

# Answers to Selected Exercises

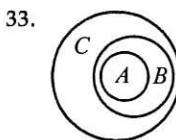
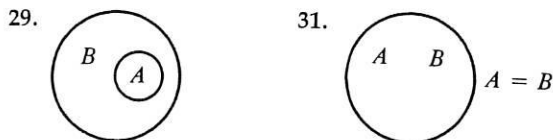
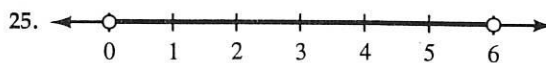
## Chapter 1 Numbers and Variables

### Written Exercises, pages 4–5

1. 30, -30, thirty losses 3. 5000, -5000, a loss of \$5000 5. 3, -3, three floors down 7. 400, -400, 400 m below sea level 9. 90, -90, 90 km west
- 11.
- 13.
- 15.
- 17.
19. < 21. > 23. > 25. > 27. <, < 29. >, >
31. <, < 33. -9, -7, -3, 0, 4, 5 35.  $-\frac{1}{2}$ ,  $-\frac{1}{3}$ ,  $-\frac{1}{4}$ ,  $-\frac{1}{5}$ ,  $-\frac{1}{6}$ ,  $-\frac{1}{10}$  37. -2.5, -2, -1.5, 0, 4.5, 5.5 39. 5
41.  $1\frac{1}{2}$  43.  $-\frac{1}{2}$  45.  $5\frac{1}{3}$  47.  $4\frac{2}{5}$  49.  $\frac{1}{3}$  51. 4
53. -3

### Written Exercises, pages 9–10

1.  $\in$  3.  $\subset$  5.  $\in$  7.  $\subset$
- 9.
- 11.
- 13.
- 15.
- 17.
- 19.
- 21.
- 23.



35.  $\{a\}$ ,  $\{b\}$ ,  $\{c\}$  37.  $\{a, b, c\}$  39. 8 41.  $\{a\}$ ,  $\{b\}$ ,  $\{c\}$ ,  $\{d\}$ ,  $\{e\}$ ,  $\{a, b\}$ ,  $\{a, c\}$ ,  $\{a, d\}$ ,  $\{a, e\}$ ,  $\{b, c\}$ ,  $\{b, d\}$ ,  $\{b, e\}$ ,  $\{c, d\}$ ,  $\{c, e\}$ ,  $\{d, e\}$ ,  $\{a, b, c\}$ ,  $\{a, b, d\}$ ,  $\{a, b, e\}$ ,  $\{a, c, d\}$ ,  $\{a, c, e\}$ ,  $\{a, d, e\}$ ,  $\{b, c, d\}$ ,  $\{b, c, e\}$ ,  $\{b, d, e\}$ ,  $\{c, d, e\}$ ,  $\{a, b, c, d\}$ ,  $\{a, b, c, e\}$ ,  $\{a, b, d, e\}$ ,  $\{a, c, d, e\}$ ,  $\{b, c, d, e\}$ ,  $\{a, b, c, d, e\}$ ,  $\emptyset$ ;
- 32 43. 256

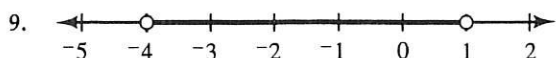
### Written Exercises, pages 13–15

1.  $\{-1, 0, 1, 2, 3, \dots\}$  3.  $\{1, 2, 3, 4, 5, 6\}$  5.  $\{-9, -8, -7, \dots, 1\}$  7.  $\{-2, -1\}$  9.  $\{10, 11, 12, \dots, 99\}$
11. {the natural numbers less than 6} 13. {the integers greater than -7} 15. {the even integers greater than 1 and less than 101} 17. {the integers that are multiples of 3} 19. {the integers greater than 1}
21. {the natural numbers less than 2}
- 23.
- 25.
- 27.
- 29.
31. All 33. No 35. Some 37. All 39. All
41. No 43.  $\{-3, 0, 3\}$  45.  $\{-3, -2, 0, 1, 2, 3\}$
47.  $\{-3, -2, -\frac{1}{2}, 0, \frac{1}{2}, 1, \frac{3}{2}, 2, 3\}$  49.  $\emptyset$
51.  $\{4, 5, 6, \dots\}$

### Self-Test 1, page 15

- 1.
- 2.

3. > 4. < 5. >, > 6. false 7. false 8. true



**Written Exercises, pages 19–20**

1. 4665 3. 900 5. 11.51 7. 50 9.  $150\frac{1}{4}$  11.  $9\frac{1}{3}$

13. 23 15. 80 17. 21 19.  $\frac{1}{5}$  21. 22 23. 144

25. 20 27.  $\frac{1}{2}$  29. 14 31. 576 33. 36 35. 16

37.  $\frac{5}{6}$  39. 2.16 41.  $1\frac{3}{8}$  43.  $1\frac{1}{2}$  45. 17 47.  $1\frac{1}{2}$

49. 5 51.  $\frac{1}{4}$  53. Examples:  $z - 2$ ,  $\frac{z}{3}$ ,  $2z - 5$

55. Examples:  $a = 1$ ,  $b = 0$  57. Examples:  $a = 2$ ,  $b = 1$  59.  $\frac{1}{n}$  decreases toward 0;  $n + \frac{1}{n}$  increases

**Written Exercises, pages 22–23**

1. 109 3. 14 5. 176 7. 4 9. 54 11.  $\frac{1}{2}$  13. 12

15. 240 17. 18 19. 21 21. 4 23. 1 25. 7

27. 3 29.  $5\frac{4}{5}$  31. 32 33. 60 35. 0 37. 70

39.  $\neq$  41. = 43. = 45. = 47. 37; 1 49. 190; 1

51. 5;  $3\frac{1}{5}$  53.  $\frac{1}{4}$ ; 0

**Computer Exercises, page 24**

1. 14 3. 3 5. 0.5 7. 1.4 9.  $\frac{2n-1}{2n+1}$  increases to 1

**Written Exercises, pages 26–27**

1.  $x^5$  3.  $7a^4$  5.  $(x-y)^3$  7.  $m^2$  9.  $p+q^2$

11.  $\frac{1}{2}t^5$  13. 243 15. 2401 17. 43 19. 287

21. 94 23. 152 25. 10 27. 25 29. 35 31. 8

33. 0 35. 1 37. 41 39. 78 41. 54 43. 2169

45. 0 47.  $\frac{9}{10}$  49. 0.75 51. 7 53. 0.25 55.  $\div$ ;

$+$ ;  $\times$ ;  $-$  57.  $\times$ ;  $\div$ ;  $\times$ ;  $-$ ;  $\div$  59.  $-$ ;  $\div$ ;  $\times$ ;  $\times$ ;  $+$

**Self-Test 2, pages 27–28**

1. 11 2. 7 3. 12 4. 37 5. 8 6. 2 7. 625  
8. 88 9. 4

**On the Calculator, page 28**

1. 55 3. 163 5. 216 7. 58 9. 82 11. 2316

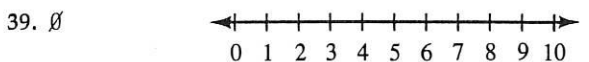
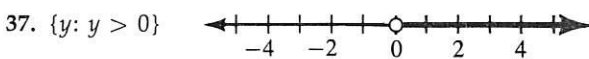
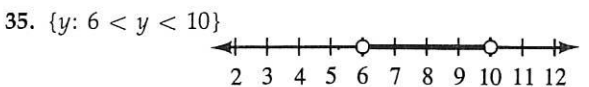
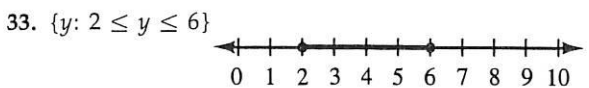
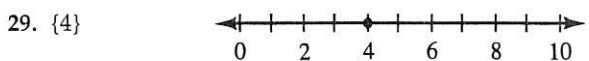
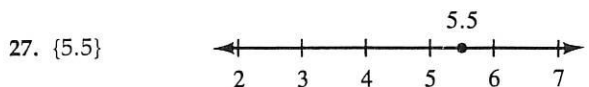
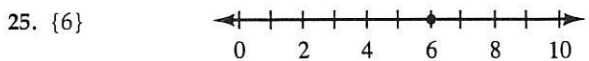
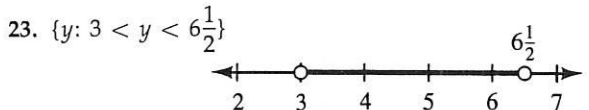
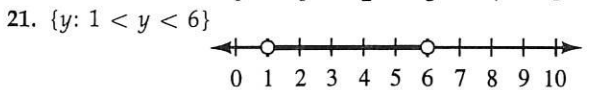
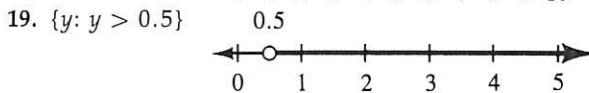
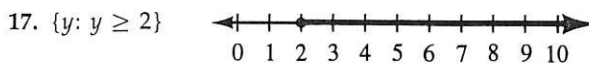
**Reading Algebra, page 29**

1. Examples: fourteen minus eight, the difference when eight is subtracted from fourteen 3. Examples: four multiplied by fifteen, the product of four and fifteen 5.  $6 \times 20$  7.  $\frac{1}{10} \times 90$  9.  $12 + 4$  11.  $\frac{9}{3}$

**Written Exercises, pages 32–33**

1. {4} 3. {7} 5. {2} 7.  $\emptyset$  9. {4} 11. {0, 1, 2, 3}

13. {0, 1} 15. {3, 4, 5, 6, 7, 8}



41.  $1 + 3 = 6$ , False;  $2 + 3 = 6$ , False;  $1 + 4 = 6$ , False;  $2 + 4 = 6$ , True. 43.  $7 - 3 = 2(1)$ , False;  $7 - 4 = 2(1)$ , False;  $7 - 3 = 2(2)$ , True;  $7 - 4 = 2(2)$ , False 45.  $3 < 3(1)$ , False;  $4 < 3(1)$ , False;  $3 < 3(2)$ , True;  $4 < 3(2)$ , True 47.  $3(1) + 3 > 7$ , False;  $3(1) + 4 > 7$ , False;  $3(2) + 3 > 7$ , True;  $3(2) + 4 > 7$ , True 49. Examples:  $x - 1 = 4$ ,  $x + 1 = 6$  51. Examples:  $x + 1 > x$ ,  $x - 2 < x$  53. Examples:  $2x \neq 0$ ,  $x^2 > 0$

**On the Calculator, page 33**

1. 5.58 3. 6.48 5. 0.54 7. 7.8 9. 1.5 11. 8.7

**Written Exercises, pages 37–39**

1.  $2x + 5$  3.  $45 - \frac{1}{4}z$  5.  $17(m - 7)^2$

7.  $(p + 11)(q - 14)$  9.  $\frac{a + 2b}{c + d^5}$  11.  $7w$  13.  $\frac{h}{24}$

15.  $5n + 10d$  17.  $0.05n + 0.25q$  19.  $j + (j + 1)$   
 21.  $x(x + 2)$  23.  $24 - a$  25.  $2(m - 6)$   
 27.  $48 - x$  29.  $a + 10$  31.  $5n + 25(n + 6)$   
 33.  $9d + 10d$  35.  $3(m - 5)$  37.  $y + y + (y + 5)$   
 39.  $vh - (v - x)h$  41.  $gn + r(n + z)$

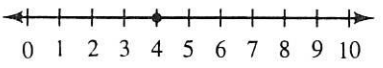
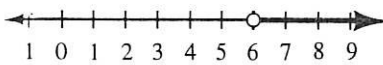
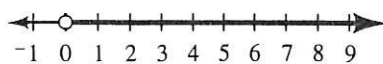
**On the Calculator, page 39**

1. {1} 3. {3} 5. {10}

**Written Exercises, pages 41–43**

1.  $4x = 76$  3.  $20 - z < 4$  5.  $21 = 1 + \frac{2}{3}v$   
 7.  $m + 8 = 3m$  9.  $6w = 21$  11.  $10d + 25q \neq 90$   
 13. Let  $x$  = the unknown number.  $2x + 2 = 42$   
 15. Let  $z$  = the second number.  $3z + z = 32$   
 17. Let  $b$  = the cost in dollars of a new basketball.  
 $\frac{b}{5} < 6$  19. Let  $s$  = the length in centimeters of one  
 side of the square.  $4s = 96$  21. Let  $n$  = the  
 number of nickels.  $5n < 90$  23. Let  $n$  = the first  
 integer.  $n + (n + 1) = 139$  25. Let  $x$  = the  
 length in centimeters of the shorter piece of balsa  
 wood.  $x + (x + 4) = 14$   
 27. Let  $w$  = the width in centimeters of the rectangle.  
 $w(w + 3) < 45$  29. Let  $a$  = the measure in  
 centimeters of the adjacent side of the parallelogram.  
 $2a + 2\left(\frac{1}{3}a - 1\right) = 22$  31. Let  $j$  = Jack's age now.  
 $\frac{1}{2}(j + 20) = 2(j - 1)$  33. Let  $q$  = the number of  
 quarters Carlos has.  $0.10(q - 5) + 0.25q = 7.55$   
 35. Let  $g$  = the number of girls.  $g + (g + 3) = 25$ ;  
 {11} 37. Let  $n$  = the number.  $5n - 4 = n + 8$ ; {3}

**Self-Test 3, page 43**

1. {4}   
 2.  $\{x: x > 6\}$    
 3.  $\{x: x > 0\}$  

4.  $\frac{(m + 1)^3}{m^6}$  5.  $10d + 100x$  6.  $\left(\frac{n}{3}\right)^2 < \frac{n^2}{3}$   
 7.  $\frac{1}{2}(b + 14) = 2(b - 10)$

**Chapter Review, pages 45–47**

1. d 2. c 3. b 4. d 5. a 6. c 7. d 8. b  
 9. b 10. c 11. a 12. d 13. c 14. d 15. a  
 16. d

**Contest Problems, page 47**

1. 2 values 3. 576

**Written Exercises, pages 51–52**

1.  $u = 5$  3.  $j = 1$  5.  $s = 0$  7.  $p = 0$  9.  $a = 1$   
 11.  $m = 0$  13. For any real number  $x$ , there is a real  
 number  $y$  such that  $y = 3 + x$ . 15. For every  
 whole number  $x$ , there exists a whole number  $y$  such  
 that  $y = 5 + 3x$ . 17. For all real numbers  $x$  and  $y$ ,  
 $x + y = y + x$ . 19. There exists a nonzero real  
 number  $y$  such that, for each real number  $x$ ,  $\frac{x}{y} = x$ .  
 21. Examples: 7. For some real number  $p$ ,  $p^2 > 0$ .  
 8. There is a positive integer  $q$  such that  $q < q^3$ .  
 9. There exists a natural number  $a$  such that  
 $a^2 + a > 2$ . 10. For at least one whole number  $b$ ,  
 $0 < b^2 - b$ . 11. For some integer  $m$ ,  $5m \neq \frac{m}{5}$   
 12. There is a real number  $n$  such that  $2n \neq n^2$ .

**Written Exercises, pages 56–57**

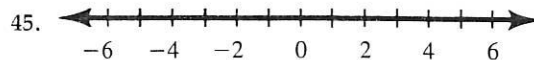
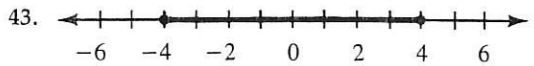
1. 680 3. 690 5. 108 7. 16 9. 16 11. 21  
 13.  $6z + 117$  15.  $52m$  17.  $91pq$  19. {47}  
 21.  $\mathcal{R}$  23.  $\mathcal{R}$  25.  $\emptyset$  27.  $\emptyset$  29. a. 9 b. True  
 c. Commutative d. Associative 31. a. 13 b. True  
 c. Not commutative d. Not associative 33. a. 49  
 b. True c. Commutative d. Not associative  
 35. a.  $5\frac{1}{2}$  b. False c. Not commutative d. Not  
 associative 37. Transitive 39. Symmetric

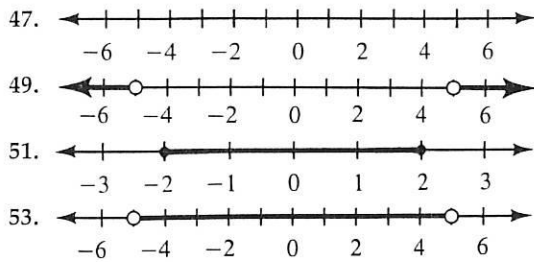
**Written Exercises, pages 60–61**

1. 44 3. 312 5. 540 7.  $81x$  9.  $100z^2$  11.  $9g$   
 13.  $29s + 43$  15.  $17p + 9q$  17.  $11a^2 + 2a$   
 19.  $23c^3 + 2c^2$  21.  $6m + 25$  23.  $22x + 18y$   
 25.  $25p^4 + 10$  27.  $9u + 15$  29.  $11c^2 + 42$   
 31.  $20a + 28$  33.  $19y^2 + 31y$  35.  $18j + 15k$   
 37.  $6g^2 + 12g + 9$  39.  $8a^3 + 11a^2 + 9a$   
 41.  $12p^3 + 10p^2 + 17p + 11$   
 43.  $6y^3 + 13y^2 + 14y + 5$   
 45.  $19m^2 + 5m + 12$  47.  $33r + 12s + 51$   
 49.  $3(u + v) + 2(u + 2v)$ ;  $5u + 7v$   
 51.  $5(3 + w^2) + 2(w^2 + 5)$ ;  $7w^2 + 25$   
 53.  $2y^3 + 6(3y^2 + 2y^3)$ ;  $14y^3 + 18y^2$   
 55.  $70a + 42$  57.  $53x + 53$   
 59.  $48m + 34n + 44$  61.  $49p^2 + 27p + 34$

**Written Exercises, page 65**

1. 3.5 3. -85 5. 57 7.  $6\frac{1}{7}$  9. -6.2 11. 84  
 13. 4 15. 60 17. 0 19. {-18} 21. {4}  
 23. {5, -5} 25. {0} 27. {10, -10} 29. {6, -6}  
 31. {-4} 33. {-15} 35. {6, -6} 37. {25, -25}  
 39. {1, -1} 41. {6, -6}





55. {negative real numbers} 57. {nonpositive real numbers}

**Computer Exercises, page 66**

1. 25; 25 3. 25; 25 5. 27; 27 7. 50; 50

**Self-Test 1, page 66**

1.  $n = 7$  2.  $w = 0$  3. 20 4. 77 5.  $5x^2 + 15$   
6.  $21y + 28$  7. 15 8. 35 9.  $\{-8\}$  10.  $\{19, -19\}$

**Written Exercises, page 70**

1. -8 3. 10 5. -3 7. -18 9. -25 11.  $\frac{5}{7}$   
13. 2 15. -18 17. 6 19. -3 21. -23 23. 0  
25.  $\{-4\}$  27.  $\{-8\}$  29.  $\{11\}$  31.  $\{-1\}$  33.  $\{0\}$   
35.  $\{20\}$  37.  $\{-17\}$  39.  $\{-9\}$  41.  $\{14\}$  43.  $\{0\}$   
45.  $\{9\}$  47.  $\{16\}$  49.  $\{-4\}$  51.  $\left\{-2\frac{1}{2}\right\}$  53.  $\{-4\}$   
55. -7 57. -5 59. -7

**Written Exercises, pages 73-74**

1. 6 3. -72 5. 40 7. 9 9. -315 11. 3 13.  $\frac{1}{9}$   
15. -4 17. -15 19.  $(-8)x$  21.  $(-17)m + (-9)n$   
23.  $(-4)r^2 + 8r$  25.  $(-21)a + 15b + 5c$   
27.  $(-15)j^3 + (-9)j^2 + 4j$  29.  $3p + (-17)$   
31. a. -1 b. 3 c. -1 d. -3 33. a. 0 b. 8  
c. 0 d. -8 35. a. 0.4 b. 1 c. -0.4 d. -1  
37. = 39. <

**Problems, pages 74-76**

1. a. 43, -51 b.  $43 + (-51) = -8$  c. The helicopter was 8 km directly south of its base.  
3. a. 3200, -340, 75, -800 b.  $3200 + (-340) + 75 + (-800) = 2135$  c. The glider's new altitude was 2135 m.  
5. a. -12.05, -13.15, -13.45, -12.05, 12.25, 12.85, 13.75, 12.95 b.  $-12.05 + (-13.15) + (-13.45) + (-12.05) + 12.25 + 12.85 + 13.75 + 12.95 = 1.10$  c. She made \$1.10 in selling the coins.  
7. a. 8, -15, 9, -2 b.  $8 + (-15) + 9 + (-2) = 0$  c. The temperature was  $0^\circ\text{C}$  at midnight of the second day.  
9. a. -38.50, -220.95, 84, 84, -6.55 b.  $-38.50 + (-220.95) + 84 + 84 + (-6.55) = -98$  c. Alice still owed \$98 on her account.  
11. 13 m below 13. \$255 15. at the 6th floor  
17. at his starting point

**Written Exercises, pages 81-82**

1. 82 3. 104 5. -52 7. -49 9. -53 11. 81

13. 1. Hypothesis 2. Axiom of additive inverses  
3. Commutative axiom for addition 4. Associative axiom for addition 5. Axiom of additive inverses  
6. Identity axiom for addition 7. Transitive axiom of equality  
15. 1. Hypothesis 2. Property of the opposite of a sum 3. Commutative axiom for addition  
4. Associative axiom for addition 5. Axiom of additive inverses 6. Identity axiom for addition  
7. Transitive axiom of equality

17. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-a$  is a real number. Ax. of add. inv.  
3.  $-a + (a + b)$  Assoc. ax. for add.  
 $= (-a + a) + b$   
4.  $= 0 + b$  Ax. of add. inv.  
5.  $= b$  Iden. ax. for add.  
6.  $\therefore -a + (a + b) = b$  Trans. ax. of =

19. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-a$  and  $-b$  are real numbers. Ax. of add. inv.  
3.  $[a + (-b)] + (-a)$  Comm. ax. for add.  
 $= (-b + a) + (-a)$   
4.  $= -b + [a + (-a)]$  Assoc. ax. for add.  
5.  $= -b + 0$  Ax. of add. inv.  
6.  $= -b$  Iden. ax. for add.  
7.  $\therefore [a + (-b)] + (-a) = -b$  Trans. ax. of =

21. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-a$  and  $-b$  are real numbers. Ax. of add. inv.  
3.  $-(a + b) + b$  Prop. of opp. of a sum  
 $= [-a + (-b)] + b$  Assoc. ax. for add.  
4.  $= -a + (-b + b)$  Assoc. ax. for add.  
5.  $= -a + 0$  Ax. of add. inv.  
6.  $= -a$  Iden. ax. for add.  
7.  $\therefore -(a + b) + b = -a$  Trans. ax. of =

23. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-a$  and  $-b$  are real numbers. Ax. of add. inv.  
3.  $-[a + (-b)] + (-b)$  Prop. of opp. of a sum  
 $= [-a + (-(-b))] + (-b)$   
4.  $= (-a + b) + (-b)$  Canc. prop. of opp.  
5.  $= -a + [b + (-b)]$  Assoc. ax. for add.  
6.  $= -a + 0$  Ax. of add. inv.  
7.  $= -a$  Iden. ax. for add.  
8.  $\therefore -[a + (-b)] + (-b) = -a$  Trans. ax. of =

25. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-a$  and  $-b$  are real numbers. Ax. of add. inv.  
3.  $(a + b) + [-a + (-b)]$  Prop. of opp. of a sum  
 $= (a + b) + [-(a + b)]$   
4.  $= 0$  Ax. of add. inv.  
5.  $\therefore (a + b) + [-a + (-b)] = 0$  Trans. ax. of =

27. 1.  $a, b,$  and  $c$  are real numbers. Hypothesis  
 2.  $-a, -b,$  and  $-c$  are real numbers. Ax. of add. inv.  
 3.  $-[(a + b) + c]$   
 $= -(a + b) + (-c)$  Prop. of opp. of a sum  
 4.  $= [-a + (-b)] + (-c)$  Prop. of opp. of a sum  
 5.  $\therefore -[(a + b) + c]$  Trans. ax. of =  
 $= [-a + (-b)] + (-c)$

#### Written Exercises, pages 84–85

1.  $-23$  3.  $-53$  5.  $44$  7.  $100$  9.  $-10.6$   
 11.  $4.4$  13.  $\frac{5}{8}$  15.  $6\frac{4}{7}$  17.  $-69$  19.  $24$  21.  $23$   
 23.  $25$  25.  $133$  27.  $95$  29.  $-140$  31.  $-16x - 3$   
 33.  $-21z^2 - 8$  35.  $-23m^2 - 9m - 6$  37.  $-15a - 6$   
 39.  $-21p - 3$  41.  $3m + 13n$  43.  $-11x^3 + 7x$   
 45.  $-22z^2 + 4z + 7$  47. 1. Hypothesis 2. Definition of subtraction 3. Associative axiom for addition 4. Axiom of additive inverses 5. Identity axiom for addition 6. Transitive axiom of equality  
 49. 1.  $a$  and  $b$  are real numbers. Hypothesis  
 2.  $(a - b) + b = [a + (-b)] + b$  Def. of subt.  
 3.  $= a + (-b + b)$  Assoc. ax. for add.  
 4.  $= a + 0$  Ax. of add. inv.  
 5.  $= a$  Iden. ax. for add.  
 6.  $\therefore (a - b) + b = a$  Trans. ax. of =  
 51. 1.  $a, b,$  and  $c$  are real numbers. Hypothesis  
 2.  $-[(a + b) + c]$  Prop. of opp. of a sum  
 $= -(a + b) + (-c)$   
 3.  $= [-a + (-b)] + (-c)$  Prop. of opp. of a sum  
 4.  $= (-a - b) - c$  Def. of subt.  
 5.  $\therefore -[(a + b) + c]$  Trans. ax. of =  
 $= (-a - b) - c$   
 53. closed 55. not closed 57. not closed  
 59. closed 61. closed

#### Problems, pages 86–87

1. a.  $-2 - 29 = -31$  b. Carlos rode 31 floors down. 3. a.  $1935 - 1882 = 53$  b. She was 53 years old. 5. a.  $58 - (-88.3) = 146.3$  b. The record high is  $146.3^\circ\text{C}$  higher than the record low. 7. a.  $-17 - 2 = -19$  b. The temperature feels  $19^\circ\text{C}$  colder (or lower). 9. 10,915 m below sea level  
 11.  $71^\circ$  north latitude

#### Computer Exercises, page 87

1.  $|a - b| = |b - a|$  for all  $a, b \in \mathcal{R}$

#### Self-Test 2, page 87

1.  $-5$  2.  $-9$  3.  $0$  4.  $39$  5.  $(-5)a + (-7)b$   
 6. Identity axiom for addition 7. Axiom of additive inverses 8. Cancellation property of opposites 9.  $-54$  10.  $6n + 10$

#### Written Exercises, pages 91–93

1.  $595$  3.  $0$  5.  $-540$  7.  $150$  9.  $-792$  11.  $250$   
 13.  $-270$  15.  $0$  17.  $560$  19.  $-350$  21.  $-660$   
 23.  $-890$  25.  $-x^3$  27.  $72a^3$  29.  $-80pqr$   
 31.  $-10m - 6$  33.  $-70j - 28k$  35.  $3x - 6y$   
 37.  $w - 2x$  39.  $-11j^2 - j$  41.  $-3a^2 - a - 9$   
 43.  $-2m + n$  45.  $r + 3s$  47.  $11c - 9d$   
 49.  $-10a - b$  51.  $-x - 28y$  53.  $8p + q$   
 55.  $-7$  57.  $-4$  59.  $2$  61. 1. Hypothesis  
 2. Axiom of additive inverses 3. Multiplicative property of  $-1$  4. Associative axiom for multiplication 5. Multiplicative property of  $-1$   
 6. Transitive axiom of equality  
 63. 1.  $a$  and  $b$  are real numbers. Hypothesis  
 2.  $-a$  is a real number. Ax. of add. inv.  
 3.  $(-a)b = [(-1)a]b$  Mult. prop. of  $-1$   
 4.  $= (-1)(ab)$  Assoc. ax. for mult.  
 5.  $= -ab$  Mult. prop. of  $-1$   
 6.  $\therefore (-a)b = -ab$  Trans. ax. of =  
 65. 1.  $a, b,$  and  $c$  are real numbers. Hypothesis  
 2.  $-a$  is a real number. Ax. of add. inv.  
 3.  $-a(b + c) = (-a)b + (-a)c$  Dist. ax.  
 4.  $= -ab + (-ac)$  Prop. of opp. in products  
 5.  $= -ab - ac$  Def. of subt.  
 6.  $\therefore -a(b + c) = -ab - ac$  Trans. ax. of =  
 67. 1.  $a, b, c$  and  $d$  are real numbers. Hypothesis  
 2.  $a[(b - c) - d]$  Exercise 62, page 92  
 3.  $= a(b - c) - ad$  Exercise 62, page 92  
 4.  $= [ab + (-ac)] + (-ad)$  Def. of subt.  
 5.  $= ab + [-ac + (-ad)]$  Assoc. ax. for add.  
 6.  $= ab + [(-1)(ac) + (-1)(ad)]$  Mult. prop. of  $-1$   
 7.  $= ab + [(-1)(ac + ad)]$  Dist. ax.  
 8.  $= ab + [-(ac + ad)]$  Mult. prop. of  $-1$   
 9.  $= ab - (ac + ad)$  Def. of subt.  
 10.  $\therefore a[(b - c) - d]$  Trans. ax. of =  
 $= ab - (ac + ad)$

