the points P and Q with coordinates $(4, 2)$ and $(-6, -4)$, respectively. As with real numbers and a number line, we use the ordered pair (a, b) for both the name of the point and its coordinates.

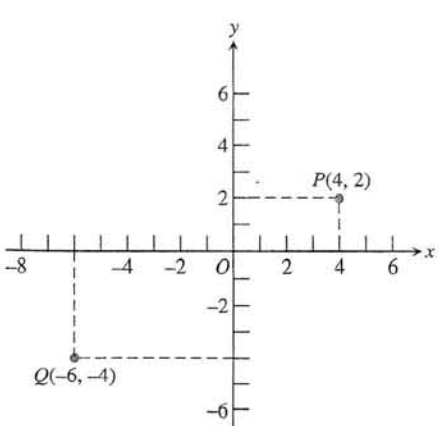


Figure P.6 The Cartesian coordinate plane.

Definition Standard Form Equation of a Circle

The **standard form equation of a circle** with center (h, k) and radius r is

$$(x - h)^2 + (y - k)^2 = r^2.$$

Example 9 FINDING STANDARD FORM EQUATIONS OF CIRCLES

Find the standard form equation of the circle.

(a) Center $(-4, 1)$, radius 8 **(b)** Center $(0, 0)$, radius 5

Solution

(a)

$$(x - h)^2 + (y - k)^2 = r^2 \quad \text{Standard form equation}$$

$$(x - (-4))^2 + (y - 1)^2 = 8^2 \quad \text{Substitute } h = -4, k = 1, r = 8$$

$$(x + 4)^2 + (y - 1)^2 = 64$$

(b)

$$(x - h)^2 + (y - k)^2 = r^2 \quad \text{Standard form equation}$$

$$(x - 0)^2 + (y - 0)^2 = 5^2 \quad \text{Substitute } h = 0, k = 0, r = 5$$

$$x^2 + y^2 = 25$$

Quick Review P.2

In Exercises 1 and 2, plot the two numbers on a number line. Then find the distance between them.

1. $\sqrt{7}, \sqrt{2}$ **2.** $-5/3, -9/5$

In Exercises 3 and 4, plot the real numbers on a number line.

3. $-3, 4, 2.5, 0, -1.5$ **4.** $-\frac{5}{2}, -\frac{1}{2}, \frac{2}{3}, 0, -1$

In Exercises 5 and 6, plot the points.

5. $A(3, 5), B(-2, 4), C(3, 0), D(0, -3)$

6. $A(-3, -5), B(2, -4), C(0, 5), D(-4, 0)$

In Exercises 7–10, use a calculator to evaluate the expression. Round your answer to two decimal places.

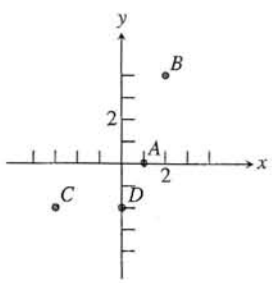
7. $\frac{-17 + 28}{2}$ **8.** $\sqrt{13^2 + 17^2}$

9. $\sqrt{6^2 + 8^2}$ **10.** $\sqrt{(17 - 3)^2 + (-4 - 8)^2}$

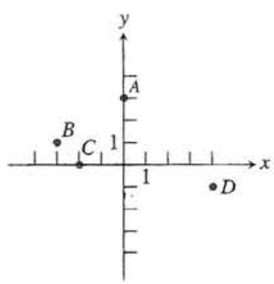
Section P.2 Exercises

In Exercises 1 and 2, estimate the coordinates of the points.

1.



2.



In Exercises 3 and 4, name the quadrants containing the points.

3. **(a)** $(2, 4)$ **(b)** $(0, 3)$ **(c)** $(-2, 3)$ **(d)** $(-1, -4)$

4. **(a)** $\left(\frac{1}{2}, \frac{3}{2}\right)$ **(b)** $(-2, 0)$ **(c)** $(-1, -2)$ **(d)** $\left(-\frac{3}{2}, -\frac{7}{3}\right)$

In Exercises 5–8, evaluate the expression.

5. $3 + |-3|$ **6.** $2 - |-2|$

7. $|(-2)3|$ **8.** $\frac{-2}{|-2|}$

In Exercises 9 and 10, rewrite the expression without using absolute value symbols.

9. $|\pi - 4|$ **10.** $|\sqrt{5} - 5/2|$

In Exercises 11–18, find the distance between the points.

