INSTRUCTOR'S SOLUTIONS MANUAL

JAMES LAPP

A SURVEY OF MATHEMATICS WITH APPLICATIONS

ELEVENTH EDITION

Allen R. Angel

Monroe Community College

Christine D. Abbott

Monroe Community College

Dennis C. Runde

State College of Florida

Reproduced by Pearson from electronic files supplied by the author.

ISBN-13: 978-0-13-574072-9
ISBN-10: 0-13-574072-X

Table of Contents

Chapter 11: Probability

Chapter 12: Statistics

Chapter 13: Graph Theory

Chapter 14: Voting and Apportionment

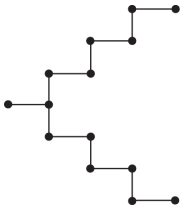
Chapter One: Critical Thinking Skills

Section 1.1: Inductive and Deductive Reasoning

1. Natural
2. Divisible
3. Counterexample
4. Hypothesis
5. Inductive
6. Deductive
7. Deductive
8. Inductive
9. $5 \times 3 = 15$
10. $19 \times 10 = 190$
11. $1 \underset{(1+4)}{5} \underset{(4+6)}{10} \underset{(4+6)}{10} \underset{(1+4)}{5} 1$
12. $100{,}000 = 10^5$
13. 
14. 
15. 
16. 
17. 9, 11, 13 (Add 2 to previous number.)
18. 16, 19, 22 (Add 3 to the previous number.)
19. 5, –5, 5 (Alternate 5 and –5.)
20. 16, –32, 64 (Multiply previous number by –2.)
21. $\frac{1}{5}, \frac{1}{6}, \frac{1}{7}$ (Increase denominator value by 1.)
22. $\frac{1}{9}, \frac{1}{11}, \frac{1}{13}$ (Increase denominator value by 2.)
23. 21, 28, 36 $(15+6=21,\ 21+7=28,\ 28+8=36)$
24. 16, 22, 29 (Add 1, then 2, then 3, ….)
25. 34, 55, 89 (Each number in the sequence is the sum of the previous two numbers.)
26. 76, 123, 199 (Each number in the sequence is the sum of the previous two numbers.)
27. There are three letters in the pattern. $39 \times 3 = 117$, so, the 117th entry is the second R in the pattern. Therefore, the 118th entry is Y.
28. a) Answers will vary.
    b) The sum of the digits is 9.
    c) The sum of the digits in the product when a one- or two-digit number is multiplied by 9 is divisible by 9.
29. a) 36, 49, 64
    b) Square the numbers 6, 7, 8, 9 and 10.
    c) $8 \times 8 = 64,\ 9 \times 9 = 81$; 72 is not a square number since it falls between the two square numbers 64 and 81.
30. a) 28 and 36
    b) To find the 7th triangular number, add 7 to the 6th triangular number.
    To find the 8th triangular number, add 8 to the 7th triangular number.
    To find the 9th triangular number, add 9 to the 8th triangular number.
    To find the 10th triangular number, add 10 to the 9th triangular number.
    To find the 11th triangular number, add 11 to the 10th triangular number.
    c) $36+9=45,\ 45+10=55,\ 55+11=66;\ 66+12=78$; 72 is not a triangular number since it falls between the consecutive triangular numbers 66 and 78.
31. Blue: 1, 5, 7, 10, 12; Purple: 2, 4, 6, 9, 11; Yellow: 3, 8
32. a) 19 (Each new row has two additional triangles.)
    b) $1+3+5+7+9+11+13+15+17+19=100$
33. a) \$3700
    b) We are using observation of specific cases to make a prediction.

34. a) $410
    b) We are using observation of specific cases to make a prediction.

35. 

36. 

