

Explorations

59. Exploring the Graph of
- $\frac{x}{a} + \frac{y}{b} = c$
- ,
- $a \neq 0$
- ,
- $b \neq 0$

Let $c = 1$.

- (a) Draw the graph for $a = 3$, $b = -2$.
 (b) Draw the graph for $a = -2$, $b = -3$.
 (c) Draw the graph for $a = 5$, $b = 3$.
 (d) Use your graphs in (a), (b), (c) to conjecture what a and b represent when $c = 1$. Prove your conjecture.
 (e) Repeat (a)–(d) for $c = 2$.
 (f) If $c = -1$, what do a and b represent?



60. Writing to Learn Perpendicular Lines

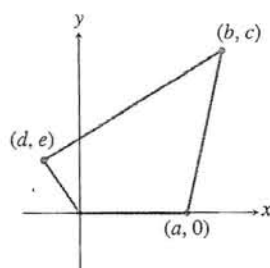
- (a) Is it possible for two lines with positive slopes to be perpendicular? Explain.
 (b) Is it possible for two lines with negative slopes to be perpendicular? Explain.

61. Group Activity Parallel and Perpendicular Lines

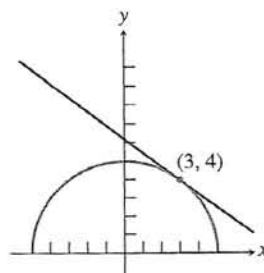
- (a) Assume that $c \neq d$ and a and b are not both zero. Show that $ax + by = c$ and $ax + by = d$ are parallel lines. Explain why the restrictions on a , b , c , and d are necessary.
 (b) Assume that a and b are not both zero. Show that $ax + by = c$ and $bx - ay = d$ are perpendicular lines. Explain why the restrictions on a and b are necessary.

Extending the Ideas

62. Connecting Algebra and Geometry Show that if the midpoints of consecutive sides of any quadrilateral (see figure) are connected, the result is a parallelogram.

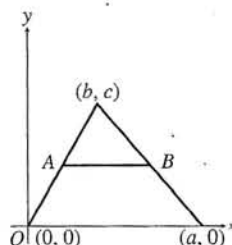


Art for Exercise 62



Art for Exercise 63

63. Connecting Algebra and Geometry Consider the semicircle of radius 5 centered at $(0, 0)$ as shown in the figure. Find an equation of the line tangent to the semicircle at the point $(3, 4)$. (Hint: A line tangent to a circle is perpendicular to the radius at the point of tangency.)
 64. Connecting Algebra and Geometry Show that in any triangle (see figure), the line segment joining the midpoints of two sides is parallel to the third side and half as long.



P.5

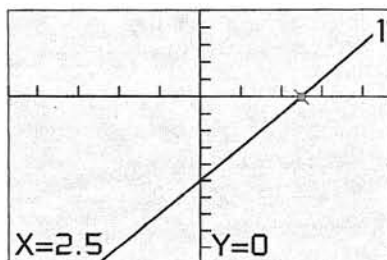
Solving Equations Graphically, Numerically, and Algebraically

Solving Equations Graphically • Solving Equations Numerically with Tables • Solving Quadratic Equations • Solving Equations by Factoring • Solving Equations Involving Fractions • Solving Equations by Finding Intersections

Solving Equations Graphically

The graph of the equation $y = 2x - 5$ (in x and y) can be used to solve the equation $2x - 5 = 0$ (in x). Using the techniques of Section P.3, we can show algebraically that $x = 5/2$ is a solution of $2x - 5 = 0$. Therefore, the ordered pair $(5/2, 0)$ is a solution of $y = 2x - 5$. Figure P.30 suggests that the x -intercept of the graph of the line $y = 2x - 5$ is the point $(5/2, 0)$ as it should be.

One way to solve an equation graphically is to find all its x -intercepts. There are many graphical techniques that can be used to find x -intercepts.



[-4.7, 4.7] by [-10, 5]

Figure P.30 Using trace we see that $(2.5, 0)$ is an x -intercept of the graph of $y = 2x - 5$ and, therefore, $x = 2.5$ is a solution of the equation $2x - 5 = 0$.