11. $-9.3, 10.6$ **12.** $-5, -17$

13. $(-3, -1), (5, -1)$ **14.** $(-4, -3), (1, 1)$

15. $(0, 0), (3, 4)$ **16.** $(-1, 2), (2, -3)$

17. $(-2, 0), (5, 0)$ **18.** $(0, -8), (0, -1)$

In Exercises 19–22, find the area and perimeter of the figure determined by the points.

19. $(-5, 3), (0, -1), (4, 4)$

20. $(-2, -2), (-2, 2), (2, 2), (2, -2)$

21. $(-3, -1), (-1, 3), (7, 3), (5, -1)$

22. $(-2, 1), (-2, 6), (4, 6), (4, 1)$

In Exercises 23–28, find the midpoint of the line segment with the given endpoints.

23. $-9.3, 10.6$

24. $-5, -17$

25. $(-1, 3), (5, 9)$

26. $(3, \sqrt{2}), (6, 2)$

27. $(-7/3, 3/4), (5/3, -9/4)$

28. $(5, -2), (-1, -4)$

In Exercises 29–34, draw a scatter plot of the data given in the table.

29. Trends in Nursing Education The number (y) in thousands of first-year fall enrollments in bachelor's-level nursing programs at 326 nursing schools that reported data for all of the five years (x). (*Source:* National League for Nursing as reported in *The Chronicle of Higher Education*, September 24, 1999.)

x	1994	1995	1996	1997	1998
y	77.1	76.5	71.9	67.2	63.7

30. U.N. Written Documents The number y of pages of printed material (in millions) produced by the United Nations for each year x from 1990 to 1997 is given in the table. (*Source:* United Nations, as reported in the *USA TODAY*, March 5, 1998)

x	1990	1991	1992	1993
y	733	735	795	749

x	1994	1995	1996	1997
y	775	794	553	550

31. U.S. Imports from Mexico The total in billions of dollars of U.S. imports from Mexico from 1991 to 1998 is given in Table P.3.

Table P.3 U.S. Imports from Mexico

Year	U.S. Imports (billions of dollars)
1991	31.1
1992	35.2
1993	39.9
1994	49.5
1995	61.7
1996	74.3
1997	85.9
1998	94.6

Source: Bureau of the Census, Foreign Trade Division, FINAL 1991–1998

32. U.S. Farm Exports The total in billions of dollars of U.S. farm exports from 1991 to 1998 is given in Table P.4.

Table P.4 U.S. Farm Exports

Year	U.S. Farm Exports (billions of dollars)
1991	39.4
1992	43.1
1993	42.9
1994	46.3
1995	56.3
1996	60.5
1997	57.1
1998	52.0

Source: U.S. Department of Commerce, as reported in USA TODAY, August 24, 1999

33. U.S. Farm Trade Surplus The total in billions of dollars of U.S. farm trade surplus from 1991 to 1998 is given in Table P.5.

Table P.5 U.S. Farm Trade Surplus

Year	U.S. Farm Trade Surplus (billions of dollars)
1991	17.2
1992	19.6
1993	19.2
1994	20.3
1995	27.1
1996	27.9
1997	21.9
1998	16.2

Source: U.S. Department of Commerce, as reported in USA TODAY, August 24, 1999

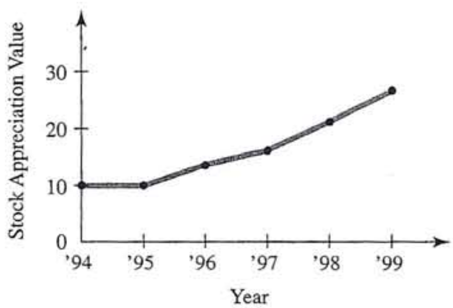
34. **U.S. Exports to Botswana** The total in millions of dollars of U.S. exports to Botswana from 1991 to 1998 is given in Table P.6.

Table P.6 U.S. Exports to Botswana

Year	U.S. Exports (millions of dollars)
1991	30.8
1992	46.5
1993	24.9
1994	22.7
1995	35.8
1996	28.9
1997	43.1
1998	35.6

Source: Bureau of the Census, Foreign Trade Division, FINAL 1991–1998

In Exercises 35 and 36, use the graph of the stock appreciation value of a $10,000 investment in an index of the S&P 500 as of January 1994, shown below.



35. **Reading from Graphs** Use the graph to estimate the value of the $10,000 investment in **(a)** January 1997 and **(b)** January 1999.

36. **Percent Increase** Estimate the percent increase in the value of the $10,000 investment in **(a)** January 1997 and **(b)** January 1999.

