Answers

RECREATIONAL MATH. PAGE 24

The farmer crosses with the goat first. Then he can take the herbs across the river. But he must return the goat temporarily so that the goat doesn't eat the herbs. He then takes the wolf across the river. Then he returns for the goat. He will make seven crossings—four forward and three back.

The answer to the St. Ives riddle is 1.

SECTION 1.1, PAGE 5

1. Counting   3. Hypothesis   5. Inductive   7. Deductive

9. Inductive reasoning; a general conclusion is obtained from observation of specific cases.

11. $5 \times 5 = 25$ 13. 1 5 10 10 5 1   15. ⬡   17. ⬠

19. 10, 12, 14   21. 3, -3, 3   23. $\frac{1}{5}, \frac{1}{6}, \frac{1}{7}$ 25. 36, 49, 64

27. 34, 55, 89   29. Y

31. a) 36, 49, 64   b) square 6, 7, 8, 9 and 10
    c) No, 72 is between 8^2 and 9^2, so it is not a square number.

33. Blue: 1, 5, 7, 10, 12; Purple: 2, 4, 6, 9, 11; Yellow: 3, 8

35. a) $\approx$ $200,000
    b) We are using specific cases to make a prediction.

37.

39. a) You should obtain the original number.
    b) You should obtain the original number.
    c) The result is the original number.
    d) $n, 4n, 4n + 12, \frac{4n + 12}{4} = n + 3, n + 3 - 3 = n$

41. a) 5
    b) You should obtain the number 5.
    c) The result is always the number 5.
    d) $n, n + 1, \frac{n + (n + 1) + 9}{2} = \frac{2n + 10}{2} = n + 5, n + 5 - n = 5$

43. $7 - 5 = 2$, which is not an odd number.

45. $(3 + 2)/2 = 5/2$, which is not an even number.

47. $1 - 2 = -1$, which is not a counting number.

49. a) The sum of the measures of the interior angles should be 180°.
    b) Yes, the sum of the measures of the interior angles should be 180°.
    c) The sum of the measures of the interior angles of a triangle is 180°.

51. 129, the numbers in positions are found as follows:
    a b
    c $a + b + c$

53. (c)

SECTION 1.2, PAGE 14

1. Estimation   3. 760   5. 600,000   7. 8000

9. 350,000,000   11. 320   13. $2   15. $1440   17. $3000

19. 400 lb   21. $3.90   23. $51   25. $120   27. $42

29. $\approx$ 60 mi   31. a) 210   b) 70   c) 175

33. a) 5 million   b) 98 million   c) 65 million   d) 280 million

35. a) 85%   b) 15%   c) 59,500,000 acres
    d) No, since we are not given the area of each state

37. 20   39. $\approx$ 120 bananas   41. 150°   43. 10%

45. 9 square units   47. 150 feet   49. Answers will vary.

51. Answers will vary.

53. Answers will vary.   55. Answers will vary.

57. a) Answers will vary.   b) Answers will vary.
    c) Answers will vary.

58. There are 118 ridges around the edge.

59. a) Answers will vary.   b) 11.6 days

SECTION 1.3, PAGE 28

1. 69 mi   3. 48.4 ft   5. $8092

7. a) $117.25   b) $295.75

9. a) $308,920   b) $185,220   c) $1620

11. $70   13. $47,784.60   15. a) 10,000   b) 1 in 10,000

17. $\approx$ 18.7 mpg   19. $82.08   21. Snow   23. $84,010

25. a) 4106.25 gal   b) $45.99

27. a) $\approx$ 35.61 gal   b) $106.83   c) $\approx$ 4,985,400,000 gal

29. $897.76   31. $392

33. a) Water/milk: 3 cups; salt: $\frac{3}{8}$ tsp; Cream of Wheat: 9 tbsp (or $\frac{9}{16}$ cup)
    b) Water/milk: $2\frac{7}{8}$ cups; salt: $\frac{3}{8}$ tsp; Cream of Wheat: $\frac{5}{8}$ cup (or 10 tbsp)
    c) Water/milk: $2\frac{7}{4}$ cups; salt: $\frac{3}{8}$ tsp; Cream of Wheat: $\frac{9}{16}$ cup (or 9 tbsp)
    d) Differences exist in water/milk because the amount for 4 servings is not twice that for 2 servings. Differences also exist in Cream of Wheat because $\frac{1}{2}$ cup is not twice 3 tbsp.

35. a) 1 box of 20 and 1 box of 12   b) $420

37. 144 square inches

39. The area is 4 times as large.

41. The volume is 8 times as large.   43. 10¢   45. 3

47. a) 30   b) 140
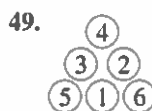
49.
51.
8	6	16
18	10	2
4	14	12

53. The sum of the four corners is 4 times the number in the center.

55. Multiply the center number by 9.

57. 6 ways

59.
	7	
3	1	4
5	8	6
	2	

Other answers are possible, but 1 and 8 must appear in the center.
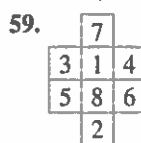
61.
1	2	3	4	5
2	3	4	5	1
3	4	5	1	2
4	5	1	2	3
5	1	2	3	4

Other answers are possible.

63. Mary is the skier.   **65.** 714 square units

67. Thomas would have opened the box labeled grapes and cherries. Because all the boxes are labeled incorrectly, whichever fruit he pulls from the grapes and cherries box will be the only fruit in that box. If he pulls a grape from the box, the box must be labeled grapes; if he pulls a cherry from the box, the box must be labeled cherries. That leaves two boxes whose original labels were incorrect. Because all labels must be changed, there will be only one way for Thomas to assign the two remaining labels.

REVIEW EXERCISES, PAGE 35

1. 27, 32, 37   **2.** 26, 37, 50   **3.** −48, 96, −192

4. 25, 32, 40   **5.** 10, 4, −3   **6.** $\frac{3}{8}, \frac{3}{16}, \frac{3}{32}$

7. ◯▯⊣◯   **8.** [△] [◯] [▯]   **9.** (c)

10. a) The final number is twice the original number.

   b) The final number is twice the original number.

   c) The final number is twice the original number.

   d) n, $10n$, $10n + 5$, $\dfrac{10n + 5}{5} = 2n + 1$,

      $2n + 1 - 1 = 2n$

11. This process will always result in an answer of 3.

12. $1^2 + 2^2 = 5$ **13.** 420,000,000   **14.** 2000   **15.** 200

16. Answers will vary.   **17.** $5000   **18.** $140   **19.** 3 mph

20. $14.00   **21.** 2 mi   **22.** 0.4 million   **23.** 1.0 million

24. 13 square units   **25.** Length ≈ 22 ft; height ≈ 8 ft

26. $30   **27.** $1.16   **28.** Taylor Rental is less expensive by $3

29. $4   **30. a)** 288 lb   **b)** 12,500 ft²   **31.** $661   **32.** 7.05 mg

33. $980   **34.** 6 hr 45 min   **35.** July 26, 11:00 A.M.

36. a) ≈ 1.47 ft/sec   **b)** ≈ 80.67 ft/sec   **37.** 201

38.

21	7	8	18
10	16	15	13
14	12	11	17
9	19	20	6

39.

23	25	15
13	21	29
27	17	19

40. 59 min 59 sec   **41.** 6   **42.** $ 25 Room

                                $ 3 Friends

43. 140 lb $ 2 Clerk

                                $ 30

44. Yes; 3 quarters and 4 dimes, or 1 half dollar, 1 quarter and 4 dimes, or 1 quarter and 9 dimes. Other answers are possible.

45. 216 cm³

46. Place six coins in each pan with one coin off to the side. If it balances, the heavier coin is the one on the side. If the pan does not balance, take the six coins on the heavier side and split them into two groups of three. Select the three heavier coins and weigh two coins. If the pan balances, it is the third coin. If the pan does not balance, you can identify the heavier coin.