Solving Equations by Finding Intersections

Sometimes we can rewrite an equation and solve it graphically by finding the *points of intersection* of two graphs. A point (a, b) is a **point of intersection** of two graphs if it lies on both graphs.

We illustrate this procedure with the absolute value equation in Example 10.

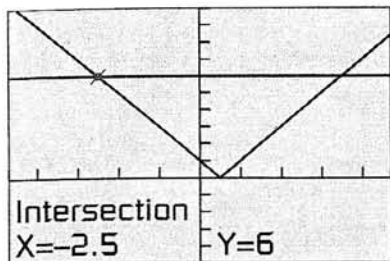
Example 10 SOLVING BY FINDING INTERSECTIONS

Solve the equation $|2x - 1| = 6$.

Solution Figure P.37 suggests that the V-shaped graph of $y = |2x - 1|$ intersects the graph of the horizontal line $y = 6$ twice. We can use trace or the intersection feature of our grapher to see that the two points of intersection have coordinates $(-2.5, 6)$ and $(3.5, 6)$. This means that the original equation has two solutions: -2.5 and 3.5 .

We can use algebra to find the exact solutions. The only two real numbers with absolute value 6 are 6 itself and -6 . So, if $|2x - 1| = 6$, then

$$\begin{aligned} 2x - 1 &= 6 & \text{or} & & 2x - 1 &= -6 \\ x &= \frac{7}{2} = 3.5 & \text{or} & & x &= \frac{-5}{2} = -2.5 \end{aligned}$$



$[-4.7, 4.7]$ by $[-5, 10]$

Figure P.37 The graphs of $y = |2x - 1|$ and $y = 6$ intersect at $(-2.5, 6)$ and $(3.5, 6)$. (Example 10)

Quick Review P.5

In Exercises 1–4, expand the product.

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

In Exercises 5–8, factor completely.

- $25x^2 - 20x + 4$
- $15x^3 - 22x^2 + 8x$

$$7. 3x^3 + x^2 - 15x - 5 \qquad 8. y^4 - 13y^2 + 36$$

In Exercises 9 and 10, combine the fractions and reduce the resulting fraction to lowest terms.

$$9. \frac{x}{2x+1} - \frac{2}{x-3} \qquad 10. \frac{x+1}{x^2-5x+6} - \frac{3x+11}{x^2-x-6}$$

Section P.5 Exercises

In Exercises 1–6, solve the equation by extracting square roots.

- $4x^2 = 25$
- $2(x - 5)^2 = 17$
- $3(x + 4)^2 = 8$
- $4(u + 1)^2 = 18$
- $2y^2 - 8 = 6 - 2y^2$
- $(2x + 3)^2 = 169$

In Exercises 7–12, solve the equation by completing the square.

- $x^2 + 6x = 7$
- $x^2 + 5x - 9 = 0$
- $x^2 - 7x + \frac{5}{4} = 0$
- $4 - 6x = x^2$
- $2x^2 - 7x + 9 = (x - 3)(x + 1) + 3x$
- $3x^2 - 6x - 7 = x^2 + 3x - x(x + 1) + 3$

In Exercises 13–18, solve the equation using the quadratic formula.

- $x^2 + 8x - 2 = 0$
- $2x^2 - 3x + 1 = 0$

$$15. 3x + 4 = x^2 \qquad 16. x^2 - 5 = \sqrt{3}x$$

$$17. x(x + 5) = 12$$

$$18. x^2 - 2x + 6 = 2x^2 - 6x - 26$$

In Exercises 19–24, solve the equation by factoring. Support your work graphically.

$$19. x^2 - x - 20 = 0$$

$$20. 2x^2 + 5x - 3 = 0$$

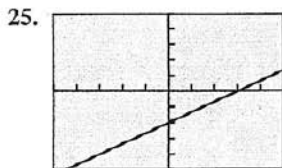
$$21. 4x^2 - 8x + 3 = 0$$

$$22. x^2 - 8x = -15$$

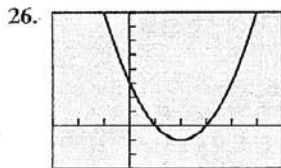
$$23. x(3x - 7) = 6$$

$$24. x(3x + 11) = 20$$

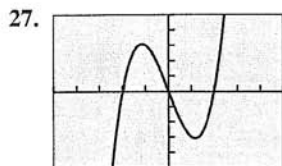
In Exercises 25–28, estimate any x - and y -intercepts that are shown in the graph.