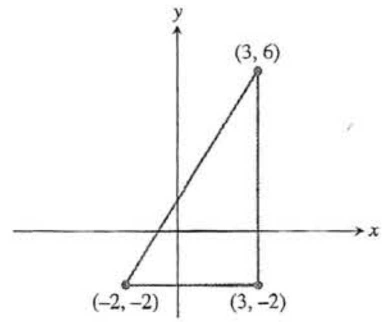
37. **Group Activity** Prove that the figure determined by the points is an isosceles triangle: $(1, 3)$, $(4, 7)$, $(8, 4)$

38. **Group Activity** Prove that the diagonals of the figure determined by the points bisect each other.

(a) Square $(-7, -1)$, $(-2, 4)$, $(3, -1)$, $(-2, -6)$

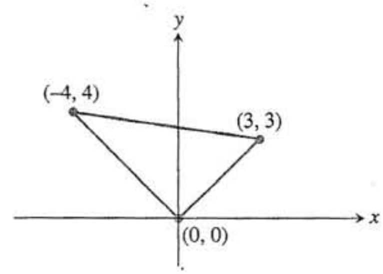
(b) Parallelogram $(-2, -3)$, $(0, 1)$, $(6, 7)$, $(4, 3)$

39. **(a)** Find the lengths of the sides of the triangle in the figure.



(b) Writing to Learn Show that the triangle is a right triangle.

40. **(a)** Find the lengths of the sides of the triangle in the figure.



(b) Writing to Learn Show that the triangle is a right triangle.

In Exercises 41–44, find the standard form equation for the circle.

41. Center $(1, 2)$, radius 5

42. Center $(-3, 2)$, radius 1

43. Center $(-1, -4)$, radius 3

44. Center $(0, 0)$, radius $\sqrt{3}$

In Exercises 45–48, find the center and radius of the circle.

45. $(x - 3)^2 + (y - 1)^2 = 36$

46. $(x + 4)^2 + (y - 2)^2 = 121$

47. $x^2 + y^2 = 5$

48. $(x - 2)^2 + (y + 6)^2 = 25$

In Exercises 49–52, write the statement using absolute value notation.

49. The distance between x and 4 is 3.

50. The distance between y and -2 is greater than or equal to 4.

51. The distance between x and c is less than d units.

52. y is more than d units from c.

Explorations

53. **Dividing a Line Segment Into Thirds**

(a) Find the coordinates of the points one-third and two-thirds of the way from $a = 2$ to $b = 8$ on a number line.

(b) Repeat (a) for $a = -3$ and $b = 7$.

(c) Find the coordinates of the points one-third and two-thirds of the way from a to b on a number line.

(d) Find the coordinates of the points one-third and two-thirds of the way from the point (1, 2) to the point (7, 11) in the coordinate plane.

(e) Find the coordinates of the points one-third and two-thirds of the way from the point (a, b) to the point (c, d) in the coordinate plane. ■

54. Determining a Line Segment with Given Midpoint Let (4, 4) be the midpoint of the line segment determined by the points (1, 2) and (a, b). Determine a and b.

55. Writing to Learn Isosceles but Not Equilateral Triangle Prove that the triangle determined by the points (3, 0), (−1, 2), and (5, 4) is isosceles but not equilateral.

56. Writing to Learn Equidistant Point from Vertices of a Right Triangle Prove that the midpoint of the hypotenuse of the right triangle with vertices (0, 0), (5, 0), and (0, 7) is equidistant from the three vertices.

57. Writing to Learn Describe the set of real numbers that satisfy $|x - 2| < 3$.

58. Writing to Learn Describe the set of real numbers that satisfy $|x + 3| \geq 5$.

Extending the Ideas

59. Writing to Learn Equidistant Point from Vertices of a Right Triangle Prove that the midpoint of the hypotenuse of any right triangle is equidistant from the three vertices.

60. Comparing Areas Consider the four points $A(0, 0)$, $B(0, a)$, $C(a, a)$, and $D(a, 0)$. Let P be the midpoint of the line segment CD and Q the point one-fourth of the way from A to D on segment AD.

(a) Find the area of triangle BPQ.

(b) Compare the area of triangle BPQ with the area of $ABCD$.

In Exercises 61–63, let $P(a, b)$ be a point in the first quadrant.

61. Find the coordinates of the point Q in the fourth quadrant so that PQ is perpendicular to the x-axis.

62. Find the coordinates of the point Q in the second quadrant so that PQ is perpendicular to the y-axis.

63. Find the coordinates of the point Q in the third quadrant so that the origin is the midpoint of the segment PQ.

64. Writing to Learn Prove that the distance formula for the number line is a special case of the distance formula for the Cartesian plane.