47. 125,250   **48.** 16 blue   **49.** 90

50. The fifth figure will be an octagon with sides of equal length. Inside the octagon will be a seven-sided figure with each side of equal length. The figure will have one antenna.

51. 61

52. Some possible answers are shown. Others are possible.
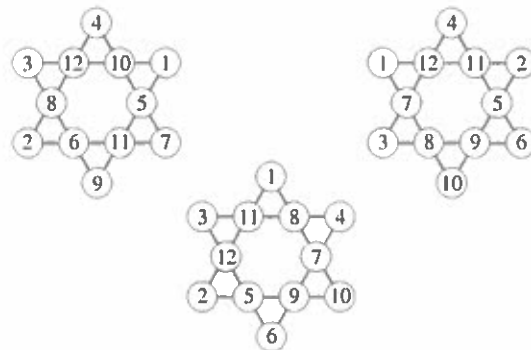
53. a) 2   **b)** 6   **c)** 24   **d)** 120

   e) $n(n-1)(n-2)\ldots 1$, (or $n!$), where n = the number of people in the line

CHAPTER TEST, PAGE 38

1. 27, 33, 39   **2.** $\frac{1}{16}, \frac{1}{32}, \frac{1}{64}$

3. a) The result is the original number plus 1.

   b) The result is the original number plus 1.

   c) The result will always be the original number plus 1.

   d) n, $5n$, $5n + 10$, $\dfrac{5n + 10}{5} = n + 2$,

      $n + 2 - 1 = n + 1$

4. 16,000   **5.** 1,700,000   **6.** 9 square units

7. a) ≈ 23.03   **b)** He is in the at-risk range.

8. a) 3.5 million   **b)** 0.3 million

9. 65 min   **10.** 32 cans   **11.** $7\frac{1}{2}$ min

12. ≈ 39.5 in. by 29.6 in. (The actual dimensions are 100.5 cm by 76.5 cm.)   **13.** $49.00

14.

40	15	20
5	25	45
30	35	10

15. Less time if she had driven at 45 mph for the entire trip

16. $\frac{1}{2}$ tablespoon   **17.** 48 square meters   **18.** 243 jelly beans

19. a) $11.97   **b)** $11.81   **c)** Save 16 cents by using the 25% off coupon.   **20.** 24

Chapter 2

SECTION 2.1, PAGE 47

1. Set   **3.** Description, roster form, set-builder notation.

5. Infinite   **7.** Equivalent   **9.** Empty or null

11. Universal   **13.** Not well defined   **15.** Well defined

17. Well defined   **19.** Infinite   **21.** Infinite   **23.** Infinite

25. { Maine, Maryland, Massachusetts, Michigan, Minnesota, Mississippi, Missouri, Montana }

27. { 11, 12, 13, 14, …, 177 }   **29.** B = { 2, 4, 6, 8, … }

31. { } or ∅   **33.** E = { 14, 15, 16, 17, …, 84 }

35. { Louvre Museum, British Museum, National Gallery of Art, Tate Modern, Metropolitan Museum of Art }

37. { Musee d'Orsay, Musee d'Art Moderne Prado, Museum of Modern Art }

39. { 2007, 2008 }

41. { 2004, 2005, 2006, 2007 }

43. $B = \{x \mid x \in N \text{ and } 6 < x < 15\}$ or
$B = \{x \mid x \in N \text{ and } 7 \le x \le 14\}$

45. $C = \{x \mid x \in N \text{ and } x \text{ is a multiple of } 3\}$

47. $E = \{x \mid x \in N \text{ and } x \text{ is odd}\}$

49. $C = \{x \mid x \text{ is February}\}$

51. Set A is the set of natural numbers less than or equal to 7.

53. Set V is the set of vowels in the English alphabet.

55. Set T is the set of species of trees.

57. Set S is the set of seasons.

59. { China, India, United States }

61. { Russia, Brazil, Indonesia, Japan, Germany }

63. { 2008, 2009, 2010, 2011 }

65. { 2000, 2001, 2002, 2003, 2004, 2005, 2007 }

67. False; { e } is a set, and not an element of the set.

69. False; h is not an element of the set.

71. False; 3 is an element of the set.

73. True   75. 4   77. 0   79. Both

81. Neither   83. Equivalent

85. a) Set A is the set of natural numbers greater than 2. Set B is the set of all numbers greater than 2.

b) Set A contains only natural numbers. Set B contains other types of numbers, including fractions and decimal numbers.

c) $A = \{3, 4, 5, 6, \dots\}$

d) No; because there are an infinite number of elements between any two elements in set B, we cannot write set B in roster form.

87. Cardinal   89. Ordinal   91. Answers will vary.

93. Answers will vary.

SECTION 2.2, PAGE 55

1. Subset   3. 2^n 5. True

7. False; McIntosh is not in the second set.

9. True   11. False; no set is a proper subset of itself.

13. True   15. False; {swimming} is a set not an element

17. True   19. True

21. False; the set $\{\varnothing\}$ contains the element $\varnothing$.

23. False; the set $\{0\}$ contains the element 0.

25. False; 0 is a numbner and { } is a set.

27. $B \subseteq A, B \subset A$ 29. $A \subseteq B, A \subset B$,   31. $B \subseteq A, B \subset A$

33. $A = B, A \subseteq B, B \subseteq A$ 35. { }

37. { }, {cow}, {horse}, {cow, horse}

39. a) $\{ \ \}, \{a\}, \{b\}, \{c\}, \{d\}, \{a,b\}, \{a,c\},$
$\{a,d\}, \{b,c\}, \{b,d\}, \{c,d\}, \{a,b,c\},$
$\{a,b,d\}, \{a,c,d\}, \{b,c,d\}, \{a,b,c,d\}$

b) $\{a, b, c, d\}$

41. False   43. True   45. True   47. True   49. True

51. True   53. 2^8 or 256   55. 2^7 or 128   57. $E = F$

59. a) Yes   b) No   c) Yes   61. 1   62. Yes   63. Yes

64. No

SECTION 2.3, PAGE 63

1. Complement   3. Intersection   5. Cartesian   7. Disjoint

9.

11.

13.
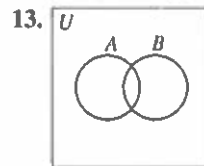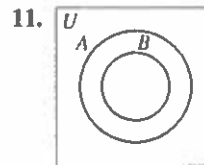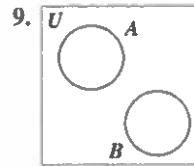
15. *And* is generally interpreted to mean *intersection*.

17.