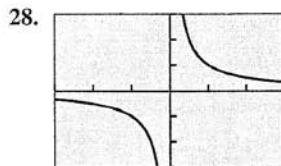
$[-5, 5]$ by $[-5, 5]$



$[-3, 6]$ by $[-3, 8]$



$[-5, 5]$ by $[-5, 5]$



$[-3, 3]$ by $[-3, 3]$

In Exercises 29–34, solve the equation graphically by finding x -intercepts.

29. $x^2 + x - 1 = 0$

30. $4x^2 + 20x + 23 = 0$

31. $x^3 + x^2 + 2x - 3 = 0$

32. $x^3 - 4x + 2 = 0$

33. $x^2 + 4 = 4x$

34. $x^2 + 2x = -2$

In Exercises 35–40, solve the equation graphically by finding intersections. Confirm your answer algebraically.

35. $|t - 8| = 2$

36. $|x + 1| = 4$

37. $|2x + 5| = 7$

38. $|3 - 5x| = 4$

39. $|2x - 3| = x^2$

40. $|x + 1| = 2x - 3$

In Exercises 41 and 42, the table permits you to estimate a zero of an expression. State the expression and give the zero as accurately as can be read from the table.

41.

X	Y1
.4	-.04
.41	-.019
.42	.0164
.43	.0449
.44	.0736
.45	.1025
.46	.1316

Y1 $X^2 + 2X - 1$

42.

X	Y1
-1.795	-.0177
-1.794	-.017
-1.793	-.0057
-1.792	3E-4
-1.791	.0063
-1.79	.01228
-1.789	.01826

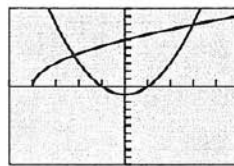
Y1 $X^3 - 3X$

In Exercises 43 and 44, use tables to find the indicated number of solutions of the equation accurate to two decimal places.

43. Two solutions of $x^2 - x - 1 = 0$

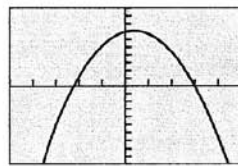
44. One solution of $-x^3 + x + 1 = 0$

45. **Interpreting Graphs** The graphs in the two viewing windows shown here can be used to solve the equation $3\sqrt{x+4} = x^2 - 1$ graphically.



$[-5, 5]$ by $[-10, 10]$

(a)



$[-5, 5]$ by $[-10, 10]$

(b)

(a) The viewing window in (a) illustrates the intersection method for solving. Identify the two equations that are graphed.

(b) The viewing window in (b) illustrates the x -intercept method for solving. Identify the equation that is graphed.

(c) **Writing to Learn** How are the intersection points in (a) related to the x -intercepts in (b)?

46. **Writing to Learn Revisiting Example 3** Explain why all real numbers x that satisfy $1.324 < x < 1.325$ round to 1.32.

In Exercises 47–62, use a method of your choice to solve the equation.

47. $x^2 + x - 2 = 0$

48. $x^2 - 3x = 12 - 3(x - 2)$

49. $|2x - 1| = 5$

50. $x + 2 - 2\sqrt{x+3} = 0$

51. $x^3 + 4x^2 - 3x - 2 = 0$

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

53. $x + \frac{10}{x} = 7$

54. $x + 2 = \frac{15}{x}$

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

56. $\frac{3x}{x+5} + \frac{1}{x-2} = \frac{7}{x^2 + 3x - 10}$

57. $\frac{x-3}{x} - \frac{3}{x+1} + \frac{3}{x^2+x} = 0$

58. $\frac{3}{x+2} + \frac{6}{x^2+x} = \frac{3-x}{x}$

59. $|x^2 + 4x - 1| = 7$

60. $|x + 5| = |x - 3|$

61. $|0.5x + 3| = x^2 - 4$

62. $\sqrt{x+7} = -x^2 + 5$

Explorations

63. **Deriving the Quadratic Formula** Follow these steps to use completing the square to solve $ax^2 + bx + c = 0$, $a \neq 0$.