P.3 Linear Equations and Inequalities

Equations • Solving Equations • Linear Equations in One Variable • Linear Inequalities in One Variable

Equations

An **equation** is a statement of equality between two expressions. Here are some properties of equality that we will use to solve equations algebraically.

Properties of Equality

Let u, v, w, and z be real numbers, variables, or algebraic expressions.

1. Reflexive	$u = u$
2. Symmetric	If $u = v$, then $v = u$.
3. Transitive	If $u = v$, and $v = w$, then $u = w$.
4. Addition	If $u = v$ and $w = z$, then $u + w = v + z$.
5. Multiplication	If $u = v$ and $w = z$, then $uw = vz$.

Solving Equations

A **solution of an equation in x** is a value of x for which the equation is true. To **solve an equation in x** means to find all values of x for which the equation is true, that is, to find all solutions of the equation.

Quick Review P.3

In Exercises 1 and 2, simplify the expression by combining like terms.

1. $2x + 5x + 7 + y - 3x + 4y + 2$
2. $4 + 2x - 3z + 5y - x + 2y - z - 2$

In Exercises 3 and 4, use the distributive property to expand the products. Simplify the resulting expression by combining like terms.

3. $3(2x - y) + 4(y - x) + x + y$
4. $5(2x + y - 1) + 4(y - 3x + 2) + 1$

In Exercises 5–10, use the LCD to combine the fractions. Simplify the resulting fraction.

5. $\frac{2}{y} + \frac{3}{y}$
6. $\frac{1}{y-1} + \frac{3}{y-2}$
7. $2 + \frac{1}{x}$
8. $\frac{1}{x} + \frac{1}{y} - x$
9. $\frac{x+4}{2} + \frac{3x-1}{5}$
10. $\frac{x}{3} + \frac{x}{4}$

Section P.3 Exercises

In Exercises 1–4, find which values of x are solutions of the equation.

1. $2x^2 + 5x = 3$
   (a) $x = -3$ (b) $x = -\frac{1}{2}$ (c) $x = \frac{1}{2}$
2. $\frac{x}{2} + \frac{1}{6} = \frac{x}{3}$
   (a) $x = -1$ (b) $x = 0$ (c) $x = 1$
3. $\sqrt{1 - x^2} + 2 = 3$
   (a) $x = -2$ (b) $x = 0$ (c) $x = 2$
4. $(x - 2)^{1/3} = 2$
   (a) $x = -6$ (b) $x = 8$ (c) $x = 10$

In Exercises 5–10, determine whether the equation is linear in x.

5. $5 - 3x = 0$
6. $5 = 10/2$
7. $x + 3 = x - 5$
8. $x - 3 = x^2$
9. $2\sqrt{x} + 5 = 10$
10. $x + \frac{1}{x} = 1$

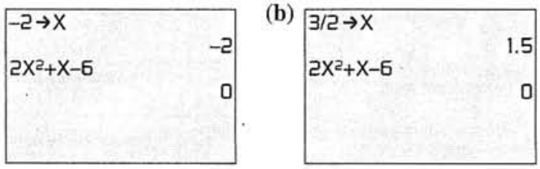
In Exercises 11–24, solve the equation.

11. $3x = 24$
12. $4x = -16$
13. $3t - 4 = 8$
14. $2t - 9 = 3$
15. $2x - 3 = 4x - 5$
16. $4 - 2x = 3x - 6$
17. $4 - 3y = 2(y + 4)$
18. $4(y - 2) = 5y$
19. $\frac{1}{2}x = \frac{7}{8}$
20. $\frac{2}{3}x = \frac{4}{5}$
21. $\frac{1}{2}x + \frac{1}{3} = 1$
22. $\frac{1}{3}x + \frac{1}{4} = 1$
23. $2(3 - 4z) - 5(2z + 3) = z - 17$
24. $3(5z - 3) - 4(2z + 1) = 5z - 2$

In Exercises 25–28, solve the equation. Support your answer with a calculator.

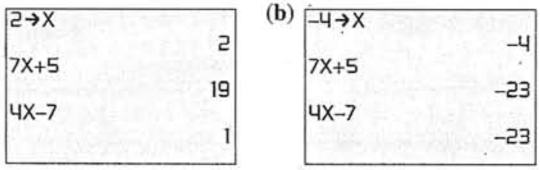
25. $\frac{2x-3}{4} + 5 = 3x$
26. $2x - 4 = \frac{4x-5}{3}$
27. $\frac{t+5}{8} - \frac{t-2}{2} = \frac{1}{3}$
28. $\frac{t-1}{3} + \frac{t+5}{4} = \frac{1}{2}$
29. **Writing to Learn** Write a statement about solutions of equations suggested by the computations in the figure.