19.
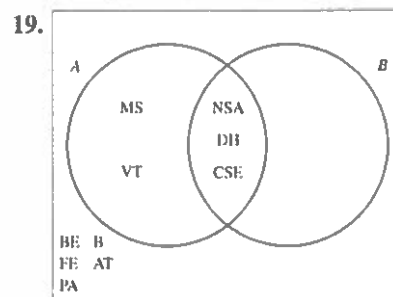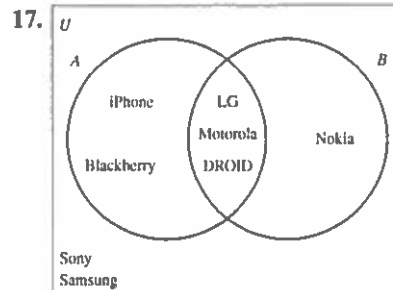
21. The set of animals in U.S. zoos that are not in the San Diego Zoo

23. The set of farms in the United States that do not produce corn

25. The set of farms in the United States that produce corn or produce tomatoes

27. The set of farms in the United States that produce corn and do not produce tomatoes

29. The set of furniture stores that sell mattresses or leather furniture

31. The set of furniture stores that do not sell outdoor furniture and sell leather furniture

33. The set of furniture stores that sell mattresses or outdoor furniture or leather furniture

35. $\{b, c, t, w, a, h\}$ **37.** $\{a, h\}$

39. $\{c, w, b, t, a, h, f, r, d, g\}$ **41.** $\{p, m, z\}$

43. $\{L, \Delta, @, \$, *\}$ **45.** $\{L, \Delta, @, *, \$, R, \square, \alpha, \propto, \Sigma, Z\}$

47. $\{R, \square, \alpha, *, \$, \propto, Z, \Sigma\}$ **49.** $\{R, \square, \alpha\}$

51. $\{1, 2, 3, 4, 5, 6, 7\}$ **53.** $\{1, 4, 7, 8\}$ **55.** $\{8\}$

57. $\{\ \}$ **59.** $\{8\}$ **61.** $\{a, e, h, i, j, k\}$ **63.** $\{a, f, i\}$

65. $\{b, c, d, e, g, h, j, k\}$ **67.** $\{a, c, d, e, f, g, h, i, j, k\}$

69. $\{a, b, c, d, e, f, g, h, i, j, k\}$, or U **71.** $\{2, 6, 9\}$

73. $\{1, 4\}$ **75.** $\{1, 3, 4, 5, 7, 8, 10\}$ **77.** $\{4, 9\}$

79. $\{(a, 1), (a, 2), (b, 1), (b, 2), (c, 1), (c, 2)\}$

81. No. The ordered pairs are not the same. For example, $(a, 1) \neq (1, a)$.

83. 6   **85.** $\{\ \}$ **87.** $\{2, 4, 6, 8\}$, or B **89.** $\{7, 9\}$

91. $\{1, 3, 5, 6, 7, 8, 9\}$ **93.** $\{6, 8\}$

95. $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, or U

97. $\{1, 2, 3, 4, 5\}$, or C

**99.** A set and its complement will always be disjoint. For example, if $U = \{1, 2, 3\}$ and $A = \{1, 2\}$, then $A' = \{3\}$, and $A \cap A' = \{\ \}$.

101. 49

103. a) $8 = 4 + 6 - 2$
   b) Answers will vary.
   c) Answers will vary.

105. $\{1, 2, 3, 4, \ldots\}$, or A

107. $\{2, 4, 6, 8, \ldots\}$, or C

109. $\{2, 4, 6, 8, \ldots\}$, or C

111. $\{2, 6, 10, 14, 18, \ldots\}$

113. $\{2, 6, 10, 14, 18, \ldots\}$

115. $\{\ \}$ **117.** A **119.** U **121.** U **123.** $B \subseteq A$

125. A and B are disjoint sets.   **127.** $A \subseteq B$

SECTION 2.4, PAGE 72

1. 8   **3. a)** $A' \cap B'$ **b)** $A' \cup B'$ **5.** 8

7. a) Yes
   b) No, one specific case cannot be used as proof.
   c) No, not equal

9.

11.

13.
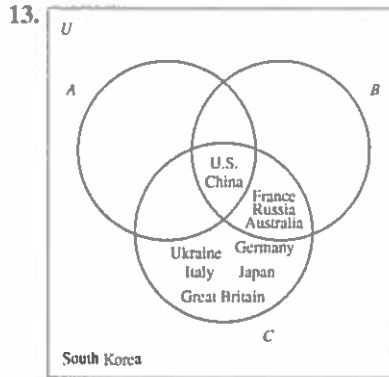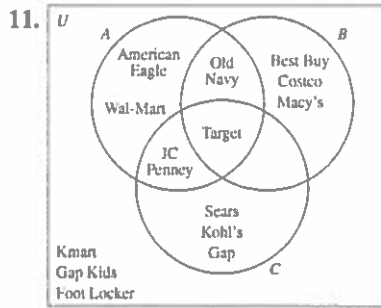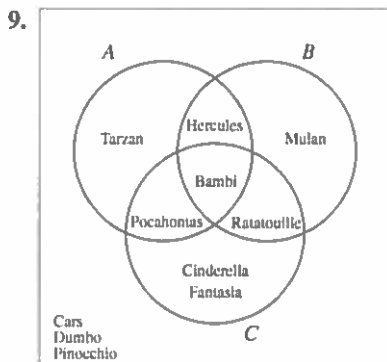
15. II   **17.** VIII   **19.** III   **21.** VI   **23.** III   **25.** III   **27.** V

29. II   **31.** VII   **33.** I   **35.** VIII   **37.** VI

39. $\{1, 2, 3, 4, 5, 7\}$ **41.** $\{3, 4, 5, 6, 8, 9, 12, 14\}$

43. $\{3, 4, 5\}$ **45.** $\{1, 2, 3, 7, 9, 10, 11, 12, 13, 14\}$

47. $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 12, 14\}$ **49.** $\{9, 10, 12, 13, 14\}$

51. $\{6, 8, 9, 10, 11, 12, 13, 14\}$ **53.** Yes   **55.** No

57. No   **59.** Yes   **61.** No   **63.** Yes   **65.** Yes   **67.** Yes

69. No   **71.** $(A \cup B)'$ **73.** $(A \cup B) \cap C'$

75. a) Both equal $\{6, 7\}$.   **b)** Answers will vary.
   c) Both are represented by the regions IV, V, VI.

77.

79. a)
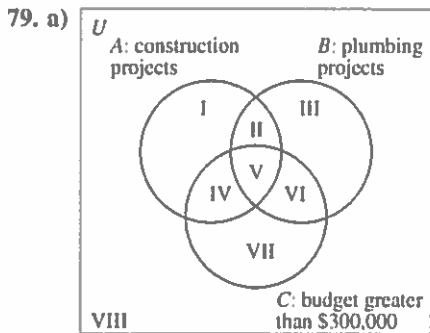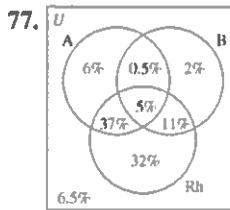
   b) V; $A \cap B \cap C$ **c)** VI; $A' \cap B \cap C$
   d) I; $A \cap B' \cap C'$

81. a)
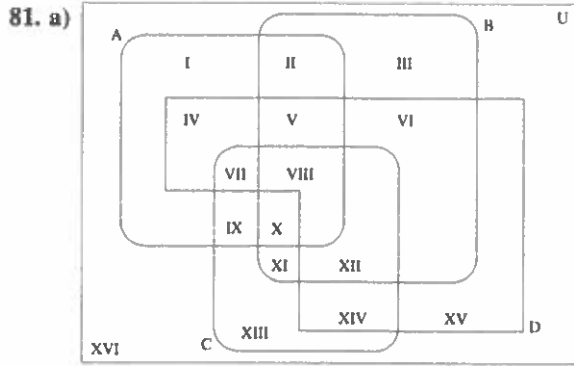
b)

Region	Set	Region	Set
I	$A \cap B' \cap C' \cap D'$	IX	$A \cap B' \cap C \cap D'$
II	$A \cap B \cap C' \cap D'$	X	$A \cap B \cap C \cap D'$
III	$A' \cap B \cap C' \cap D'$	XI	$A' \cap B \cap C \cap D'$
IV	$A \cap B' \cap C' \cap D$	XII	$A' \cap B \cap C \cap D$
V	$A \cap B \cap C' \cap D$	XIII	$A' \cap B' \cap C \cap D'$
VI	$A' \cap B \cap C' \cap D$	XIV	$A' \cap B' \cap C \cap D$
VII	$A \cap B' \cap C \cap D$	XV	$A' \cap B' \cap C' \cap D$
VIII	$A \cap B \cap C \cap D$	XVI	$A' \cap B' \cap C' \cap D'$