37. a) You should obtain the original number.
    b) You should obtain the original number.
    c) Conjecture: The result is always the original number.
    d) $n \to 3n \to 3n+6 \to \dfrac{3n+6}{3} = \dfrac{3n}{3} + \dfrac{6}{3} = n+2 \to n+2-2 = n$

38. a) You should obtain twice the original number.
    b) You should obtain twice the original number.
    c) Conjecture: The result is always twice the original number.
    d) $n \to 4n \to 4n+6 \to \dfrac{4n+6}{2} = \dfrac{4n}{2} + \dfrac{6}{2} = 2n+3 \to 2n+3-3 = 2n$

39. a) You should obtain the number 5.
    b) You should obtain the number 5.
    c) Conjecture: The result is always the number 5.
    d) $n \to n+1 \to n+(n+1) = 2n+1 \to 2n+1+9 = 2n+10 \to \dfrac{2n+10}{2} = \dfrac{2n}{2} + \dfrac{10}{2} = n+5 \to n+5-n = 5$

40. a) You should obtain the number 0.
    b) You should obtain the number 0.
    c) Conjecture: The result is always the number 0.
    d) $n \to n+10 \to \dfrac{n+10}{5} \to 5\left(\dfrac{n+10}{5}\right) = n+10 \to n+10-10 = n \to n-n = 0$

41. $3 \times 5 = 15$ is one counterexample.

42. $10+11+12=33$, which is not a three digit number.

43. Two is a counting number. The sum of 2 and 3 is 5. Five divided by two is $5/2$, which is not an even number.

44. 900 is a three-digit number. The product of 900 and 900 is 810,000, which is not a five-digit number.

45. One and two are counting numbers. The difference of 1 and 2 is $1-2=-1$, which is not a counting number.

46. The sum of the odd numbers 1 and 5 is 6, which is not divisible by 4.

47. 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) Conjecture: The sum of the measures of the interior angles of a triangle is $180°$.

48. a) The sum of the measures of the interior angles should be $360°$.
    b) Yes, the sum of the measures of the interior angles should be $360°$.
    c) Conjecture: The sum of the measures of the interior angles of a quadrilateral is $360°$.

49. Inductive reasoning: a general conclusion is obtained from observation of specific cases.

50. Inductive reasoning: a general conclusion is obtained from observation of specific cases.

51. 129; The numbers in the positions of each inner 4×4 square are determined as follows.

$$\begin{matrix} a & b \\ c & a+b+c \end{matrix}$$

52. 1881, 8008, 8118 (They look the same when looked at in a mirror.)

53. c

Section 1.2: Estimation Techniques

Answers in this section will vary depending on how you round your numbers. The answers may differ from the answers in the back of the textbook. However, your answers should be something near the answers given. All answers are approximate.)

1. Estimation

2. Equal

3. $26.9 + 67.3 + 219 + 143.3$
$\approx 30 + 67 + 220 + 143 = 460$

4. $86 + 47.2 + 289.8 + 532.4 + 12.8$
$\approx 90 + 50 + 290 + 530 + 10 = 970$

5. $197{,}500 \div 4.063 \approx 200{,}000 \div 4.000 = 50{,}000$

6. $\dfrac{405}{0.049} \approx \dfrac{400}{0.05} = 8000$

7. $1776 \times 0.0098 \approx 1800 \times 0.01 = 18$

8. $0.63 \times 1523 \approx 0.6 \times 1500 = 900$

9. $23.97 - 7.05 \approx 24 - 7 = 17$

10. $400.15 - 297.87 \approx 400 - 300 = 100$

11. $22\% \times 9116 \approx 20\% \times 9000 = 0.20 \times 9000$
$= 1800$

12. 11% of $8221 \approx 10\%$ of $8000 = 0.10 \times 8000$
$= 800$

13. $\dfrac{\$91.35}{3} \approx \dfrac{\$90}{3} = \$30$

14. $\dfrac{\$210}{8} \approx \dfrac{\$200}{8} = \$25$

15. $12 \text{ months} \times \$47 \approx 12 \times \$50 = \$600$

16. $19 \text{ gallons} \times \$3.11 \approx 20 \times \$3 = \$60$

17. $\$7.99 + \$4.23 + \$16.82 + \$3.51 + \$20.12 \approx \$8 + \$4 + \$17 + \$4 + \$20 = \$53$