(a) (b)



30. **Writing to Learn** Write a statement about solutions of equations suggested by the computations in the figure.

(a) (b)



In Exercises 31–34, find which values of x are solutions of the inequality.

31. $2x - 3 < 7$
   (a) $x = 0$ (b) $x = 5$ (c) $x = 6$
32. $3x - 4 \geq 5$
   (a) $x = 0$ (b) $x = 3$ (c) $x = 4$
33. $-1 < 4x - 1 \leq 11$
   (a) $x = 0$ (b) $x = 2$ (c) $x = 3$
34. $-3 \leq 1 - 2x \leq 3$
   (a) $x = -1$ (b) $x = 0$ (c) $x = 2$

In Exercises 35–42, solve the inequality, and draw a number line graph of the solution set.

35. $x - 4 < 2$
36. $x + 3 > 5$
37. $2x - 1 \leq 4x + 3$
38. $3x - 1 \geq 6x + 8$
39. $2 \leq x + 6 < 9$
40. $-1 \leq 3x - 2 < 7$

41. $2(5 - 3x) + 3(2x - 1) \leq 2x + 1$

42. $4(1 - x) + 5(1 + x) > 3x - 1$

In Exercises 43–54, solve the inequality.

43. $\frac{5x + 7}{4} \leq -3$

44. $\frac{3x - 2}{5} > -1$

45. $4 \geq \frac{2y - 5}{3} \geq -2$

46. $1 > \frac{3y - 1}{4} > -1$

47. $0 \leq 2z + 5 < 8$

48. $-6 < 5t - 1 < 0$

49. $\frac{x - 5}{4} + \frac{3 - 2x}{3} < -2$

50. $\frac{3 - x}{2} + \frac{5x - 2}{3} < -1$

51. $\frac{2y - 3}{2} + \frac{3y - 1}{5} < y - 1$

52. $\frac{3 - 4y}{6} - \frac{2y - 3}{8} \geq 2 - y$

53. $\frac{1}{2}(x - 4) - 2x \leq 5(3 - x)$

54. $\frac{1}{2}(x + 3) + 2(x - 4) < \frac{1}{3}(x - 3)$

In Exercises 55–58, find the solutions of the equation or inequality displayed in Figure P.18.

55. $x^2 - 2x < 0$

56. $x^2 - 2x = 0$

57. $x^2 - 2x > 0$

58. $x^2 - 2x \leq 0$

X	Y1	
0	0	
1	-1	
2	0	
3	3	
4	8	
5	15	
6	24	

Y1 = X²–2X

Figure P.18 The second column gives values of $y_1 = x^2 - 2x$ for $x = 0, 1, 2, 3, 4, 5$, and 6.

59. Writing to Learn Explain how the second equation was obtained from the first.

$$x - 3 = 2x + 3, \quad 2x - 6 = 4x + 6$$

60. Writing to Learn Explain how the second equation was obtained from the first.

$$2x - 1 = 2x - 4, \quad x - \frac{1}{2} = x - 2$$

61. Group Activity Determine whether the two equations are equivalent.

(a) $3x = 6x + 9, \quad x = 2x + 9$

(b) $6x + 2 = 4x + 10, \quad 3x + 1 = 2x + 5$

62. Group Activity Determine whether the two equations are equivalent.

(a) $3x + 2 = 5x - 7, \quad -2x + 2 = -7$

(b) $2x + 5 = x - 7, \quad 2x = x - 7$

Explorations

63. Testing Inequalities on a Calculator

(a) The calculator we use indicates that the statement $2 < 3$ is true by returning the value 1 (for true) when $2 < 3$ is entered. Try it with your calculator.

(b) The calculator we use indicates that the statement $2 < 1$ is false by returning the value 0 (for false) when $2 < 1$ is entered. Try it with your calculator.

(c) Use your calculator to test which of these two numbers is larger: 799/800, 800/801.

(d) Use your calculator to test which of these two numbers is larger: −102/101, −103/102.

(e) If your calculator returns 0 when you enter $2x + 1 < 4$, what can you conclude about the value stored in x? ■

Extending the Ideas

64. Perimeter of a rectangle The formula for the perimeter P of a rectangle is

$$P = 2(L + W).$$

Solve this equation for W.

65. Area of a Trapezoid The formula for the area A of a trapezoid is

$$A = \frac{1}{2}h(b_1 + b_2).$$

Solve this equation for b_1.

66. Volume of a Sphere The formula for the volume V of a sphere is

$$V = \frac{4}{3}\pi r^3.$$

Solve this equation for r.