SECTION 2.5, PAGE 80

1.

a) 48   b) 37   c) 54

3.

a) 17   b) 12   c) 59

5.

a) 3   b) 6   c) 22   d) 11   e) 12

7.

a) 22   b) 11   c) 64   d) 50   e) 23

9.

a) 3   b) 12   c) 3   d) 17   e) 8

11.
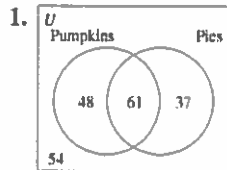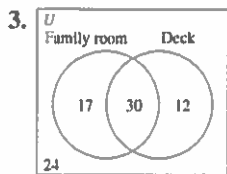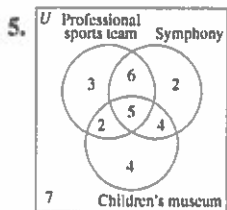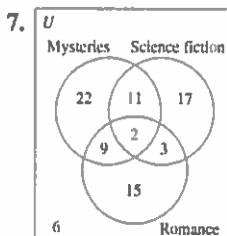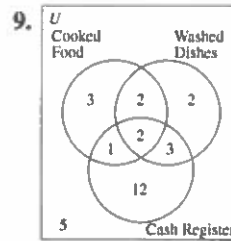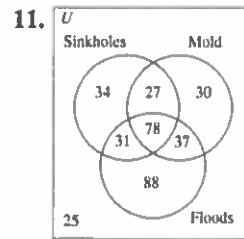
a) 67   b) 237   c) 37   d) 25

13. In a Venn diagram, regions II, IV, and V contain a total of 37 cars driven by women. This total is greater than the 35 cars driven by the women, as given in the exercise.

15.
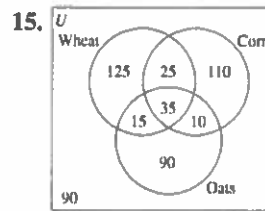
a) 410   b) 35   c) 90   d) 50

17. a) 10   b) 10   c) 6

SECTION 2.6, PAGE 86

1. Infinite

3. $\{3, 4, 5, 6, 7, \dots, n + 2, \dots\}$
↓↓↓↓↓   ↓
$\{4, 5, 6, 7, 8, \dots, n + 3, \dots\}$

5. $\{3, 5, 7, 9, 11, \dots, 2n + 1, \dots\}$
↓↓↓↓ ↓   ↓
$\{5, 7, 9, 11, 13, \dots, 2n + 3, \dots\}$

7. $\{5, 9, 13, 17, 21, \dots, 4n + 1, \dots\}$
↓ ↓ ↓ ↓ ↓   ↓
$\{9, 13, 17, 21, 25, \dots, 4n + 5, \dots\}$

9. $\left\{\dfrac{1}{2}, \dfrac{1}{4}, \dfrac{1}{6}, \dfrac{1}{8}, \dfrac{1}{10}, \dots, \dfrac{1}{2n}, \dots\right\}$
↓↓↓ ↓ ↓   ↓
$\left\{\dfrac{1}{4}, \dfrac{1}{6}, \dfrac{1}{8}, \dfrac{1}{10}, \dfrac{1}{12}, \dots, \dfrac{1}{2n + 2}, \dots\right\}$

11. $\left\{\dfrac{4}{11}, \dfrac{5}{11}, \dfrac{6}{11}, \dfrac{7}{11}, \dfrac{8}{11}, \dots, \dfrac{n + 3}{11}, \dots\right\}$
↓ ↓ ↓ ↓ ↓   ↓
$\left\{\dfrac{5}{11}, \dfrac{6}{11}, \dfrac{7}{11}, \dfrac{8}{11}, \dfrac{9}{11}, \dots, \dfrac{n + 4}{11}, \dots\right\}$

13. $\{1, 2, 3, 4, 5, \ldots, n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{3, 6, 9, 12, 15, \ldots, 3n, \ldots\}$

15. $\{1, 2, 3, 4, 5, \ldots, \quad n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{4, 6, 8, 10, 12, \ldots, 2n + 2, \ldots\}$

17. $\{1, 2, 3, 4, 5, \ldots, \quad n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{2, 5, 8, 11, 14, \ldots, 3n - 1, \ldots\}$

19. $\{1, 2, 3, 4, 5, \ldots, n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\left\{\dfrac{1}{3}, \dfrac{1}{6}, \dfrac{1}{9}, \dfrac{1}{12}, \dfrac{1}{15}, \ldots, \dfrac{1}{3n}, \ldots\right\}$

21. $\{1, 2, 3, 4, 5, \ldots, \quad n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\left\{\dfrac{1}{3}, \dfrac{1}{4}, \dfrac{1}{5}, \dfrac{1}{6}, \dfrac{1}{7}, \ldots, \dfrac{1}{n + 2}, \ldots\right\}$

23. $\{1, 2, 3, 4, 5, \ldots, n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{1, 4, 9, 16, 25, \ldots, n^2, \ldots\}$

25. $\{1, 2, 3, 4, 5, \ldots, n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{3, 9, 27, 81, 243, \ldots, 3^n, \ldots\}$

27. $\approx$ **29.** $=$ **31.** $=$

REVIEW EXERCISES, PAGE 88

1. True

2. False; the word best makes the statement not well defined.

3. True   **4.** False; no set is a proper subset of itself.

5. False; the elements 6, 12, 18, 24, … are members of both sets.

6. True

7. False; both sets do not contain exactly the same elements.

8. True   **9.** True   **10.** True   **11.** True   **12.** True

13. True   **14.** True   **15.** $A = \{7, 9, 11, 13, 15\}$

16. {Colorado, Nebraska, Missouri, Oklahoma}

17. $C = \{1, 2, 3, 4, \ldots, 161\}$

18. $D = \{9, 10, 11, 12, \ldots, 80\}$

19. $A = \{x \mid x \in N \text{ and } 50 < x < 150\}$

20. $B = \{x \mid x \in N \text{ and } x > 42\}$

21. $C = \{x \mid x \in N \text{ and } x < 7\}$

22. $D = \{x \mid x \in N \text{ and } 27 \leq x \leq 51\}$

23. A is the set of capital letters in the English alphabet from E through M, inclusive.

24. B is the set of U.S. coins with a value of less than a dollar.

25. C is the set of the first three lowercase letters in the English alphabet.

26. D is the set of numbers greater than or equal to 3 and less than 9

27. $\{3, 7\}$ **28.** $\{1, 2, 3, 4, 5, 6, 7, 8\}$ **29.** $\{9, 10\}$

30. $\{1, 2, 4, 6, 7, 8, 10\}$ **31.** $\{1, 5\}$ **32.** $\{1, 7\}$

33. $\{(1, 1), (1, 7), (1, 10), (3, 1), (3, 7), (3, 10), (5, 1), (5, 7),$
$(5, 10), (7, 1), (7, 7), (7, 10)\}$

34. $\{(3, 1), (3, 3), (3, 5), (3, 7), (7, 1), (7, 3), (7, 5), (7, 7),$
$(9, 1), (9, 3), (9, 5), (9, 7), (10, 1), (10, 3), (10, 5), (10, 7)\}$

35. 16   **36.** 15

37.
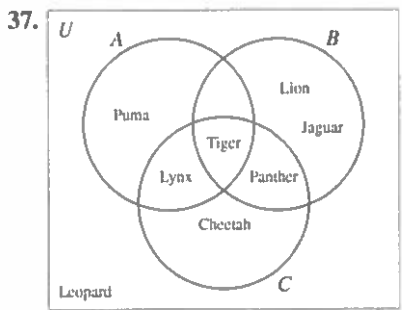
38. $\{a, c, d, f, g, i, k, l\}$ **39.** $\{i, k\}$