18. $\$1.29 + \$6.86 + \$12.43 + \$25.62 + \$8.99 \approx \$1 + \$7 + \$12 + \$26 + \$9 = \$55$

19. $95\,\text{lb} + 127\,\text{lb} + 210\,\text{lb} \approx 100 + 100 + 200 = 400\,\text{lb}$

20. $16.1 \text{ lb} + 7.9 \text{ lb} + 21.4 \text{ lb} + 11.6 \text{ lb} + 3.7 \text{ lb} \approx 16 + 8 + 21 + 12 + 4 = 61 \text{ lb}$

21. 15% of $\$26.32 \approx 15\%$ of $\$26 = 0.15 \times \$26 = \$3.90$

22. $\dfrac{\$400}{\$23} \approx \dfrac{\$400}{\$25} = 16$

23. $\$595 + \$289 + \$120 + \$110 + 230 \approx \$600 + \$300 + \$100 + \$100 + \$200 = \$1300$

24. Team A: $189 + 172 + 191 \approx 190 + 170 + 190 = 550$
Team B: $183 + 229 + 167 \approx 180 + 230 + 170 = 580$
$580 - 550 = 30$ lb

25. $11 \times 8 \times \$1.50 \approx 10 \times 8 \times \$1.50 = 10 \times \$12 = \$120$

26. 9 min, 55 sec/mi $\times$ 26.2 mi ≈ 10 min $\times$ 26 mi $= 260$ min/mi; $\dfrac{260 \text{ min}}{60 \text{ min}} \approx 4\dfrac{1}{3}$ hours

27. $\dfrac{599 \text{ Mexican pesos}}{20.14 \text{ Mexican pesos / U.S. dollars}} \approx \dfrac{600}{20} = \$30$

28. $\$973 + 6(\$61) + 6(\$97) + 6(\$200) \approx \$970 + 6(\$60) + 6(\$100) + 6(\$200)$
$= \$970 + \$360 + \$600 + \$1200$
$= \$3130$

29. 90 miles

30. 75 miles

31. a) $23\% \text{ of } 700 \approx 25\% \text{ of } 700 = 0.25 \times 700 = 175$

b) $12\% \text{ of } 700 \approx 10\% \text{ of } 700 = 0.10 \times 700 = 70$

c) $21\% \text{ of } 700 \approx 20\% \text{ of } 700 = 0.20 \times 700 = 140$

32. a) $18\% \text{ of } 2987 \approx 18\% \text{ of } 3000 = 0.18 \times 3000 = 540$

b) $42\% \text{ of } 2987 \approx 42\% \text{ of } 3000 = 0.42 \times 3000 = 1260$

c) $7\% \text{ of } 2987 \approx 7\% \text{ of } 3000 = 0.07 \times 3000 = 210$

33. a) 5 million

b) 98 million

c) 98 million − 33 million = 65 million

d) 19 million + 79 million + 84 million + 65 million + 33 million = 280 million

34. a) 19%

b) 25%

c) $20\% \text{ of } 179 \text{ lb} \approx 20\% \text{ of } 180 = 0.2 \times 180 = 36 \text{ lb}$

35. a) 85%

b) $68\% - 53\% = 15\%$

c) 85% of 70 million acres = 59,500,000 acres

d) No, since we are not given the area of each state.

36. a) $2(410) + 4(545) \approx 2(400) + 4(500) = 800 + 2000 = 2800$ calories

b) Running: $4(920) \approx 4(900) = 3600$ calories

Walking: $4(330) \approx 4(300) = 1200$ calories

Difference: $3600 - 1200 = 2400$ calories

c) $3(545) + 3(545) \approx 3(550) + 3(550) = 1650 + 1650 = 3300$ calories per week

3300 calories per week $(52 \text{ weeks}) \approx 3000 \times 50 = 150{,}000$ calories

37. 20

38. 25

39. 120 bananas

40. 100 grapes

41. 150°

42. 315°

43. 10%

44. 25%

45. 9 square units

46. 12 square units

47. 160 feet

48. 4(60) = 240 in. or $\frac{240}{12} \approx 20$ ft

49. – 57. Answers will vary.