(a) Subtract c from both sides of the original equation and divide both sides of the resulting equation by a to obtain

$$x^2 + \frac{b}{a}x = -\frac{c}{a}.$$

(b) Add the square of one-half of the coefficient of x in (a) to both sides and simplify to obtain

$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$

(c) Extract square roots in (b) and solve for x to obtain the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

64. Group Activity Discriminant of a Quadratic The radicand $b^2 - 4ac$ in the quadratic formula is called the **discriminant** of the quadratic polynomial $ax^2 + bx + c$ because it can be used to describe the nature of its zeros.

(a) **Writing to Learn** If $b^2 - 4ac > 0$, what can you say about the zeros of the quadratic polynomial $ax^2 + bx + c$? Explain your answer.

(b) **Writing to Learn** If $b^2 - 4ac = 0$, what can you say about the zeros of the quadratic polynomial $ax^2 + bx + c$? Explain your answer.

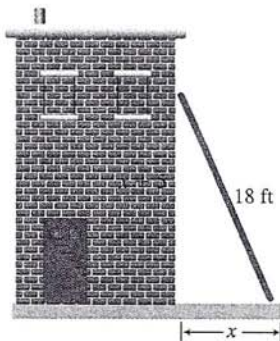
(c) **Writing to Learn** If $b^2 - 4ac < 0$, what can you say about the zeros of the quadratic polynomial $ax^2 + bx + c$? Explain your answer.

65. Group Activity Discriminant of a Quadratic Use the information learned in Exercise 64 to create a quadratic polynomial with the following number of real zeros. Support your answer graphically.

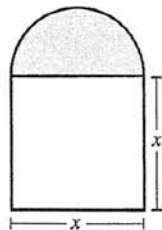
- (a) Two real zeros (b) Exactly one real zero
(c) No real zeros.

66. Size of a Soccer Field Several of the World Cup '94 soccer matches were played in Stanford University's stadium in Menlo Park, California. The field is 30 yd longer than it is wide, and the area of the field is 8800 yd². What are the dimensions of this soccer field?

67. Height of a Ladder John's paint crew knows from experience that its 18-ft ladder is particularly stable when the distance from the ground to the top of the ladder is 5 ft more than the distance from the building to the base of the ladder as shown in the figure. In this position, how far up the building does the ladder reach?



68. Finding the Dimensions of a Norman Window A Norman window has the shape of a square with a semicircle mounted on it. Find the width of the window if the total area of the square and the semicircle is to be 200 ft².



Extending the Ideas

69. Finding Number of Solutions Consider the equation $|x^2 - 4| = c$

(a) Find a value of c for which this equation has four solutions. (There are many such values.)

(b) Find a value of c for which this equation has three solutions. (There is only one such value.)

(c) Find a value of c for which this equation has two solutions. (There are many such values.)

(d) Find a value of c for which this equation has no solutions. (There are many such values.)

(e) **Writing to Learn** Are there any other possible number of solutions of this equation? Explain.

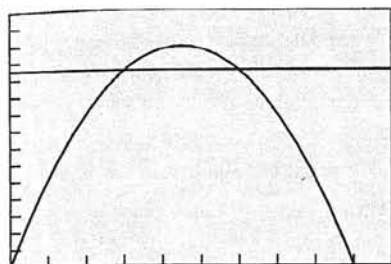
70. Sums and Products of Solutions of $ax^2 + bx + c = 0$, $a \neq 0$

Suppose that $b^2 - 4ac > 0$.

(a) Show that the sum of the two solutions of this equation is $-(b/a)$.

(b) Show that the product of the two solutions of this equation is c/a .

71. Exercise 70 Continued The equation $2x^2 + bx + c = 0$ has two solutions x_1 and x_2 . If $x_1 + x_2 = 5$ and $x_1 \cdot x_2 = 3$, find the two solutions.