40. $\{a, b, c, d, f, g, h, i, k, l\}$ **41.** $\{f\}$

42. $\{a, f, i\}$ **43.** $\{a, b, d, f, h, i, l\}$ **44.** True

45. True   **46.** II   **47.** III   **48.** I   **49.** IV   **50.** IV

51. II   **52.** II   **53.** $450

54.
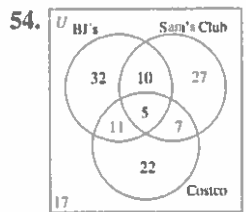
a) 131   b) 32   c) 10   d) 65

55.

a) 38   b) 298   c) 28   d) 236   e) 106

56. $\{2, 4, 6, 8, 10, \ldots, \quad 2n, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{4, 6, 8, 10, 12, \ldots, 2n + 2, \ldots\}$

57. $\{3, 5, 7, 9, 11, \ldots, 2n + 1, \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{5, 7, 9, 11, 13, \ldots, 2n + 3, \ldots\}$

58. $\{1, 2, 3, 4, 5, \ldots, \quad n, \quad \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{5, 8, 11, 14, 17, \ldots, 3n + 2, \ldots\}$

59. $\{1, 2, 3, 4, 5, \ldots, \quad n, \quad \ldots\}$
$\quad \downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
$\{4, 9, 14, 19, 24, \ldots, 5n - 1, \ldots\}$

CHAPTER TEST, PAGE 91

1. True

2. False; the sets do not contain exactly the same elements.

3. True

4. False; the second set has no subset that contains the element 7.

5. False; the set has 2^4, or 16 subsets.   **6.** True

7. False; for any set A, $A \cup A' = U$, not $\{\ \}$.

8. True   **9.** $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

10. Set A is the set of natural numbers less than 10.

11. $\{7, 9\}$ **12.** $\{3, 5, 7, 9, 13\}$

13. $\{7, 9\}$ **14.** 2   **15.** $\{3, 5\}$

16. $\{(3, 3), (3, 11), (3, 15), (5, 3), (5, 11), (5, 15), (7, 3),$
    $(7, 11), (7, 15), (9, 3), (9, 11), (9, 15)\}$

17.

    18. Equal

19.
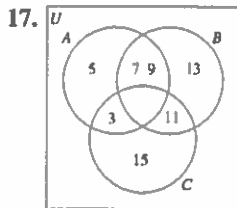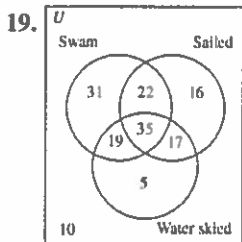
    a) 52   b) 10   c) 93   d) 22   e) 69   f) 5

20. $\{7, 8, 9, 10, 11, \ldots, n + 6, \ldots\}$
    $\downarrow \downarrow \downarrow \downarrow \downarrow \qquad \downarrow$
    $\{8, 9, 10, 11, 12, \ldots, n + 7, \ldots\}$

Chapter 3

Answer to Recreational Math on page 97

7	1	9	4	8	2	5	6	3
5	4	6	7	3	9	8	1	2
2	3	8	6	5	1	4	9	7
8	2	4	3	9	5	1	7	6
6	7	5	1	2	4	3	8	9
1	9	3	8	6	7	2	4	5
9	6	1	5	4	3	7	2	8
3	8	7	2	1	6	9	5	4
4	5	2	9	7	8	6	3	1

SECTION 3.1, PAGE 101

1. Statement   **3.** Compound

5. a) Not   b) And   c) Or   d) If-then   e) If and only if

7. Some   **9.** Simple statement

11. Compound; biconditional, $\leftrightarrow$

13. Compound; conjunction, $\wedge$

15. Compound; conditional, $\rightarrow$

17. Compound; negation, $\sim$

19. Some butterflies are not insects.

21. All turtles have claws.

23. Some bicycles have three wheels.

25. No pedestrians are in the crosswalk.

27. Some Holsteins are Guernseys.

29. $\sim p$ **31.** $\sim q \vee \sim p$

33. $\sim p \rightarrow \sim q$

35. $\sim p \wedge q$ **37.** $\sim q \leftrightarrow p$

39. $\sim(p \vee q)$

41. Brie does not have a MacBook.

43. Joe has an iPad and Brie has a MacBook.

45. If Joe does not have an iPad then Brie has a MacBook.

47. Joe does not have an iPad or Brie does not have a MacBook.

49. It is false that Joe has an iPad and Brie has a MacBook.

51. $(p \wedge \sim q) \wedge r$ **53.** $(p \wedge q) \vee r$

55. $p \rightarrow (q \vee \sim r)$ **57.** $(r \leftrightarrow q) \wedge p$

59. $q \rightarrow (p \leftrightarrow r)$

61. The water is 70° or the sun is shining, and we do not go swimming.

63. The water is not 70°, and the sun is shining or we go swimming.

65. If we do not go swimming, then the sun is shining and the water is 70°.

67. If the sun is shining then we go swimming, and the water is 70°.

69. The sun is shining if and only if the water is 70°, and we go swimming.

71. Not permissible, you cannot have both soup and salad. The *or* used on menus is the *exclusive or*.

73. Not permissible, you cannot have both potatoes and pasta. The *or* used on menus is the *exclusive or*.

75. a) $w \wedge \sim p$ b) Conjunction

77. a) $\sim (b \rightarrow \sim p)$ b) Negation

79. a) $(f \vee v) \rightarrow h$ b) Conditional

81. a) $c \leftrightarrow (\sim f \vee p)$ b) Biconditional

83. a) $(c \leftrightarrow w) \vee s$ b) Disjunction

85. a) Answers will vary.   b) Answers will vary.

86.

6	4	8	7	5	3	2	1	9
3	9	2	8	6	1	7	5	4
7	5	1	9	4	2	8	6	3
9	1	6	3	2	5	4	8	7
5	7	3	4	8	6	9	2	1
8	2	4	1	9	7	5	3	6
4	3	5	6	7	8	1	9	2
2	6	9	5	1	4	3	7	8
1	8	7	2	3	9	6	4	5

SECTION 3.2, PAGE 114

1. Opposite   **3.** False

5.	**7.**	**9.**	**11.**	**13.**
F	T	F	T	T
F	F	T	F	F
	T	T	T	T
	T	T	T	T
				F
				F
				T
				T

15.	**17.**	**19.** $p \wedge q$
T	F	T
F	F	F
T	T	F
T	F	F
T	F	
F	F	
T	T	
F	T	

21. $p \wedge \sim q$	**23.** $\sim(p \wedge q)$	**25.** $p \vee (q \vee r)$
F	F	T
T	T	T
F	T	T
F	T	T
		T
		T
		T
		F

27. a) False   **b)** False   **29. a)** False   **b)** False
31. a) True   **b)** False   **33. a)** False   **b)** True
35. a) True   **b)** True   **37.** True   **39.** True
41. False   **43.** False   **45.** False   **47.** True
49. True   **51.** False

53. $p \wedge \sim q$	**55.** $p \vee \sim q$
F	T
T	T
F	F
F	T
True in case 2	True in cases 1, 2, and 4.

57. $(r \vee q) \wedge p$	**59.** $q \vee (p \wedge \sim r)$
T	T
T	T
T	F
F	T
F	T
F	T
F	F
F	F
True in cases 1, 2, and 3	True in cases 1, 2, 4, 5, and 6.

61. a) Mr. Duncan and Mrs. Tuttle qualify.

   b) Mrs. Rusinek does not qualify, since their combined income is less than $46,000.

63. b) Gina Vela is returning on April 3. Kara Sharo is returning on a Monday. Christos Supernaw is not staying over on a Saturday. Alex Chang is returning on a Monday.