58. Cost of one vitamin C tablet: $\frac{\$24.99}{500} \approx \frac{\$25}{500} = \$0.05$

Cost of one fish oil tablet: $\frac{\$47.99}{120} \approx \frac{\$48}{120} = \$0.40$

Cost of one vitamin D tablet: $\frac{\$17.99}{180} \approx \frac{\$18}{180} = \$0.10$

Cost of one multivitamin tablet: $\frac{\$19.99}{80} \approx \frac{\$20}{80} = \$0.25$

Roberto's daily cost: $5 \times \$0.05 + 4 \times \$0.40 + 1 \times \$0.10 + 1 \times \$0.25 = \$1.40$

59. There are 118 ridges around the edge.

60. a) Answers will vary.

b) 11.6 days. There are $24 \cdot 60 \cdot 60 = 86,400$ seconds in a day, and $1,000,000 / 86,400 = 11.5\overline{740}$.

62. Answers will vary.

63. Answers will vary.

Section 1.3: Problem-Solving Procedures

1. $\frac{1 \text{ in.}}{12 \text{ mi}} = \frac{4.25 \text{ in.}}{x \text{ mi}}$

$x = 12(4.25)$

$x = 51 \text{ mi}$

2. $\frac{1 \text{ in.}}{2.5 \text{ yd}} = \frac{22.4 \text{ in.}}{x \text{ yd}}$

$1x = 2.5(22.4)$

$x = 56 \text{ yd}$

3. $\frac{3 \text{ ft}}{1.2 \text{ ft}} = \frac{x \text{ ft}}{15.36 \text{ ft}}$

$3(15.36) = 1.2x$

$\frac{46.03}{1.2} = \frac{1.2x}{1.2}$

$x = \frac{46.03}{1.2} = 38.4 \text{ ft}$

4. $\frac{1 \text{ bag}}{4000 \text{ ft}^2} = \frac{x \text{ bags}}{35,000 \text{ ft}^2}$

$4000x = 1(35,000)$

$\frac{4000x}{4000} = \frac{35,000}{4000}$

$x = \frac{35,000}{4000} = 8.75 \text{ bags}$

5. $4 \times \$113 = \$452$

9.25% of $\$452 = 0.0925 \times \$452 = \$41.81$

$\$452 + \$41.81 = \$493.81$

6. $2 \times \$187 = \$374$

9.5% of $\$374 = 0.095 \times \$374 = \$35.53$

$\$374 + \$35.53 = \$409.53$

7. a) Entertainment/Miscellaneous: 19.1% of $\$1950 = 0.191 \times \$1950 = \$372.45$

Food: 12.7% of $\$1950 = 0.127 \times \$1950 = \$247.65$

$\$372.45 - \$247.65 = \$124.80$

b) Housing: 34.4% of $\$1950 = 0.344 \times \$1950 = \$670.80$

Transportation: 16% of $\$1950 = 0.16 \times \$1750 = \$312.00$

$\$670.80 - \$312.00 = \$358.80$

8. a) Business: 19% of $2,895,000 = 0.19 \times 2,895,000 = 550,050$

Engineering: 5% of $2,895,000 = 0.05 \times 2,895,000 = 144,750$

$550,050 - 144,750 = 405,300$ degrees

8. (continued)

   b) Health Professions: 11% of $2,895,000 = 0.11 \times 2,895,000 = 318,450$
   Psychology: 6% of $2,895,000 = 0.06 \times 2,895,000 = 173,700$
   $318,450 - 173,700 = 144,750$ degrees

9. $43 \text{ rides} \times \$2.00 \text{ per ride} = \$86.00$; In order for the cost of rides with the \$84.50 MetroCard to be less than the cost of the rides without the CharlieCard, Marcelo would have to take 43 bus rides per month.
   Note that $\frac{\$84.50}{43 \text{ rides}} \approx \$1.97 \text{ per ride}$.