#### Computer Exercises, page 93

1. positive 3. negative 5. zero 7. positive  
 9. positive 11. positive

#### Written Exercises, pages 97–98

1.  $\frac{1}{18}$  3.  $-\frac{1}{28}$  5.  $-15$  7.  $24$  9.  $3$  11.  $-1$   
 13.  $-3$  15.  $jk$  17.  $-27a^3$  19.  $-18m$  21.  $-4q$   
 23.  $5h^2$  25.  $-5a + 11$  27.  $-4c + 6d$   
 29.  $-7j - 5k$  31.  $6w - 9z$  33.  $8s - 11t$   
 35.  $-5m^2 - 6m - 7$  37.  $-6w^2$  39.  $-2r - 10s$

41.  $4a - 50b$  43.  $\{-4\}$  45.  $\left\{\frac{2}{5}\right\}$  47.  $\emptyset$  49.  $\emptyset$
51. 1.  $a$  and  $b$  are real numbers such that  $b \neq 0$  Hypothesis  
 2.  $\frac{1}{b}$  is a real number. Ax. of mult. inv.  
 3.  $(ab)\left(\frac{1}{b}\right) = a\left[b\left(\frac{1}{b}\right)\right]$  Assoc. ax. for mult.  
 4.  $= a \cdot 1$  Ax. of mult. inv.  
 5.  $= a$  Iden. ax. for mult.  
 6.  $\therefore (ab)\left(\frac{1}{b}\right) = a$  Trans. ax. of =
53. 1.  $a$  and  $b$  are real numbers such that  $b \neq 0$  Hypothesis  
 2.  $\frac{1}{b}$  is a real number. Ax. of mult. inv.  
 3.  $-\frac{1}{b}(ab) = -\left[\frac{1}{b}(ab)\right]$  Prop. of opp. in products  
 4.  $= -\left[\left(\frac{1}{b} \cdot b\right)a\right]$  Comm. and assoc. ax. for mult.  
 5.  $= -(1 \cdot a)$  Ax. of mult. inv.  
 6.  $= -a$  Iden. ax. for mult.  
 7.  $\therefore -\frac{1}{b}(ab) = -a$  Trans. ax. of =
55. 1.  $a$  and  $b$  are real numbers such that  $a, b, \neq 0$  Hypothesis  
 2.  $\frac{1}{a}$  and  $\frac{1}{b}$  are real numbers. Ax. of mult. inv.  
 3.  $-\frac{1}{a}\left(-\frac{1}{b}\right) = \frac{1}{a} \cdot \frac{1}{b}$  Prop. of opp. in products  
 4.  $= \frac{1}{ab}$  Prop. of recip. of a product  
 5.  $-\frac{1}{a}\left(-\frac{1}{b}\right) = \frac{1}{ab}$  Trans. ax. of =
2.  $(a \div b)b = \left(a \cdot \frac{1}{b}\right)b$  Def. of div.  
 3.  $= a\left(\frac{1}{b} \cdot b\right)$  Assoc. ax. for mult.  
 4.  $= a \cdot 1$  Ax. of mult. inv.  
 5.  $= a$  Iden. ax. for mult.  
 6.  $\therefore (a \div b)b = a$  Trans. ax. of =
45. 1.  $a$  is a real number such that  $a \neq 0$  Hypothesis  
 2.  $\frac{a}{a} = a \cdot \frac{1}{a}$  Def. of div.  
 3.  $= 1$  Ax. of mult. inv.  
 4.  $\therefore \frac{a}{a} = 1$  Trans. ax. of =
47. 1.  $a$  and  $b$  are real numbers such that  $b \neq 0$  Hypothesis  
 2.  $\frac{a+b}{b} = (a+b)\frac{1}{b}$  Def. of div.  
 3.  $= a \cdot \frac{1}{b} + b \cdot \frac{1}{b}$  Dist. ax.  
 4.  $= a \cdot \frac{1}{b} + 1$  Ax. of mult. inv.  
 5.  $= \frac{a}{b} + 1$  Def. of div.  
 6.  $= 1 + \frac{a}{b}$  Comm. ax. for add.  
 7.  $\therefore \frac{a+b}{b} = 1 + \frac{a}{b}$  Trans. ax. of =

49. closed 51. closed 53. not closed 55. closed  
 57. closed

Written Exercises, pages 101–103

1.  $-32$  3.  $-25$  5.  $75$  7.  $-\frac{1}{3}$  9.  $-29jk$   
 11.  $-12$  13.  $-272w^3$  15.  $14r$  17.  $39$  19.  $0$   
 21. a.  $\frac{1}{2}$  b.  $\frac{1}{2}$  23. a.  $1$  b.  $1$  25. a.  $-1$  b.  $1$   
 27. a.  $-1$  b.  $-1$  29.  $16$  31.  $-2$  33.  $-\frac{3}{2}$   
 35.  $4$  37.  $-7$  39.  $\frac{1}{2}$  41. 1. Hypothesis  
 2. Definition of division 3. Associative axiom for multiplication  
 4. Axiom of multiplicative inverses  
 5. Identity axiom for multiplication 6. Transitive axiom of equality  
 43. 1.  $a$  and  $b$  are real numbers such that  $b \neq 0$  Hypothesis

Self-Test 3, page 103

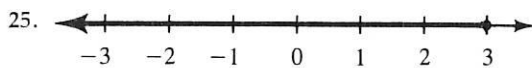
1.  $-44$  2.  $63x^2$  3.  $-12y + 7$  4.  $z^3 - 9z$  5.  $\frac{1}{21}$   
 6.  $-15w$  7.  $-7p + q$  8.  $-13$  9.  $\frac{8}{5}$  10.  $-4n$

Chapter Review, pages 105–106

1. c 2. c 3. d 4. c 5. a 6. d 7. b 8. a  
 9. c 10. b 11. c 12. d 13. d 14. c 15. d  
 16. d 17. a 18. b 19. c 20. a

Mixed Review, pages 107–108

1.  $-18$  3.  $140$  5.  $-16a$  7.  $36c$  9.  $17$  11.  $10$   
 13.  $\emptyset$  15.  $\emptyset$  17.  $\{-4, -3\}$  19.  $\{-4, -3, -2, -1, 0\}$  21.  $-14$  23.  $-56$



29. True 31. True 33.  $5n + 25q + 100x$   
35. 9000 m

**On the Calculator, page 108**

1. 0.0625 3. -16 5. 0.025 7. 0.25

**Preparing for College Entrance Exams, page 109**

1. E 3. D 5. C 7. C

**Application, page 111**

1.  $25^{\circ}\text{C}$  3.  $-39.15^{\circ}\text{C}$  to  $355.85^{\circ}\text{C}$

**Chapter 3 Solving Equations and Problems**

**Written Exercises, pages 116–118**

1. (a) Addition property of equality (b) Associative axiom for addition (c) Axiom of additive inverses (d) Identity axiom for addition 3. (a) Multiplication property of equality (b) Associative axiom for multiplication (c) Axiom of multiplicative inverses (d) Identity axiom for multiplication 5. (a) Definition of subtraction (b) Addition property of equality (c) Associative axiom for addition (d) Axiom of additive inverses (e) Identity axiom for addition
7. 1. Hypothesis 2. Axiom of additive inverses  
3. Hypothesis 4. Addition property of equality  
5. Definition of subtraction
9. 1.  $a, b,$  and  $c$  are real numbers. Hypothesis  
2.  $-c$  is a real number. Ax. of add. inv.  
3.  $a + c = b + c$  Hypothesis  
4.  $(a + c) + (-c)$  Add. prop. of =  
 $= (b + c) + (-c)$   
5.  $a + [c + (-c)]$  Assoc. ax. for  
 $= b + [c + (-c)]$  add.  
6.  $a + 0 = b + 0$  Ax. of add. inv.  
7.  $\therefore a = b$  Iden. ax. for add.
11. 1.  $a, b,$  and  $c$  are real numbers. Hypothesis  
 $a - c = b - c$   
2.  $a + (-c) = b + (-c)$  Def. of subt.  
3.  $[a + (-c)] + c$  Add. prop. of =  
 $= [b + (-c)] + c$  of =  
4.  $a + [(-c) + c]$  Assoc. ax. for  
 $= b + [(-c) + c]$  add.  
5.  $a + 0 = b + 0$  Ax. of add. inv.  
6.  $\therefore a = b$  Iden. ax. for add.
13. 1.  $a$  and  $b$  are real numbers. Hypothesis  
2.  $-b$  is a real number. Ax. of add. inv.  
3.  $a + b = 0$  Hypothesis  
4.  $(a + b) + (-b) = 0 + (-b)$  Add. prop. of =  
5.  $a + [b + (-b)] = 0 + (-b)$  Assoc. ax. for add.

6.  $a + 0 = 0 + (-b)$   
7.  $\therefore a = -b$

Ax. of add. inv.  
Iden. ax. for add.

15. 1.  $a, b,$  and  $x$  are real numbers;  $a - b = x$  Hypothesis  
2.  $x = a - b$  Symm. ax. of =  
3.  $x = a + (-b)$  Def. of subt.  
4.  $x + b = [a + (-b)] + b$  Add. prop. of =  
5.  $x + b = a + [(-b) + b]$  Assoc. ax. for add.  
6.  $x + b = a + 0$  Ax. of add. inv.  
7.  $x + b = a$  Iden. ax. for add.  
8.  $\therefore b + x = a$  Comm. ax. for add.
17. 1.  $a, b, c,$  and  $d$  are real numbers;  $a = b$  Hypothesis  
2.  $a + c = b + c$  Add. prop. of =  
3.  $c = d$  Hypothesis  
4.  $\therefore a + c = b + d$  Subs. prin.
19. 1.  $a, b, c,$  and  $d$  are real numbers;  $a = b$  Hypothesis  
2.  $ac = bc$  Mult. prop. of =  
3.  $c = d$  Hypothesis  
4.  $\therefore ac = bd$  Subs. prin.
21. 1.  $a, b, c,$  and  $d$  are real numbers;  $a = b$  Hypothesis  
2.  $a - c = b - c$  Subt. prop. of =  
3.  $c = d$  Hypothesis  
4.  $\therefore a - c = b - d$  Subs. prin.

**Written Exercises, pages 120–121**

1.  $\{-2\}$  3.  $\{12\}$  5.  $\{1\}$  7.  $\{43\}$  9.  $\{5\}$   
11.  $\{-21\}$  13.  $\{20\}$  15.  $\{0\}$  17.  $\{-3\}$  19.  $\left\{-\frac{1}{6}\right\}$   
21.  $\{0.22\}$  23.  $\{7\}$  25.  $\{-11\}$  27.  $\{-1\}$   
29.  $\{-0.72\}$  31.  $\{14, -14\}$  33.  $\{1, -1\}$  35.  $\emptyset$   
37.  $\{-11\}$  39.  $\{23\}$  41.  $\{-3\}$  43.  $\{-14\}$   
45.  $\left\{-\frac{8}{3}\right\}$  47.  $\left\{-\frac{11}{6}\right\}$  49.  $\{0.1\}$  51.  $\{8, -8\}$   
53.  $\emptyset$  55.  $\{0\}$  57.  $\{-13\}$  59.  $\left\{\frac{2}{3}\right\}$  61.  $t > 0$   
63.  $t < -1$  65.  $t < 2$

**Written Exercises, pages 123–124**

1.  $\{-11\}$  3.  $\{-21\}$  5.  $\{14\}$  7.  $\{60\}$  9.  $\{0\}$   
11.  $\{90\}$  13.  $\left\{-\frac{7}{6}\right\}$  15.  $\{11\}$  17.  $\left\{-\frac{4}{49}\right\}$  19.  $\{1\}$   
21.  $\{-0.1\}$  23.  $\{1.5\}$  25.  $\{-0.8\}$  27.  $\left\{\frac{8}{3}\right\}$   
29.  $\{2, -2\}$  31.  $\{15, -15\}$  33.  $\left\{\frac{9}{8}, -\frac{9}{8}\right\}$  35.  $\emptyset$   
37.  $\{0\}$  39.  $\{400, -400\}$  41.  $\emptyset$  43.  $\{6\}$   
45.  $\left\{\frac{3}{4}\right\}$  47.  $\left\{\frac{3}{2}, -\frac{3}{2}\right\}$  49.  $\{-2\}$

Written Exercises, pages 127–128

1. {1} 3. {2,4} 5. {6} 7. {-8} 9.  $\left\{-\frac{17}{2}\right\}$   
 11.  $\left\{\frac{16}{3}\right\}$  13. {9} 15.  $\left\{\frac{7}{3}\right\}$  17.  $\left\{\frac{41}{5}\right\}$  19.  $\left\{\frac{5}{6}\right\}$   
 21. {0} 23. {3} 25.  $\left\{-\frac{14}{3}\right\}$  27. {2} 29. {12}  
 31. {-14} 33. {3} 35. {4} 37. {-6} 39. {6}  
 41. {17} 43. {15} 45.  $\left\{\frac{17}{4}\right\}$  47.  $\left\{\frac{15}{4}\right\}$  49. {4}  
 51. {0} 53. {-6} 55. {3} 57.  $\left\{\frac{1}{4}\right\}$  59.  $\left\{-\frac{2}{3}\right\}$

Computer Exercises, page 129

1. {-2} 3. {-12} 5. {26} 7. {1} 9. {14, -14}  
 11. {7, -7}

Self-Test 1, page 129

1. Addition property of equality 2. Multiplication property of equality 3. {-26} 4. {16} 5. {-75}  
 6. {9, -9} 7. {5} 8. {12} 9. {-1} 10. {-1}

Problems, pages 132–134

1. 19, 25 3. 22 min 5. Darcy's: 1.2 m; Damon's: 1.6 m 7. width: 1 m; length: 9 m 9. 9 atoms  
 11. 52, 17 13. 38 quarters 15. Aardvark: \$1860; Afghan: \$950; Armadillo: \$1020. 17. Debating: 24; Math: 32; Ecology: 12 19. 18 nickels, 22 quarters  
 21. 273 m<sup>2</sup> 23. 4550 m<sup>2</sup> 25. boxer: \$200; Dalmatian: \$220; Airedale: \$250; miniature schnauzer: \$200

Written Exercises, page 136–137

1. {7} 3. {11} 5.  $\emptyset$  7. {-9} 9.  $\left\{\frac{18}{25}\right\}$  11.  $\mathcal{R}$   
 13. {0} 15.  $\left\{\frac{3}{10}\right\}$  17. {3} 19.  $\left\{\frac{66}{35}\right\}$  21. {9}  
 23.  $\left\{-\frac{20}{7}\right\}$  25. {1} 27.  $\left\{-\frac{29}{11}\right\}$  29. {-4}  
 31.  $\left\{\frac{7}{4}\right\}$  33.  $\left\{\frac{5}{9}\right\}$  35.  $\left\{\frac{1}{2}\right\}$  37.  $\left\{\frac{23}{16}\right\}$  39. {34}  
 41.  $\left\{-\frac{13}{4}\right\}$  43.  $\left\{-\frac{3}{2}\right\}$  45.  $\emptyset$  47. {5} 49. {-2.2}  
 51. {-5} 53. a. 7 b. 3 c.  $2p + 3$  d. Example:  $2p + 2$  e.  $2p + 3$  55. a. 7 b. 1 c.  $3k + 1$  d. Example:  $3k + 2$  e.  $3k + 1$

Computer Exercises, page 137

1. {1} 3. {3} 5.  $\emptyset$

Problems, pages 139–141

1. -6 3. 11 5. 3, 13 7. 19 years 9. in 1992  
 11. 6400 km 13. Panama Canal: 160 km; Suez Canal: 81 km 15. 35 books 17. width: 30 m; length: 50 m 19. \$17.10 21. 2013 23. a. 1954 b. 2010

Reading Algebra, page 143

1.  $3d$  3.  $d + 3d + (3d + 4)$  5. No 7. Yes  
 9. a. 8 is the number of dimes. b. \$7.00 is the value of the quarters.

Written Exercises, page 146

1.  $I = \frac{V}{R}$  3.  $v = \frac{-4xy}{3w}$  5.  $c = \frac{a^2b}{3x}$  7.  $h = \frac{-xy}{3g^2}$   
 9.  $x = \frac{b - 2c}{-2a}$  11.  $c = \frac{-2ax - b}{-2}$ , or  $\frac{2ax + b}{2}$   
 13.  $a = \frac{-4d}{b - c}$  15.  $b = \frac{ac - 4d}{a}$ , or  $c = \frac{4d}{a}$   
 17.  $c = \frac{ab + 4d}{a}$ , or  $b + \frac{4d}{a}$  19.  $x = \frac{9a^2 + 4c}{3a^2}$ , or  $3 + \frac{4c}{3a^2}$  21.  $b = \frac{2A}{h}$  23.  $m = \frac{2E}{c^2}$  25.  $c = 3n - t$   
 27.  $s = \frac{-0.06k}{t^2}$  29.  $h = \frac{2A}{a + b}$  31.  $a = \frac{2(A - wt)}{t^2}$   
 33.  $b = \frac{3}{2}C - a$  35.  $y = 3x - \frac{2A}{5h}$ , or  $\frac{15hx - 2A}{5h}$   
 37.  $P = \frac{A}{1 + rt}$  39.  $d = \frac{kA}{4\pi C}$  41.  $t = \frac{c_1 - c_2}{2C}$   
 43.  $c_2 = c_1 - 2Ct$  45.  $E = I(R + r)$   
 47.  $r = \frac{E - IR}{I}$ , or  $\frac{E}{I} - R$  49.  $b = \frac{at + 3}{t - 4}$   
 51.  $t = \frac{-4b - 3}{a - b}$  53.  $f_1 = \frac{-Ff_2}{F - f_2}$  55. {0} 57. {6}

Problems, page 147

1. a.  $h = \frac{V}{lw}$ ,  $l, w \neq 0$  b. 14 cm 3. a.  $h = \frac{SA}{2\pi r} - r$ ,  $r \neq 0$  b. 11 cm 5. 24 m 7. 48 ft

Self-Test 2, page 148

1.  $x + (x + 6) = 42$ ; {18}; 18, 24  
 2.  $10d + 5(d - 5) = 110$ ; {9}; 9 dimes 3. {2}  
 4. {-10} 5. 17 years 6. width: 1 cm; length: 4 cm  
 7.  $b = \frac{2A}{a}$ ,  $a \neq 0$  8.  $b = \frac{2A}{h} - a$ ,  $h \neq 0$

Extra, page 150

1. Plan: Assume  $a = b$ .  
 1.  $a + c = b + c$  Add. prop. of =  
 2.  $a + c \neq b + c$  Hypothesis  
 Statement (1) contradicts the hypothesis  $a + c \neq b + c$ .  $\therefore$  the assumption  $a = b$  is incorrect and the conclusion  $a \neq b$  is true.  
 3. Plan: Assume  $a = b$ .  
 1.  $ac = bc$  Mult. prop. of =  
 2.  $ac \neq bc$  Hypothesis  
 Statement (1) contradicts the hypothesis  $ac \neq bc$ .  $\therefore$  the assumption  $a = b$  is incorrect and the conclusion  $a \neq b$  is true.  
 5. Plan: Assume  $-a = -b$ .  
 1.  $-1(-a) = -1(-b)$  Mult. prop. of =  
 2.  $1 \cdot a = 1 \cdot b$  Prop. of opp. in prod.  
 3.  $a = b$  Iden. ax. of mult.  
 4.  $a \neq b$  Hypothesis  
 Statement (3) contradicts the hypothesis  $a \neq b$ .



$\therefore$  the assumption  $-a = -b$  is incorrect and the conclusion  $-a \neq -b$  is true.

7. *Plan:* Assume  $1 = 2$ .

1.  $1 + (-1) = 2 + (-1)$  Add. prop. of =
2.  $0 = 2 + (-1)$  Ax. of add. inv.
3.  $0 = 1$  Subst. prin.

Statement (3) contradicts the iden. ax. for mult. which states  $1 \neq 0$ .

$\therefore$  the assumption  $1 = 2$  is incorrect and the conclusion  $1 \neq 2$  is true.

### Chapter Review, pages 151–152

1. b 2. a 3. c 4. a 5. b 6. c 7. d 8. b
9. d 10. d 11. b 12. c 13. a 14. c 15. b
16. b 17. c 18. a.

### Cumulative Review, pages 154–155

1. True 3. True 5.  $7\frac{13}{24}$  7. 26 9. 26 11. 12

13. 3 15.  $\frac{13}{2}$  17. -83 19. 253 21. -28

23.  $-4a^2 + 7$  25.  $105c^3$  27.  $21u - 12v$

29. Axiom of additive inverses 31. Property of the opposite of a sum 33. Property of opposites in

- products 35.  $\{20\}$  37.  $\{-\frac{1}{2}\}$  39.  $\{-11\}$  41.  $\{-2\}$

43.  $\{7\}$  45.  $\{-4\}$  47. width: 6 cm; length: 10 cm

### Contest Problems, page 155

1.  $-\frac{1}{6}$  3.  $-\frac{1}{5}$  5. a. Yes b. u

3.  $x^2 \cdot x > 0 \cdot x$  Mult. prop. of order

4.  $x^2 \cdot x = x \cdot x \cdot x$  Def. of  $x^2$

5.  $x \cdot x \cdot x = x^3$  Def. of  $x^3$

6.  $x^2 \cdot x = x^3$  Trans. ax. of =

7.  $0 \cdot x = 0$  Mult. prop. of 0

8.  $\therefore x^3 > 0$  Subst. prin.

37. 1.  $x$  and  $y$  are real numbers; Hypothesis  
 $x < 0$  and  $y < 0$

2.  $xy > 0 \cdot y$  Mult. prop. of order

3.  $\therefore xy > 0$  Mult. prop. of 0

39. 1.  $m$  and  $n$  are real numbers; Hypothesis  
 $m > 0$  and  $n > 0$ ;  
 $m < n$

2.  $m \cdot m < m \cdot n$  Mult. prop. of order

3.  $m \cdot n < n \cdot n$  Mult. prop. of order

4.  $m \cdot m < n \cdot n$  Trans. prop. of order

5.  $m \cdot m = m^2$  Def. of  $m^2$

6.  $n \cdot n = n^2$  Def. of  $n^2$

7.  $\therefore m^2 < n^2$  Subst. prin.

41. 1.  $x$  and  $y$  are real numbers; Hypothesis  
 $x < y$

2.  $x + x < x + y$  Add. prop. of order

3.  $2x < x + y$  Subst. prin.

4.  $\frac{2x}{2} < \frac{x + y}{2}$  Mult. prop. of order

5.  $\therefore x < \frac{x + y}{2}$  Subst. prin.

43. False;  $a = \frac{1}{2}$ ,  $b = \frac{1}{3}$  45. False;  $a = \frac{1}{2}$ ,  $b = \frac{1}{3}$

## Chapter 4 Solving Inequalities and Problems

### Written Exercises, pages 161–163

1.  $<$  3.  $<$  5.  $>$  7.  $<$  9.  $<$  11.  $=$  13.  $>$

15.  $>$  17.  $<$  19.  $<$  21. 1. Hypothesis 2. Addition property of order 3. Hypothesis 4. Addition property of order

5. Transitive property of order 23. 1. Hypothesis 2. Addition property of order 3. Definition of subtraction 4. Axiom of additive inverses 25.  $\{0\}$  27.  $\{t: t \neq 0\}$  29.  $\{t: t < 0\}$

31.  $\{x, y: |x| < |y|\}$

33. 1.  $a$  is a real number; Hypothesis  
 $a < 0$

2.  $-1(a) > -1(0)$  Mult. prop. of order

3.  $-1(a) = -a$  Mult. prop. of  $-1$

4.  $-1(0) = 0$  Mult. prop. of 0

5.  $\therefore -a > 0$  Subst. prin.

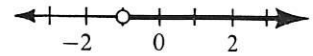
35. 1.  $x$  is a real number; Hypothesis

$x > 0$

2.  $x^2 > 0$  Exercise 34

### Written Exercises, page 166

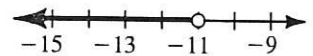
1.  $\{a: a > -1\}$



3.  $\{c: c > -6\}$



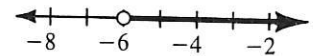
5.  $\{b: b < -11\}$



7.  $\{m: m < 12\}$



9.  $\{t: t > -6\}$



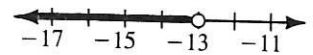
11.  $\{w: w > 0\}$



13.  $\{c: c > 7\}$

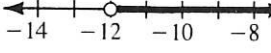




15.  $\{d: d < -13\}$



17.  $\{e: e < -6\}$



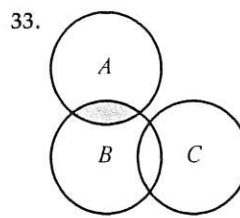
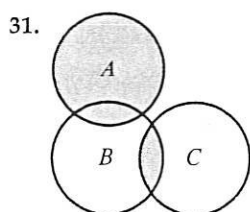
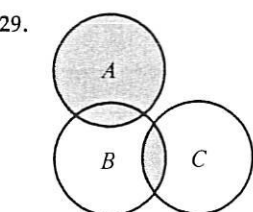
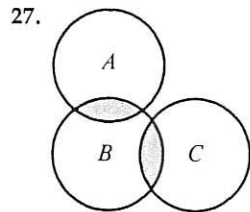
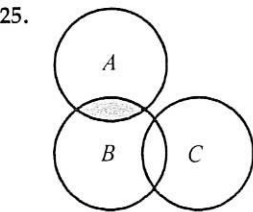
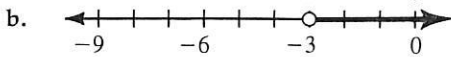
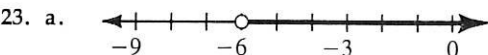
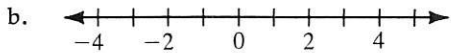
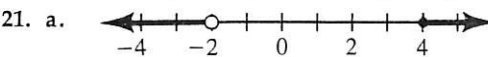
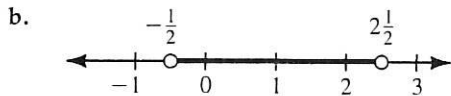
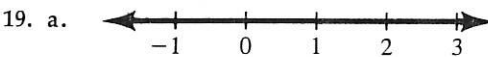
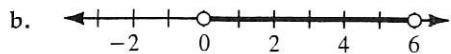
19.  $\{f: f > -12\}$    
 21.  $\{u: u > 15\}$    
 23.  $\{h: h < 19\}$    
 25.  $\{i: i < 2\}$  27.  $\{j: j < 12\}$  29.  $\{k: k > -10\}$   
 31.  $\{t: t > \frac{1}{9}\}$  33.  $\{a: a > -6\}$  35.  $\emptyset$   
 37.  $\{s: s < -2\}$  39.  $\{b: b < 4\}$

**Computer Exercises, pages 166–167**

1.  $\{x: x < 3\}$  3.  $\{z: z > -6\}$  5.  $\{a: a < 4\}$   
 7.  $\{b: b > -3\}$  9.  $\{m: m < 5\}$  11.  $\{r: r > 3\}$   
 13.  $\emptyset$

**Written Exercises, pages 169–170**

1.  $\{-1, 1\}$ ;  $\{-3, -1, 0, 1, 3\}$  3.  $\emptyset$ ;  $\{-6, -4, 1, 2, 4, 6\}$   
 5.  $\{-2, 1, 8, 10\}$ ;  $\{-2, 1, 8, 10\}$  7.  $\emptyset$ ;  $\{1, 2, 3, 4\}$   
 9.  $\{2, 4\}$ ;  $\{1, 3, \text{the even whole numbers}\}$  11.  $\emptyset$ ;  $\{\text{the integers less than 4 and the integers greater than 6}\}$   
 13.  $\{2, 3, 4\}$ ;  $\{1, 2, 3, 4, 5\}$  15.  $\{0, 1, 2, 3, 4, 5, 6\}$ ;  $\{0, 1, 2, 3, 4, 5, 6, 7\}$

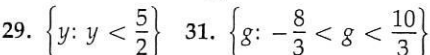
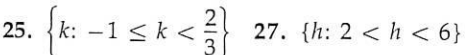


35.  $\mathcal{R}$   
 37.  $\emptyset$   
 39.  $\{1, 3, 6\}$   
 41.  $\{0, 1, 2, 3, 4, 5\}$   
 43.  $\{0, 3, 5, 6\}$

**Written Exercises, pages 173–174**



3.  $\emptyset$



33.  $\{x: -6 \leq x \leq 10\}$  35.  $\{d: 2 < d < 5\}$  37.  $\mathcal{R}$

39.  $\{e: -4 < e < 1\}$  41.  $\{x: \frac{1}{2} < x \leq 2\}$  43.  $\mathcal{R}$

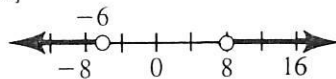
45.  $\{x: -2 \leq x < 3\}$  47.  $\{x: x \geq -3\}$

**Written Exercises, pages 177–178**

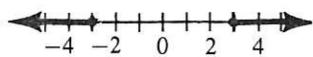
1.  $|x - 5| = 2$  3.  $|x + 1| < 3$  5.  $|x - 1| \leq 6$   
 7.  $|x - 10| \geq 5$  9.  $|x - 5| > b$



21.  $\{x: x < -6 \text{ or } x > 8\}$



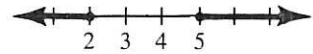
23.  $\{v: v \leq -3 \text{ or } v \geq 3\}$



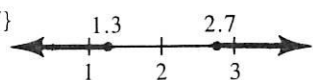
25.  $\{w: -6 \leq w \leq 6\}$



27.  $\{w: w \leq 2 \text{ or } w \geq 5\}$



29.  $\{c: c \leq 1.3 \text{ or } c \geq 2.7\}$



31.  $\mathcal{R}$



33.  $\{x: -11 < x < -1\}$



35.  $\{c: c \leq 0 \text{ or } c \geq 6\}$  37.  $\emptyset$  39.  $\left\{c: -\frac{13}{2} < c < \frac{7}{2}\right\}$

41.  $\{x: 1 \leq x \leq 11\}$  43.  $\{d: d < -9 \text{ or } d > -1\}$

Examples are given for Exercises 45–55.