67. Celsius and Fahrenheit The formula for Celsius temperature in terms of Fahrenheit temperature is

$$C = \frac{5}{9}(F - 32).$$

Solve the equation for F.

Quick Review P.4

In Exercises 1–4, solve for x.

1. $-75x + 25 = 200$
2. $400 - 50x = 150$
3. $3(1 - 2x) + 4(2x - 5) = 7$
4. $2(7x + 1) = 5(1 - 3x)$

In Exercises 5–8, solve for y.

5. $2x - 5y = 21$
6. $\frac{1}{3}x + \frac{1}{4}y = 2$
7. $2x + y = 17 + 2(x - 2y)$
8. $x^2 + y = 3x - 2y$

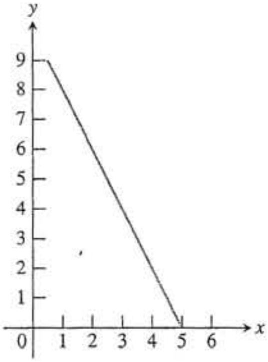
In Exercises 9 and 10, simplify the fraction.

9. $\frac{9 - 5}{-2 - (-8)}$
10. $\frac{-4 - 6}{-14 - (-2)}$

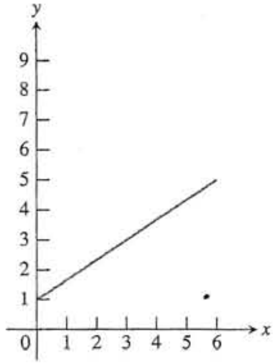
Section P.4 Exercises

In Exercises 1 and 2, estimate the slope of the line.

1.



2.



In Exercises 3–6, graph the linear equation on a grapher. Choose a viewing window that shows the line intersecting both the x- and y-axes.

3. $8x + y = 49$
4. $2x + y = 35$
5. $123x + 7y = 429$
6. $2100x + 12y = 3540$

In Exercises 7–10, find the slope of the line through the pair of points.

7. $(-3, 5)$ and $(4, 9)$
8. $(-2, 1)$ and $(5, -3)$
9. $(-2, -5)$ and $(-1, 3)$
10. $(5, -3)$ and $(-4, 12)$

In Exercises 11–14, find the value of x or y so that the line through the pair of points has the given slope.

Points	Slope
11. $(x, 3)$ and $(5, 9)$	$m = 2$
12. $(-2, 3)$ and $(4, y)$	$m = -3$
13. $(-3, -5)$ and $(4, y)$	$m = 3$
14. $(-8, -2)$ and $(x, 2)$	$m = 1/2$

In Exercises 15–18, find a *point-slope form* equation for the line through the point with given slope.

Point	Slope	Point	Slope
15. $(1, 4)$	$m = 2$	**16.** $(-4, 3)$	$m = -2/3$
17. $(5, -4)$	$m = -2$	**18.** $(-3, 4)$	$m = 3$

In Exercises 19–24, find a *general form equation* for the line through the pair of points.

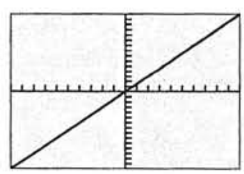
19. $(-7, -2)$ and $(1, 6)$
20. $(-3, -8)$ and $(4, -1)$
21. $(1, -3)$ and $(5, -3)$
22. $(-1, -5)$ and $(-4, -2)$
23. $(-1, 2)$ and $(2, 5)$
24. $(4, -1)$ and $(4, 5)$

In Exercises 25–30, find a slope-intercept form equation for the line.

25. The line through $(0, 5)$ with slope $m = -3$
26. The line through $(1, 2)$ with slope $m = 1/2$
27. The line through the points $(-4, 5)$ and $(4, 3)$
28. The line through the points $(4, 2)$ and $(-3, 1)$
29. The line $2x + 5y = 12$
30. The line $7x - 12y = 96$

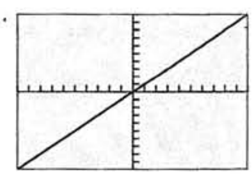
In Exercises 31 and 32, the line contains the origin and the poin in the upper right corner of the grapher screen.

31. **Writing to Learn** Which line shown here has the greater slope? Explain.



[–10, 10] by [–15, 15]

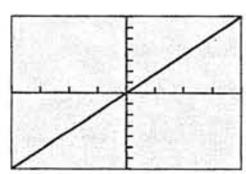
(a)



[–10, 10] by [–10, 10]

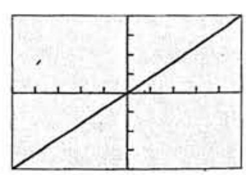
(b)

32. **Writing to Learn** Which line shown here has the greater slope? Explain.