10. $45 \text{ rides} \times \$2.75 \text{ per ride} = \$123.75$; In order for the cost of rides with the \$121.50 MetroCard to be less than the cost of the rides without the MetroCard, Karissa would have to take 45 subway rides per month.
    Note that $\frac{\$121.50}{45 \text{ rides}} = \$2.70 \text{ per ride}$

11. $\$250 + \$130(18) = \$250 + \$2340 = \$2590$
    Savings: $\$2590 - \$2500 = \$90$

12. $\$349.72 - \$32.39(4) = \$349.72 - 129.56 = \$220.16$

13. 15-year mortgage: $\$887.63(12)(15) = \$159,773.40$
    30-year mortgage: $\$572.90(12)(30) = \$206,244.00$
    Savings: $\$206,244.00 - \$159,773.40 = \$46,470.60$

14. Points needed for 80 average: $80(5) = 400$ points
    Wallace's points so far: $79 + 93 + 91 + 68 = 331$ points
    Grade needed on fifth exam: $400 - 331 = 69$

15. a) $10 \times 10 \times 10 \times 10 = 10,000$
    b) 1 in 10,000

16. a) $\frac{460}{25} = 18.4 \text{ min}$
    b) $\frac{1550}{50} = 31 \text{ min}$
    c) $\frac{1400}{35} = 40 \text{ min}$
    d) $\frac{1550}{80} + \frac{2200}{80} = \frac{3750}{80} \approx 47 \text{ min}$

17. $38,687.0 \text{ mi} - 38,451.4 \text{ mi} = 235.6 \text{ mi}$; $\frac{235.6 \text{ mi}}{12.6 \text{ gal}} \approx 18.7 \text{ mpg}$

18. a) $40 \times \$8.50 \times 52 = \$17,680$
    b) Each week he makes $40 \times \$8.50 = \$340$, it will take him $\frac{\$1275}{\$340} = 3.75$ weeks.

19. By mail: $(\$52.80 + \$5.60 + \$8.56) \times 4 = \$66.96 \times 4 = \$267.84$
    Tire store: $\$324 + 0.08 \times \$324 = \$324 + \$25.92 = \$349.92$
    Savings: $\$349.92 - \$267.84 = \$82.08$

20. $\$1750 - \$50(15) = \$1750 - \$750 = \$1000$ and $\frac{\$1000}{\$40} = 25 \text{ hours}$

21. 15,000 ft − 3000 ft = 12,000 ft decrease in elevation. Temperature increases $2.4°\text{F}$ for every 1000 ft decrease in elevation.
$-6°\text{F} + 28.8°\text{F} = 22.8°\text{F}$ and $-6°\text{F} + 28.8°\text{F} = 22.8°\text{F}$; The precipitation at the airport will be snow.

22. a) $\$620(0.12) = \$74.40$

    b) $\$1200(0.22) = \$264$

    c) The store lost $\$1200 - \$1000 = \$200$ on the purchase, so the store's profit is $\$264 - \$200 = \$64$.

23. a) Since \$876 is less than $10\% \times \$9525 = \$952.50$, Shenile's tax was 10% of her taxable income. Her taxable income was $\dfrac{\$876}{0.10} = \$8760$.

    b) Since \$2017.50 is greater than \$952.50 and less than \$4453.50, Logan's taxable income was in the 12% bracket. Since $\$2017.50 - \$962.50 = \$1065$ was 12% of his taxable income above \$9525, he made an additional $\dfrac{\$1065}{0.12} = \$8875$. His taxable income was $\$9625 + \$8875 = \$18,400$.

24. a) Since \$4541.50 is greater than \$4453.50 and less than \$14,089.50, Lewis' taxable income was in the 22% bracket. Since $\$4541.50 - \$4453.50 = \$88$ was 22% of his taxable income above \$38,700, he made an additional $\dfrac{\$88}{0.22} = \$400$. His taxable income was $\$38,700 + \$400 = \$39,100$.

    b) Since \$14,593.50.50 is greater than \$14,089.50 and less than \$32,089, Leticia's taxable income was in the 24% bracket. Since $\$14,593.50 - \$14,089.50 = \$504$ was 24% of his taxable income above \$82,500, she made an additional $\dfrac{\$504}{0.24} = \$2100$. Her taxable income was $\$82,500 + \$2100 = \$84,600$.