45.  $|x| = 2$  47.  $|x| < -1$  49.  $|x - 7| = 2$

51.  $|x + 10| = 2$  53.  $|x| < 4$  55.  $|x - 2| > 3$

57. a.  $\emptyset$  b.  $\{x: x \geq -3\}$  c.  $\{x: x < -3\}$

59. a.  $\mathcal{R}$  b.  $\mathcal{R}$  c.  $\{x: x \leq 0\}$  61. a.  $\{x: x > 0\}$

b.  $\{x: x \leq 0\}$  c.  $\emptyset$

63.  $\{d: -5 < d < -3 \text{ or } 3 < d < 5\}$  65.  $\emptyset$

**Self-Test 1, pages 178–179**

1. Addition property of order 2. Multiplication property of order 3.  $\{x: x > -4\}$  4.  $\{y: y \geq -1\}$   
 5. {the whole numbers less than 5} 6. {the integers greater than  $-5$  and less than or equal to 6}

7.  $\{t: -10 \leq t < 2\}$

8.  $\{m: m > 5 \text{ or } m < -11\}$

9.  $\{-5, 7\}$

10.  $\{-6, -2\}$

11.  $\{p: p < 2 \text{ or } p > 8\}$

12.  $\{x: -\frac{3}{2} \leq x \leq \frac{9}{2}\}$

**Problems, pages 182–183**

1. 191, 192 3.  $-81, -79$  5. 21, 28, 35 7. 94, 96, 98  
 9. 23, 25 11. 7 13.  $360 \text{ m}^2$  15. 12 years, 15 years, 18 years, 21 years 17.  $\{3, 4, 5\}, \{4, 5, 6\}, \{5, 6, 7\},$

$\{6, 7, 8\}$  19.  $\{-45, -42, -39\}, \{-42, -39, -36\}$

21. 4, 6; 0, 2 23. The sum of an odd integer  $x$  and the next odd integer  $x + 2$  is  $2x + 2$  or  $2(x + 1)$ , which is even because it is a multiple of 2.

**Problems, pages 186–187**

1.  $61^\circ$  3.  $74^\circ, 16^\circ$  5.  $4^\circ$  7.  $72^\circ, 24^\circ, 84^\circ$  9.  $50^\circ, 130^\circ, 130^\circ$  11.  $30^\circ$  13.  $52^\circ, 54^\circ, 74^\circ$  15. 15 17. 36  
 19. 22 21. a.  $75^\circ$  b.  $89^\circ$  23. measure of  $\angle A$  is  $80^\circ$ , measure of  $\angle B$  is  $60^\circ$ , measure of  $\angle C$  is  $40^\circ$

**Problems, pages 192–194**

1. van, 84 km/h; truck, 60 km/h 3.  $3\frac{1}{2}$  h 5. 4 km  
 7. 4.5 m/s 9. 56 km/h; 20 km/h 11. 100 km/h  
 13. 80 km/h; 240 km/h 15. 1560 km 17. 52.2 km/h;  
 84.4 km/h 19. 27 km/h 21. 2 km/h 23. 30 km  
 25. 12 m 27. 0.8 km; 21 s

**Problems, pages 199–200**

1. 7.5 g 3. 100 g 5. 15 dimes, 30 quarters 7. 19 students  
 9. 55 km/h 11. 100 yellow, 105 pink, 410 red 13. 28 students  
 15. 1 h 17. 40 kg;  $6\frac{2}{3}\%$

**Problems, pages 202–203**

1. No solution; the sum of two consecutive integers must be odd because the sum of an odd integer and an even integer is odd. 3. 42 m, 44 m, 46 m  
 5. No solution,  $\angle B$  and  $\angle C$  are complementary angles so they are acute angles whose measures total  $90^\circ$ ; the measure of  $\angle A$  is  $90^\circ$ , and so the measure of  $\angle B$  cannot be greater than the measure of  $\angle A$ . 7. Yes, the clerk received 20 nickels, 40 dimes, and 60 quarters. 9. 5 dimes 11. No solution; not enough information is given; the time traveled by bus is needed. 13. 1440 km 15. 45 kg  
 17. 60 km/h; 150 km/h; no solution because the return trip would have to be made in zero hours.

**Self-Test 2, page 203**

1. 76, 78, 80 2. the measure of  $\angle A$  is  $50^\circ$ , the measure of  $\angle B$  is  $62^\circ$ , and the measure of  $\angle C$  is  $68^\circ$  3. 7.5 km 4. 3 kg 5. 13 quarters

**Extra, page 206**

1. T 3. T 5. T 7. T 9. T 11.  $p \rightarrow q$  is false implies that  $p$  is true and  $q$  is false.  $\sim q$  is true, so  $p \wedge \sim q$  is true.  
 13. No;

$p$	$q$	$p \vee q$	$(p \vee q) \rightarrow p$
T	T	T	T
T	F	T	T
F	T	T	F
F	F	F	T

15. Yes;

$p$	$q$	$p \vee q$	$q \vee p$	$(p \vee q) \leftrightarrow (q \vee p)$
T	T	T	T	T
T	F	T	T	T
F	T	T	T	T
F	F	F	F	T

17. Yes

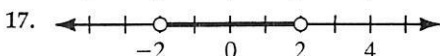
**Chapter Review, pages 208–209**

1. c 2. d 3. a 4. c 5. c 6. c 7. a 8. c 9. b  
10. a 11. b 12. d 13. b 14. d

**Mixed Review, page 210**

1.  $\frac{8}{3}$  3.  $-\frac{3}{2}$  5.  $-3a^2$  7.  $4s^2$  9.  $-6$  11. 113

13.  $-5$



21.  $\left\{-\frac{1}{2}\right\}$  23.  $\{-1\}$  25.  $\{m: m < 3\}$  27.  $\emptyset$

29.  $\{3, 7\}$  31.  $\left\{j: -4 < j < \frac{3}{2}\right\}$  33. 11 nickels,

9 dimes, 5 quarters 35. 6 years

**Preparing for College Entrance Exams, page 211**

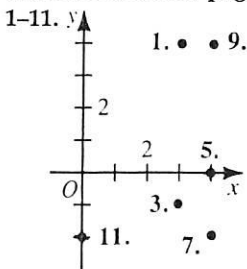
1. A 3. B 5. D 7. A

**Application, page 213**

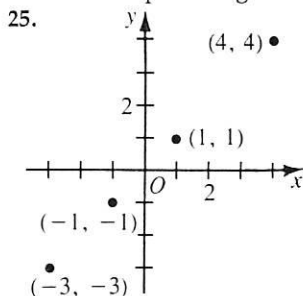
1. a. 17 km/h/s b. 42.5 km/h c. approximately 0.06 km  
3. approximately 0.16 km

**Chapter 5 Graphs and Functions**

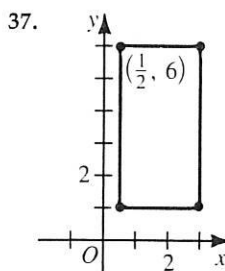
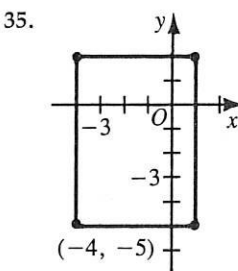
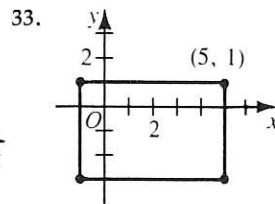
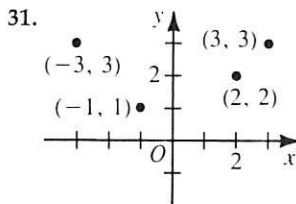
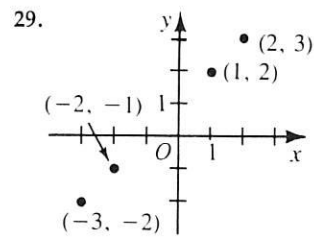
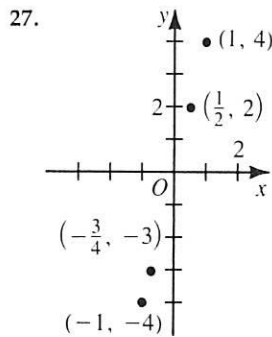
**Written Exercises, page 218**



25–31. Examples are given.



13. quad. I 15. quad. IV  
17.  $y$ -axis 19. quad. I,  
quad. III 21.  $x$ -axis,  
 $y$ -axis 23. quad. I,  
quad. III,  $x$ -axis,  $y$ -axis



39.  $(1, 0), (9, 2), (3, -6)$  41.  $(-2, -2), (6, -6)$

43.  $|b - c|$

**Written Exercises, pages 222–223**

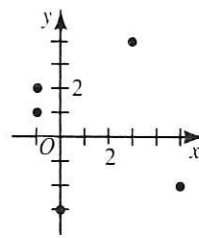
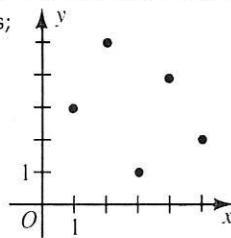
1.  $\left\{\left(\frac{3}{4}, -\frac{3}{4}\right), \left(\frac{1}{2}, -\frac{1}{2}\right), \left(\frac{1}{4}, -\frac{1}{4}\right)\right\}$

3.  $\{(0, 0), (1, -1), (1, 1)\}$

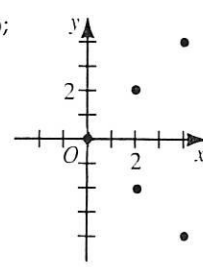
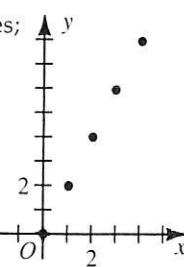
5.  $\{(-1, 1), (0, 0), (1, 1), (2, 4)\}$

7.  $\{(1, 10), (2, 10), (5, 10), (10, 10)\}$

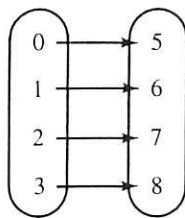
9. Yes; 11. No;



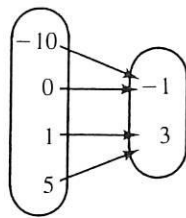
13. Yes; 15. No;



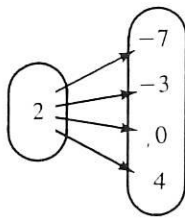
17. Yes;



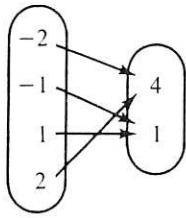
19. Yes;



21. No;



23. Yes;



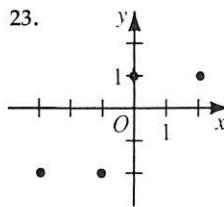
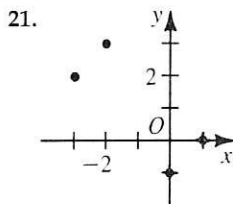
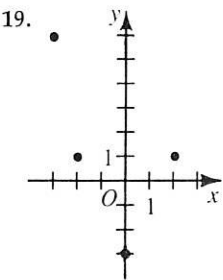
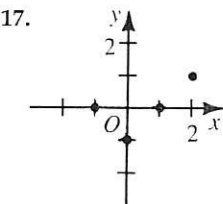
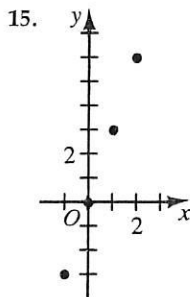
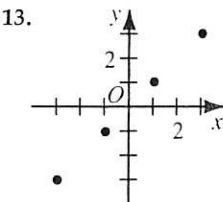
25.  $\{(2, 1), (3, 1), (5, 2), (5, 1), (10, 5), (5, 5)\}$ ; Yes; subtract the second coordinate from the first. 27. 2 29. 5 31. No, at least one element of the domain must be mapped onto at least two elements of the range.  $\therefore$  Two ordered pairs will have the same first coordinate.

**Computer Exercises, page 223**

1. quad. I; quad. III; quad. IV; quad. II;  $x$ -axis;  $y$ -axis; quad. IV; quad. III; quad. I; quad. III;  $y$ -axis;  $x$ -axis,  $y$ -axis

**Written Exercises, pages 226-227**

1.  $\{1, 2, 3, 4, 5\}$  3.  $\{-4, -2, 0, 2, 4\}$  5.  $\{-7, -4, -1, 2, 5\}$  7.  $\{2, 1, 0\}$  9.  $\{4, 1, 0\}$  11.  $\{9, 4, 1, 0\}$



25. a. 5 b.  $x = -5$

27. a. 0 b.  $x = 0$

29. a. 6 b.  $x = -3$

31. a. -1 b.  $x = 1$ ;

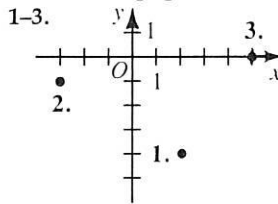
$x = -1$  33. a. -9

b.  $x = 3$ ;  $x = -3$

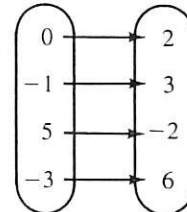
35. a. 0 b.  $x = 0$

37. 9 39. 36 41. 17 43. 5 45. 0 47. 0 49. 3  
51. -1 53.  $x + 2$  55. a. 3 b. 3 c. -3 d. -4

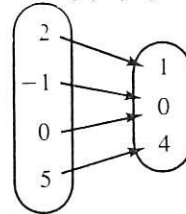
**Self-Test 1, page 227**



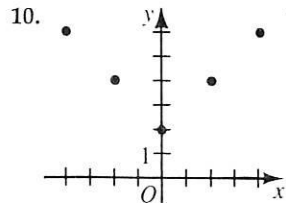
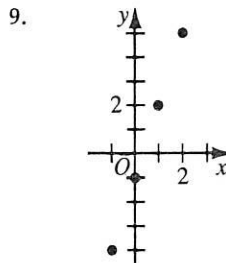
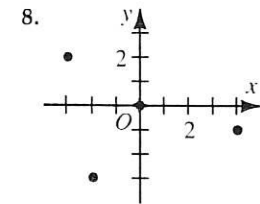
4.  $D = \{0, -1, 5, -3\}$ ,  
 $R = \{2, 3, -2, 6\}$



5.  $D = \{2, -1, 0, 5\}$ ,  
 $R = \{1, 0, 4\}$



6. Yes 7. No

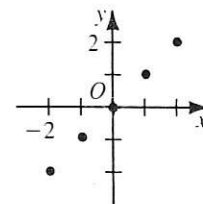


**Written Exercises, pages 230-231**

1.  $(5, -5), (0, 0), (-3, 3)$  3.  $(9, 4), (5, 0), (-7, -12)$  5.  $(1, 1), (0, -1), (-3, -7)$

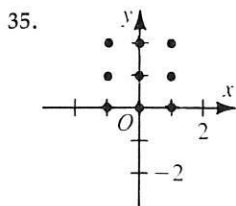
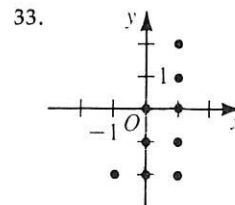
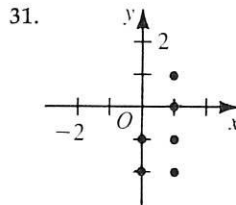
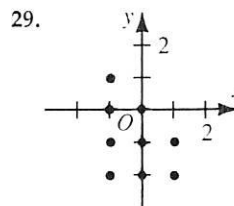
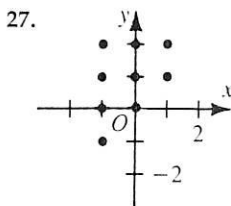
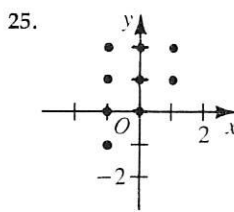
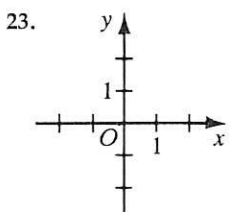
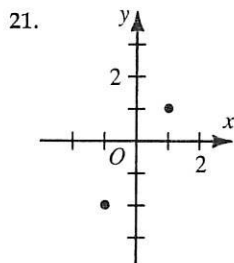
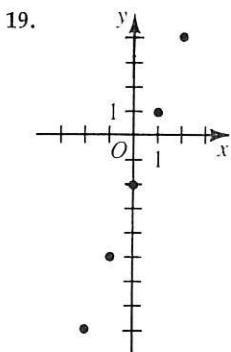
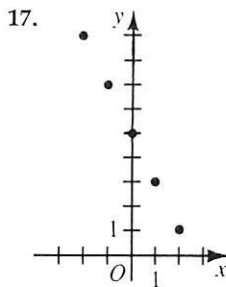
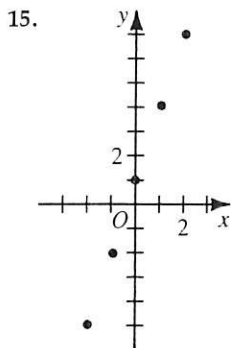
7.  $(2, 1), (0, 9), (-5, 29)$  9.  $(1, 3), (\frac{11}{2}, 0), (13, -5)$  11.  $(3, 4), (2, -1), (-2, -1)$

13.  $\{(-2, -2), (-1, -1), (0, 0), (1, 1), (2, 2)\}$



Exercises 15–35: graphs follow.

15.  $\{(-2, -5), (-1, -2), (0, 1), (1, 4), (2, 7)\}$   
 17.  $\{(-2, 9), (-1, 7), (0, 5), (1, 3), (2, 1)\}$   
 19.  $\{(-2, -8), (-1, -5), (0, -2), (1, 1), (2, 4)\}$   
 21.  $\{(-1, -2), (1, 1)\}$  23.  $\emptyset$   
 25.  $\{(-1, -1), (-1, 0), (-1, 1), (-1, 2), (0, 0), (0, 1), (0, 2), (1, 1), (1, 2)\}$   
 27.  $\{(-1, -1), (-1, 0), (-1, 1), (-1, 2), (0, 0), (0, 1), (0, 2), (1, 1), (1, 2)\}$   
 29.  $\{(-1, -2), (-1, -1), (-1, 0), (-1, 1), (0, -2), (0, -1), (0, 0), (1, -2), (1, -1)\}$   
 31.  $\{(0, -2), (0, -1), (1, -2), (1, -1), (1, 0), (1, 1)\}$   
 33.  $\{(-1, -2), (0, -2), (0, -1), (0, 0), (1, -2), (1, -1), (1, 0), (1, 1), (1, 2)\}$   
 35.  $\{(-1, 0), (-1, 1), (-1, 2), (0, 0), (0, 1), (0, 2), (1, 0), (1, 1), (1, 2)\}$



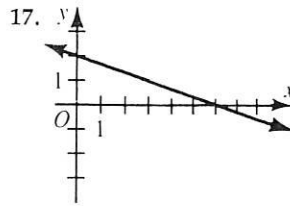
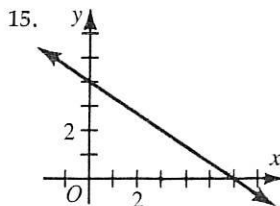
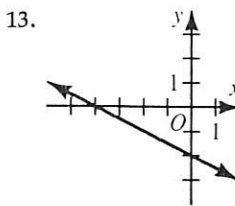
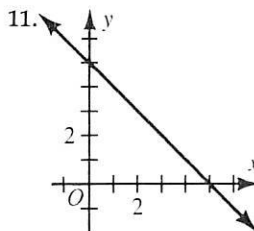
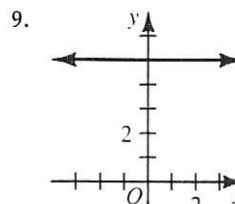
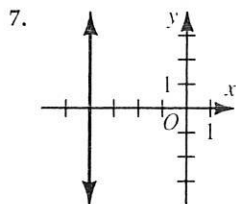
37.  $\{(2, 1), (2, 2), (3, 1)\}$   
 39.  $\{(-2, -3), (-2, -2), (-2, -1), (-1, -1)\}$   
 41.  $\{(3, 0), (3, 1), (4, 0), (5, 0)\}$   
 43.  $\{(-3, 2), (-2, 3), (2, 3), (3, 2)\}$   
 45.  $\{(-5, -3), (-5, 3), (-3, -1), (-3, 1), (3, -1), (3, 1), (5, -3), (5, 3)\}$   
 47.  $\{(-1, 0), (0, -1), (1, 0)\}$

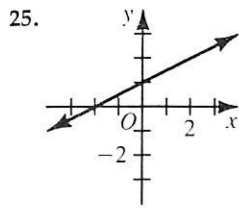
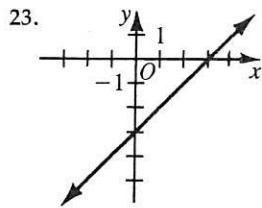
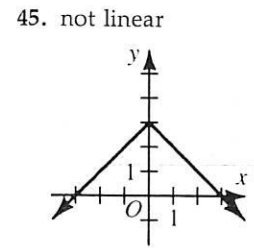
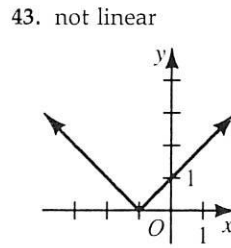
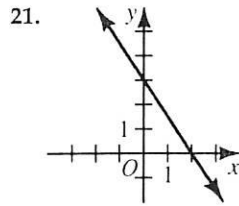
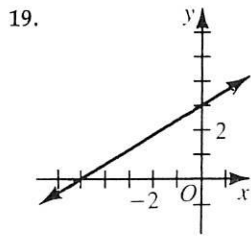
Computer Exercises, page 231

1. Yes 3. No 5. Yes 7. Yes 11.  $(-6, 12); (-3, 10); (0, 8); (3, 6); (6, 4); (9, 2); (12, 0)$

Written Exercises, pages 235–236

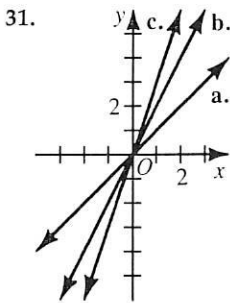
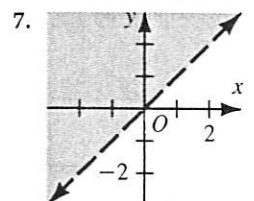
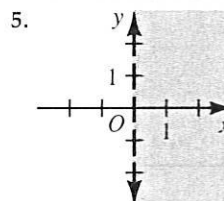
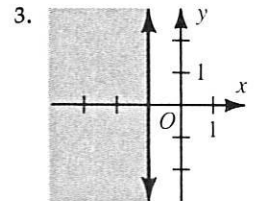
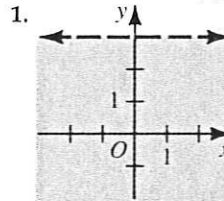
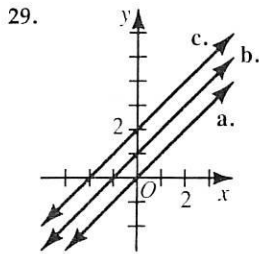
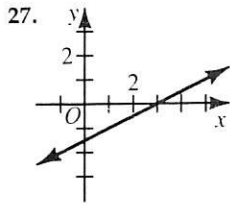
1.  $3x - 4y = -5$  3.  $5x - 3y = 8$  5.  $x + 2y = 6$



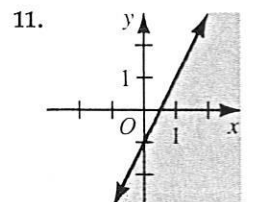
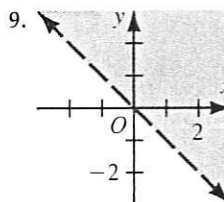


47. The graph of  $y = |x| + k$  is the graph of  $y = |x|$  translated (slid) vertically  $k$  units (up if  $k > 0$  and down if  $k < 0$ ).

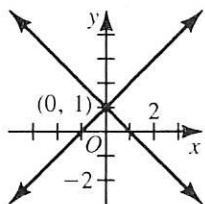
Written Exercises, page 239



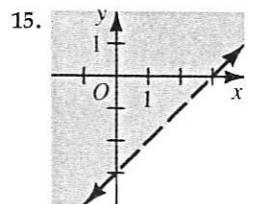
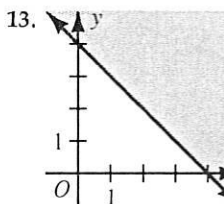
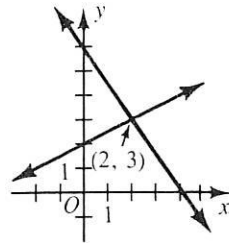
33. The graph of  $y = x + k$  is parallel to the graph of  $y = x$ , which intersects the  $y$ -axis at the origin, but the graph of  $y = x + k$  intersects the  $y$ -axis at  $(0, k)$ .



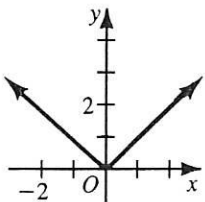
35.  $(0, 1)$ ; it satisfies both equations.



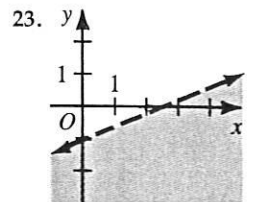
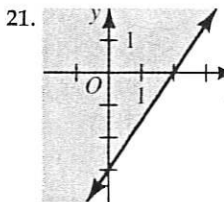
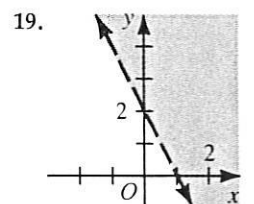
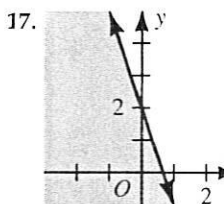
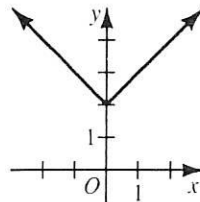
37.  $(2, 3)$ ; it satisfies both equations.