65.	**67.** Yes
T	
T	
T	
T	
F	
T	
F	
T	

SECTION 3.3, PAGE 124

1. False   **3.** True   **5.** Self-contradiction

7.	**9.**	**11.**	**13.**	**15.**	**17.**
T	T	F	T	F	T
T	F	T	T	T	T
T	F	T	F	T	T
F	F	F	T	T	T
					T
					F
					F
					F

19.	**21.**	**23.**	**25.** $p \rightarrow (q \wedge r)$
F	T	T	T
F	T	T	F
T	T	T	F
F	T	F	F
T	T	T	T
T	F	T	T
F	F	F	T
T	F	T	T

27. $(p \leftrightarrow q) \vee r$	**29.** $(\sim p \rightarrow q) \vee r$
T	T
T	T
T	T
F	T
T	T
F	T
T	T
T	F

31. Neither   **33.** Self-contradiction   **35.** Tautology
37. Not an implication   **39.** Implication   **41.** Implication
43. True   **45.** False   **47.** False   **49.** True   **51.** True
53. True   **55.** False   **57.** True   **59.** True   **61.** True
63. False   **65.** False   **67.** True   **69.** False   **71.** True
73. No, the statement only states what will occur if your sister gets straight A's. If your sister does not get straight A's, your parents may still get her a computer.

75. F   **77.** It is a tautology. The statement may be expressed as $(p \rightarrow q) \vee (\sim p \rightarrow q)$, where p: It is a head and q: I win. This statement is a tautology.

F
T
T
T
F
F
F

79. Allen was born in January. Booker was born in February. Chris was born in March. Dennis was born in April.

80.

Tiger	Boots	Sam	Sue
Blue	Yellow	Red	Green
Nine Lives	Whiskas	Friskies	Meow Mix

81. Katie was born last. Katie and Mary are saying the same thing.

SECTION 3.4, PAGE 136

Answer to Recreational Math on page 134

1. Equivalent **3.** $\sim p \vee q$ **5.** $q \to p$ **7.** $\sim q \to \sim p$

9. Not equivalent **11.** Equivalent **13.** Not equivalent

15. Equivalent **17.** Equivalent **19.** Equivalent

21. Equivalent **23.** Equivalent

25. Not equivalent **27.** Equivalent

29. Oregon does not border the Atlantic Ocean or Delaware does not border the Pacific Ocean.

31. It is false that the dog was a bulldog or the dog was a boxer.

33. If Ashley Tabai takes the new job, then it is false that she will move and she will not buy a new house in town.

35. Janette Campbell does not buy a new car or she sells her old car.

37. If Bob the Tomato did not visit the nursing home then he did not visit the Cub Scout meeting.

39. If Chase is hiding, then the pitcher is broken.

41. We go to Chicago and we do not go to Navy Pier.

43. It is false that if I am cold then the heater is working.

45. Amazon has a sale and we will not buy $100 worth of books.

47. It is false that if John Deere will hire new workers then the city of Dubuque will not retrain the workers.

49. *Converse:* If she needs extra yarn, then Nanette Berry teaches macramé.

Inverse: If Nanette Berry does not teach macramé, then she does not need extra yarn.

Contrapositive: If she does not need extra yarn, then Nanette Berry does not teach macramé.

51. *Converse:* If I buy silver jewelry, then I go to Mexico.

Inverse: If I do not go to Mexico, then I do not buy silver jewelry.

Contrapositive: If I do not buy silver jewelry, then I do not go to Mexico.

53. *Converse*: If I scream, then that annoying paper clip shows up on my computer screen.

Inverse: If that annoying paper clip does not show up on my computer screen, then I will not scream.

Contrapositive: If I do not scream, then that annoying paper clip does not show up on my screen.

55. If a natural number is not divisible by 7, then the natural number is not divisible by 14. True.

57. If a natural number is not divisible by 6, then the natural number is not divisible by 3. False.

59. If two lines are not parallel, then the two lines intersect in at least one point. True.

61. b) and c) are equivalent. **63.** a) and c) are equivalent.

65. b) and c) are equivalent. **67.** b) and c) are equivalent.

69. None are equivalent. **71.** None are equivalent.

73. a) and c) are equivalent.

75. True. If $p \to q$ is false, it must be of the form $T \to F$. Therefore, the converse must be of the form $F \to T$, which is true.

77. False. A conditional statement and its contrapositive always have the same truth values.

79. Answers will vary.

81. Answers will vary.

83.

SECTION 3.5, PAGE 147

1. Valid **3.** Fallacy **5.** Valid **7.** Inverse **9.** Syllogism

11. Syllogism **13.** Invalid **15.** Valid **17.** Valid

19. Invalid **21.** Invalid **23.** Valid **25.** Valid

27. Invalid **29.** Invalid **31.** Valid

33. a) $p \to q$ | **b)** Valid   **35. a)** $p \to q$ | **b)** Valid
$\sim q$ | | p
$\therefore \sim p$ | | $\therefore q$

37. a) $p \to q$ | **b)** Valid   **39. a)** $p \to q$ | **b)** Invalid
$\sim q$ | | q
$\therefore \sim p$ | | $\therefore p$

41. a) $p \vee q$ | **b)** Valid   **43. a)** $p \to q$ | **b)** Valid
$\sim p$ | | $q \to r$
$\therefore q$ | | $\therefore p \to r$

45. a) $p \wedge q$ | **b)** Valid   **47. a)** $s \wedge g$ | **b)** Valid
$q \to r$ | | $g \to c$
$\therefore r \to p$ | | $\therefore s \to c$

49. a) $p \rightarrow q$ **b)** Valid   **51. a)** $p \vee q$ **b)** Valid
  $\dfrac{\sim q}{\therefore \sim p}$ $\dfrac{\sim p}{\therefore q}$

53. a) $t \wedge g$ **b)** Valid   **55. a)** $c \wedge \sim h$ **b)** Invalid
  $\dfrac{\sim t \vee \sim g}{\therefore \sim t}$ $\dfrac{h \rightarrow c}{\therefore h}$

57. a) $p \rightarrow q$ **b)** Invalid
  $q \rightarrow \sim r$
  $\overline{\therefore p \rightarrow r}$

59. Therefore, you must rest for three days.

61. Therefore, I am stressed out.

63. Therefore, you did not close the deal.

65. Yes, if the conclusion does not necessarily follow from the premises, the argument is invalid, even if the conclusion is true.

67. Yes, if the conclusion does not necessarily follow from the premises, the argument is invalid, even if the premises are true.

69. Valid   **71. a)** $p \rightarrow q$ **b)** No   **c)** This argument is
  $\dfrac{\sim p}{\therefore \sim q}$ the fallacy of the inverse.

SECTION 3.6, PAGE 154

1. Euler   **3.** Invalid   **5.** No   **7.** Valid   **9.** Valid

11. Invalid   **13.** Valid   **15.** Invalid   **17.** Invalid

19. Invalid   **21.** Valid   **23.** Invalid

25. Invalid   **27.** Valid

29. Yes, if the conclusion necessarily follows from the premises, the argument is valid.

SECTION 3.7, PAGE 161

1. Series   **3.** Closed

5. a) $p \vee q$
  b) The lightbulb will be on when either p or q are closed.

7. a) $(p \vee q) \wedge \sim q$
  b) The lightbulb will be on when p is closed and q is open.

9. a) $(p \wedge q) \wedge [(p \wedge \sim q) \vee r]$
  b) The lightbulb will be on when p, q, and r are all closed.

11. a) $p \vee q \vee (r \wedge \sim p)$
  b) The lightbulb will be on in all cases except when p, q, and r are all open.

13.

15.

17.