$[0, 20]$ by $[0, 1500]$

Figure P.46 The graphs of $s = -16t^2 + 288t$ and $s = 1152$. We know from Example 10a that the two graphs intersect at $(6, 1152)$ and $(12, 1152)$.

$$s = -16t^2 + 288t$$

$$1152 = -16t^2 + 288t \quad \text{Substitute } s = 1152.$$

$$16t^2 - 288t + 1152 = 0 \quad \text{Add } 16t^2 - 288t.$$

$$t^2 - 18t + 72 = 0 \quad \text{Divide by 16.}$$

$$(t - 6)(t - 12) = 0 \quad \text{Factor.}$$

$$t = 6 \quad \text{or} \quad t = 12 \quad \text{Solve for } t.$$

The projectile is 1152 ft above ground twice; the first time at $t = 6$ sec on the way up, and the second time at $t = 12$ sec on the way down (Figure P.46).

(b) The projectile will be at least 1152 ft above ground when $s \geq 1152$. We can see from Figure P.46 together with the algebraic work in (a) that the solution is $[6, 12]$. This means that the projectile is at least 1152 ft above ground for times between $t = 6$ sec and $t = 12$ sec, including 6 and 12 sec.

In Exercise 38 we ask you to use algebra to solve the inequality $s = -16t^2 + 288t \geq 1152$.

Quick Review P.6

In Exercises 1–3, solve for x .

- $-7 < 2x - 3 < 7$
- $5x - 2 \geq 7x + 4$
- $|x + 2| = 3$

In Exercises 4–6, factor the expression completely.

- $4x^2 - 9$
- $x^3 - 4x$
- $9x^2 - 16y^2$

In Exercises 7 and 8, reduce the fraction to lowest terms.

$$7. \frac{z^2 - 25}{z^2 - 5z} \qquad 8. \frac{x^2 + 2x - 35}{x^2 - 10x + 25}$$

In Exercises 9 and 10, add the fractions and simplify.

$$9. \frac{x}{x-1} + \frac{x+1}{3x-4} \qquad 10. \frac{2x-1}{x^2-x-2} + \frac{x-3}{x^2-3x+2}$$

Section P.6 Exercises

In Exercises 1–8, solve the inequality algebraically. Write the solution in interval notation and draw its number line graph.

- $|x + 4| \geq 5$
- $|2x - 1| > 3.6$
- $|x - 3| < 2$
- $|x + 3| \leq 5$
- $|4 - 3x| - 2 < 4$
- $|3 - 2x| + 2 > 5$
- $\left| \frac{x+2}{3} \right| \geq 3$
- $\left| \frac{x-5}{4} \right| \leq 6$

In Exercises 9–16, solve the inequality. Use algebra to solve the corresponding equation.

- $2x^2 + 17x + 21 \leq 0$
- $6x^2 - 13x + 6 \geq 0$
- $2x^2 + 7x > 15$
- $4x^2 + 2 < 9x$
- $2 - 5x - 3x^2 < 0$
- $21 + 4x - x^2 > 0$

$$15. x^3 - x \geq 0$$

$$16. x^3 - x^2 - 30x \leq 0$$

In Exercises 17–20, solve the inequality graphically.

- $x^2 - 4x < 1$
- $12x^2 - 25x + 12 \geq 0$
- $8x - 2x^3 < 0$
- $3x^3 - 12x \geq 0$

In Exercises 21–30, use a method of your choice to solve the inequality.

- $6x^2 - 5x - 4 > 0$
- $4x^2 - 1 \leq 0$
- $9x^2 + 12x - 1 \geq 0$
- $4x^2 - 12x + 7 < 0$
- $4x^2 + 1 > 4x$
- $x^2 + 9 \leq 6x$
- $x^2 - 8x + 16 < 0$
- $9x^2 + 12x + 4 \geq 0$
- $2x^3 > 18x$
- $12x \leq 27x^3$

In Exercises 31–36, solve the inequality algebraically.

31. $\frac{5}{x+2} \geq 1$

32. $\frac{13}{x+5} > 2$

33. $\frac{x+3}{x+5} > 0$

34. $\frac{x-2}{x-9} \geq 0$

35. $\frac{x+2}{2x-3} \geq 1$

36. $\frac{2x+1}{3x+2} \leq 1$

37. **Group Activity** Give an example of a quadratic inequality with the indicated solution.