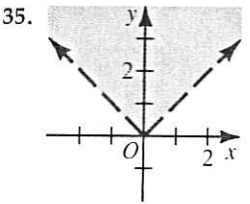
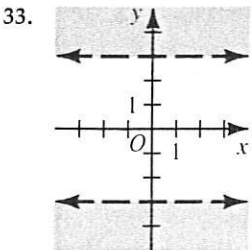
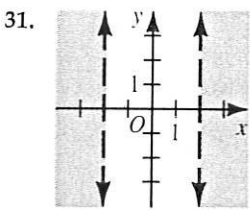
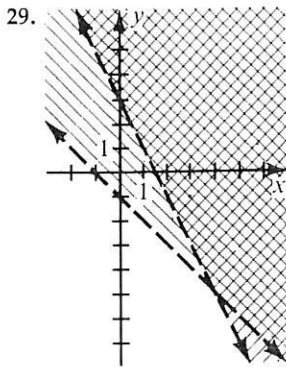
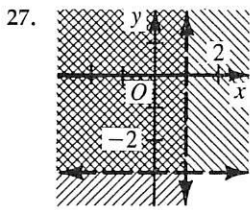
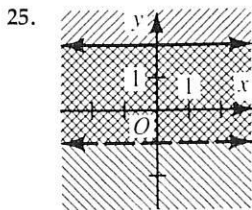


39. not linear



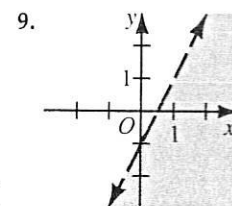
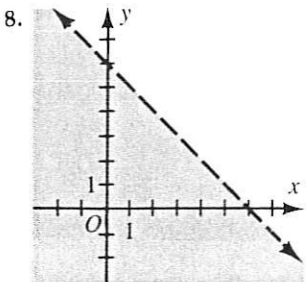
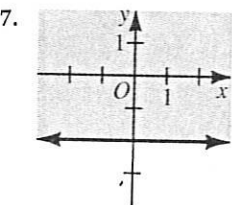
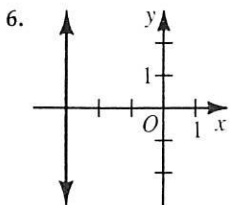
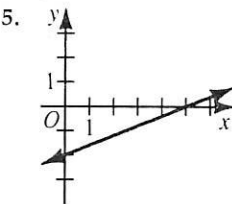
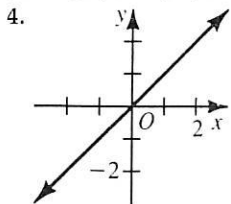
41. not linear





**Self-Test 2, page 240**

1.  $\{(2, -2)\}$  2.  $\{(2, -4)\}$  3.  $\{(-2, -4), (-2, -2), (0, -4), (0, -2), (2, -4), (2, -2)\}$

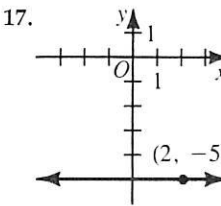
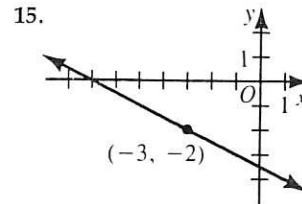
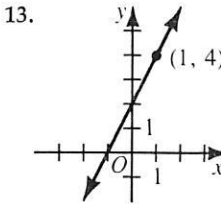


**Reading Algebra, page 241**

1. Obj. 1, p. 228 3. Obj. 2, p. 228 5. Sec. 5-5  
 7. The opposite of the sum of  $a$  and  $b$  is equal to the sum of the opposite of  $a$  and the opposite of  $b$ .  
 9. SOLUTION Given  $f(x) = 0$ :  $5 - |x| = 0$   
 $|x| = 5$   
 $x = 5$  or  $x = -5$   
 $\therefore$  the solution set is  $\{-5, 5\}$ .

**Written Exercises, page 246**

1. 2 3. 0 5. -1 7. -2 9.  $\frac{7}{2}$  11. no slope

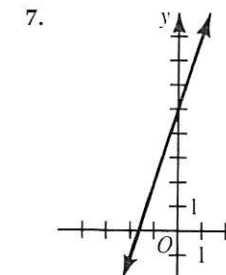
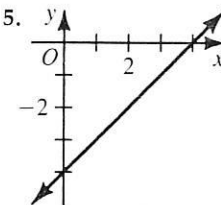
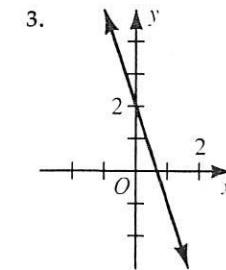
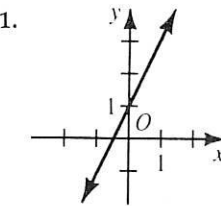


19. collinear; slope = 2  
 21. collinear; slope =  $-\frac{1}{3}$   
 23. collinear; slope = 0  
 25. -17 27. 2 29.  $\frac{1}{2}$   
 31.  $\overline{AB} : -2; \overline{AC} : -\frac{1}{3}; \overline{BC} : \frac{1}{2}$

**Written Exercises, pages 251-252**

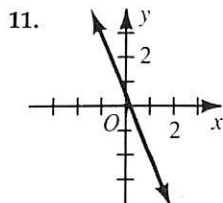
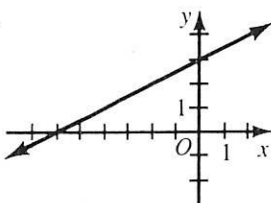
Exercises 1-11: graphs follow.

1. slope = 2; y-intercept = 1  
 3. slope = -3; y-intercept = 2  
 5. slope = 1; y-intercept = -4  
 7. slope = 3; y-intercept = 5  
 9. slope =  $\frac{1}{2}$ ; y-intercept = 3  
 11. slope = -3; y-intercept =  $\frac{1}{2}$





9.



13.  $5x - y = 1$  15.  $2x + y = 0$  17.  $y = 2$   
 19.  $x - 2y = 8$  21.  $3x - 2y = -4$   
 23.  $6x + 10y = 5$  25.  $5x + y = 3$   
 27.  $3x - y = 11$  29.  $x - y = 7$  31.  $x = -3$   
 33.  $\frac{3}{2}$  35.  $-4$  37.  $y = -\frac{a}{b}x + \frac{c}{b}, b \neq 0$

39. If  $by - c = 0, y = \frac{c}{b}$ . From Exercise 37, the  $y$ -intercept of the graph of  $ax + by = c$  is  $\frac{c}{b}$ .

Replacing  $y$  with  $\frac{c}{b}$  in the equation  $by - c = 0$ , you obtain  $b\left(\frac{c}{b}\right) - c = 0$ , or  $0 = 0$ . Thus,  $\frac{c}{b}$  is a root of  $by - c = 0$ .

**Written Exercises, pages 254–255**

1.  $2x - y = 1$  3.  $2x + y = 4$  5.  $x - 2y = -6$   
 7.  $x + 5y = -13$  9.  $y = 5$  11.  $x = -2$   
 13.  $x + y = 6$  15.  $3x + y = 0$  17.  $5x + y = 24$   
 19.  $x - 3y = 8$  21.  $y = 7$  23.  $x = -3$  25. 3  
 27.  $-3$  29. 0 31.  $f: x \rightarrow -x + 3$

33.  $f: x \rightarrow \frac{5}{2}x + \frac{1}{2}$  35.  $f: x \rightarrow \frac{4}{3}x + \frac{20}{3}$

37.  $r = -9, s = 4$  39. The equation of the line with slope  $m$  and  $y$ -intercept  $b$  is  $y = mx + b$ . Since point  $(x_1, y_1)$  is on the line, the coordinates satisfy the equation. So  $y_1 = mx_1 + b. \therefore b = y_1 - mx_1$

**Self-Test 3, page 255**

1. 3 2.  $-\frac{3}{2}$  3.  $m = 3, b = -5$  4.  $m = -\frac{3}{2}, b = \frac{7}{2}$   
 5.  $4x - y = 1$  6.  $2x + 5y = 15$   
 7.  $3x - y = 0$  8.  $4x - 3y = 6$

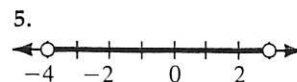
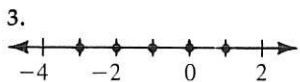
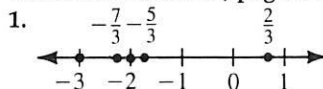
**Extra, page 257**

1. a.  $x' = x + 1, y' = y - 3$  b.  $(-6, 0)$   
 3. a.  $x' = x + 13, y' = y - 3$  b.  $(6, 0)$   
 5. a.  $x' = x + 7, y' = y + 2$  b.  $(0, 5)$   
 7. a.  $x' = x + 9, y' = y - 5$  b.  $(2, -2)$   
 9. A translation in which  $h = 0$ ;  
 a translation in which  $k = 0$

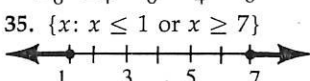
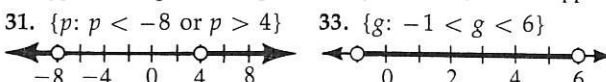
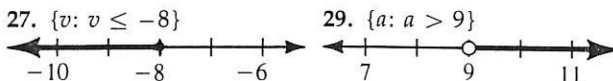
**Chapter Review, pages 259–261**

1. c 2. c 3. d 4. b 5. b 6. a 7. d 8. c  
 9. a 10. c 11. d 12. b 13. c 14. b 15. c  
 16. c 17. b 18. d 19. b 20. a

**Cumulative Review, pages 262–263**



7. 54 9. 2 11.  $\frac{1}{2}$  13. Subtraction property of equality 15.  $\{39\}$  17.  $\{-96\}$  19.  $\{6\}$  21.  $\emptyset$   
 23.  $\{2\}$  25. 52 years



37.  $\{-2, -1, 0, 1, 2, 3\}; \{-1\}$  39.  $\{2, 4, \text{the odd whole numbers}\}; \{1, 3\}$  41.  $\mathcal{R}; \{\text{the real numbers between } -\frac{1}{3} \text{ and } 2\frac{2}{3}\}$

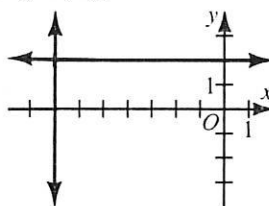
**Application, page 265**

1. Thursday 3. Tuesday

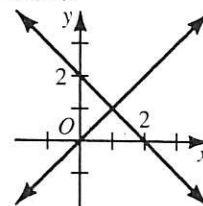
**Chapter 6 Systems of Open Sentences**

**Written Exercises, pages 272–273**

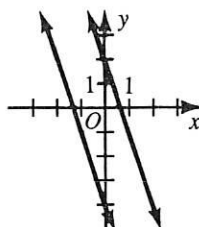
1.  $\{(-7, 2)\}$



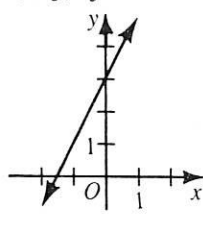
3.  $\{(1, 1)\}$



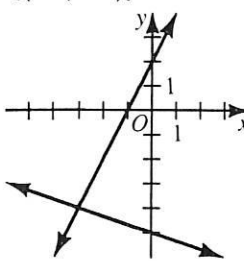
5.  $\emptyset$



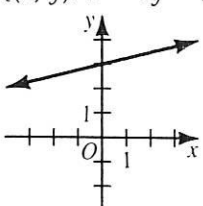
7.  $\{(x, y): y = 2x + 3\}$



9.  $\{(-3, -4)\}$

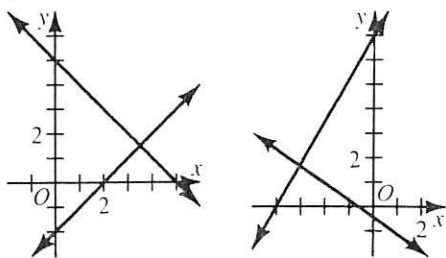


11.  $\{(x, y): x = 4y - 12\}$



13. exactly one member; consistent 15. infinite set; consistent 17. exactly one member; consistent 19. infinite set; consistent 21. empty set; inconsistent 23. empty set; inconsistent

25.  $\left\{\left(3\frac{1}{2}, 1\frac{1}{2}\right)\right\}$  27.  $\{(-3, 2)\}$



29. (2, 2) 31. (5, -5) 33. a. (-2, -1), (3, 4), (3, -6) b. 25 sq. u. 35. a. (1, 7), (-3, 8), (-3, -9) b. 34 sq. u. 37. a. (6, 4), (6, -4), (-3, -7), (-3, 1) b. 72 sq. u.

### Computer Exercises, page 273

1. No 3. Yes

### Written Exercises, page 276

1.  $\{(6, -11)\}$  3.  $\left\{\left(-\frac{1}{3}, 4\right)\right\}$  5.  $\left\{\left(\frac{1}{2}, -2\right)\right\}$   
 7.  $\left\{\left(\frac{1}{2}, -\frac{2}{3}\right)\right\}$  9.  $\left\{\left(-4, \frac{3}{4}\right)\right\}$  11.  $\emptyset$  13.  $\left\{\left(-\frac{2}{3}, 0\right)\right\}$   
 15.  $\left\{\left(-\frac{11}{2}, -\frac{3}{2}\right)\right\}$  17.  $\left\{\left(\frac{7}{3}, \frac{3}{5}\right)\right\}$  19.  $\{(-2, 5)\}$   
 21.  $\{(-5, 7)\}$  23.  $\emptyset$  25.  $\left\{\left(1, \frac{14-c}{3}\right)\right\}$  27.  $a = -b$

### Computer Exercises, page 277

1.  $\{(10, 3)\}$  3.  $\emptyset$

### Written Exercises, pages 279–280

1.  $\{(1, 1)\}$  3.  $\{(4, 0)\}$  5.  $\{(0, -3)\}$   
 7.  $\left\{\left(-3, \frac{1}{3}\right)\right\}$  9.  $\emptyset$  11.  $\{(0, 2)\}$  13.  $\{(n, 2n)\}$   
 15.  $\left\{\left(\frac{k}{3}, -\frac{k}{2}\right)\right\}$  17.  $\{(b, -4a)\}$   
 19. (0, 3), (-3, 0), (3, 0)

### Written Exercises, pages 282–283

1.  $\{(-2, 5)\}$  3.  $\{(8, 1)\}$  5.  $\left\{\left(6, \frac{1}{3}\right)\right\}$  7.  $\{(7, 1)\}$   
 9.  $\{(-1, -2)\}$  11.  $\emptyset$  13.  $\left\{\left(\frac{1}{2}, 5\right)\right\}$  15.  $\left\{\left(\frac{3}{5}, \frac{2}{5}\right)\right\}$   
 17.  $\{(3, 1)\}$  19.  $\{(2, -3)\}$  21.  $\left\{\left(-\frac{2}{3}, \frac{5}{3}\right)\right\}$   
 23.  $\left\{\left(\frac{50}{31}, \frac{15}{31}\right)\right\}$  25.  $\emptyset$  27.  $\left\{\left(-\frac{1}{2}, -\frac{3}{2}\right)\right\}$   
 29.  $\{(8, 6)\}$  31.  $a = \frac{1}{2}, b = -1$  33.  $a = 3,$   
 $b = -4$  35. Assume that  $(x_1, y_1)$  is a solution of the system. Then  $m_1x_1 + b_1 = m_2x_1 + b_2$ . By hypothesis  $m_1 = m_2$ , so  $m_1x_1 + b_1 = m_1x_1 + b_2$ . Then  $b_1 = b_2$ ,

but this contradicts the hypothesis  $b_1 \neq b_2$ .  
 $\therefore$  the system has no solution.

### Self-Test 1, page 283

1. inconsistent 2.  $\{(2, 3)\}$  3.  $\{(2, -1)\}$   
 4.  $\{(-3, 4)\}$  5.  $\{(5, -1)\}$

### Problems, pages 286–288

1. Susan has 25 fish, Tammy has 18 fish. 3.  $105^\circ$   
 5. \$3.25 7. 12 m by 4 m 9. Charles read 21 books, Frank read 8 books. 11. 6 nickels, 34 quarters  
 13. twenty 20¢ stamps, fifteen 25¢ stamps  
 15. Lee's mother: 47 years; her aunt: 36 years  
 17. 3 bath towels, 5 hand towels 19. 40 cm by 80 cm 21. 40 nickels, 6 dimes, 4 quarters

### On the Calculator, page 288

1.  $\{(1.2, -0.6)\}$  3.  $\{(3.3, 1.9)\}$

### Problems, pages 290–291

1. wind speed: 50 km/h; air speed: 550 km/h 3. air speed: 310 km/h; wind speed: 10 km/h 5. rowing rate: 4 km/h; speed of current: 2 km/h 7. 15 km/h  
 9. rate in still water: 4 km/h; rate of current: 2 km/h.  
 11.  $s = 2c$  13. 0.6 km/h; 25 min 15. original wind speed: 25 km/h; distance from Reno: 1125 km

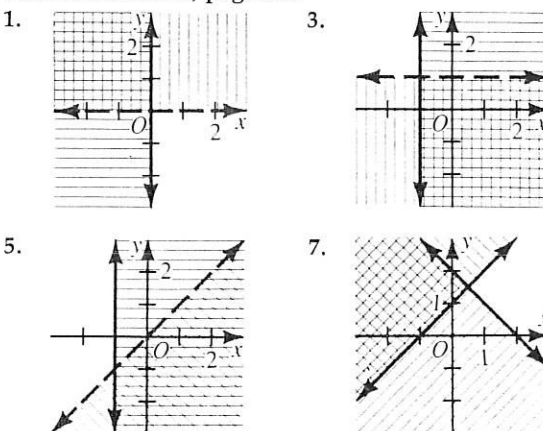
### Problems, pages 296–297

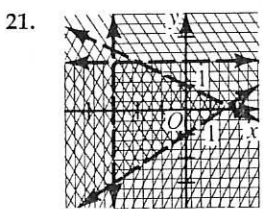
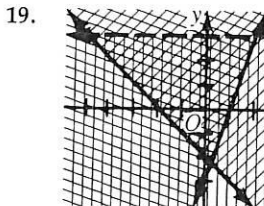
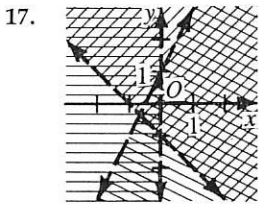
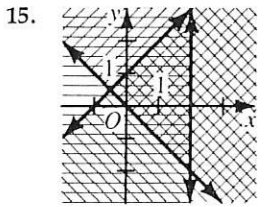
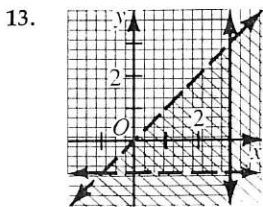
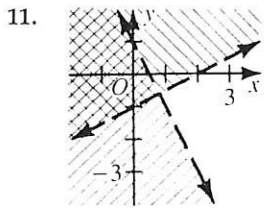
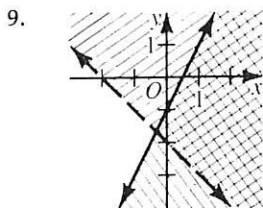
1. 64 3. 13 5. 75 7. 19 9. 386 11. 824  
 13.  $100h + 10t + u$  may be rewritten  $99h + h + 9t + t + u$  or  $9(11h + t) + h + t + u$ . Since  $9(11h + t)$  is divisible by 9, the entire number is divisible by 9 if and only if  $h + t + u$  is divisible by 9. 15.  $10t + u + 10u + t = 11t + 11u = 11(t + u)$ , which is divisible by 11. 17. 832  
 19.  $10t + u - [10(t - 1) + (u + 1)] = 10t + u - (10t - 10 + u + 1) = 9$

### Self-Test 2, page 297

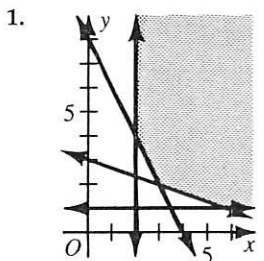
1. 8 years 2. rowing rate: 6 km/h; rate of current: 2 km/h 3. 81

### Written Exercises, page 300

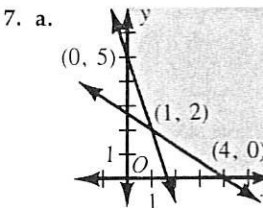




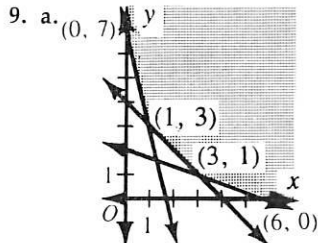
**Written Exercises, pages 304–306**



3. a. 11 b. 14 c. 5 d. 8



b. 8



b. 9

11. Let  $x$  = number of hamsters  $x \geq 0$   
 Let  $y$  = number of rabbits  $y \geq 0$   
 $x + y \geq 8$   
 $5x + 25y \geq 100$

13. 5 hamsters and 3 rabbits 15. Shop A: 5 hours;  
 Shop B: 6 hours

**Written Exercises, pages 309–310**

1.  $\{(1, -1, 2)\}$  3.  $\{(2, 3, 1)\}$  5.  $\{(2, -3, -2)\}$   
 7.  $\left\{\left(\frac{1}{2}, 3, -2\right)\right\}$  9.  $\left\{\left(\frac{104}{19}, \frac{35}{19}, \frac{120}{19}\right)\right\}$

11.  $\emptyset$  13.  $a = 4, b = -3, c = 1$  15.  $a = 3, b = -2, c = 4$  17.  $a = 1, b = -1, c = 3$

**Problems, page 310**

1. length: 3 cm; width: 5 cm; height: 9 cm  
 3. 1 nickel, 4 dimes, 6 quarters 5. 564

**Self-Test 3, page 311**

1. 2. 480 3. 1 order from Provincial and 5 orders from Rocky Mountain  
 4.  $\{(5, -4, 2)\}$

**Extra, page 315**

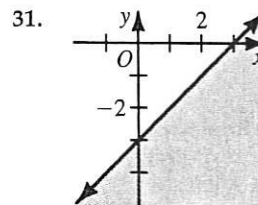
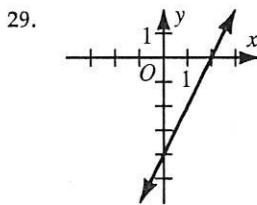
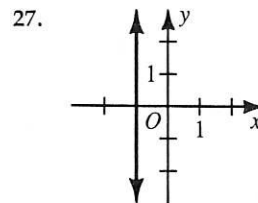
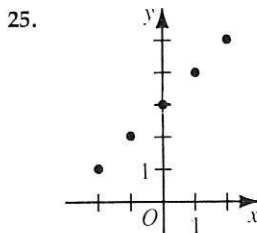
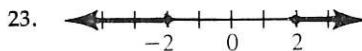
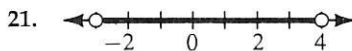
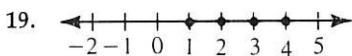
1.  $\{(1, 2)\}$  3.  $\{(4, 2)\}$  5.  $\{(4, -1)\}$

**Chapter Review, pages 316–317**

1. d 2. a 3. d 4. c 5. c 6. a 7. c 8. c  
 9. b 10. c 11. b 12. b 13. d 14. c 15. a

**Mixed Review, page 319**

1. 8 3.  $-7$  5.  $\frac{1}{6}$  7.  $\frac{1}{2}$  9.  $4x + 10y$  11.  $7a - 1$   
 13.  $11m + 34$  15.  $-15c - 12d$  17.  $60pqr$



33. 0 35.  $-12$  37.  $16x + 20y = 35$  39.  $y = 6$

**Preparing for College Entrance Exams, page 320**

1. E 3. D 5. D

Contest Problems, page 321

1. 15 sq. units 3.  $-7c + 9$  5. 27

Chapter 7 Polynomials and Factoring

Written Exercises, pages 326–327

1. 3; 5 3. 3;  $j$  5. 2 7.  $\frac{3rs}{2} + \frac{2}{3} - \frac{2rs}{3} - \frac{3}{2} = rs - 1$  9.  $\frac{b^2}{9} - \frac{7b}{3} - \frac{6b^2}{9} + \frac{b}{3} = -5b^2 - 6b$   
 11.  $-\frac{3t}{11} + \frac{t^3}{11} - \frac{5t}{11} - \frac{t^3}{11} - \frac{1}{11} = -8t - 1$   
 13.  $\frac{9ab}{13} + \frac{bc}{13} + \frac{2ab}{13} + \frac{bc}{13} + 7 = 11ab + 2bc + 7$   
 15.  $\frac{4p^3q^2}{17} - \frac{5p^2q^3}{17} - 9pq + \frac{p^2q^3}{17} - \frac{2p^3q^2}{17} = 2p^3q^2 - 4p^2q^3 - 9pq$   
 17.  $\frac{9rs}{17} - \frac{3st}{17} + \frac{6rt}{17} - \frac{5st}{17} - \frac{6rt}{17} - \frac{rs}{17} = 8rs - 8st$   
 19.  $7a + 8b + c$  21.  $12s^2 + 4s - 2$   
 23.  $4m^4 - 4m^2 - 1$  25.  $-3a + 2b - 3c$   
 27.  $6s^2 + 4s - 8$  29.  $8m^4 - 6m^2 + 1$   
 31.  $5p + q + 6r - s$  33.  $-x^2 - 6x - 5$   
 35.  $ab - 3b + 12a$  37.  $-5m + 8$   
 39.  $3b^2c + 3bc - 3bc^2$  41.  $7x^3 + 3x^2 + 2x - 4$   
 43. {2} 45. {3} 47. {-4}  
 49.  $-3c + 6cd - c^2d^2 - 2d^2$   
 51.  $7rs - 2r^2 + 3r^2s^2 - 3s^2$   
 53. No, a term of one that is the additive inverse of a term of the other may change the degree of the sum.

Written Exercises, pages 330–331

1.  $-10b^3$  3.  $-192m^6n$  5.  $9a^3z^4$  7.  $-8y^7$   
 9.  $-15u^3v^4$  11.  $4c^9$  13.  $72g^7$  15.  $a^{10}b^{11}$   
 17.  $-4a^{16}b^{11}$  19.  $x^5y^5$  21.  $-12m^8n^4$  23.  $r^5s^7t^4$   
 25.  $11z^4$  27.  $-6b^4c^4$  29.  $14x^7y^5$   
 31.  $-3y^9 - 32y^7$  33.  $b^7 - 11b^4$   
 35.  $5c^4d^2 + 125c^3d^6$  37.  $3r^{11}s^{11}t^{10}$  39.  $x^3n$   
 41.  $z^{2n}$  43.  $r^{3n}$  45. {6} 47. {4} 49. {7}

Written Exercises, page 334

1.  $2m^3 + 10m^2 - 18m$  3.  $z^4 - 5z^3 + 2z^2$   
 5.  $-3a^3 + 7a^4 + 4a^5$  7.  $12s^5 - 8s^4 + 4s^3 - 20s^2$   
 9.  $2p^4q - 2p^3q^2 + 2p^2q^3 - 2pq^4$   
 11.  $-10u^2v^7 + 4u^4v^5 - 6u^6v^3$  13.  $2x^3 + 3x^2 - 10x$   
 15.  $2a^3 - 5a^2$  17.  $7j^3 + 5j^2$  19.  $a^2 + 4a + 3$   
 21.  $m^2 - 2m - 8$  23.  $2b^2 + 7b + 3$   
 25.  $8t^2 + 6t - 9$  27.  $9z^2 - 49$  29.  $4c^2 + 20c + 25$   
 31.  $r^3 + r^2 - 8r - 6$  33.  $2c^3 - 9c^2 + 10c - 3$   
 35.  $u^3 - 2uv^2 + v^3$  37.  $6c^3 - c^2d - 12cd^2 - 5d^3$   
 39. {5} 41. {-5} 43. {3} 45.  $x^3 + 2x^2 - 5x - 6$   
 47.  $6m^3 + 11m^2 - 3m - 2$  49.  $r^3 + 6r^2 + 12r + 8$   
 51.  $x^4 + 4x + 3$  53.  $x^{2n} + x^n$  55.  $x^{2n+1} + x^{n+1}$   
 57. The degree of the product is the degree of the product of the terms of greatest degree of the two polynomials, which is the sum of the degrees of the polynomials.

Written Exercises, pages 338–339

1.  $j^2 + 2j - 15$  3.  $21 + 10u + u^2$  5.  $s^2 - 121$

7.  $m^2 - 14m + 49$  9.  $3y^2 + 5y - 2$   
 11.  $4c^2 + 12c + 9$  13.  $6p^2 - p - 2$  15.  $16a^2 - 49$   
 17.  $12r^2 - rs - 6s^2$  19.  $12c^2 - 28cd + 15d^2$   
 21.  $25b^2 + 20bc + 4c^2$  23.  $9a^4 - 1$   
 25.  $16m^4 + 24m^2 + 9$  27.  $j^4 - 2k^2j^2 + k^4$   
 29.  $25c^6 - 10c^3d^3 + d^6$  31.  $x^3 + 6x^2 + 12x + 8$   
 33.  $27m^3 - 27m^2 + 9m - 1$  35.  $a^6 + 3a^4 + 3a^2 + 1$   
 37.  $100^2 - 1^2 = 9999$  39.  $30^2 - 2^2 = 896$   
 41.  $90^2 - 3^2 = 8091$  43.  $9^2 - 0.1^2 = 80.99$

45. {1} 47. {2} 49. {-1} 51. {7} 53.  $\left\{-\frac{4}{3}\right\}$

55.  $x^{2n} + 2x^ny^n + y^{2n}$   
 57.  $x^{3n} - 3x^{2n}y^n + 3x^ny^{2n} - y^{3n}$   
 59.  $|(x + 1)^2 - x^2| = |x^2 + 2x + 1 - x^2| = |2x + 1| = |x + x + 1|$

Problems, pages 339–340

1. 7 cm 3. 40 and 42 5. 17 and 19 7.  $h = 5$  cm;  $w = 7$  cm;  $l = 12$  cm 9. 9 cm 11. Any three consecutive integers have this property.