[–20, 20] by [–35, 35]

(a)



[–5, 5] by [–20, 20]

(b)

In Exercises 33–36, find the value of x and the value of y for which $(x, 14)$ and $(18, y)$ are points on the graph.

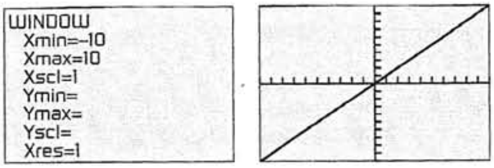
33. $y = 0.5x + 12$

34. $y = -2x + 18$

35. $3x + 4y = 26$

36. $3x - 2y = 14$

In Exercises 37–40, find the values for Ymin, Ymax, and Yscl that will make the graph of the line appear in the viewing window as shown here.



37. $y = 3x$

38. $y = 5x$

39. $y = \frac{2}{3}x$

40. $y = \frac{5}{4}x$

In Exercises 41–44, **(a)** find an equation for the line passing through the point and parallel to the given line, and **(b)** find an equation for the line passing through the point and perpendicular to the given line. Support your work graphically.

	Point	Line
41.	$(1, 2)$	$y = 3x - 2$
42.	$(-2, 3)$	$y = -2x + 4$
43.	$(3, 1)$	$2x + 3y = 12$
44.	$(6, 1)$	$3x - 5y = 15$

45. Real Estate Appreciation Bob Michaels purchased a house 8 years ago for \$42,000. This year it was appraised at \$67,500.

(a) A linear equation $V = mt + b$, $0 \le t \le 15$, represents the value V of the house for 15 years after it was purchased. Determine m and b.

(b) Graph the equation and trace to estimate in how many years after purchase this house will be worth \$72,500.

(c) Write and solve an equation algebraically to determine how many years after purchase this house will be worth \$74,000.

(d) Determine how many years after purchase this house will be worth \$80,250.

46. Investment Planning Mary Ellen plans to invest \$18,000, putting part of the money (x) into a savings that pays 5% annually and the rest into an account that pays 8% annually.

(a) What are the possible values of x in this situation?

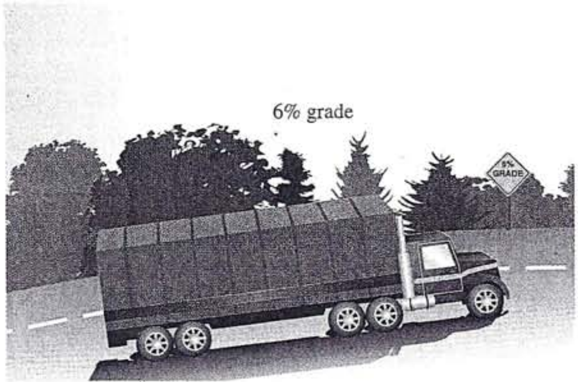
(b) If Mary Ellen invests x dollars at 5%, write an equation that describes the total interest I received from both accounts at the end of one year.

(c) Graph and trace to estimate how much Mary Ellen invested at 5% if she earned \$1,020 in total interest at the end of the first year.

(d) Use your grapher to generate a table of values for I to find out how much Mary Ellen should invest at 5% to earn \$1,185 in total interest in one year.

47. Navigation A commercial jet airplane climbs at takeoff with slope $m = 3/8$. How far in the horizontal direction will the airplane fly to reach an altitude of 12,000 ft above the takeoff point?

48. Grade of a Highway Interstate 70 west of Denver, Colorado, has a section posted as a 6% grade. This means that for a horizontal change of 100 ft there is a 6-ft vertical change.



(a) Find the slope of this section of the highway.

(b) On a highway with a 6% grade what is the horizontal distance required to climb 250 ft?

(c) A sign along the highway says 6% grade for the next 7 mi. Estimate how many feet of vertical change there are along those next 7 mi. (There are 5280 ft in 1 mile.)

49. Writing to Learn Building Specifications Asphalt shingles do not meet code specifications on a roof that has less than a 4-12 pitch. A 4-12 pitch means there are 4 ft of vertical change in 12 ft of horizontal change. A certain roof has slope $m = 3/8$. Could asphalt shingles be used on that roof? Explain.

50. Revisiting Example 8 Use the linear equation found in Example 8 to estimate Americans' income in the months displayed in Figure P.28.

51. Americans' Spending From July 1998 to July 1999, Americans' spending rose from 5.82 trillion dollars to 6.20 trillion dollars as illustrated in Figure P.29.