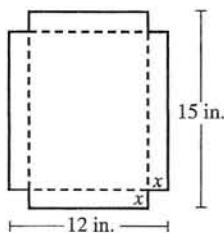
- (a) All real numbers (b) No solution
 (c) Exactly one solution (d) $[-2, 5]$
 (e) $(-\infty, -1) \cup (4, \infty)$ (f) $(-\infty, 0] \cup [4, \infty)$

38. **Revisiting Example 10** Solve the inequality $-16t^2 + 288t \geq 1152$ algebraically and compare your answer with the result obtained in Example 10.

Explorations

39. **Constructing a Box with No Top** An open box is formed by cutting squares from the corners of a regular piece of cardboard (see figure) and folding up the flaps.

- (a) What size corner squares should be cut to yield a box with a volume of 125 in.^3 ?
 (b) What size corner squares should be cut to yield a box with a volume more than 125 in.^3 ?
 (c) What size corner squares should be cut to yield a box with a volume of at most 125 in.^3 ?



40. **Projectile Motion** A projectile is launched straight up from ground level with an initial velocity of 256 ft/sec .

- (a) When will the projectile's height above ground be 768 ft ?
 (b) When will the projectile's height above ground be at least 768 ft ?
 (c) When will the projectile's height above ground be less than or equal to 768 ft ?

41. **Projectile Motion** A projectile is launched straight up from ground level with an initial velocity of 272 ft/sec .

- (a) When will the projectile's height above ground be 960 ft ?
 (b) When will the projectile's height above ground be more than 960 ft ?
 (c) When will the projectile's height above ground be less than or equal to 960 ft ?

42. **Writing to Learn** Explain the role of equation solving in the process of solving an inequality. Give an example.

43. **Travel Planning** Barb wants to drive to a city 105 mi from her home in no more than 2 h . What is the lowest average speed she must maintain on the drive?

44. **Connecting Algebra and Geometry** Consider the collection of all rectangles that have length 2 in. less than twice their width.

(a) Find the possible widths (in inches) of these rectangles if their perimeters are less than 200 in.

(b) Find the possible widths (in inches) of these rectangles if their areas are less than or equal to 1200 in.^2 .

45. **Boyle's Law** For a certain gas, $P = 400/V$, where P is pressure and V is volume. If $20 \leq V \leq 40$, what is the corresponding range for P ?

46. **Cash-Flow Planning** A company has current assets (cash, property, inventory, and accounts receivable) of $\$200,000$ and current liabilities (taxes, loans, and accounts payable) of $\$50,000$. How much can it borrow if it wants its ratio of assets to liabilities to be no less than 2 ? Assume the amount borrowed is added to both current assets and current liabilities.

Extending the Ideas

In Exercises 47 and 48, use a combination of algebraic and graphical techniques to solve the inequalities.

47. $|2x^2 + 7x - 15| < 10$

48. $|2x^2 + 3x - 20| \geq 10$

Completing the Square

To complete the square for the expression $x^2 + bx$, add $(b/2)^2$. The completed square is

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2.$$

Solving Quadratic Equations Algebraically

1. Factoring
2. Extracting Square Roots
3. Completing the Square
4. Quadratic Formula

Chapter P Review Exercises

The collection of exercises marked in red could be used as a chapter test.

In Exercises 1 and 2, find the endpoints and state whether the interval is bounded or unbounded.

1. $[0, 5]$
2. $(2, \infty)$

3. **Distributive Property** Use the distributive property to write the expanded form of $2(x^2 - x)$.

4. **Distributive Property** Use the distributive property to write the factored form of $2x^3 + 4x^2$.

In Exercises 5 and 6, simplify the expression. Assume that denominators are not zero.

5. $\frac{(uv^2)^3}{v^2u^3}$
6. $(3x^2y^3)^{-2}$

In Exercises 7 and 8, write the number in scientific notation.

7. The mean distance from Pluto to the sun is about 3,680,000,000 miles.
8. The diameter of a red blood corpuscle is about 0.000007 meter.