Self-Test 1, page 340

1.  $4r^2 - r + 4$  2.  $-4c^3 + 3c^2 + c + 1$   
 3.  $2u^2 + 5u^2v - 3uv^2 + v^2$  4.  $p^7$  5.  $-8a^5$   
 6.  $3x^3y^4$  7.  $m^{10}$  8.  $9s^2t^2$  9.  $8u^6v^9$  10.  $5y^3 - 10y^2$   
 11.  $3a^4b - 2a^3b^2 + a^2b^3$  12.  $c^2 + c - 6$   
 13.  $2d^2 + 3d - 20$  14.  $9x^2 - 12x + 4$   
 15.  $4m^2 - 25n^2$

Written Exercises, pages 344–345

1.  $3 \cdot 5^2$  3.  $2 \cdot 7 \cdot 11$  5.  $2^4 \cdot 3^2$  7.  $2^4 \cdot 3^4$   
 9. 1, 2, 3, 6, 9, 18 11. 1, 2, 3, 6, 9, 18, 27, 54  
 13. 1, 101 15. 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96  
 17. 1, -1, 2, -2, 4, -4, 8, -8,  $a$ ,  $-a$ ,  $2a$ ,  $-2a$ ,  $4a$ ,  $-4a$ ,  $8a$ ,  $-8a$  19. 1, -1, 3, -3,  $r$ ,  $-r$ ,  $rs$ ,  $-rs$ ,  $rs^2$ ,  $-rs^2$ ,  $s$ ,  $-s$ ,  $s^2$ ,  $-s^2$ ,  $3r$ ,  $-3r$ ,  $3rs$ ,  $-3rs$ ,  $3rs^2$ ,  $-3rs^2$ ,  $3s$ ,  $-3s$ ,  $3s^2$ ,  $-3s^2$  21. 11, 66 23. 15, 225  
 25. 1, 210 27. 45, 270 29.  $3ab$ ,  $90a^3b^2$   
 31.  $48r^3s^2$ ,  $144qr^5s^2$  33.  $22abc^3$ ,  $770a^2b^2c^5$  35.  $3k$   
 37.  $-5r^2s$  39.  $13s^3t$  41.  $-5uvw$  43.  $6b^3c^3$  45. 0  
 47.  $3x$  49.  $-9a^n$  51.  $6j^{n+1}$  53.  $3a^7b^4$

Written Exercises, pages 347–348

1.  $7(r + 2s)$  3.  $m(5m - 6)$  5.  $3b(5b + 2)$   
 7.  $2pq(5 - 6p)$  9.  $12r^2s^2(3r - 5s)$   
 11.  $16x^2y^2(x^2y^3 + 1)$  13.  $5b(b^2 - 7b + 2)$   
 15.  $7z(3z^4 - 11z^2 - 7)$  17.  $2bc(3b - 2c + 2)$   
 19.  $5y^3z(3y + 2z - 4z^2)$  21.  $9a^2b^3(5b + 2a^2 - 9ab)$   
 23.  $6r^2s^2t(7s^3t^2 + 9r)$  25.  $(z - 1)(z + 2)$   
 27.  $(m + 5)(2m - 3)$  29.  $(d - 5)(d - 7)$   
 31.  $(1 - q)(9 + q)$  33.  $(x + 7)(x + 12)$   
 35.  $(a - 6)(a - 2)$  37.  $(m - 8)(m - 7)$   
 39.  $(z + 1)(4z + 7)$  41.  $(p - 3)(5p - 13)$   
 43.  $(a - 1)(3a - 5)$  45.  $1 + x$  47.  $1 - j^n$   
 49.  $r^4ns - s^3$  51.  $w^3 + v$  53.  $a^2b - ab^4$

Reading Algebra, page 349

1. an equation 3. coincident lines 5. a coordinate

**Written Exercises, pages 352–353**

1.  $(8z + 5)(8z - 5)$  3.  $(11c^2 + 1)(11c^2 - 1)$
5.  $(8u + 11v)(8u - 11v)$  7.  $(a + 7)^2$  9.  $(6 - r)^2$
11.  $(m + n)^2$  13.  $(2c + 1)^2$  15.  $(2g - 5)^2$
17.  $(5y - 4z)^2$  19.  $(r + 2)(r^2 - 2r + 4)$
21.  $(4u - 1)(16u^2 + 4u + 1)$
23.  $(3j - k)(9j^2 + 3jk + k^2)$
25.  $3(c^2 - 25) = 3(c + 5)(c - 5)$
27.  $5(16 + 8x + x^2) = 5(4 + x)^2$
29.  $5(9v^2 - 24v + 16) = 5(3v - 4)^2$
31.  $4m(4m^2 - 9) = 4m(2m + 3)(2m - 3)$
33.  $3x(x^2 + 2x + 1) = 3x(x + 1)^2$
35.  $2j(25j^2 + 20j + 4) = 2j(5j + 2)^2$
37.  $(a + 6 + b)(a + 6 - b)$
39.  $(5x - 1 + y)(5x - 1 - y)$  41.  $(a - b)(3a + 2)$
43.  $(5 + r)(r - s)$  45.  $(2a + 3b)(5c + 2d)$
47.  $(2p + 3r)(p + 5q)$  49.  $(x^n + 1)(x^n - 1)$

(Note: If  $n$  is an even integer, the second factor may be factored further.) 51.  $(x^n - 1)^2$  (Note: If  $n$  is an even integer, both factors may be factored further.)

53.  $(x^n - y)(x^{2n} + x^n y + y^2)$

**Written Exercises, page 357**

1.  $(a + 3)(a + 4)$  3.  $(r + 5)(r - 1)$  5. irreducible
7.  $(g - 8)(g + 3)$  9.  $(m - 5)(m - 4)$
11.  $-(x + 8)(x + 3)$  13.  $(6 + x)(1 + x)$
15.  $-(j - 12)(j + 3)$  17.  $(m + 2n)(m + n)$
19.  $4(c^2 - 11c + 30) = 4(c - 5)(c - 6)$
21.  $k(k^2 - 8k + 15) = k(k - 3)(k - 5)$
23.  $m^2(m^2 - 7m - 18) = m^2(m - 9)(m + 2)$
25.  $3v(v^2 - v - 20) = 3v(v - 5)(v + 4)$
27.  $5b^2(b^2 - 3b + 2) = 5b^2(b - 2)(b - 1)$
29.  $-6x^3(x^2 - 4x + 3) = -6x^3(x - 3)(x - 1)$
31.  $2x^2(y^2 - 4y - 45) = 2x^2(y - 9)(y + 5)$
33.  $st(15 + 8s + s^2) = st(3 + s)(5 + s)$
35.  $2u^3(20 + 8v - v^2) = 2u^3(10 - v)(2 + v)$
37.  $s(s^2 - st - 12t^2) = s(s - 4t)(s + 3t)$
39.  $m^2(m^2 - 5mn + 6n^2) = m^2(m - 3n)(m - 2n)$
41.  $2j^2(1 - 5k + 4k^2) = 2j^2(1 - 4k)(1 - k)$
43. a. 3, -3 b. 1, -1 45. a. 7, -7, 8, -8, 13, -13 b. 1, -1, 4, -4, 11, -11
47.  $(x^2 - 2)(x^2 + 1)$  49.  $(x^4 + 3)(x^4 + 2)$
51.  $(x^n + 5)(x^n - 2)$

**Written Exercises, pages 360–361**

1.  $(5a + 2)(a + 1)$  3.  $(2c - 5)(c + 1)$
5.  $(3x - 8)(x + 1)$  7.  $(3r - 2)(2r + 1)$
9.  $(2z - 5)(2z - 3)$  11.  $(4m - 5)(2m + 3)$
13.  $(j - 4)(10j + 3)$  15.  $(3p + 2)(4p + 5)$
17.  $(5u - 2)(4u + 5)$  19.  $4(x + 1)(x + 5)$
21.  $2(2m + 1)(m + 3)$  23.  $2(2a - 1)(3a + 2)$
25.  $6m(2m - 1)(m + 1)$  27.  $2z^2(3z + 1)^2$
29.  $4a^3(2a + 1)(2a - 1)$
31.  $2x(x + 2)(x - 2)(3x^2 + 1)$
33.  $3z^2(z + 2)(z - 2)(2z^2 + 1)$
35.  $b(1 - 2b)(1 + 2b)(1 + 3b^2)$

37.  $u(3u - 2v)(2u + 9v)$
39.  $w^2(3w - 8z)(4w - z)$  41.  $2yz(3y - z)(y + 2z)$
43.  $(x^2 + y^2)(x + y)(x - y)$
45.  $(x + y)(x^2 - xy + y^2)(x - y)(x^2 + xy + y^2)$
47.  $(y^2 + y + 1)(y^2 - y + 1)$
49.  $a = 2, b = 1, c = -3$

**Self-Test 2, page 361**

1.  $2^4 \cdot 3 \cdot 5$  2.  $16c^2d^5; 96bc^3d^6$  3.  $5m(5m - 8)$
4.  $2x^4y(3y - 5xy^2 + 7x^2)$  5.  $(s + 3)^2$
6.  $(9m + 7)(9m - 7)$  7.  $(x - y)^2$
8.  $(n - 1)(n^2 + n + 1)$  9.  $(t - 3)(t - 4)$
10.  $(u - 4)(2u + 5)$  11.  $3g(g + 3)(g - 3)$
12.  $2h(3h^2 - 5h + 4)$

**Written Exercises, pages 366–367**

1.  $\{4, -1\}$  3.  $\left\{\frac{1}{5}, \frac{3}{2}\right\}$  5.  $\{0, 2, -5\}$  7.  $\left\{0, -7, \frac{3}{5}\right\}$
9.  $\{-5, 2\}$  11.  $\{3, -3\}$  13.  $\left\{\frac{4}{3}, -3\right\}$  15.  $\left\{\frac{1}{3}, -\frac{3}{2}\right\}$
17.  $\left\{-\frac{1}{4}, -\frac{4}{5}\right\}$  19.  $\left\{\frac{5}{2}, \frac{2}{5}\right\}$  21.  $\left\{\frac{5}{2}, -\frac{5}{2}\right\}$
23.  $\{0, 4\}$  25.  $\{0, 9, -4\}$  27.  $\{0, 3, 1\}$
29.  $\left\{0, 1, -\frac{3}{2}\right\}$  31.  $\left\{0, \frac{5}{3}, -\frac{5}{3}\right\}$  33.  $\{2, -2\}$
35.  $\{1, -1, 2, -2\}$  37.  $\left\{5, -\frac{3}{2}\right\}$  39.  $\left\{\frac{1}{3}, -\frac{5}{3}\right\}$
41.  $\{-6, 1\}$  43.  $\left\{\frac{5}{3}, -\frac{4}{5}\right\}$  45.  $x^2 - 10x + 21 = 0$
47.  $x^2 - x - 6 = 0$  49.  $8x^2 - 10x + 3 = 0$
51.  $10x^2 + 9x - 9 = 0$  53. 1. Axiom of multiplicative inverses 2. Hypothesis 3. Multiplication property of equality 4. Identity axiom for multiplication 5. Multiplicative property of zero

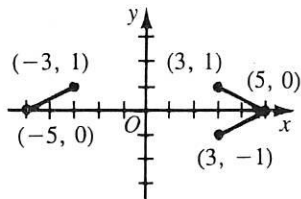
**Problems, pages 369–371**

1. 11 and 12 3. 8 5. -8 and -7 7. 1 m 9. 6 m
11. 2 and 18 13. after 3 s and after 2 s 15. 30 s
17. 6 cm and 16 cm 19. 4 m by 18 m or 9 m by 8 m
21. 4 years and 16 years 23. 6 m 25. The sum of the squares of two consecutive integers,  $x^2 + (x + 1)^2$ , may be represented as  $2(x^2 + x) + 1$ . If  $x$  is even,  $x$  may be represented as  $2y$  and the sum above as  $2[(2y)^2 + 2y] + 1$  or  $4(2y^2 + y) + 1$ . If  $x$  is odd,  $x$  may be represented as  $2y + 1$  and the sum as  $2[(2y + 1)^2 + 2y + 1] + 1$  or  $4(2y^2 + 3y + 1) + 1$ . Both expressions are one greater than a multiple of four.

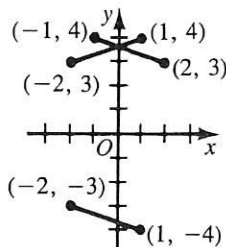
**Self-Test 3, page 371**

1.  $\{-2, 7\}$  2.  $\left\{0, -\frac{5}{3}\right\}$  3.  $\{6, -3\}$
4.  $\left\{0, 5, -\frac{5}{2}\right\}$  5.  $\left\{\frac{2}{3}, -\frac{3}{2}\right\}$  6.  $\left\{0, 2, -\frac{3}{2}\right\}$
7. 3 m by 16 m 8. 8 and 9

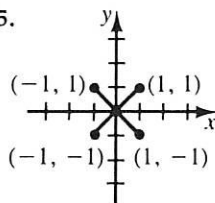
1.



3.



5.



9. It is perpendicular to the  $y$ -axis; it is perpendicular to the  $x$ -axis. 11. The line segment with endpoints  $(1, 2)$  and  $(2, 5)$

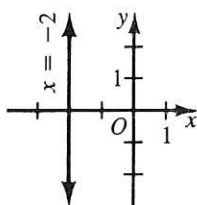
Chapter Review, pages 374–376

1. d 2. c 3. d 4. d 5. c 6. d 7. d 8. b  
 9. d 10. d 11. d 12. b 13. d 14. d 15. c  
 16. a 17. d 18. a 19. b 20. c 21. c 22. c  
 23. c

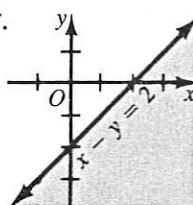
Cumulative Review, pages 377–379

1. False 3. False 5. Associative axiom for multiplication 7. Identity axiom for addition  
 9. 60 11.  $16x + 2$  13.  $x + 8y$  15.  $-6cd$   
 17. Range:  $\{1, 3, 5\}$ ; not a function 19. Range:  $\{0, 1, 2, 3\}$ ; a function 21.  $-1$  23.  $-20$

25.



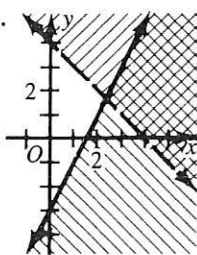
27.



29.  $x - 4y = -4$  31.  $x = -2$  33.  $\{(5, -2)\}$

35.  $\{(5, -1)\}$  37.  $\emptyset$  39.  $\left\{\left(\frac{9}{4}, \frac{1}{2}\right)\right\}$  41.  $\{(-2, 3)\}$

43.



45. 13 blocks  
 47. 153

Contest Problems, page 379

1.  $-24$  3. 3 5. 31

Written Exercises, pages 384–385

1.  $x^4$  3.  $\frac{1}{b^4}$  5.  $2c$  7.  $-\frac{1}{11n^2}$  9.  $8e^{4f}$  11.  $\frac{1}{3v}$   
 13.  $-\frac{3b^3}{2c}$  15.  $2p$  17.  $\frac{4a^2}{b^2c^2}$  19.  $\frac{20m^2}{n^2}$  21.  $xy^2$   
 23.  $-a^4$  25.  $t^4$  27.  $-\frac{1}{d}$  29.  $\frac{1}{3a^6}$  31.  $\frac{(3t-1)^2}{s}$   
 33.  $d^n$  35.  $\frac{1}{3p^{3n-1}}$  37.  $\frac{1}{f^2}$  39.  $u^{m+3}$   
 41. a.  $m \in \{\text{all integers greater than 5}\}$  b.  $\{4\}$   
 c.  $\{5\}$  43.  $x^{1-m}$  when  $m \in \{\text{all integers less than 1}\}$ ;  
 $\frac{1}{x^{m-1}}$  when  $m \in \{2, 3\}$ ; 1 when  $m = 1$   
 45.  $a^{-1-2t}$  when  $t \in \{-2, -1\}$ ;  $\frac{1}{a^{1+2t}}$  when  $t \in \{0, 1\}$

Written Exercises, pages 386–387

1.  $2m + 3n$  3.  $3e - 1$  5.  $\frac{7}{2h^2} + \frac{3}{2h^3}$  7.  $\frac{1}{2ab^2} - \frac{3b}{4a^3}$  9.  $\frac{-1}{4t^2} + \frac{t}{2}$  11.  $-1 - 3v^4$  13.  $3r^2 + 4r - 7$   
 15.  $-6z^2 + 3z - 8$  17.  $\frac{5uv^2}{3} + \frac{2v}{3} - \frac{4u^2}{3}$   
 19.  $\frac{-5e^2}{t^2} + \frac{5}{2} - \frac{2t^2}{e^2}$  21.  $4x^4 - 3x^2 + 5$   
 23.  $4x^4 - x^2 + 3 - \frac{1}{8x^2}$  25.  $b^{2n} - b^n + b$   
 27.  $-a^{2n}b^n - 2a^nb + \frac{3b^{n-1}}{a^{n-1}}$  29. 34 31. 0.6  
 33. a. Yes, the solution set for each equation is  $\{2\}$ .  
 b. No, the solution set of the first equation is  $\emptyset$ ; the solution set of the second equation is  $\{0\}$ .

Written Exercises, page 391

1.  $m + 3$  3.  $3s + 2$  5.  $5t - 3 - \frac{2}{7t - 6}$   
 7.  $-2x^2 + 5x - 4 + \frac{3}{x + 1}$  9.  $d^2 + 2d + 4 + \frac{133}{d - 2}$   
 11.  $6x^2 + 3x - 1 - \frac{3x - 1}{3x^2 + 1}$  13.  $t^4 + t^2 + 1 + \frac{2}{t^2 - 1}$  15.  $r^2 - 2r + 9 - \frac{24r - 26}{r^2 + 2r - 3}$  17. Yes  
 19. No 21.  $(k - 3)^2(k + 5)$   
 23.  $(w + 1)(w - 1)(w + 2)(w^2 - 2w + 4)$   
 25.  $p = -12$  27. a.  $a^{99} + a^{98} + a^{97} + \dots + 1$   
 b.  $a^{n-1} + a^{n-2} + a^{n-3} + \dots + 1$   
 29. No; the quotient is a polynomial only if the dividend is divisible by the divisor.

Self-Test 1, page 392

1.  $7m^2$  2.  $\frac{10}{s}$  3.  $3b^2 - 4b + 1$  4.  $2e^{3f} - 3e^2 + \frac{4}{ef}$   
 5.  $c + 7$  6.  $3r - 5 + \frac{5}{2r + 3}$

Written Exercises, pages 395–396

1.  $\frac{5ab}{7}$  3.  $\frac{b-4}{3}$  5.  $\frac{3w+2}{3w-2}$  7.  $-\frac{3b^2}{5}$  9.  $\frac{2}{f-5}$   
 11.  $\frac{c+3}{-2(c+2)}$  13.  $\frac{d+3}{3d+4}$  15.  $\frac{a-4b}{a-3b}$   
 17.  $\frac{3(2e-1)}{4(e+1)}$  19.  $x = a + 4; a \neq \frac{3}{2}$   
 21.  $x = a + 3; a \neq \frac{5}{2}$  23.  $\frac{3(a^2+2a+4)}{a-2}$   
 25.  $\frac{a^4-a^2+1}{a^2-1}$  27.  $\frac{3x-14}{x-2}$  29.  $\frac{2a+3b}{3b}$   
 31.  $x = \frac{4}{7}$  33. a.  $a = -2$  b.  $a = 2$  c.  $x = \frac{a+3}{a-2}$   
 35. 1.  $r, s,$  and  $t$  are real numbers with  $s$  and  $t \neq 0$  Hypothesis  
 2.  $\frac{r}{s} = \frac{r}{s} \cdot 1$  Ident. ax. for mult.  
 3.  $= \frac{r}{s} \cdot \frac{t}{t}$  Ex. 45, p. 102  
 4.  $= \frac{rt}{st}$  Basic prop. of quotients  
 5.  $\therefore \frac{r}{s} = \frac{r \cdot t}{s \cdot t}$  Trans. ax. of eq.

Written Exercises, pages 400–401

1. 10 3.  $-\frac{1}{32}$  5.  $\frac{5}{z^3}$  7.  $\frac{6b^2}{c^3}$  9.  $\frac{m^3}{n^3}$  11.  $\frac{1}{a^5}$   
 13.  $\frac{r^4}{2}$  15.  $\frac{1}{u^2v^4}$  17. 1 19.  $\frac{1}{e+f}$  21.  $\frac{s}{5}$  23.  $\frac{d^3}{2c^2}$   
 25. 2500 27. 0.000016 29. 0.0000000144  
 31. 30 33.  $-\frac{h^4}{2c}$  35.  $-\frac{1}{2}$  37.  $\frac{s^2r^2}{625}$  39.  $3m^{-1}n^{-5}$   
 41.  $2d^{-1}e^{-6f^7}$  43.  $\frac{2x^4z^{-1}}{5}$  45. 30 47.  $-\frac{5}{13}$   
 49.  $\frac{8a^3}{b^2} = \frac{8(2^m)^3}{(2^{m+1})^2} = \frac{8(2^{3m})}{2^{2m+2}} = \frac{2^3(2^{3m})}{2^{2m+2}} = \frac{2^{3m+3}}{2^{2m+2}} = 2^{m+1}$

Self-Test 2, page 402

1.  $-\frac{2b}{3d}$  2.  $\frac{3}{5}$  3.  $2a + 1$  4.  $\frac{1}{c^3}$  5.  $x^4$  6.  $\frac{b^{10}}{9a^4}$   
 7. 1 8.  $\frac{3b}{2a^2}$  9.  $r^5pm$  10.  $2.7 \times 10^5$   
 11.  $2.7 \times 10^{-3}$

Written Exercises, pages 406–407

1.  $m$  3.  $\frac{15a}{2}$  5.  $-\frac{5}{4}$  7.  $-6t$  9.  $\frac{2p^2}{5q}$   
 11.  $\frac{s(r+s)}{4}$  13. 1 15.  $\frac{t+2}{3t-1}$  17.  $\frac{3}{2}$  19.  $\frac{2}{v^3}$   
 21. 15 23.  $\frac{1}{6x}$  25.  $\frac{8a^6c^6}{27b^{12}d^6}$  27. 1 29.  $-\frac{72b^3}{a^9c^4}$   
 31. 3 33.  $\frac{t-5}{t-2}$  35.  $\frac{(m+2)(m+3)}{(m-2)(m+1)}$   
 37.  $\frac{x^2+2xy+4y^2}{x-2y}$  39.  $\frac{2t+3}{3t-1}$  41.  $\frac{3x+2}{x+1}$   
 43.  $-\frac{(j+5)}{12(j+1)}$  45.  $-\frac{h}{h+6}$  47. Yes

49. If you multiply any two rational numbers, the product is a rational number.

51. Case 1:  $n > 0$

1.  $a$  and  $b$  are real numbers. Hypothesis

$$2. \left(\frac{a}{b}\right)^n = \underbrace{\frac{a}{b} \cdot \frac{a}{b} \cdot \dots \cdot \frac{a}{b}}_{n \text{ factors}} \quad \text{Def. of a power}$$

$$3. = \frac{a \cdot a \cdot \dots \cdot a}{b \cdot b \cdot \dots \cdot b} \quad \text{Theorem, p. 403}$$

$$4. = \frac{a^n}{b^n} \quad \text{Def. of a power}$$

$$5. \therefore \left(\frac{a}{b}\right)^n = \frac{a^n}{b^n} \quad \text{Trans. ax. of =}$$

The proofs of Case 2 ( $n = 0$ ) and Case 3 ( $n < 0$ ) are similar.

Written Exercises, page 409

1.  $\frac{9}{a}$  3.  $\frac{3n-1}{n+1}$  5.  $\frac{2t+1}{4}$  7. 1 9.  $\frac{3}{2}$   
 11.  $\frac{x}{x-3}$  13.  $-1$  15.  $2(a-1)$  17.  $\frac{-2}{d-2}$   
 19.  $\frac{1}{c+1}$  21.  $\frac{4}{3d+4}$  23.  $\frac{-1}{4n+3}$  25.  $\frac{e}{e-5}$   
 27.  $\frac{1}{v+3}$  29.  $\frac{3r+2}{3r-5}$  31.  $\frac{1}{x-y} + \frac{1}{y-x} = \frac{1}{x-y} + \frac{-1}{x-y} = \frac{1}{x-y} - \frac{1}{x-y} = 0$

Written Exercises, pages 412–413

1.  $\frac{10x}{3}$  3.  $\frac{5d+c}{cd}$  5.  $\frac{3t+1}{t}$  7.  $\frac{h+2}{2h^2}$   
 9.  $\frac{u^2+2uv-v^2}{uv}$  11.  $\frac{-7}{3(a-2)}$   
 13.  $\frac{2t^2-t+3}{(t+3)(t-3)}$  15.  $\frac{b^2-2b-3}{b-2}$  17.  $\frac{3-5a}{a(a-3)}$   
 19.  $\frac{3h}{g-3}$  21.  $\frac{-6}{(w+2)(w-2)}$  23.  $\frac{5x-3}{6x(x-2)}$   
 25.  $\frac{2m+3n}{(m-n)^2}$  27.  $\frac{10b}{(b+5)(b-5)(b+4)}$   
 29.  $\frac{c^2}{c-5}$  31.  $\frac{2a^2+10a+16}{(a+2)(a+5)(a-3)}$   
 33.  $\frac{q^2-p^2}{pq}$  35.  $\frac{s^3-2s^2-41s+12}{s^2-36}$  37.  $\frac{t+s}{t-s}$   
 39.  $\frac{a^2+ab+b^2}{a^2-ab+b^2}$  41.  $\frac{-a(a-b)^2}{2b(2a-3b)}$  43. a. Yes  
 b. Yes

Programming in BASIC, page 415

1.  $9x^4 + 12x^3 + 10x^2 + 4x + 1$  3.  $6x^8 + 23x^7 + 19x^6 - 18x^5 - 9x^4 + 9x^3 - 6x^2 + 4x - 1$   
 5.  $2x^3 - x^2 - 7x + 2$

Written Exercises, page 418

1.  $\frac{3}{2}$  3.  $\frac{3}{2}$  5.  $cd^2$  7.  $\frac{4e+3f}{6e-4f}$  9.  $\frac{5w-9z}{2w+z}$   
 11.  $u-v$  13.  $\frac{3d+1}{d-1}$  15.  $\frac{x(x+2y)}{y(y-2x)}$  17.  $3c+1$   
 19.  $\frac{1}{x-2}$  21.  $\frac{rs}{s-r}$  23.  $\frac{u^2+v^2}{u^2v^2}$  25.  $\frac{c^2+d^2}{cd}$

$$27. \frac{e}{e+1} \quad 29. \frac{-1}{z-3} \quad 31. \frac{5-2t}{2-t}$$

$$33. r = \frac{1 - \frac{1+t}{1-t}}{1 + \frac{1+t}{1-t}} = \frac{1-t - (1+t)}{1-t + (1+t)}$$

$$= \frac{-2t}{2} = -t; \therefore r + t = -t + t = 0$$

Self-Test, page 419

$$1. \frac{3(x-1)}{2x} \quad 2. \frac{2(c-4)}{3} \quad 3. \frac{1}{2d-1}$$

$$4. \frac{9e^2+4}{6e^3} \quad 5. \frac{6b^2+4}{2b^2+b} \quad 6. \frac{a^2+1}{a^2-a}$$

Chapter Review, pages 420–422

1. b 2. a 3. c 4. a 5. c 6. b 7. a 8. a 9. c  
10. d 11. b 12. c 13. d 14. b 15. a 16. d