(a) Let $x = 0$ represent July 1998, $x = 1$ represent August 1998, …, and $x = 12$ represent July 1999. Write a linear equation for Americans' spending in terms of the month x using the pairs $(0, 5.82)$ and $(12, 6.20)$.

(b) Use the equation in (a) to estimate Americans' spending in the months displayed in Figure P.29.

(c) Use the equation in (a) to predict Americans' spending in July 2002.

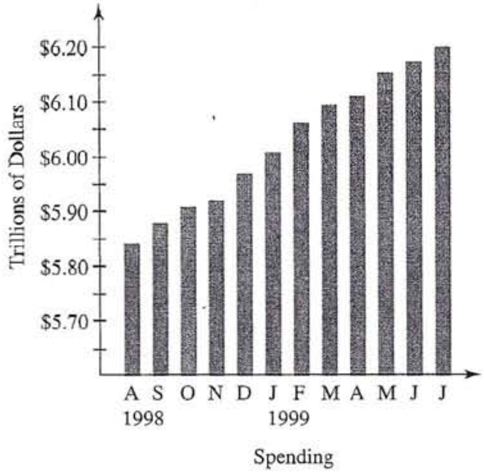


Figure P.29 Americans' spending in July 1998 was 5.82 trillion dollars and in July 1999 was 6.20 trillion dollars. *Source:* AP, Commerce Department as reported in *The Columbus Dispatch* on August 28, 1999.

52. **U.S. Imports from Mexico** The total (y) in billions of dollars of U.S. imports from Mexico for each year (x) from 1991 to 1998 is given in the table. (Source: Bureau of the Census, Foreign Trade Division, FINAL 1991–1998)

x	1991	1992	1993	1994	1995	1996	1997	1998
y	31.1	35.2	39.9	49.5	61.7	74.3	85.9	94.6

(a) Use the pairs (1992, 35.2) and (1996, 74.3) to write a linear equation for x and y.

(b) Superimpose the graph of the linear equation in (a) on a scatter plot of the data.

(c) Use the equation in (a) to predict the total U.S. Imports from Mexico in 2001.

53. **World Population** The midyear world population for the years 1993 to 1998 (in millions) is shown in Table P.7.

Table P.7 World Population

Year	Population (millions)
1993	5523
1994	5603
1995	5682
1996	5761
1997	5840
1998	5919

Source: U.S. Bureau of the Census, International Data Base, Data updated 12-28-98

(a) Let $x = 0$ represent 1990, $x = 1$ represent 1991, and so forth. Draw a scatter plot of the data.

(b) Use the 1993 and 1998 data to write a linear equation for the population y in terms of the year x. Superimpose the graph of the linear equation on the scatter plot in (a).

(c) Use the equation in (b) to predict the midyear world population in 2003. Compare it with the Census Bureau estimate of 6301 million.

54. **U.S. Imports from Mexico** The total in billions of dollars of U.S. imports from Mexico from 1991 to 1998 is given in Table P.8.

Table P.8 U.S. Imports from Mexico

Year	U.S. Imports (billions of dollars)
1991	31.1
1992	35.2
1993	39.9
1994	49.5
1995	61.7
1996	74.3
1997	85.9
1998	94.6

Source: Bureau of the Census, Foreign Trade Division, FINAL 1991–1998

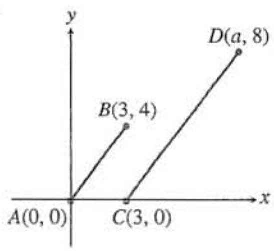
(a) Let $x = 0$ represent 1990, $x = 1$ represent 1991, and so forth. Draw a scatter plot of the data.

(b) Use the 1992 and 1998 data to write a linear equation for the U.S. Imports from Mexico (y) in terms of the year (x). Superimpose the graph of the linear equation on the scatter plot in (a).

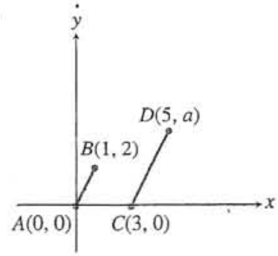
(c) Use the equation in (b) to predict the U.S. Imports from Mexico in 2002.

In Exercises 55 and 56, determine a so that the line segments AB and CD are parallel.

55.

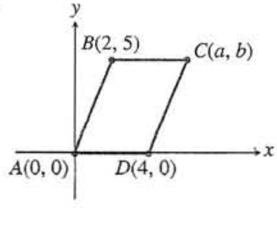


56.



In Exercises 57 and 58, determine a and b so that figure $ABCD$ is a parallelogram.

57.



58.