25. a) $1 \times 60 \times 24 \times 365 = 525,600$ oz and $\dfrac{525,600 \text{ oz}}{128} = 4106.25$ gal

    b) $\dfrac{4106.25}{1000} \times \$11.20 = 4.10625 \times \$11.20 = \$45.99$

26. a) $0.1 \times 60 \times 60 \times 24 \times 365 = 3,153,600 \text{ cm}^3$

    b) $\dfrac{\text{Volume of basin}}{\text{Daily water loss}} = \dfrac{(30 \text{ cm})(20 \text{ cm})(20 \text{ cm})}{0.1 \times 60 \times 60 \times 24} = \dfrac{12,000 \text{ cm}^3}{8640 \text{ cm}^3} \approx 1.4$; It would take about 1.4 days.

27. a) $\dfrac{20,000}{20.8} - \dfrac{20,000}{21.6} \approx 961.538 - 925.926 = 35.612 \approx 35.61$ gal

    b) $35.61 \times \$3.00 = \$106.83$

    c) $140,000,000 \times 35.61 = 4,985,400,000$ gal

28. a) Parking: $\$30 \times 6 = \$180$
    Tax: 9.5% of $\$180 = 0.095 \times \$180 = \$17.10$
    Total: $\$180 + \$17.10 = \$197.10$

    b) Parking: $\$17.95 \times 6 = \$107.70$
    Tax: 8.75% of $\$107.70 = 0.0875 \times \$107.70 \approx \$9.42$
    Total: $\$107.70 + \$9.42 = \$117.12$

    c) She can save $\$197.10 - \$117.12 = \$79.98$.

29. Cost after 1 year: $\$999 + 0.02(\$999) = \$999 + \$19.98 = \$1018.98$

    Cost after second year: $\$1018.98 + 0.02(\$1018.98) = \$1018.98 + \$20.38 = \$1039.36$

30. Value after first year: $\$1000 + 0.10(\$1000) = \$1000 + \$100 = \$1100$

    Value after second year: $\$1100 - 0.10(\$1100) = \$1100 - \$110 = \$990$

    \$990 is less than the initial investment of \$1000.

31. After paying the \$100 deductible, Yungchen must pay 20% of the cost of x-rays.

    First x-ray: $\$100 + 0.20(\$620) = \$100 + \$124 = \$224$

    Second x-ray: $0.20(\$980) = \$196$

    Total: $\$224 + \$196 = \$420$

32. \$3000 is the difference between one-fourth of the cost and one-fifth of the cost.

    $\frac{1}{4} - \frac{1}{5} = \frac{1}{20}$ and $20 \times \$3000 = \$60,000$

33. a) water/milk: $3(1) = 3$ cups

    salt: $3\left(\frac{1}{8}\right) = \frac{3}{8}$ tsp

    Cream of wheat: $3(3) = 9$ tbsp $= \frac{9}{16}$ cup (because 16 tbsp = 1 cup)

    b) water/milk: $\frac{2 + 3\frac{3}{4}}{2} = \frac{\frac{23}{4}}{2} = \frac{23}{8} = 2\frac{7}{8}$ cups

    salt: $\frac{\frac{1}{4} + \frac{1}{2}}{2} = \frac{\frac{3}{4}}{2} = \frac{3}{8}$ tsp

    cream of wheat: $\frac{\frac{1}{2} + \frac{3}{4}}{2} = \frac{\frac{5}{4}}{2} = \frac{5}{8}$ cups =5 tbsp

    c) water/milk: $3\frac{3}{4} - 1 = \frac{15}{4} - \frac{4}{4} = \frac{11}{4} = 2\frac{3}{4}$ cups

    salt: $\frac{1}{2} - \frac{1}{8} = \frac{4}{8} - \frac{1}{8} = \frac{3}{8}$ tsp

    cream of wheat: $\frac{3}{4} - \frac{3}{16} = \frac{12}{16} - \frac{3}{16} = \frac{9}{16}$ cup = 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.