Mixed Review, page 423

$$1. 6c^2 - c - 15 \quad 3. -36x^6y^3 \quad 5. 4x^2 - 12x + 9$$

$$7. 49x^2 - 4y^2 \quad 9. 2ax(4x+3)(4x-3)$$

$$11. x^2(x-6)(x+4) \quad 13. (6+x)(3-4x)$$

$$15. (y^2+4)(y+2)(y-2) \quad 17. 3a(2a^2+3a-1)$$

$$19. 5(r-2s)(r^2+2rs+4s^2) \quad 21. \{-2\}$$

$$23. \{z: z > -9\} \quad 25. \left\{u: \frac{5}{3} < u < 3\right\} \quad 27. \{-3, 5\}$$

$$29. \{(-5, 2)\} \quad 31. n = \frac{m}{t+v} \quad 33. b = \frac{3a-T}{4}$$

$$35. c = \frac{ef}{2bd} \quad 37. 20 \text{ km/h}$$

Preparing for College Entrance Exams, page 424

1. B 3. B 5. E 7. C 9. C

Application, page 425

1. less 3. a. 5.9 terameters (5.9 Tm) b. 20 kilo-seconds (20 ks) c. 4 femtograms (4 fg)

Chapter 9 Rational Expressions in Open Sentences

Written Exercises, pages 429–430

$$1. \{6\} \quad 3. \{6\} \quad 5. \left\{f: f \leq \frac{10}{3}\right\} \quad 7. \{n: n < 8\}$$

$$9. \{7\} \quad 11. \{p: p \leq 9\} \quad 13. \{s: s > 10\}$$

$$15. \{s: s > -2\} \quad 17. \left\{-\frac{9}{4}\right\} \quad 19. \left\{\frac{3}{5}\right\} \quad 21. \left\{\frac{11}{2}\right\}$$

$$23. \{a: a > -15\} \quad 25. \left\{\frac{9}{50}\right\} \quad 27. \{4\}$$

$$29. y = -\frac{2}{3}x + \frac{11}{36}; m = -\frac{2}{3} \quad 31. y = \frac{7}{4}x; m = \frac{7}{4}$$

$$33. \{(15, 14)\} \quad 35. \left\{\left(\frac{17}{48}, -\frac{133}{72}\right)\right\} \quad 37. \left\{\frac{\sqrt{2}}{2}, -\frac{\sqrt{2}}{2}, \frac{2}{3}\right\}$$

Computer Exercises, page 430

$$1. \{1\} \quad 3. \{8\} \quad 5. \{3\} \quad 7. \left\{-\frac{24}{11}\right\}$$

Problems, pages 433–435

1. 1100 3. 35% 5. 5 L 7. \$32 9. \$2,000 at 5%; \$1,000 at 12% 11. 25 13. \$12,500 15. \$2000 at 9%;

$$\text{\$1500 at 8\%; \$1200 at } 6\frac{1}{2}\% \quad 17. \text{\$3000} \quad 19. 12 \text{ L}$$

Self-Test 1, page 435

1. {48} 2. {1} 3.  $\{b: b \geq -4\}$  4.  $\{x: x > 10\}$   
5. \$44.90 6. \$2300 at 8%; \$2700 at  $10\frac{1}{2}\%$

Written Exercises, pages 438–439

$$1. \{14\} \quad 3. \{12\} \quad 5. \{8\} \quad 7. \{2\} \quad 9. \emptyset$$

$$11. \left\{3, -\frac{11}{2}\right\} \quad 13. \{-5, 3\} \quad 15. \left\{\frac{20}{9}, 3\right\} \quad 17. \left\{\frac{3}{5}\right\}$$

$$19. \{-4, 3\} \quad 21. \{-2\} \quad 23. \left\{\frac{1}{3}, 2\right\} \quad 25. \{10\}$$

$$27. \{-2\} \quad 29. x = \frac{by}{1-y} \quad 31. x = \frac{cn-m}{cP}$$

$$33. \left\{\frac{9}{11}, 3\right\} \quad 35. \{-4\} \quad 37. \{-3\}$$

39. a. No; the solution set for the first equation is  $\{x: x \neq \pm 1\}$  and the solution set for the second equation is  $\mathcal{R}$ . b. Yes; the solution set for each equation is  $\mathcal{R}$ . 41.  $k = 20$  43.  $\{x: 1 < x < 4\}$   
45.  $\{x: -6 < x < 1\}$

Problems, pages 442–443

1. 12, 18 3. 42 5. 8, 9 7. 32, 18 9.  $\frac{77}{33}$  11. 6,  
8 13. -3, -12 or 3, 12 15. -8, -12 or 8, 12  
17.  $\frac{5}{4}, \frac{4}{5}$  or  $-\frac{5}{4}, -\frac{4}{5}$  19. 12, 48 21. 12, 88  
23. 1.  $a < b, 0 < a, 0 < b$  Hypothesis  
2.  $0 \cdot b < a \cdot b$  Mult. prop. of order  
3.  $0 < ab$  Mult. prop. of zero  
4.  $\frac{a}{ab} < \frac{b}{ab}$  Mult. prop. of order  
5.  $\frac{a}{a} \cdot \frac{1}{b} < \frac{1}{a} \cdot \frac{b}{b}$  Basic prop. of quotients  
6.  $1 \cdot \frac{1}{b} < \frac{1}{a} \cdot 1$  Ex. 45, p. 102  
7.  $\therefore \frac{1}{b} < \frac{1}{a}$  (or  $\frac{1}{a} > \frac{1}{b}$ ) Iden. ax. for mult.

Problems, pages 445–446

1.  $3\frac{3}{7}$  h 3.  $1\frac{1}{11}$  h 5. 20 h 7. 16 min, 48 min.  
9.  $4\frac{1}{2}$  h 11. 9 min 13.  $2\frac{3}{16}$  h 15. 16 h

Problems, pages 447–448

1. 80 km/h, 120 km/h 3. 30 km/h 5. 100 km/h  
7. 255 km/h 9. 5 km/h 11. 42 km/h on bicycle;  
105 km/h on motorcycle 13. 30 km

Self-Test 2, page 449

1. {3} 2. {13} 3. {7} 4. {-2} 5. 16, 80  
6.  $3\frac{1}{3}$  h 7. 40 km/h

Written Exercises, pages 453–454

1.  $\frac{6}{5}$  3.  $\frac{2}{9}$  5.  $\frac{14}{17}$  7.  $\frac{3}{2}$  9.  $\left\{\frac{10}{3}\right\}$  11. {0} 13. {25}  
15. {3} 17. {10} 19. {12} 21. 6 to 1 23. -1 to 2



25. 3 to 4 27.  $c$  to  $d$  29. 9 to 2 31.  $-5$  to 4

33.  $\left\{\frac{R}{R^2 - 1}\right\}$  35.  $\{-y, 6y\}$  37.  $\{6\}$

39. 1.  $\frac{a}{b} = \frac{c}{d}; b, d \neq 0$  Hypothesis  
 2.  $\frac{a}{b}(bd) = \frac{c}{d}(bd)$  Mult. prop. of eq.  
 3.  $\left(\frac{a}{b} \cdot b\right)d = \left(\frac{c}{d} \cdot d\right)b$  Commut. and assoc. ax. for mult.  
 4.  $ad = cb$  Ex. 43, page 102  
 5.  $ad = bc$  Commut. ax. for mult.

41. 1.  $\frac{a}{b} = \frac{c}{d}; b, d \neq 0$  Hypothesis  
 2.  $\frac{a}{b} + 1 = \frac{c}{d} + 1$  Add. prop. of eq.  
 3.  $\frac{a}{b} + \frac{b}{b} = \frac{c}{d} + \frac{d}{d}$  Subs. prin.  
 4.  $\frac{a+b}{b} = \frac{c+d}{d}$  Theorem, page 407

**Problems, pages 454–456**

1. 240 acres, 300 acres 3.  $42^\circ, 48^\circ$  5. 12 cm, 12 cm, 20 cm 7. 10 kg 9. 8 cubes 11. \$84 13.  $19.5 \text{ m}^2$   
 15. 48  
 17. Selling price ( $S$ ) = Profit ( $P$ ) + Cost ( $C$ )

$$\begin{aligned} S &= P + C \\ \frac{P}{S} &= \frac{1}{4} & \frac{3P}{3C} &= \frac{C}{3C} \\ \frac{P}{P+C} &= \frac{1}{4} & \frac{P}{C} &= \frac{1}{3} \\ 4P &= P + C \end{aligned}$$

19.  $\frac{an}{a+b}, \frac{bn}{a+b}$  21. 2 h 23. 10 g of calcium, 8 g of sulfur, 16 g of oxygen 25. 168 g of iron, 40 g of nickel, 30 g of copper

**Computer Exercises, page 456**

1. 21 3.  $-11.25$  5. 2.66666667 7.  $-12.5$

**Problems, pages 461–462**

1.  $\frac{28}{3}$  3.  $3a$  5. 6 cm 7. 144 cm 9. 28  
 11.  $e = 500f^3$  13.  $384 \text{ cm}^2$  15. \$35,000 17. No; the graph of the function must go through the origin.  
 19.  $r_1 = kt; r_2 = k(2t) = 2(kt); \therefore r_2 = 2r_1$   
 21.  $u = 6v$

**Problems, pages 465–466**

1. 20 3. 14 5. 400 kHz 7. 125 cm 9. 64 rpm  
 11. 5.6 13.  $a = \frac{0.18}{t^2}$  15. \$12,800 17.  $y$  is halved.  
 19.  $a$  will be quadrupled.

**Problems, pages 470–471**

1. 24 3. 0.15 5. 14 7. 4 9. No change 11.  $Q$  is divided by 4. 13.  $75\pi \text{ cm}^3$  15.  $\frac{16}{3} \text{ h}$  17.  $96 \text{ cm}^3$   
 19.  $x$  is multiplied by 12 21. Halve the resistance.

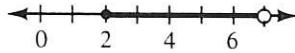
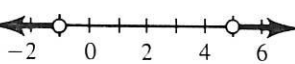

**Self-Test 3, page 472**

1. 3.5 m, 4.9 m 2. \$2350 3. 6 4.  $264 \text{ cm}^3$  5. 2

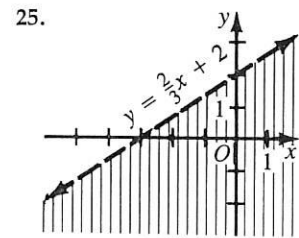
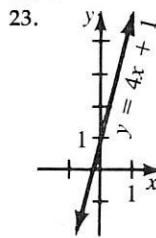
**Chapter Review, pages 473–475**

1. b 2. a 3. c 4. b 5. c 6. b 7. c 8. a  
 9. b 10. a 11. d 12. c 13. b 14. b 15. d  
 16. d 17. a 18. c 19. a 20. c

**Cumulative Review, pages 477–478**

1.  $\{x: 2 \leq x < 7\}$    
 3.  $\{a: a > 5 \text{ or } a < -1\}$    
 5.  $\{p: -3 \leq p \leq -1\}$  

7.  $130^\circ$  9. 2.8 km 11. False 13. False  
 15.  $\{(-1, -1)\}$  17.  $\{(-1, 2), (0, 2), (1, 2)\}$  19. 17  
 21. 7



27.  $y = -\frac{3}{2}x + 1$  29.  $y = -2x - 6$   
 31.  $x^4 + x^3 + 3x - 6$  33.  $24y^9$  35.  $-x^6y^2 + 4x^5y^4 - 2x^3y^5$  37.  $2x^2 - x - 3$  39.  $16c^2 + 24c + 9$  41.  $8x^3 + 12x^2 + 6x + 1$  43.  $(4x - 3)^2$   
 45.  $10(n + 1)(n^2 - n + 1)$  47.  $(3x + 5y)(3x - 5y)$   
 49.  $4x(3x - 1)(x + 3)$  51.  $\left\{0, 3, -\frac{1}{3}\right\}$   
 53.  $\left\{-\frac{3}{2}, -1\right\}$  55.  $-9, -11$  57.  $\frac{e^8 h^4}{k^2}$   
 59.  $-5m^4 - 7m^2 + 9$  61.  $\frac{4m + 3}{2m - 5}$  63.  $\frac{3}{5c - 3}$   
 65.  $\frac{(4x - y)(x + y)}{6(4x + y)}$  67.  $\frac{x - y}{4}$   
 69.  $a + 7 + \frac{3}{2a - 3}$

**Application, page 479**

1. 9.8 N 3.  $1.5 \times 10^{-10} \text{ N}$

**Chapter 10 Irrational Numbers and Radicals**

**Written Exercises, pages 484–485**

1.  $<$  3.  $<$  5.  $=$  7.  $>$  9.  $<$  11.  $=$   
 13.  $\frac{3}{16}, \frac{8}{29}, \frac{5}{14}$  15.  $-\frac{15}{40}, -\frac{27}{81}, -\frac{14}{63}$   
 17.  $\frac{7}{43}, \frac{4}{24}, \frac{13}{65}, \frac{5}{16}$  19.  $\frac{9}{40}$  21.  $-\frac{37}{60}$  23.  $\frac{27}{8}$

25.  $\frac{58}{45}$  27.  $-\frac{77}{72}$  29. 9 31.  $\frac{59a}{60}$  33.  $\frac{99}{70}$

Written Exercises, pages 490–491

1. 0.25 3.  $0.\bar{5}$  5.  $0.41\bar{6}$  7.  $-0.525$  9.  $-6.\bar{2}$   
 11.  $4.\overline{428571}$  13.  $\frac{21}{25}$  15.  $\frac{2627}{50}$  17.  $\frac{4}{9}$  19.  $\frac{25}{99}$   
 21.  $\frac{229}{99}$  23.  $\frac{5155}{999}$  25.  $-\frac{31}{30}$  27.  $-\frac{10604}{909}$   
 29.  $\frac{2}{9}$  31.  $\frac{34}{15}$  33.  $\frac{5}{27}$  35.  $-\frac{20}{121}$  37.  $\frac{9}{8}$  39.  $\frac{19}{45}$   
 41.  $\frac{10}{9}$  43.  $\frac{29}{33}$  45.  $\frac{31}{10}$  47. 6 49. a.  $\frac{36}{9}, \frac{72}{9}, \frac{144}{9}$

b. The value of the entire decimal is one greater than the whole-number part of the decimal.

Written Exercises, pages 495–496

1. 9 3.  $-3$  5. 17 7. 4 9. 25  
 11.  $-\frac{4}{9}$  13.  $\{5, -5\}$  15.  $\{9, -9\}$  17.  $\{\frac{9}{10}, -\frac{9}{10}\}$   
 19.  $\{4, -4\}$  21.  $8|c|$  23.  $3|mn|$  25.  $4u^2$   
 27.  $|\frac{c}{e}|$  29.  $5a^2|b|$  31.  $\frac{x^2}{3|y|}$  33.  $-1.1g^2h^2$   
 35.  $5|ef|$  37.  $|r + s|$  39.  $(f + g)^4$  41.  $14x^2y^8$   
 43.  $\frac{13|j^{15}|}{8k^{10}}$  45.  $\sqrt{25a^2 + 30ab + 9b^2} =$

$\sqrt{(5a + 3b)^2} = |5a + 3b|$  47.  $c^{2m}$  49.  $|q^{5m}|$   
 51. No 53. Yes; domain:  $\{x: x \geq 0\}$ , range:  $\{y: y \geq 0\}$  55.  $\sqrt{a^2} = \sqrt{(-a)^2} = |a|$ . You must know if  $a$  is negative or nonnegative before you can decide if  $|a| = a$  or  $-a$ .

Written Exercises, pages 500–501

1.  $4\sqrt{3}$  3.  $5\sqrt{3}$  5.  $8\sqrt{5}$  7.  $8\sqrt{6}$  9.  $\frac{1}{4}\sqrt{5}$   
 11.  $0.6\sqrt{2}$  13.  $\{\sqrt{11}, -\sqrt{11}\}$  15.  $\{\sqrt{7}, -\sqrt{7}\}$   
 17.  $\{2\sqrt{5}, -2\sqrt{5}\}$  19.  $\{\sqrt{30}, -\sqrt{30}\}$   
 21.  $\{2\sqrt{15}, -2\sqrt{15}\}$  23.  $\{\frac{3}{2}\sqrt{5}, -\frac{3}{2}\sqrt{5}\}$   
 25. 4.461 27. 57.295 29. 16.662 31. 0.779  
 33. 29.226 35. 6.261 37.  $20 - \sqrt{85}$   
 39.  $2 + \sqrt{8}$  41.  $\sqrt{204} - 1$   
 43.  $(3 - \sqrt{5})^2 \gtrless 3 - \sqrt{5}$ ;  $(3 - 2.24)^2 \gtrless 3 - 2.24$ ;  
 $(0.76)^2 \gtrless 0.76$ ;  $0.58 < 0.76\sqrt{\quad}$   
 45.  $\{1.79\}$  47.  $x = -y$ ; for example  $x = 1$ ,  
 $y = -1$  49.  $-5$  51.  $-9$  53. 15 55.  $a - b$   
 57. No;  $\sqrt{2} - 1$  59. Yes; if  $r = s$  then  $\frac{r}{s} = 1$  is rational.



Self-Test 1, page 502

1.  $>$  2.  $<$  3.  $2\frac{5}{6}$  4. 0.625 5.  $0.458\bar{3}$  6.  $\frac{48}{125}$   
 7.  $\frac{24}{55}$  8. 8 9. 36 10. 18 11.  $2\sqrt{6}$  12.  $4\sqrt{21}$   
 13.  $8\sqrt{5}$  14. 9.381 15. 8.307 16. 15.652

On the Calculator, page 502

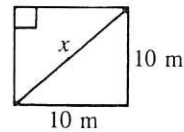
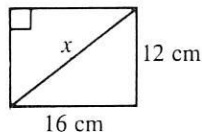
1. 2.65 3. 11.18 5. 1.58 7. 0.79

Written Exercises, page 510

1. 5.39 3. 7.48 5. 11.18 7. 5.10 9. 8.25  
 11. 5.66 13. Yes 15. No 17. No 19. Yes  
 21. No 23. No 25. Yes 27. Yes 29. Yes  
 31. Yes 33.  $0.625 \approx 0.63$  35. 8.94 37. 40  
 39.  $a = 8.94$ ;  $b = 4.47$  41.  $a = 4.47$ ;  $c = 6.71$

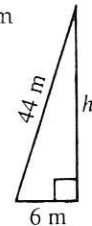
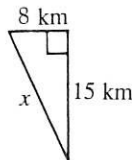
Problems, pages 511–512

1.  $x = 20$  cm 3.  $x = 14.14$  m



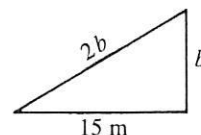
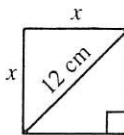
5.  $x = 17$  km

7.  $h = 43.59$  m

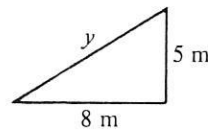
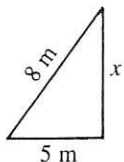


9.  $x = 8.49$  cm

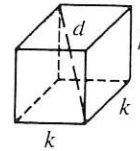
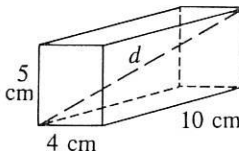
11.  $b = 8.66$  m



13.  $x = 6.24$  m or  $y = 9.43$  m



15. diagonal = 11.87 cm 17.  $d = k\sqrt{3}$



Written Exercises, pages 514–515

1.  $\sqrt{5}$  3. 5 5.  $3\sqrt{5}$  7.  $3\sqrt{2}$  9. 17 11.  $18\sqrt{2}$   
 13.  $2\sqrt{a^2 + b^2}$  15.  $|a - b|\sqrt{2}$  17.  $|a - b|\sqrt{2}$   
 19. Yes 21. Yes 23. No 25. No  
 27.  $y = -7x + 5$  29.  $A = (18, 4)$ ,  $B = (12, 12)$ ,  
 $C = (8, 4)$ ;  $AB = AC = 10$   
 31.  $d = \sqrt{(x - 0)^2 + (y - 0)^2} = \sqrt{x^2 + y^2}$   
 33.  $m = -6.5$  or  $m = -1.5$

Self-Test 2, page 516

1. Yes 2. No 3. No 4. Yes 5. 30 6. 6.24  
 7. 14.07 8. 10.58 9.  $\sqrt{41}$  10. 13  
 11.  $6\sqrt{29}$  12.  $2\sqrt{73}$

Written Exercises, pages 519–520

1.  $5\sqrt{2}$  3.  $6\sqrt{2}$  5.  $6\sqrt{5}$  7.  $3\sqrt{2}$  9.  $\frac{\sqrt{30}}{3}$   
 11. 2 13.  $\sqrt{2}$  15.  $4\sqrt{10}$  17. 4.47 19. 16.97  
 21. 0.45 23. 0.76 25.  $c\sqrt{6}$  27.  $10e\sqrt{e}$  29.  $\frac{\sqrt{3}t}{t}$   
 31.  $16r^4$  33.  $\frac{5\sqrt{2}}{e}$  35.  $\frac{3\sqrt{10}c}{4c}$  37.  $m\sqrt{n}$   
 39.  $\frac{\sqrt{15}k}{3}$  41.  $\frac{8\sqrt{3}gh}{h}$  43.  $2\sqrt{2}$  45.  $\frac{\sqrt{a+b}}{a+b}$   
 47.  $\frac{\sqrt{2x+1}}{2x+1}$  49.  $\frac{\sqrt{x+3}}{x+3}$  51.  $\frac{(r+s)\sqrt{r-s}}{(r-s)}$

Written Exercises, pages 523–524

1.  $4\sqrt{6}$  3.  $10\sqrt{2}$  5.  $-20\sqrt{2}$  7.  $-4\sqrt{c}$   
 9.  $15\sqrt{30}$  11.  $3\sqrt{2} - 6$  13. 2 15.  $-5 + 2\sqrt{13}$   
 17.  $1 + \sqrt{2}$  19.  $26 + 7\sqrt{3}$  21.  $-5$  23. 17  
 25.  $a - 2\sqrt{ac} + c$  27.  $9 + 6\sqrt{2}$  29.  $23 + 4\sqrt{15}$   
 31.  $1 + \sqrt{3}$  33.  $4\sqrt{6} - 4\sqrt{3}$  35.  $\frac{5 + 3\sqrt{3}}{2}$   
 37.  $-4 - 3\sqrt{2} - 2\sqrt{3} - 2\sqrt{6}$   
 39.  $\frac{10 + \sqrt{6} + 2\sqrt{10} + \sqrt{15}}{17}$   
 41.  $\frac{5 + 6\sqrt{6} - 3\sqrt{10} - 2\sqrt{15}}{-13}$  43.  $6\sqrt{6}$   
 45.  $-34j\sqrt{2k}$  47.  $\frac{5}{6}u$  49.  $(82 + 8\sqrt{10})m^2$   
 51.  $10 - 3\sqrt{3}$  53.  $13 - 9\sqrt{2}$  55.  $(2 + \sqrt{5})^2 - 4(2 + \sqrt{5}) - 1 = 4 + 4\sqrt{5} + 5 - 8 - 4\sqrt{5} - 1 = 0$ ;  
 $(2 - \sqrt{5})^2 - 4(2 - \sqrt{5}) - 1 = 4 - 4\sqrt{5} + 5 - 8 + 4\sqrt{5} - 1 = 0$

Written Exercises, page 526

1. 3 3. 3 5.  $-128$  7.  $2\sqrt[4]{5}$  9.  $5\sqrt[3]{3}$  11.  $\frac{3\sqrt[3]{4}}{2}$   
 13.  $3\sqrt[4]{2}$  15.  $\frac{\sqrt[3]{5}}{2}$  17.  $\frac{\sqrt[5]{18}}{2}$  19.  $\frac{\sqrt[3]{10}}{4}$  21.  $x^3$   
 23.  $x^2y^3z$  25.  $x^2y^3z^2\sqrt[3]{xy^2z^2}$  27.  $\frac{y^2\sqrt[4]{x^2y}}{x}$   
 29.  $\frac{\sqrt[3]{x(x-1)}}{x-1}$  31.  $\frac{\sqrt[6]{(x+1)^5}}{x+1}$

On the Calculator, page 526

1. 54.96 3. 1.21 5. 1.17 7. 0.89

Written Exercises, page 529

1. {64} 3. {4} 5.  $\emptyset$  7.  $\left\{\frac{1}{9}\right\}$  9. {100} 11. {13}  
 13.  $\left\{-\frac{3}{2}\right\}$  15.  $\left\{\frac{81}{4}\right\}$  17.  $\left\{\frac{9}{25}\right\}$  19.  $\left\{\frac{7}{2}\right\}$  21. {12}

23.  $\{3\sqrt{2}, -3\sqrt{2}\}$  25. {4} 27. {14} 29.  $\{-3\}$   
 31. {2} 33.  $\left\{-\frac{1}{3}\right\}$  35. {0, 4} 37. {(4, 16)}

Self-Test 3, page 530

1.  $18\sqrt{6}$  2.  $\frac{4\sqrt{10}}{15}$  3.  $9\sqrt{3} - 6\sqrt{2}$   
 4.  $3\sqrt{2} + 2\sqrt{3}$  5.  $\frac{\sqrt{35} - 2\sqrt{7} - 3\sqrt{5} + 6}{-2}$   
 6.  $18 - \sqrt{2}$  7. 3 8.  $\frac{\sqrt[3]{20}}{6}$  9.  $7\sqrt[4]{2}$  10. {63}  
 11. {11} 12. {3}

Extra, page 532

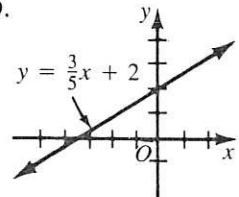
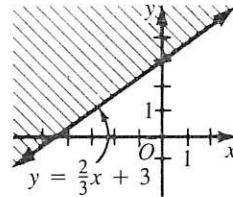
1. 1 3.  $-1$  5.  $i$  7.  $2i\sqrt{7}$  9.  $2i\sqrt{15}$  11.  $15i$   
 13.  $-24\sqrt{2}$  15.  $-\frac{2i}{7}$  17.  $-\frac{4i\sqrt{5}}{15}$  19. {7i, -7i}  
 21.  $\{4i\sqrt{5}, -4i\sqrt{5}\}$  23. {4i, -4i}

Chapter Review, pages 534–535

1. c 2. c 3. d 4. d 5. b 6. c 7. c 8. c  
 9. a 10. b 11. c 12. a 13. d 14. b 15. b  
 16. b 17. c 18. b 19. c 20. d 21. b 22. c  
 23. d 24. a

Mixed Review, pages 537–538

1.  $3n^3$  3.  $4x^2 - 25$  5.  $x^3 - 15x^2 + 75x - 125$   
 7.  $x^4z^3$  9.  $-\frac{m+2}{2}$  11.  $-14ab + 9b^2 - 1$   
 13.  $\frac{c^2 + 6cd + d^2}{3c^2 + 10cd + 3d^2}$  15.  $-\frac{5}{2}$  17.  $\left\{\frac{5}{2}, -3\right\}$   
 19. {1} 21. {k: k < 12} 23. {40} 25. {1, -2}  
 27.  $\left\{\frac{5}{3}\right\}$  29.  $(x-6)(x+3)$  31.  $(5z+2)(4z-1)$   
 33.  $3(m+4)(m-1)$  35.  $2ab(b-3)(b+3)$   
 37. 39.



41.  $x = -1$  43.  $y = \frac{2}{3}x - 5$ , or  $2x - 3y = 15$   
 45.  $9.07 \times 10^{13}$  47. \$2000 at  $6\frac{1}{2}\%$ ; \$4500 at 8%  
 49. 12 and 20 or  $-12$  and  $-20$  51. 8.75 cm  
 53. 15 m long and 8 m wide 55.  $24 \text{ cm}^3$

Preparing for College Entrance Exams, page 539

1. B 3. C 5. B 7. E

Application, page 541

1. 80 km 3. 226 km 5. 2 m 7. a. 106,189 km  
 b. 35,721 km c. Since  $h$  is large, the  $h^2$  term is significant and must not be omitted in the calculation.