19.
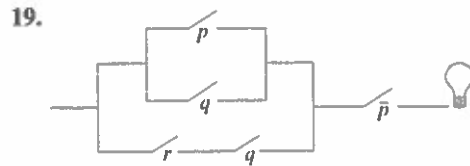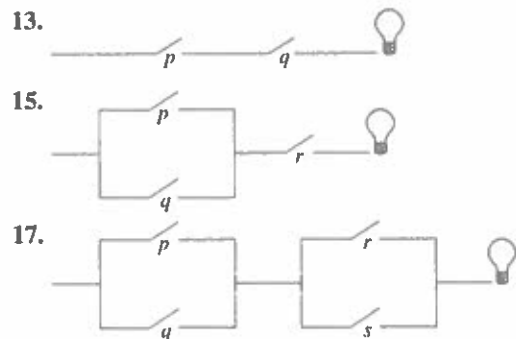
21. $p \vee \sim q$; $\bar{p} \wedge q$ not equivalent

23. $[(p \wedge q) \vee r] \wedge p$; $(q \vee r) \wedge p$; equivalent

25. $(p \vee \sim p) \wedge q \wedge r$; $p \wedge q \wedge r$; not equivalent

27. It is a series circuit; therefore, both switches must be closed for current to flow and the lightbulb to go on. When the p switch is closed, the $\bar{p}$ switch is open and no current will flow through the circuit. When the $\bar{p}$ switch is closed, the p switch is open and no current will flow through the circuit.

29. a)

b)
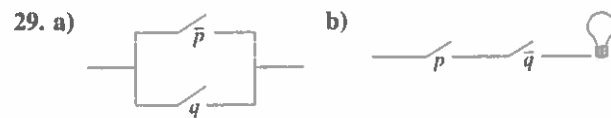
REVIEW EXERCISE, PAGE 164

1. Some Scions are not Toyotas.

2. Some pets are allowed in this park.

3. No women are presidents.   **4.** All pine trees are green.

5. The coffee is Maxwell House or the coffee is hot.

6. The coffee is not hot and the coffee is strong.

7. If the coffee is hot, then the coffee is strong and the coffee is not Maxwell House.

8. The coffee is Maxwell House if and only if the coffee is not strong.

9. The coffee is not Maxwell House, if and only if the coffee is strong and the coffee is not hot.

10. The coffee is Maxwell House or the coffee is not hot, and the coffee is not strong.

11. $p \vee r$ **12.** $r \rightarrow \sim p$ **13.** $(r \rightarrow q) \vee \sim p$

14. $(q \leftrightarrow p) \wedge \sim r$ **15.** $(r \wedge q) \vee \sim p$ **16.** $\sim (r \wedge q)$

17.	18.	19.	20.	21.	22.
F	T	T	T	F	F
F	F	T	F	T	T
T	F	T	T	F	T
F	F	T	T	F	T
		T	F	T	T
		F	F	T	T
		F	F	T	T
		T	F	T	T

23. False   **24.** True   **25.** False   **26.** True   **27.** True

28. True   **29.** False   **30.** False   **31.** Not equivalent

32. Equivalent   **33.** Equivalent   **34.** Not equivalent

35. It is false that if Lady Gaga sang "Poker Face", then Jay-Z sang "Beamer, Benz, or Bentley".

36. If Lynn Swann did not play for the Steelers, then Jack Tatum played for the Raiders.

37. Altec Lansing does not produce only speakers and Harman Kardon does not produce only stereo receivers.

38. It is false that Travis Tritt won an Academy Award or Randy Jackson does commercials for Milk Bone Dog Biscuits.

39. The temperature is above 32° or we will go ice fishing at O'Leary's Lake.

40. a) If you know Jay Stu, then you listen to Jim Rome.

b) If you do not listen to Jim Rome, then you do not know Jay Stu.

c) If you do not know Jay Stu, then you do not listen to Jim Rome.

41. a) If we will learn the table's value, then we take the table to *Antiques Roadshow*.

b) If we do not take the table to *Antiques Roadshow*, then we will not learn the table's value.

c) If we will not learn the table's value, then we do not take the table to *Antiques Roadshow*.

42. a) If you do not sell more doughnuts, then you do not advertise.

b) If you advertise, then you sell more doughnuts.

c) If you sell more doughnuts, then you advertise.

43. a) If we will not buy a desk at Miller's Furniture, then the desk is made by Winner's Only and the desk is in the Rose catalog.

b) If the desk is not made by Winner's Only or the desk is not in the Rose catalog, then we will buy a desk at Miller's Furniture.

c) If we will buy a desk at Miller's Furniture, then the desk is not made by Winner's Only or the desk is not in the Rose catalog.

44. a) If I let you attend the prom, then you will get straight A's on your report card.

b) If you do not get straight A's on your report card, then I will not let you attend the prom.

c) If I will not let you attend the prom, then you did not get straight A's on your report card.

45. a), b) and **c)** are equivalent.   **46.** None are equivalent.

47. a) and **c)** are equivalent.   **48.** None are equivalent.

49. Invalid   **50.** Valid   **51.** Valid   **52.** Invalid

53. Invalid   **54.** Valid   **55.** Invalid   **56.** Invalid

57. a) $p \land [(q \land r) \lor \sim p]$

b) The lightbulb will be on when p, q, and r are all closed.

58.
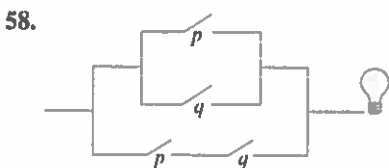
59. Equivalent

CHAPTER TEST, PAGE 167

1. $(p \land r) \lor \sim q$ **2.** $(r \to q) \lor \sim p$ **3.** $\sim(r \leftrightarrow \sim q)$

4. Phobos is not a moon of Mars and Rosalind is a moon of Uranus, if and only if Callisto is not a moon of Jupiter.

5. If Phobos is a moon of Mars or Callisto is not a moon of Jupiter, then Rosalind is a moon of Uranus.

6. F
T
F
F
F
F
F
F

7. T
T
T
T
F
T
T
F

8. True   **9.** True   **10.** True   **11.** True   **12.** Equivalent.

13. a) and **b)** are equivalent.   **14. a)** and **b)** are equivalent.

15. $s \to f$ **16.**   Invalid   **17.** Some highways are not roads.
$f \to p$
$\therefore s \to p$
Valid

18. Nick did not play football or Max did not play baseball.

19. *Converse:* If today is Saturday, then the garbage truck comes.

Inverse: If the garbage truck does not come, then today is not Saturday.

Contrapositive: If today is not Saturday, then the garbage truck does not come.

20.
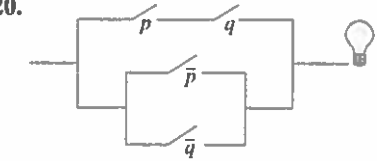
Chapter 4

SECTION 4.1, PAGE 176

1. How many   **3.** Hindu–Arabic   **5.** Subtract

7. Multiplicative   **9.** 234   **11.** 2423   **13.** 334,214

15. ∩∩∩ıı   **17.** ℓℓ∩∩∩ııııı

19. ∝𝍶𝍶𝍶𝍶𝍶ℓℓℓ999999999∩∩∩ııııı

21. 16   **23.** 194   **25.** 2642   **27.** 2946   **29.** 12,666

31. 9464   **33.** XXIV   **35.** DLV   **37.** MCMXIV

39. $\overline{\text{IV}}$DCCXCIII   **41.** $\overline{\text{IX}}$CMXCIX   **43.** $\overline{\text{XX}}$DCXLIV

45. 74   **47.** 4081   **49.** 8550   **51.** 4003

53. 五
+
三

55. 三
百
七
十
八

57. 四
千
二
百
六
十

59. 七千
零
五
十
六

61. 81   **63.** 279   **65.** 2883   **67.** $\lambda\gamma\digamma$ **69.** $\psi\kappa$ **71.** $'\epsilon\epsilon$