34. a) rice: $\frac{1}{2}(4) = 2$ cups

water: $1\frac{1}{3}(4) = \frac{4}{3}(4) = \frac{16}{3} = 5\frac{1}{3}$ cups

salt: $\frac{1}{4}(4) = 1$ tsp

butter/margarine: $1(4) = 4$ tsp

b) rice: $1(2) = 2$ cups

water: $2\frac{1}{4}(2) = \frac{9}{4}(2) = \frac{18}{4} = 4\frac{2}{4} = 4\frac{1}{2}$ cups

salt: $\frac{1}{2}(2) = 1$ tsp

butter/margarine: $2(2) = 4$ tsp

c) rice: $\frac{1}{2} + 1\frac{1}{2} = \frac{1}{2} + \frac{3}{2} = \frac{4}{2} = 2$ cups

water: $1\frac{1}{3} + 3\frac{1}{3} = \frac{4}{3} + \frac{10}{3} = \frac{14}{3} = 4\frac{2}{3}$ cups

salt: $\frac{1}{4} + \frac{3}{4} = \frac{4}{4} = 1$ tsp

butter/margarine: $1 \text{ tsp} + 1 \text{ tbsp} = 1 \text{ tsp} + 3 \text{ tsp} = 4 \text{ tsp}$

d) rice: $3 - 1 = 2$ cups

water: $6 - 2\frac{1}{4} = \frac{24}{4} - \frac{9}{4} = \frac{15}{4} = 3\frac{3}{4}$ cups

salt: $1\frac{1}{2} - \frac{1}{2} = 1$ tsp

butter/margarine: $2 \text{ tbsp} - 2 \text{ tsp} = 2(3\text{tsp}) - 2 \text{ tsp} = 6 \text{ tsp} - 2 \text{ tsp} = 4 \text{ tsp}$

e) Differences exist in water because the amount for 4 servings is not twice that for 2 servings.

35. a)

20 DVDs	12 DVDs	Total Number of DVDs
1	1	$20 + 12 = 32$
0	2	$12 + 12 = 24$

b) $\$240 + \$180 = \$420$

36. Mark will win.

37. $1 \text{ ft}^2 = 12 \text{ in.} \times 12 \text{ in.} = 144$ square inches

38. $1 \text{ ft}^3 = 12 \text{ in.} \times 12 \text{ in.} \times 12 \text{ in.} = 1728$ cubic inches

39. Area of original rectangle: lw

Area of new rectangle: $(2l)(2w) = 4(lw)$

Thus, if the length and width of a rectangle are doubled, the area is 4 times as large.

40. $20\,\text{ft} \times 20\,\text{ft} = 400\,\text{ft}^2$; $5\,\text{ft} \times 5\,\text{ft} = 25\ \text{ft}^2$; $\dfrac{400\,\text{ft}^2}{25\,\text{ft}^2} = 16\,\text{squares}$

41. Volume of original cube: lwh

Volume of new cube: $(2l)(2w)(2h) = 8(lwh)$

Thus, if the length, width, and height of a cube are doubled, the volume is 8 times as large.

42. 11 ft is one-sixth of the pole, so the length is $6 \times 11\,\text{ft} = 66\,\text{ft}$.

43. $$\frac{10 \text{ pieces}}{x} = \frac{1000 \text{ pieces}}{\$10}$$
$$1000x = 10(10)$$
$$\frac{1000x}{1000} = \frac{100}{1000}$$
$$x = \frac{100}{1000} = \$0.10 = 10¢$$

44.

Left side	Right side
$1(-6) = -6$	$1(2) = 2$
$2(-2) = -4$	$1(3) = 3$
	$(6) = 6$
$-6 + (-4) = -10$	$2 + 3 + 6 = 11$

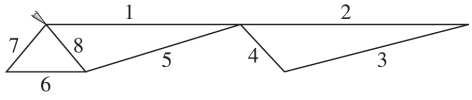
Place it at –1, so the left side would total $-10 + (-1) = -1$.