Written Exercises, page 547

1.  $\{-1, 3\}$     3.  $\{-2, -4\}$
5.  $\{-4 + \sqrt{6}, -4 - \sqrt{6}\}; \{-1.55, -6.45\}$
7.  $\{2 + 2\sqrt{3}, 2 - 2\sqrt{3}\}; \{5.46, -1.46\}$
9.  $\{1, 3\}$     11.  $\{1, 7\}$
13.  $\left\{\frac{1 + \sqrt{17}}{2}, \frac{1 - \sqrt{17}}{2}\right\}; \{2.56, -1.56\}$
15.  $\left\{\frac{-3 + \sqrt{13}}{2}, \frac{-3 - \sqrt{13}}{2}\right\}; \{0.30, -3.30\}$
17.  $\left\{\frac{9 + \sqrt{41}}{2}, \frac{9 - \sqrt{41}}{2}\right\}; \{7.70, 1.30\}$
19.  $\left\{-\frac{1}{2}, 1\right\}$     21.  $\left\{\frac{1 + \sqrt{13}}{3}, \frac{1 - \sqrt{13}}{3}\right\}$
23.  $\{-3 + \sqrt{14}, -3 - \sqrt{14}\}$     25. no real roots
27.  $\left\{\frac{-1 + \sqrt{61}}{10}, \frac{-1 - \sqrt{61}}{10}\right\}$
29.  $\left\{\frac{-2 + \sqrt{3}}{5}, \frac{-2 - \sqrt{3}}{5}\right\}$     31. no real roots
33.  $\left\{\frac{1}{2}, 2\right\}$     35.  $\left\{\frac{4 + \sqrt{10}}{3}, \frac{4 - \sqrt{10}}{3}\right\}$
37.  $\left\{\frac{5 + \sqrt{41}}{8}, \frac{5 - \sqrt{41}}{8}\right\}$
39.  $\left\{\frac{-\sqrt{3} + \sqrt{15}}{2}, \frac{-\sqrt{3} - \sqrt{15}}{2}\right\}$
41.  $\left\{\frac{1 + \sqrt{6}}{5k}, \frac{1 - \sqrt{6}}{5k}\right\}$
43.  $\left\{\frac{-b + \sqrt{b^2 - 4c}}{2}, \frac{-b - \sqrt{b^2 - 4c}}{2}\right\}$ ,  
if  $b^2 - 4c \geq 0$

Written Exercises, pages 550–551

1.  $\{5, -1\}$     3.  $\{-4, 1\}$     5.  $\left\{4, -\frac{2}{3}\right\}$     7.  $\{-1 + \sqrt{2}, -1 - \sqrt{2}\}; \{0.41, -2.41\}$
9.  $\left\{\frac{3 + \sqrt{2}}{7}, \frac{3 - \sqrt{2}}{7}\right\}; \{0.63, 0.23\}$     11. no real roots
13. two    15. none    17. two    19. one    21. none
23. two    25.  $\left\{-3, \frac{1}{2}\right\}$     27.  $\{1, 5\}$
29.  $\left\{\frac{13 + \sqrt{89}}{8}, \frac{13 - \sqrt{89}}{8}\right\}$     31.  $\left\{\frac{1}{2}, \frac{3}{2}\right\}$
33.  $\{2 + 2\sqrt{3}, 2 - 2\sqrt{3}\}$     35.  $\{7 + 2\sqrt{7}, 7 - 2\sqrt{7}\}$
37.  $\left\{\frac{\sqrt{6} + 3\sqrt{2}}{2}, \frac{\sqrt{6} - 3\sqrt{2}}{2}\right\}$
39.  $\{\sqrt{5} + 2\sqrt{2}, \sqrt{5} - 2\sqrt{2}\}$
41.  $\left\{\frac{-4 + \sqrt{10}}{3}, \frac{-4 - \sqrt{10}}{3}\right\}$     43. 9
45. By the quadratic formula, the roots are  $\frac{-b + \sqrt{b^2 - 4ac}}{2a}$  and  $\frac{-b - \sqrt{b^2 - 4ac}}{2a}$ . Thus,

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

47.  $x^2 - 4x - 1 = 0$

Problems, pages 554–555

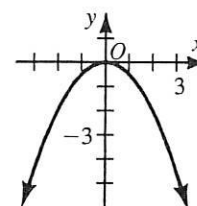
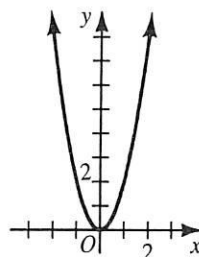
1. 70 cm; 40 cm    3.  $\frac{4}{3}$  or  $\frac{3}{4}$     5. width: 2.21 m; length: 10.85 m
7. 8 km; 15 km    9. 8 arrangements
11. 7.24 km/h    13. Ron: 8 h; Russ: 10 h
15. 40 shares    17. 60 km/h; 80 km/h

Self-Test 1, page 556

1.  $\{-2 + \sqrt{7}, -2 - \sqrt{7}\}$     2.  $\{3 + 2\sqrt{2}, 3 - 2\sqrt{2}\}$
3.  $\left\{\frac{-5 + \sqrt{17}}{4}, \frac{-5 - \sqrt{17}}{4}\right\}$
4.  $\left\{\frac{2 + \sqrt{10}}{3}, \frac{2 - \sqrt{10}}{3}\right\}$     5. 8 cm; 12 cm

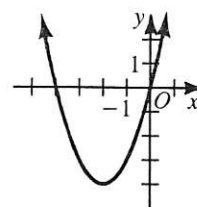
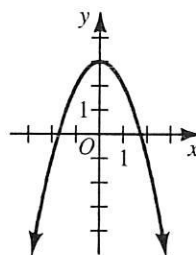
Written Exercises, pages 562–563

1. The zero is 0.    3. The zero is 0.



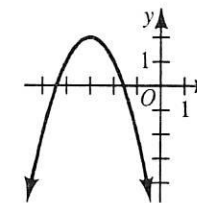
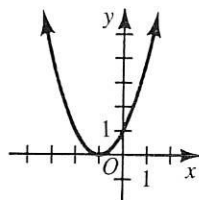
5. The zeros are  $\sqrt{3}$  and  $-\sqrt{3}$ .

7. The zeros are 0 and  $-4$ .

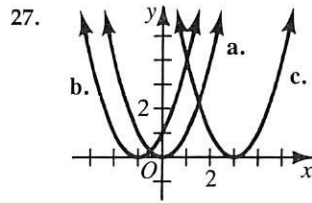
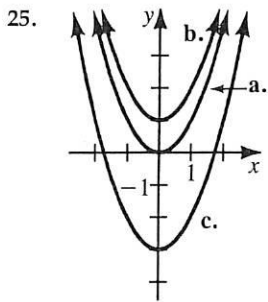


9. The zero is  $-1$ .

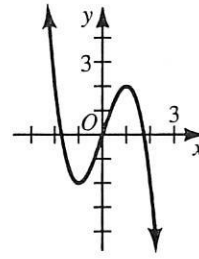
11. The zeros are  $-3 + \sqrt{2}$  and  $-3 - \sqrt{2}$ .



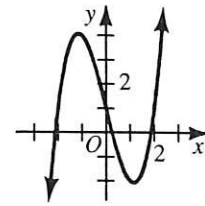
13.  $-\frac{9}{4}$     15.  $-\frac{25}{4}$     17.  $-6$     19.  $\frac{9}{4}$     21.  $-1$     23.  $\frac{1}{8}$



5. The zeros are 0 and approx.  $-1\frac{3}{4}$  and  $1\frac{3}{4}$ .

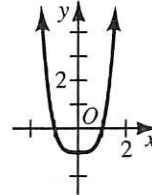


7. The zeros are approx.  $-2\frac{1}{8}$ ,  $\frac{1}{4}$ , and  $1\frac{7}{8}$ .

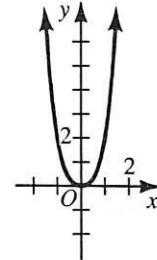


29. The graph of  $y = ax^2 + k$  is the graph of  $y = ax^2$  translated (slid) vertically  $k$  units (up if  $k$  is positive and down if  $k$  is negative).

9. The zeros are  $-1$  and  $1$ .



11. The zero is 0.



31. a. no; no b. no

33. Answers may vary. (The graph is any non-horizontal line.) 35. Least positive integral value of  $x$ : 500,000

13. a.  $-1010000$  b.  $1010000$

15. a.  $-1000100000000$  b.  $1000100000000$

17. a.  $999000000$  b.  $-999000000$  19. a. The values of  $f$  get smaller; the values of  $f$  get larger. b. The values of  $f$  get larger; the values of  $f$  get smaller. 21. No. For example,  $Q(0) = 0$ .

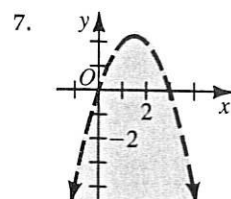
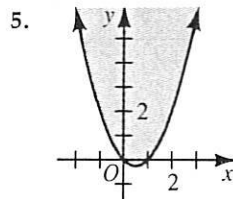
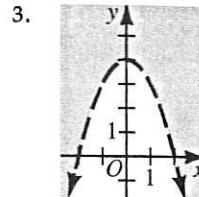
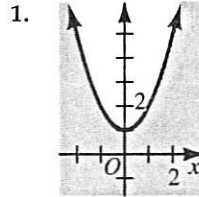
37. Let  $x = -\frac{b}{a} - u$ .

$$\begin{aligned} ax^2 + bx + c &= a\left(-\frac{b}{a} - u\right)^2 + b\left(-\frac{b}{a} - u\right) + c \\ &= a\left(\frac{b^2}{a^2} + \frac{2bu}{a} + u^2\right) - \frac{b^2}{a} - bu + c \\ &= \frac{b^2}{a} + 2bu + au^2 - \frac{b^2}{a} - bu + c \\ &= au^2 + bu + c \end{aligned}$$

Since  $P(u, v)$  lies on the graph,  
 $au^2 + bu + c = v$ .

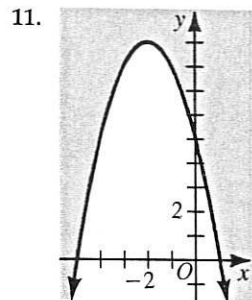
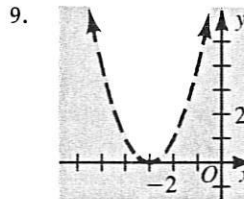
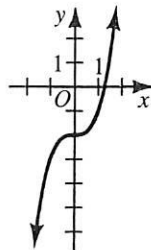
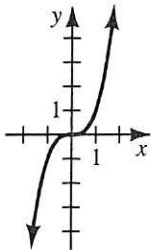
Thus,  $a\left(-\frac{b}{a} - u\right)^2 + b\left(-\frac{b}{a} - u\right) + c = v$ , and  
so  $Q\left(-\frac{b}{a} - u, v\right)$  lies on the graph.

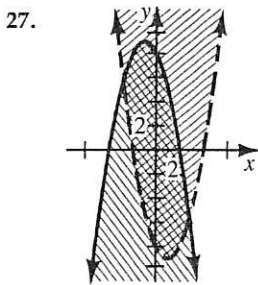
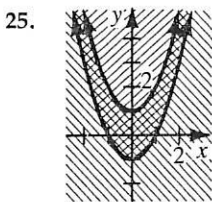
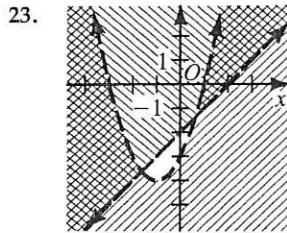
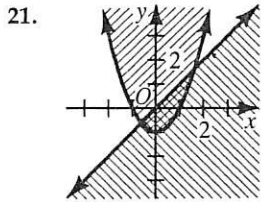
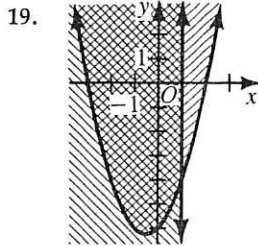
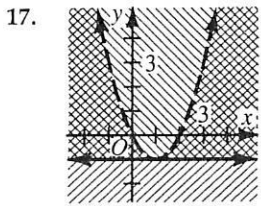
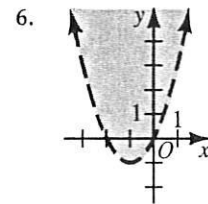
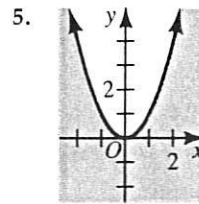
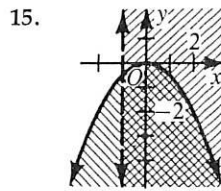
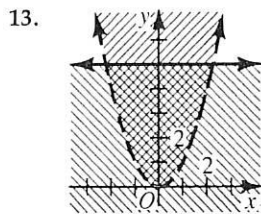
### Written Exercises, page 569



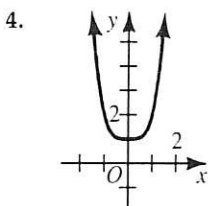
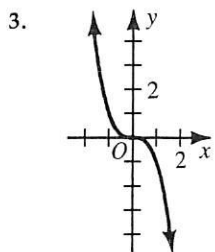
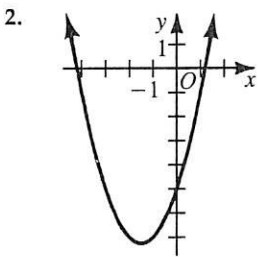
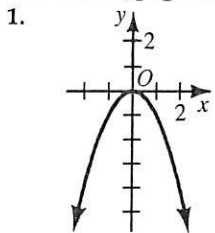
### Written Exercises, pages 565–566

1. The zero is 0. 3. The zero is approx.  $1\frac{1}{4}$ .





Self-Test 2, page 569



Extra, page 572

1. 2 3. -2 5. not a real number 7. 8 9.  $\frac{1}{6}$   
11. 9 13.  $4y^4$  15.  $4x^2$

Chapter Review, pages 573-574

1. b 2. c 3. d 4. a 5. c 6. b 7. b 8. b  
9. a 10. a 11. a 12. a 13. d 14. b

Cumulative Review, pages 575-577

1.  $\{(2, 1)\}$  3.  $\emptyset$  5.  $\{(0, 2)\}$  7.  $\{(5, 2)\}$   
9.  $\{(-4, 6)\}$  11. 15 sophomores; 13 juniors  
13.  $-3uv^2$  15.  $-r^3s + r^2s^2 - rs^3$   
17.  $16x^2 - 24x + 9$  19.  $-12cd^2e(1 + 4c^2d)$   
21.  $(1 + 6w)^2$  23.  $(2x - 5)(8x - 5)$  25. 32, 4  
27.  $\{-30\}$  29.  $\{a: a \geq -4\}$  31.  $\{-1\}$  33. 24  
35. 40 37.  $3\frac{3}{5}h$  39. 15 41. 150 43. 40  
45.  $\frac{\sqrt{14}}{6}$  47.  $\frac{\sqrt[3]{15}}{3}$  49.  $\frac{11 - 6\sqrt{3}}{-13}$ ,  
or  $\frac{-11 + 6\sqrt{3}}{13}$  51.  $\{-6, 6\}$  53.  $\{9\}$

Contest Problems, page 577

1. 30 3. 256 5. 91 7.  $n + 1$

Chapter 12 Trigonometry and Vectors

Written Exercises, pages 582-584

1.  $660^\circ$  3.  $-390^\circ$  5.  $-240^\circ$  7.  $-420^\circ$  9. III; IV  
11.  $0^\circ$ ;  $90^\circ$  13.  $270^\circ$  15.  $320^\circ$  17.  $560^\circ$  19. III; II  
21.  $0^\circ$  23.  $-45^\circ$  25. II; IV 27.  $120^\circ$  in 1 s;  
 $600^\circ$  in 5 s;  $14,400^\circ$  in 2 min 29.  $18,000^\circ$

Written Exercises, pages 588-590

1.  $\sin A = \frac{4}{5}$ ;  $\cos A = \frac{3}{5}$ ;  $\tan A = \frac{4}{3}$  3.  $\sin A = \frac{3}{5}$ ;  
 $\cos A = -\frac{4}{5}$ ;  $\tan A = -\frac{3}{4}$  5.  $\sin A = \frac{12}{13}$ ;  $\cos A = \frac{5}{13}$ ;  
 $\tan A = \frac{12}{5}$  7.  $\sin A = -\frac{\sqrt{2}}{2}$ ;  $\cos A = \frac{\sqrt{2}}{2}$ ;  
 $\tan A = -1$  9.  $\sin A = \frac{\sqrt{2}}{2}$ ;  $\cos A = \frac{\sqrt{2}}{2}$ ;  $\tan A = 1$   
11.  $\sin A = \frac{1}{2}$ ;  $\cos A = \frac{\sqrt{3}}{2}$ ;  $\tan A = \frac{\sqrt{3}}{3}$   
13.  $\sin A = \frac{1}{2}$ ;  $\tan A = \frac{\sqrt{3}}{3}$  15.  $\cos A = \frac{\sqrt{2}}{2}$ ;  
 $\tan A = -1$  17.  $\sin A = -\frac{\sqrt{2}}{2}$ ;  $\cos A = -\frac{\sqrt{2}}{2}$   
19.  $\sin A = \frac{5}{13}$ ;  $\tan A = -\frac{5}{12}$

21.		I	II	III	IV
	sin A	+	+	-	-
	cos A	+	-	-	+
	tan A	+	-	+	-

23.  $\sin A = 0$ ;  $\cos A = 1$ ;  $\tan A = 0$

25. If  $\sin A = 0$ , then  $\cos A = \pm 1$ , since  $\sin^2 A + \cos^2 A = 1$ . 27. If  $\sin A < 0$  and  $\cos A < 0$ , then  $\tan A$  must be  $> 0$  since  $\tan A = \frac{\sin A}{\cos A}$ .

29. If  $\sin A < 0$  and  $\tan A < 0$ , then  $A$  is in quadrant IV and  $\cos A$  is positive and  $< 1$ . Therefore,  $\tan A = \frac{\sin A}{\cos A}$  must be less than  $\sin A$ .

31.  $\sin A = \frac{12}{13}$ ;  $\cos A = \frac{5}{13}$ ;  $\tan A = \frac{12}{5}$

33.  $\sin A = \frac{\sqrt{2}}{2}$ ;  $\cos A = \frac{\sqrt{2}}{2}$ ;  $\tan A = 1$

35.  $k = 1\frac{1}{2}$  37.  $k = 1\frac{1}{4}$

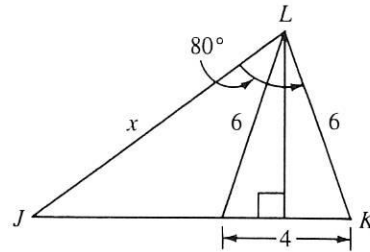
**Written Exercises, page 592**

1. 3.7321 3. 0.7071 5. 2.1445 7. 0.5736  
 9. 0.9877 11. 0.2924 13.  $14^\circ$  15.  $84^\circ$  17.  $56^\circ$   
 19.  $71^\circ$  21.  $76^\circ$  23.  $27^\circ$  25.  $\sin 45^\circ$  27.  $\sin 20^\circ$   
 29.  $\sin 30^\circ$  31.  $18^\circ$  33.  $\tan 10^\circ = \frac{\sin 10^\circ}{\sin 80^\circ}$

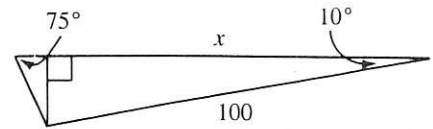
**Written Exercises, pages 596–598**

1. a.  $OB = 1$  b.  $\sin A = \frac{\sqrt{2}}{2}$  c.  $\cos A = \frac{\sqrt{2}}{2}$   
 d.  $\tan A = 1$  3. a.  $OB = 13$  b.  $\sin A = \frac{12}{13}$   
 c.  $\cos A = \frac{5}{13}$  d.  $\tan A = \frac{12}{5}$  5. a.  $OB = 3$   
 b.  $\sin A = -\frac{2}{3}$  c.  $\cos A = \frac{\sqrt{5}}{3}$  d.  $\tan A = -\frac{2\sqrt{5}}{5}$  7. a.  $\sin A = \frac{\sqrt{2}}{2}$  b.  $\cos A = \frac{\sqrt{2}}{2}$   
 c.  $\tan A = 1$  9. a.  $\sin A = \frac{1}{2}$  b.  $\cos A = -\frac{\sqrt{3}}{2}$   
 c.  $\tan A = -\frac{\sqrt{3}}{3}$  11. a.  $\sin A = \frac{\sqrt{2}}{2}$  b.  $\cos A = -\frac{\sqrt{2}}{2}$  c.  $\tan A = -1$  13. a.  $\sin A = \frac{5}{13}$   
 b.  $\cos A = \frac{12}{13}$  c.  $\tan A = \frac{5}{12}$  15. a.  $\sin A = 0$   
 b.  $\cos A = -1$  c.  $\tan A = 0$  17. a.  $\sin A = -\frac{3}{5}$   
 b.  $\cos A = -\frac{4}{5}$  c.  $\tan A = \frac{3}{4}$  19.  $x = 4.4$   
 21.  $x = 7.2$  23.  $m \angle A \approx 64^\circ$  25.  $m \angle A \approx 36^\circ$   
 27.  $m \angle A = 62^\circ$ ;  $m \angle B = 28^\circ$ ;  $m \angle C = 90^\circ$

- $a \approx 7.9$ ;  $b \approx 4.2$ ;  $c = 9$  29.  $m \angle A = 30^\circ$ ;  $m \angle B = 60^\circ$ ;  $m \angle C = 90^\circ$ ;  $a = 6$ ;  $b \approx 10.4$ ;  $c = 12$  31.  $m \angle A = 54^\circ$ ;  $m \angle B = 36^\circ$ ;  $m \angle C = 90^\circ$ ;  $a \approx 40.5$ ;  $b \approx 29.4$ ;  $c = 50$   
 33.  $m \angle A \approx 66^\circ$ ;  $m \angle B \approx 24^\circ$ ;  $m \angle C = 90^\circ$ ;  $a = 9$ ;  $b = 4$ ;  $c \approx 9.8$   
 35.  $x \approx 11.8$   
 37.  $x \approx 11.7$



39.  $x \approx 103.2$



**Problems, pages 599–600**

1.  $x = 168.6$  m 3.  $m \angle A = 12^\circ$  5. 29.7 m  
 7. 4.0 m 9. 128.7 m 11. 3.3 km; 1188 km/h

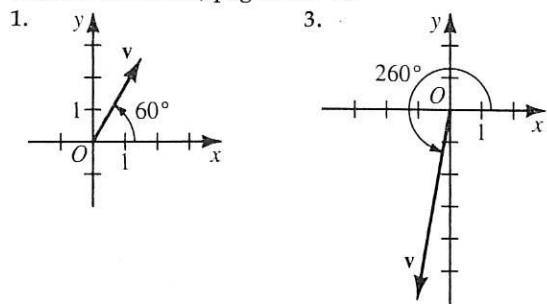
**On the Calculator, page 601**

1. 0.7071 3. 0.0524 5. 4.7572 7. 1

**Self-Test 1, page 601**

1.  $30^\circ$  2.  $120^\circ$  3.  $35^\circ$  4.  $-\frac{4}{5}$  5.  $-\frac{3}{5}$  6.  $\frac{4}{3}$   
 7. 0.9781 8. 0.6293 9. 0.5095 10.  $m \angle A = 48^\circ$ ;  $m \angle B = 42^\circ$ ;  $m \angle C = 90^\circ$ ;  $a \approx 8.9$ ;  $b = 8$ ;  $c \approx 12.0$

**Written Exercises, pages 606–607**

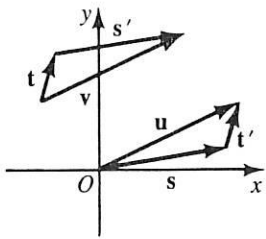


5.  $\|s\| = 3\sqrt{2} \approx 4.2$  7. 3 9. 6.4;  $51^\circ$  11. 3;  $138^\circ$   
 13. a.  $45^\circ$  b.  $315^\circ$  15. 5.8;  $121^\circ$  17. 4.5;  $63^\circ$   
 19.  $329^\circ$  21.  $27^\circ$

**Written Exercises, pages 610–611**

1. a.  $x$ -component,  $-2$ ;  $y$ -component, 1  
 b.  $\|v\| = 4.2$  3. a.  $x$ -component, 2;  $y$ -component, 4  
 b.  $\|v\| = 5.8$  5.  $45^\circ$  7.  $31^\circ$  9. (2, 4)

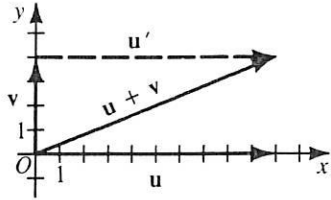
11. a.



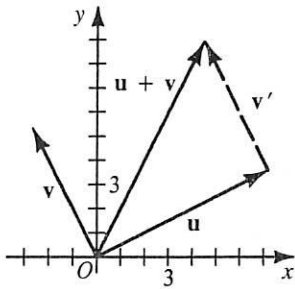
b.  $u$  and  $v$  are equivalent

13.  $p = -7; q = 4$     15.  $p = -5; q = 4$

17.  $\|u + v\| = 10.8$ ; direction  $22^\circ$



19.  $\|u + v\| = 10$ ; direction,  $67^\circ$

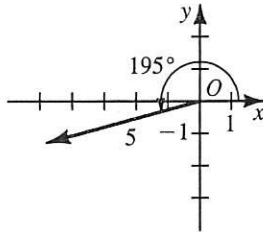


**Problems, page 614**

1.  $63^\circ$     3. 12.2 km/h;  $99^\circ$     5. 2892.5 N    7. 164.2 km;  
 $14^\circ$     9. 427.2 km/h;  $54^\circ$     11. 3.7 km; 1.3 km/h

**Self-Test 2, page 615**

1.



2.  $\|v\| = 5.8$ ; direction,  $59^\circ$   
 3.  $\|s + t\| = 6.1$   
 4. 3.6 km/h;  $124^\circ$

**Chapter Review, pages 616–617**

1. b    2. c    3. c    4. b    5. a    6. c    7. b    8. a    9. d  
 10. b    11. d    12. c    13. a    14. d

**Mixed Review, pages 618–619**

1.  $-\frac{x}{x+5}$     3.  $\frac{5n+8}{n+4}$     5.  $\frac{y^4}{x^6z}$     7.  $\frac{3n-m}{n-3m}$   
 9.  $2\sqrt{47}$     11.  $|y-4|$     13.  $\frac{2\sqrt{5}}{5}$     15.  $2\sqrt{5} - 2\sqrt{2}$   
 17.  $6 - 6\sqrt{5}$     19.  $5.31 \times 10^{-6}$     21.  $2.7 \times 10^{-2}$   
 23.  $1 \times 10^{-2}$     25.  $\{(-5, -2)\}$     27.  $\{(-7, -8)\}$   
 29.  $\emptyset$     31.  $\left\{\left(1, \frac{7}{4}\right)\right\}$     33.  $0.91\bar{6}$     35. 20    37. 4.9  
 39.  $51^\circ$     41.  $\{\sqrt{14}, -\sqrt{14}\}$     43.  $\{5, -2\}$     45.  $\{81\}$   
 47.  $\{1\}$     49. 2 quarters; 5 dimes; 3 nickels  
 51. 15.1 cm    53. 96    55.  $-9$  and  $-11$

**Preparing for College Entrance Exams, page 620**

1. E    3. E    5. A    7. B

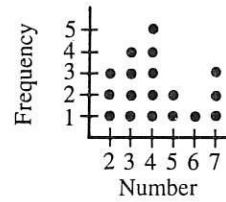
**Contest Problems, page 621**

1. 16    3.  $\{m: 0 < m < 6\}$     5. 5

**Chapter 13 Statistics and Probability**

**Written Exercises, pages 625–626**

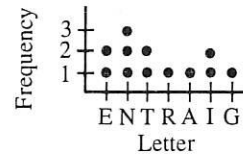
1.



3. Number	Freq.	Relative Freq.	
		Frac.	%
2	3	$\frac{3}{18}$	$16\frac{2}{3}$
3	4	$\frac{4}{18}$	$22\frac{2}{9}$
4	5	$\frac{5}{18}$	$27\frac{7}{9}$
5	2	$\frac{2}{18}$	$11\frac{1}{9}$
6	1	$\frac{1}{18}$	$5\frac{5}{9}$
7	3	$\frac{3}{18}$	$16\frac{2}{3}$

Total:            18     $\frac{18}{18} = 1$     100

5.



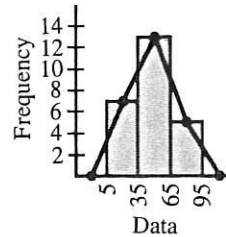


7.	Letter	Freq.	Relative Freq.	
			Frac.	%
	E	2	$\frac{2}{12}$	$16\frac{2}{3}$
	N	3	$\frac{3}{12}$	25
	T	2	$\frac{2}{12}$	$16\frac{2}{3}$
	R	1	$\frac{1}{12}$	$8\frac{1}{3}$
	A	1	$\frac{1}{12}$	$8\frac{1}{3}$
	I	2	$\frac{2}{12}$	$16\frac{2}{3}$
	G	1	$\frac{1}{12}$	$8\frac{1}{3}$
Total:		12	$\frac{12}{12} = 1$	100

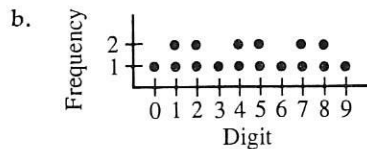
Written Exercises, pages 628–630

1. a.	Interval	Freq.	Relative Freq.	
			Frac.	%
	5–35	7	$\frac{7}{25}$	28
	35–65	13	$\frac{13}{25}$	52
	65–95	5	$\frac{5}{25}$	20
Total:		25	$\frac{25}{25} = 1$	100

b., c.