73. 1021, MXXI, 一, $'\alpha\kappa\alpha$

千
零
二
十
一

75. 527, 99999∩∩ıııııı,
DXXVII, $\phi\kappa\zeta$

77. A number is a quantity, and it answers the question "How many?" A numeral is a symbol used to represent the number.

79. $\overline{\text{CMXCIX}}$CMXCIX

81. Turn the book upside down.

83. 1888, MDCCCLXXXVIII

SECTION 4.2, PAGE 183

1. Positional   **3.** Tens   **5.** 10   **7.** Expanded

9. 60   **11.** Calendar   **13.** $(5 \times 10) + (8 \times 1)$

15. $(7 \times 100) + (1 \times 10) + (2 \times 1)$

17. $(8 \times 100) + (9 \times 10) + (7 \times 1)$

19. $(4 \times 1000) + (3 \times 100) + (8 \times 10) + (7 \times 1)$

21. $(1 \times 10,000) + (6 \times 1000) + (4 \times 100) +$
$(0 \times 10) + (2 \times 1)$

23. $(3 \times 100,000) + (4 \times 10,000) + (6 \times 1000) +$
$(8 \times 100) + (6 \times 10) + (1 \times 1)$

25. 32   **27.** 784   **29.** 4868   **31.** ⟨⟨⟨⟨𝖳

33. ⟨𝖳𝖳𝖳𝖳 ⟨⟨⟨⟨⟨𝖳   **35.** 𝖳   𝖳𝖳𝖳𝖳𝖳

37. 73   **39.** 4682   **41.** 4000

43. ⋯   **45.** ⋯   **47.** ⋯   **49.** 1944, ⟨⟨⟨𝖳𝖳 ⟨⟨𝖳𝖳𝖳𝖳

51. $\left(\triangle \times \bigcirc^{2}\right) + \left(\square \times \bigcirc\right) + \left(\Diamond \times 1\right)$

53. The Mayan system has a different base and the numerals are written vertically.

55. a) ⋅   **b)** 𝖳𝖳𝖳𝖳 ⟨⟨⟨⟨𝖳𝖳𝖳𝖳 ⟨⟨⟨⟨𝖳𝖳𝖳𝖳𝖳𝖳 ⟨⟨⟨⟨𝖳𝖳

57. 𝖳𝖳𝖳 𝖳   **59.** ⋯

SECTION 4.3, PAGE 190

1. Base   **3.** 8   **5.** 1   **7.** 8   **9.** 161   **11.** 441

13. 1395   **15.** 53   **17.** 4012   **19.** 1549   **21.** 50,809

23. 1001_2 **25.** 212_3 **27.** 311_4 **29.** 402_5 **31.** 2112_8

33. 5264_{12} **35.** $24EF_{16}$ **37.** 2202120_3 **39.** 31023_5

41. 5604_7 **43.** $8E3_{15}$ **45.** 23   **47.** 78

49. ⊖◐   **51.** ◑◐◐₅

53. 14   **55.** 36

57. ◐○₄   **59.** ●●●₄   **61. a)** 10213_5 **b)** 1373_8

63. a) 2 **b)** 8 **c)** 16 **d)** 32 **e)** b **65.** $b = 6$

67. a) $1_3, 2_3, 10_3, 11_3, 12_3, 20_3, 21_3, 22_3, 100_3, 101_3, 102_3,$
$110_3, 111_3, 112_3, 120_3, 121_3, 122_3, 200_3, 201_3, 202_3$
b) 1000_3

69. a) Answers will vary.   **b)** Answers will vary.

71. a) 876   **b)** ○●●●₄

SECTION 4.4, PAGE 198

1. 12_5 **3.** 5   **5.** 22_5 **7.** 124_5 **9.** 1101_2

11. $9B5_{12}$ **13.** 2200_3 **15.** 24001_2 **17.** 10100_2

19. 3_5 **21.** 54_9 **23.** 110_2 **25.** 11_2 **27.** 3616_7

29. 1011_3 **31.** 134_5 **33.** 1201_3 **35.** 21020_6

37. 77676_{12} **39.** 100011_2 **41.** 6031_7 **43.** 110_2

45. $146_7 R2_7$ **47.** 123_4 **49.** $103_4 R1_4$ **51.** $41_5 R1_5$

53. $45_7 R2_7$ **55.** ⊖⊖₅   **57.** ◔⊖₅   **59.** ●●₄

61. ●●○₄   **63.** ●○₄   **65.** ●○○₄   **67.** $3EAC_{16}$

69. a) 21252_8 **b)** 306 and 29 **c)** 8874 **d)** 8874 **e)** Yes

71. ○ = 0, ● = 1, ● = 2, ● = 3

SECTION 4.5, PAGE 203

1. a) Divided **b)** Doubled   **3.** Three; Two   **5.** 308

7. 663   **9.** 8260   **11.** 8649   **13.** 753   **15.** 4172   **17.** 900

19. 204,728   **21.** 112   **23.** 410   **25.** 625   **27.** 60,678

29. a) 253×46 **b)** 11,638   **31. a)** 4×382 **b)** 1528

33. 99∩∩∩∩∩∩∩𝖨𝖨𝖨𝖨𝖨   **35.** 1211_3

REVIEW EXERCISES, PAGE 205

1. 321   **2.** 42,053   **3.** 200,421   **4.** 1,214,330

5. 𝖿𝖿𝖿𝖿999 𝖨𝖨   **6.** ⌒99

7. ∞⟍𝖿𝖿𝖿𝖿999∩∩𝖨   **8.** ⚡𝖿𝖿𝖿∩∩∩𝖨𝖨

9. 24   **10.** 142   **11.** 2437   **12.** 5759   **13.** XXIX

14. DXLVII   **15.** MCMLXIV   **16.** $\overline{\text{VI}}$CDXCI

17. 32   **18.** 45   **19.** 267   **20.** 3429

21. 二十三   **22.** 五十四   **23.** 四百九十二   **24.** 二千六百五十二   **25.** 42   **26.** 789

27. 605   **28.** 3334   **29.** ση   **30.** φκα   **31.** ωξζ

32. 'δσιθ   **33.** 123   **34.** 189   **35.** 3673   **36.** 7388

37. 𝖳𝖳𝖳 𝖳   **38.** 𝖳 𝖳 ⟨⟨𝖳𝖳   **39.** 𝖳𝖳' 𝖳 ⟨⟨

40. ⟨ 𝖳𝖳𝖳 𝖳𝖳𝖳𝖳   **41.** 63   **42.** 721   **43.** 1367   **44.** 15,923

45. ⋯   **46.** ⋯   **47.** ⋯   **48.** ⋯   **49.** 39   **50.** 5

51. 28   **52.** 1244   **53.** 1552   **54.** 186   **55.** 111001111_2

56. 122011_3 **57.** 13033_4 **58.** 717_8 **59.** 327_{12} **60.** $1CF_{16}$

61. 140_7 **62.** 101111_2 **63.** 166_{12} **64.** $70F_{16}$ **65.** 12102_5

66. 12423_8 **67.** 3411_7 **68.** 100_2 **69.** $9A6_{12}$ **70.** 3324_5

71. 450_8 **72.** $CC1_{16}$ **73.** 110111_2 **74.** 21102_3 **75.** 1314_5

76. 13632_8 **77.** 5656_{12} **78.** $1D76_{16}$ **79.** $21_3 R1_3$

80. 130_4 **81.** $23_5 R1_5$ **82.** 433_6 **83.** $411_6 R1_6$

84. $664_8 R2_8$ **85.** 3408   **86.** 3408   **87.** 3408