In Exercises 9 and 10, write the number in decimal form.

9. Our solar system is about 5×10^9 years old.
10. The mass of an electron is about 9.1066×10^{-28} g (gram).
11. The data in Table P.9 give details about the year 2000 budget for education in President Clinton's budget proposal. Write the amount of the budget item in Table P.9 in scientific notation.
 - (a) Eisenhower Professional Development Program
 - (b) Safe, Drug Free Schools
 - (c) Bilingual, Immigrant Education
 - (d) Special Education

Table P.9 Department of Education

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

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

12. **Decimal Form** Find the decimal form for $-5/11$. State whether it repeats or terminates.

In Exercises 13 and 14, find (a) the distance between the points and (b) the midpoint of the line segment determined by the points.

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

In Exercises 15 and 16, show that the figure determined by the points is the indicated type.

15. Right triangle: $(-2, 1)$, $(3, 11)$, $(7, 9)$
16. Equilateral triangle: $(0, 1)$, $(4, 1)$, $(2, 1 - 2\sqrt{3})$

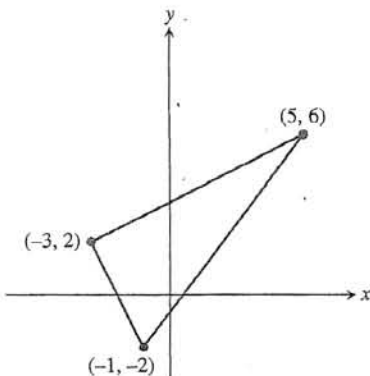
In Exercises 17 and 18, find the standard form equation for the circle,

17. Center $(0, 0)$, radius 2
18. Center $(5, -3)$, radius 4

In Exercises 19 and 20, find the center and radius of the circle.

19. $(x + 5)^2 + (y + 4)^2 = 9$
20. $x^2 + y^2 = 1$
21. (a) Find the length of the sides of the triangle in the figure.

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



22. **Distance and Absolute Value** Use absolute value notation to write the statement that the distance between z and -3 is less than or equal to 1.
23. **Finding a Line Segment with Given Midpoint** Let $(3, 5)$ be the midpoint of the line segment with endpoints $(-1, 1)$ and (a, b) . Determine a and b .
24. **Finding Slope** Find the slope of the line through the points $(-1, -2)$ and $(4, -5)$.
25. **Finding Point-Slope Form Equation** Find an equation in point-slope form for the line through the point $(2, -1)$ with slope $m = -2/3$.
26. Find an equation of the line through the points $(-5, 4)$ and $(2, -5)$ in the general form $Ax + By + C = 0$.

In Exercises 27–32, find an equation in slope-intercept form for the line.

27. The line through $(3, -2)$ with slope $m = 4/5$
28. The line through the points $(-1, -4)$ and $(3, 2)$
29. The line through $(-2, 4)$ with slope $m = 0$
30. The line $3x - 4y = 7$
31. The line through $(2, -3)$ and parallel to the line $2x + 5y = 3$.
32. The line through $(2, -3)$ and perpendicular to the line $2x + 5y = 3$.
33. **Americans' Work Time** The data in Table P.10 shows the number of hours a week Americans say they spend at work for several years.

- (a) Let $x = 0$ represent 1970, $x = 1$ represent 1971, and so forth. Draw a scatter plot of the data.
- (b) Use the 1973 and 1999 data to write a linear equation for the number of hours y Americans say they work in a week 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 estimate the number of hours Americans say they work in a week in 1990.

(d) Use the equation in (b) to predict the number of hours Americans will say they work in a week in 2002.

Table P.10 Americans' Weekly Work Time

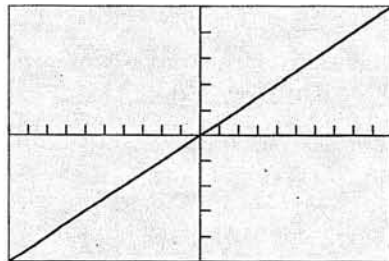
Year	Number of hours
1973	40.6
1980	46.9
1987	48.8
1994	50.7
1997	50.8
1998	49.9
1999	50.2

Source: Harris Poll, as reported in the USA TODAY, September 9, 1999

34. Consider the point $(-6, 3)$ and Line $L: 4x - 3y = 5$. Write an equation (a) for the line passing through this point and parallel to L , and (b) for the line passing through this point and perpendicular to L . Support your work graphically.