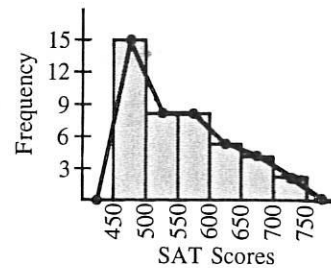


9. a.	Digit	Freq.	Relative Freq.	
			Frac.	%
	0	1	$\frac{1}{16}$	$6\frac{1}{4}$
	1	2	$\frac{2}{16}$	$12\frac{1}{2}$
	2	2	$\frac{2}{16}$	$12\frac{1}{2}$
	3	1	$\frac{1}{16}$	$6\frac{1}{4}$
	4	2	$\frac{2}{16}$	$12\frac{1}{2}$
	5	2	$\frac{2}{16}$	$12\frac{1}{2}$
	6	1	$\frac{1}{16}$	$6\frac{1}{4}$
	7	2	$\frac{2}{16}$	$12\frac{1}{2}$
	8	2	$\frac{2}{16}$	$12\frac{1}{2}$
	9	1	$\frac{1}{16}$	$6\frac{1}{4}$
Total:		16	$\frac{16}{16} = 1$	100



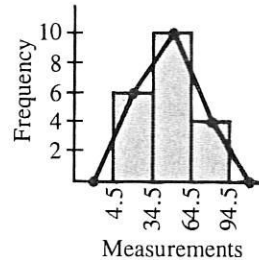
11. Answers will vary.

3.



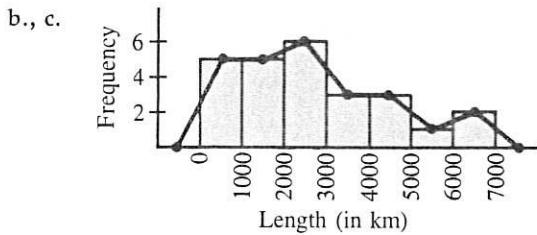
5. a.	Interval	Freq.	Relative Freq.	
			Frac.	%
	4.5–34.5	6	$\frac{6}{20}$	30
	34.5–64.5	10	$\frac{10}{20}$	50
	64.5–94.5	4	$\frac{4}{20}$	20
Total:		20	$\frac{20}{20} = 1$	100

b., c.



7. a.	Interval	Freq.	Relative Freq.	
			Frac.	%
	0-1000	5	$\frac{5}{25}$	20
	1000-2000	5	$\frac{5}{25}$	20
	2000-3000	6	$\frac{6}{25}$	24
	3000-4000	3	$\frac{3}{25}$	12
	4000-5000	3	$\frac{3}{25}$	12
	5000-6000	1	$\frac{1}{25}$	4
	6000-7000	2	$\frac{2}{25}$	8

Total: 25  $\frac{25}{25} = 1$  100



Written Exercises, pages 632-635

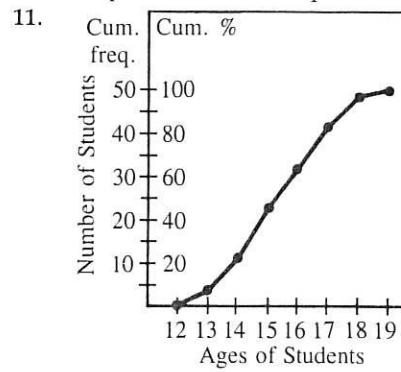
1.	Number	Freq.	%	Cum. Freq.	Cum. %
	2	1	$8\frac{1}{3}$	1	$8\frac{1}{3}$
	3	3	25	4	$33\frac{1}{3}$
	4	2	$16\frac{2}{3}$	6	50
	6	2	$16\frac{2}{3}$	8	$66\frac{2}{3}$
	7	1	$8\frac{1}{3}$	9	75
	8	2	$16\frac{2}{3}$	11	$91\frac{2}{3}$
	9	1	$8\frac{1}{3}$	12	100

Total: 12 100

3.	Cost (\$)	Freq.	%	Cum. Freq.	Cum. %
	20	2	8	2	8
	21	3	12	5	20
	22	4	16	9	36
	23	9	36	18	72
	24	6	24	24	96
	25	1	4	25	100

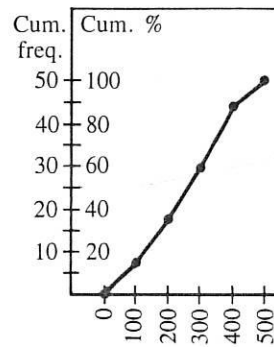
Total: 25 100

5. 6 companies 7. no companies 9. 40%



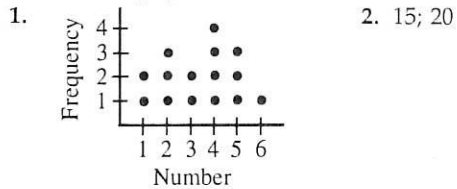
13.	Interval	Freq.	%	Cum. Freq.	Cum. %
	0-100	7	14	7	14
	100-200	10	20	17	34
	200-300	12	24	29	58
	300-400	15	30	44	88
	400-500	6	12	50	100

Total: 50 100



15. Answers will vary.

Self-Test 1, page 636

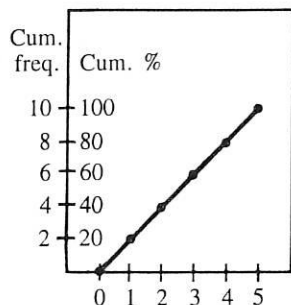


Relative frequency of 5 is  $\frac{3}{15}$ , or 20%.

3.	Number	Freq.	%	Cum. Freq.	Cum. %
	1	2	20	2	20
	2	2	20	4	40
	3	2	20	6	60
	4	2	20	8	80
	5	2	20	10	100

Total: 10 100

3. (cont.)



**Written Exercises, pages 639–640**

1. a. 5 b. 6 c. 7 3. a. 13 b. 15.5 c. 17.5  
 5. 67.3 7. 70 9. A: 3; 3; 3 B: none; 3; 3  
 C: none; 3; 3 D: 2, 4; 3; 3 They all have a  
 median and a mean of 3.

11.  $M = \frac{r_1 + r_2 + r_3 + \dots + r_n}{n}$  13. 82 15.  $x = 7$

17. Let  $x = 2m$  and let  $y = 2n + 1$ , where  $m$  and  $n$   
 are integers. Mean of  $x$  and  $y = \frac{x + y}{2} =$

$\frac{2m + 2n + 1}{2} = m + n + \frac{1}{2}$ , which is not an

integer. 19. a. Let  $a =$  equal number of measure-  
 ments one unit from  $n$ . Mean =

$\frac{a(n-1) + a(n+1)}{2a} = \frac{an - a + an + a}{2a} =$

$\frac{2an}{2a} = n$ . b. Let  $b =$  equal number of

measurements two units from  $n$ . Mean =

$\frac{b(n-2) + a(n-1) + a(n+1) + b(n+2)}{2a + 2b} =$

$\frac{bn - 2b + an - a + an + a + bn + 2b}{2a + 2b} =$

$\frac{2an + 2bn}{2a + 2b} = \frac{2n(a+b)}{2(a+b)} = n$ . c. If there are an

equal number of measurements that are the same  
 amount less than and greater than some value, then  
 the mean of the set of measurements is that value.

**Written Exercises, pages 642–643**

1. 47 3. a. 6.8 b. 2.6 5. a. 11 b. 18.8 c. 4.3  
 7. A: 0; B: 0. No.

9.  $\frac{(r_1 - m) + (r_2 - m) + \dots + (r_n - m)}{n}$

11.  $\sqrt{\frac{(r_1 - m)^2 + (r_2 - m)^2 + \dots + (r_n - m)^2}{n}}$

**Self-Test 2, page 643**

1. 4; 2; 5 2. 12; 12.8; 3.6

**Written Exercises, pages 647–648**

1. 1, 2, 3, 4, 5, 6 3.  $\frac{1}{6}$  5.  $\frac{1}{3}$  7.  $\frac{1}{2}$  9.  $\frac{1}{3}$  11.  $\frac{1}{2}$   
 13. 0 15.  $\frac{1}{5}$  17.  $\frac{1}{10}$  19.  $\frac{4}{5}$  21.  $\frac{1}{2}$  23.  $\frac{3}{5}$  25. 0  
 27.  $\frac{1}{2}$  29.  $\frac{1}{13}$  31.  $\frac{1}{13}$  33.  $\frac{1}{26}$  35.  $\frac{25}{26}$  37.  $\frac{12}{13}$

39.  $\frac{1}{2}$  41.  $\frac{1}{3}$  43.  $\frac{1}{2}$  45. HH, HT, TH, TT 47.  $\frac{5}{7}$

**Written Exercises, pages 651–652**

1. a.  $\frac{11}{20} = 0.55$  b.  $\frac{9}{20} = 0.45$  3. a.  $\frac{2}{5} = 0.4$  b. 6  
 c.  $\frac{3}{10} = 0.3$  5.  $\frac{7}{18} \approx 0.39$  7.  $\frac{1}{6} \approx 0.17$  9.  $\frac{1}{2} = 0.5$

11.  $\frac{36}{36} = 1$  13. No. There can be any number of  
 marbles that yields the same ratios. The contents of  
 the jar must be  $\frac{1}{9}$  blue,  $\frac{7}{18}$  red,  $\frac{1}{3}$  yellow, and  $\frac{1}{6}$

green. 15.  $\frac{75}{95} = \frac{15}{19} \approx 0.79$

**Self-Test 3, pages 652–653**

1.  $\frac{1}{6}$  2. 0 3.  $\frac{1}{2}$  4. 1 5.  $\frac{7}{13} \approx 0.54$  6.  $\frac{3}{20} = 0.15$   
 7.  $\frac{9}{20} = 0.45$  8.  $\frac{3}{5} = 0.6$  9. 25 10. 15

**Chapter Review, pages 654–655**

1. b 2. c 3. b 4. b 5. d 6. c 7. d 8. c 9. b  
 10. c 11. a 12. b 13. a 14. b

**Cumulative Review, pages 656–657**

1. {2} 3. {3} 5. 1480 7. 3.75 9.  $\frac{1}{3}$  11. 2 h 55 min  
 13. 1.5625 15. -35 17.  $-11\sqrt{3}$  19.  $8\sqrt{35}$   
 21.  $2\sqrt{2}$  23.  $3\sqrt{2} - 3$  25.  $10|x|y^2$  27. {3, -3}  
 29. {49} 31. {4, 2} 33.  $\left\{\frac{-7 + \sqrt{41}}{2}, \frac{-7 - \sqrt{41}}{2}\right\}$   
 35.  $\left\{\frac{1}{2}, 1\right\}$  37. 0; max: 0 39. 0, -2;  
 min: -1 41. Estimated zero:  $1\frac{1}{4}$   
 43.  $-270^\circ$  45. 0.9703 47.  $37^\circ$  49. 5.4;  $112^\circ$   
 51. 

Number	Freq.	Relative Freq. Frac.	%
4	1	$\frac{1}{10}$	10
5	1	$\frac{1}{10}$	10
7	3	$\frac{3}{10}$	30
8	2	$\frac{2}{10}$	20
9	2	$\frac{2}{10}$	20
10	1	$\frac{1}{10}$	10
Total:		$\frac{10}{10} = 1$	100

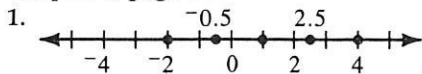
 53.  $\frac{1}{6}$

**Application, page 659**

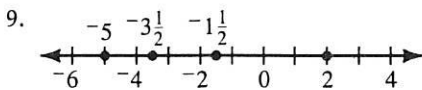
1. 6250 whales 3. 1419 bass 5. 12 moose

Extra Practice: Skills

Chapter 1, page 660



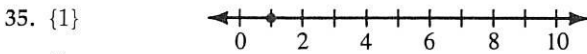
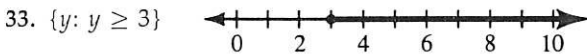
3.  $-7, -3, 0, 4, 6$  5.  $\subset$  7.  $\in$



11.  $\{ \dots, -4, -2, 0, 2, 4, 6 \}$  13. 745 15. 612 17. 8

19. 546 21. 4 23. 18 25. 288 27. 529 29. 24

31.  $\{0, 2\}$



37.  $\frac{9x}{10y}$  39.  $j + 6 = 3j$

Chapter 2, page 661

1. Example:  $n = 5$  3. Example:  $n = 0$  5. 50

7. 72 9.  $10t^2 + 4t$  11. 27 13.  $9k + 8$  15. 9

17.  $\{7\}$  19.  $-6$  21.  $-27$  23. Axiom of additive inverses 25. Commutative axiom for addition

27.  $6a + 2$  29. 146 31.  $16x^3$  33.  $-xy$  35.  $-3xz$

37.  $-2x + 5y$  39.  $-35a$

Chapter 3, page 662

1. Division property of equality 3. Subtraction property of equality 5.  $\{-4\}$  7.  $\{-15\}$  9.  $\{-20\}$

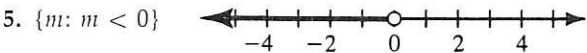
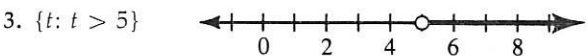
11.  $\left\{\frac{8}{5}\right\}$  13.  $\{5\}$  15.  $\{8\}$  17.  $\{15\}$  19. \$4.90

21.  $\{-6\}$  23.  $\{8\}$  25. Kim: 17 years; Terry: 9 years

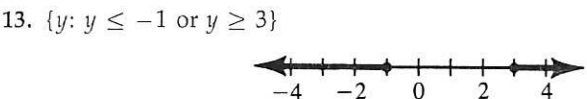
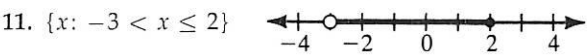
27.  $a = \frac{m}{c} - 1.5$ , or  $a = \frac{m - 1.5c}{c}$

Chapter 4, page 663

1. 1. Hypothesis 2. Addition property of order  
3. Associative axiom for addition 4. Axiom of additive inverses 5. Identity axiom for addition  
6. Definition of subtraction 7. Substitution principle



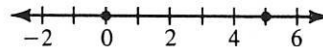
7.  $\emptyset$ ;  $\{1, 2, 3, 4\}$  9.  $\{ \text{the real numbers greater than } -2 \text{ and less than } 3 \}$ ;  $\mathcal{R}$



15.  $\{y: y < 3 \text{ or } y > 3\}$



17.  $\{0, 5\}$



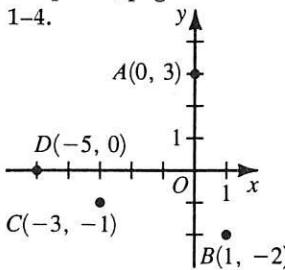
19.  $\left\{d: -1 < d < \frac{13}{3}\right\}$



21. 6 and 7 23.  $20^\circ$  25. 96 km/h 27. 20 L

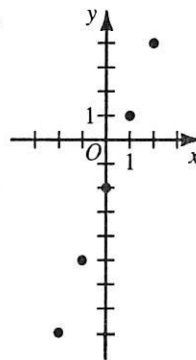
Chapter 5, page 664

1-4.



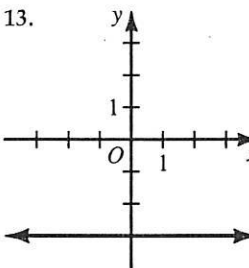
5.  $D = \{-1, 0, 2\}$ ;  
 $R = \{-1, 0, 1, 2\}$   
7. No

9.

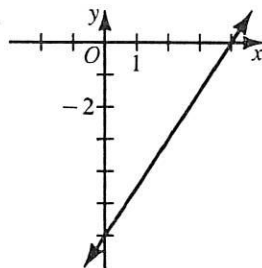


11.  $\{(0, 1), (1, -1)\}$

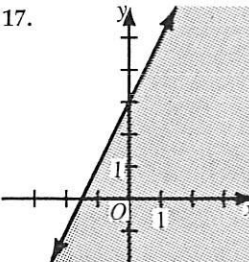
13.



15.



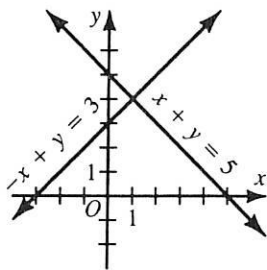
17.



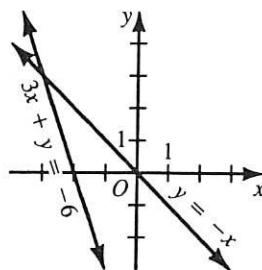
19.  $-\frac{1}{4}$  21. no slope  
23. slope:  $\frac{3}{2}$ ;  
y-intercept:  $-3$   
25.  $2x - y = -5$   
27.  $3x - 4y = 20$

Chapter 6, page 665

1.  $\{(1, 4)\}$

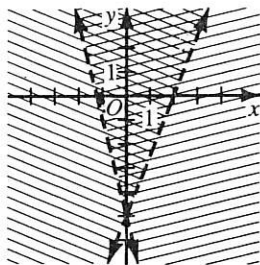


3.  $\{(-3, 3)\}$

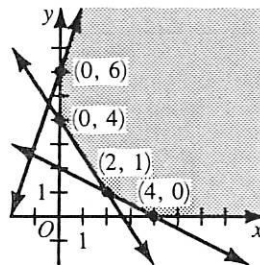


5.  $\{(-5, -2)\}$  7.  $\{(4, 4)\}$  9.  $\{(-2, 0)\}$   
 11.  $\{(6, -5)\}$  13.  $\{(-1, -8)\}$  15. \$6.48  
 17. rowing speed: 6 km/h; speed of current: 2 km/h  
 19. 625

21.



23. a.



b. 7

c. no maximum value

25.  $\{(-1, -2, 4)\}$

Chapter 7, page 666

1.  $3x^4 - x^3 - x^2 + 6x$  3.  $4s^2t - 2st$  5.  $27x^5$   
 7.  $-30c^5$  9.  $-m^8n^5$  11.  $2f^7 - f^6 - 5f^5$   
 13.  $-12m^6n + 4m^4n^3 - 28m^2n^3$  15.  $2r^2 - 22r + 48$   
 17.  $6x^2 + 5x - 4$  19.  $9t^2 + 12ty + 4y^2$   
 21.  $a^2b^2 - 2abc + c^2$  23. width: 20 cm; length: 25 cm  
 25. GCF: 13; LCM: 364 27. GCF:  $8y^3z^3$ ; LCM:  $576y^5z^4$   
 29.  $5x^2y^2(3x + 7x^2y - 5)$   
 31.  $(n + 7)(4n + 31)$  33.  $(x + 2y)^2$   
 35.  $(2x + y)(x + 3)$  37.  $(m + 7)(m - 4)$   
 39.  $-4(a^2 - a - 12) = -4(a - 4)(a + 3)$   
 41.  $(5a + 7)(a - 9)$  43.  $5d^3(2d + 1)(2d - 1)$   
 45.  $5(3s - 4)(2s + 3)$  47.  $\{1, 5\}$   
 49.  $\{-\frac{3}{5}, \frac{3}{5}\}$  51.  $\{-\frac{7}{2}, 4\}$  53. -3, -2 and 2, 3

Chapter 8, page 668

1.  $\frac{6a^4}{b}$  3.  $\frac{1}{5rs^3}$  5.  $\frac{9p^2}{5w^6}$  7.  $-4d + 1$  9.  $-9m^3 + 10m^2 + 4m$   
 11.  $2y - 1$  13.  $3y - 4$  15.  $z^2 - 1$

17.  $\frac{4}{a}$  19.  $\frac{z}{z-2}$  21.  $\frac{y-5}{2y+5}$  23.  $\frac{1}{a^5}$  25.  $\frac{1}{25a^2x^4}$   
 27.  $\frac{z^3}{6}$  29.  $\frac{c^2d^4}{b}$  31.  $6 \times 10^5$ ;  $7 \times 10^{-4}$ ; 420  
 33.  $4 \times 10^5$ ; 64,000,000,000,000,000 35.  $-\frac{15}{2a}$   
 37. -1 39.  $\frac{4c+d}{3}$  41.  $\frac{t+2}{t}$  43.  $\frac{1}{3}$   
 45.  $\frac{5a^3 + 3b^3}{a^2b^2}$  47.  $\frac{p^2+2}{4p^2}$  49.  $\frac{4}{5g-20h}$  51.  $\frac{2}{3}$   
 53.  $\frac{8t^2+12}{4t^2+t}$

Chapter 9, page 669

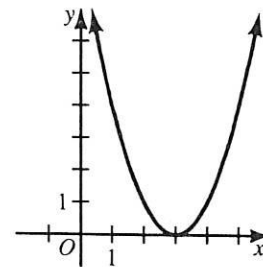
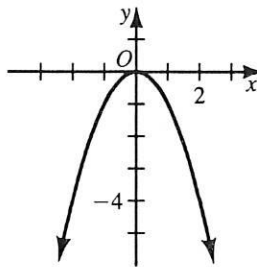
1.  $\{\frac{28}{25}\}$  3.  $\{x: x > -33\}$  5.  $\emptyset$  7. 15 9. 450  
 11.  $\{\frac{3}{2}\}$  13.  $\{-3\}$  15.  $\{2\}$  17. 20 and 28  
 19.  $2\frac{2}{5}$  h 21. 5 km/h 23.  $\{-3\}$  25.  $36^\circ$  and  $54^\circ$   
 27.  $-2r$  29. 45 31. 32 33. 48

Chapter 10, page 670

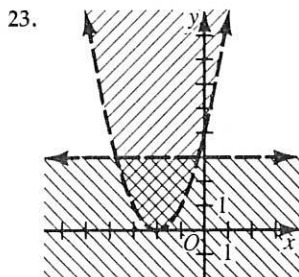
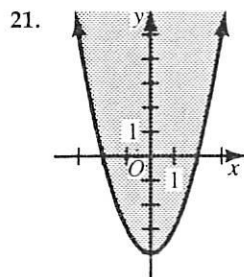
1.  $\frac{35}{91} > \frac{70}{190}$  3.  $-\frac{9}{80}$  5.  $0.0\bar{5}$  7.  $-0.6625$  9.  $\frac{8}{9}$   
 11.  $-\frac{43}{33}$  13. -13 15. -25 17.  $\{-\frac{9}{2}, \frac{9}{2}\}$   
 19.  $8\sqrt{3}$  21.  $\{4\sqrt{2}, -4\sqrt{2}\}$  23. 9.747  
 25. 17.143 27. No 29. No 31.  $\sqrt{194}$  33.  $\sqrt{170}$   
 35.  $\frac{\sqrt{13}}{2}$  37.  $8x$  39.  $\frac{2\sqrt{30}y}{3y}$  41.  $14\sqrt{5} + 30\sqrt{6}$   
 43. 41 45.  $5 + 4\sqrt{2}$  47.  $2\sqrt[3]{3}$  49.  $\frac{5\sqrt[3]{4}}{2}$  51.  $\{\frac{16}{25}\}$

Chapter 11, page 672

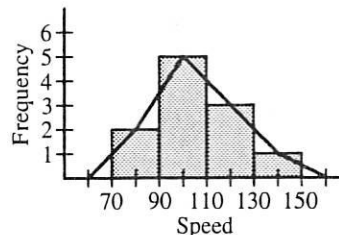
1.  $\{5, -7\}$  3.  $\{\frac{-5 + \sqrt{21}}{2}, \frac{-5 - \sqrt{21}}{2}\}$   
 5.  $\{\frac{-1 + \sqrt{41}}{4}, \frac{-1 - \sqrt{41}}{4}\}$   
 7.  $\{\frac{7 + \sqrt{33}}{2}, \frac{7 - \sqrt{33}}{2}\}$   
 9.  $\{\frac{-3 + \sqrt{29}}{10}, \frac{-3 - \sqrt{29}}{10}\}$  11. 1 or 4  
 13. The zero is 0. 15. The zero is 3.



17. The zeros are 0 and 1. 19. The zero is 0.



4, 5.

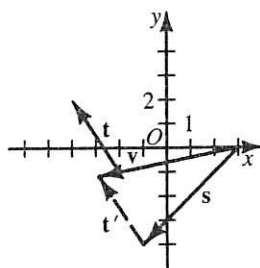
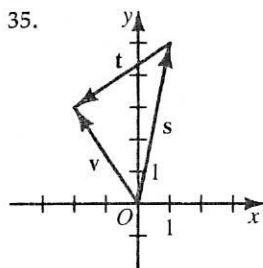


Letter	Cum. Freq.	Cum. %
D	1	10
E	2	20
I	4	40
N	6	60
O	7	70
S	10	100

9. 6 and 12; 6.5; 7.4  
 11. 2; 3; 3.3  
 13. 7; 6.5; 2.5  
 15. 2; 0.5; 0.7 17.  $\frac{1}{6}$   
 19.  $\frac{23}{30}$  21.  $\frac{1}{2}$   
 23.  $\frac{292}{300} \approx 0.97$

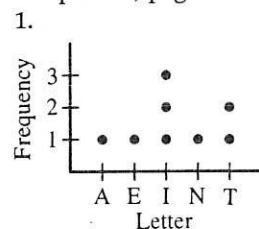
Chapter 12, page 673

1.  $80^\circ$  3.  $100^\circ$  5.  $\sin A = -\frac{15}{17}$ ;  $\cos A = \frac{8}{17}$ ;  
 $\tan A = -\frac{15}{8}$  7.  $\sin A = \frac{\sqrt{2}}{2}$ ;  $\cos A = -\frac{\sqrt{2}}{2}$ ;  
 $\tan A = -1$  9.  $\sin A = -\frac{\sqrt{3}}{2}$ ;  $\tan A = \sqrt{3}$   
 11.  $\sin A = \frac{4}{5}$ ;  $\tan A = -\frac{4}{3}$  13.  $\sin A = \frac{\sqrt{2}}{2}$ ;  
 $\cos A = -\frac{\sqrt{2}}{2}$  15. 0.9781 17. 0.6691 19.  $69^\circ$   
 21.  $8^\circ$  23.  $80^\circ$  25.  $m \angle B = 40^\circ$ ;  $a \approx 3.6$ ;  $c \approx 4.7$   
 27.  $m \angle A \approx 14^\circ$ ;  $m \angle B \approx 76^\circ$ ;  $b \approx 7.7$  29. 3.0;  
 $180^\circ$  31. 13.0;  $337^\circ$  33.  $\|v\| \approx 3.2$ ;  $72^\circ$   
 35. 37.



- a. -2; 3 b.  $\sqrt{13}$  c.  $124^\circ$   
 a. -6; -1 b.  $\sqrt{37}$  c.  $189^\circ$   
 39. 185 N, at an angle of  $71^\circ$  from the 60 N force

Chapter 13, page 674



Letter	Freq.	Rel. Freq.	
		Frac.	%
A	1	$\frac{1}{8}$	12.5
E	1	$\frac{1}{8}$	12.5
I	3	$\frac{3}{8}$	37.5
N	1	$\frac{1}{8}$	12.5
T	2	$\frac{2}{8}$	25
Total:	8	1	100

Extra Practice: Problem Solving

Chapter 1, page 675

1. Let  $x$  = the first positive integer.  $x + (x + 1) = 386$  3. Let  $b$  = the number of votes that Brian received.  $b + (b + 6) = 28$  5. Let  $w$  = the width of the rectangle.  $2w + 2(2w + 2) = 100$

Chapter 2, page 676

1. a. 285, -360 b.  $285 + (-360) = -75$  c. The pilot was 75 km south of the landing strip.  
 3. a.  $-10 - 2 = -12$  b. The temperature feels  $12^\circ\text{C}$  colder. 5. a.  $535 - (-760) = 1295$  b. The plane flew 1295 km north.

Chapter 3, page 676

1. 17 nickels; 25 dimes 3. Art: 12 years; Bob: 15 years; Cal: 18 years 5. 9 years

Chapter 4, page 677

1. 26 and 28 3.  $36^\circ$ ;  $42^\circ$ ;  $102^\circ$  5. 80 km/h 7. 10% acid; 14 L; 25% acid; 16 L

Chapter 6, page 677

1. twenty-five 22¢ stamps; fifteen 14¢ stamps  
 3. wind speed: 60 km/h; air speed: 340 km/h 5. 25

Chapter 7, page 678

1. 38 cm; 31 cm 3. 8 and 12 5. 8 m

Chapter 9, page 678

1. \$9780 3.  $\frac{10}{24}$  5. 6 km/h 7. \$92,000 9. \$1.35

Chapter 10, page 679

1. 90 m 3. 9.90 cm 5. 20 cm

Chapter 11, page 680

1. 2 or  $\frac{3}{2}$  3. Diane: 3 h; Don: 6 h

Chapter 12, page 680

1. 18.6 m 3.  $31^\circ$