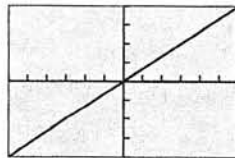
In Exercises 35 and 36, assume that each graph contains the origin and the upper right-hand corner of the viewing window.

35. Find the slope of the line in the figure.



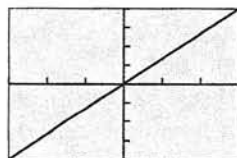
$[-10, 10]$ by $[-25, 25]$

36. **Writing to Learn** Which line has the greater slope? Explain.



$[-6, 6]$ by $[-4, 4]$

(a)



$[-15, 15]$ by $[-12, 12]$

(b)

In Exercises 37–50, solve the equation algebraically.

37. $3x - 4 = 6x + 5$

38. $\frac{x-2}{3} + \frac{x+5}{2} = \frac{1}{3}$

39. $2(5 - 2y) - 3(1 - y) = y + 1$

40. $3(3x - 1)^2 = 21$

41. $x^2 - 4x - 3 = 0$

42. $16x^2 - 24x + 7 = 0$

43. $6x^2 + 7x = 3$

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

45. $x(2x + 5) = 4(x + 7)$ 46. $|4x + 1| = 3$
47. $4x^2 - 20x + 25 = 0$ 48. $-9x^2 + 12x - 4 = 0$
49. $\frac{3x}{x+1} + \frac{5}{x-2} = \frac{15}{x^2 - x - 2}$
50. $\frac{3}{x} - x = 2$

51. **Completing the Square** Use completing the square to solve the equation $2x^2 - 3x - 1 = 0$.
52. **Quadratic Formula** Use the quadratic formula to solve the equation $3x^2 + 4x - 1 = 0$.

In Exercises 53 and 54, use factoring to solve the equation.

53. $3x^3 - 19x^2 - 14x = 0$ 54. $x^3 + 2x^2 - 4x - 8 = 0$

In Exercises 55 and 56, solve the equation graphically.

55. $x^3 - 2x^2 - 2 = 0$ 56. $|2x - 1| = 4 - x^2$

In Exercises 57 and 58, solve the inequality and draw a number line graph of the solution.

57. $-2 < x + 4 \leq 7$ 58. $5x + 1 \geq 2x - 4$

In Exercises 59–70, solve the inequality.

59. $\frac{3x - 5}{4} \leq -1$ 60. $|2x - 5| < 7$
61. $|3x + 4| \geq 2$ 62. $4x^2 + 3x > 10$
63. $x^3 \leq 9x$ 64. $4x^3 - 9x > 0$
65. $\frac{5}{x - 2} < 1$ 66. $\frac{x - 2}{x + 8} > 0$
67. $\left| \frac{x + 7}{5} \right| > 2$ 68. $2x^2 + 3x - 35 < 0$
69. $4x^2 + 12x + 9 \geq 0$ 70. $x^2 - 6x + 9 < 0$

71. **Projectile Motion** A projectile is launched straight up from ground level with an initial velocity of 320 ft/sec.
- (a) When will the projectile's height above ground be 1538 ft?
- (b) When will the projectile's height above ground be at most 1538 ft?
- (c) When will the projectile's height above ground be greater than or equal to 1538 ft?
72. **Navigation** A commercial jet airplane climbs at takeoff with slope $m = 4/9$. How far in the horizontal direction will the airplane fly to reach an altitude of 20,000 ft above the takeoff point?
73. **Connecting Algebra and Geometry** Consider the collection of all rectangles that have length 1 cm more than three times their width w .
- (a) Find the possible widths (in cm) of these rectangles if their perimeters are less than or equal to 150 cm.
- (b) Find the possible widths (in cm) of these rectangles if their areas are greater than 1500 cm².