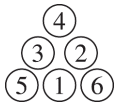
45. You have three ties, each a different color.

46. There are 10 palindromes: 2002, 2112, 2222, 2332, 2442, 2552, 2662, 2772, 2882, 2992.

47. a) refresh
b) workout

48. Answers will vary.



49. 

50. Eight pieces

51.

8	6	16
18	10	2
4	14	12

52.

10	5	6
3	7	11
8	9	4

53. $8 + 6 + 2 + 4 = 20$; $3 + 7 + 5 + 1 = 16$; $10 + 14 + 12 + 8 = 44$

The sum of the four corner entries is 4 times the number in the center of the middle row.

54. 15,12,33; Multiply the number in the center of the middle row by 3.

55. 45,36,99; Multiply the number in the center of the middle row by 9.

56. $35 - 15 = 20$ cubes

57. $3 \times 2 \times 1 = 6$ ways

58. Each salesperson shakes hands with four people.

59. Other answers are possible, but 1 and 8 must appear in the center.

	7	
3	1	4
5	8	6
	2	

60. The diagram shows the number of times each part is used.

	8	
6	7	8
④		⑨
	6	

61. Other answers are possible.

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

62. With umbrella policy:

Mustang reduced premium: $\$1648 - \$90 = \$1558$

Focus reduced premium: $\$1530 - 0.12(\$1530) = \$1530 - \$183.60 = \$1346.40$

Total for umbrella policy: $\$1558 + \$1346.40 + \$450 = \$3354.40$

Without umbrella policy: $\$1648 + \$1530 = \$3178$

Net amount for umbrella policy: $\$3354.40 - \$3178 = \$176.40$

63. Mark plays the drums.

64. $16 + 16 + 4 + 4 + 4 = 44$

65. The areas of the colored regions are 1×1, 1×1, 2×2, 3×3, 5×5, 8×8, 13×13, 21×21.

$1 + 1 + 4 + 9 + 25 + 64 + 169 + 441 = 714$ square units

66. Let x be the amount Samantha had to start.

After first store: $x - \frac{1}{2}x - 20 = \frac{1}{2}x - 20$

After second store: $\frac{1}{2}\left(\frac{1}{2}x - 20\right) - 20 = \frac{1}{4}x - 30$

$$\frac{1}{4}x - 30 = 0$$

$$x = 120$$

The original amount was \$120.

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

Review Exercises

1. 23, 28, 33 (Add 5 to previous number.)
2. 16, 13, 10 (Subtract 3 from previous number)
3. 64, –128, 256 (Multiply previous number by –2.)
4. 25, 32, 40 $(19 + 6 = 25,\ \ 25 + 7 = 32,\ \ 32 + 8 = 40)$
5. 10, 4, –3 (Subtract 1, then 2, then 3, …)
6. $\frac{3}{8}, \frac{3}{16}, \frac{3}{32}$ (Multiply previous number by $\frac{1}{2}$.)

7. 

8. 

9. c

10. a) The final number is twice the original number.
    b) The final number is twice the original number.
    c) Conjecture: The final number is twice the original number.
    d) $n \to 10n \to 10n+5 \to \dfrac{10n+5}{5} = \dfrac{10n}{5} + \dfrac{5}{5} = 2n+1 \to 2n+1-1 = 2n$

11. This process will always result in an answer of 3.
    $n \to n+5 \to 6(n+5) = 6n+30 \to 6n+30-12 = 6n+18$
    $\to \dfrac{6n+18}{2} = \dfrac{6n}{2} + \dfrac{18}{2} = 3n+9 \to \dfrac{3n+9}{3} = \dfrac{3n}{3} + \dfrac{9}{3} = n+3 \to,\ n+3-n = 3$

12. $1^2 + 2^2 = 5$ and 5 is an odd number. Other answers are possible.

Answers for Exercises 13–25 will vary depending on how you round your numbers. The answers may differ from the answers in the back of the textbook. However, your answers should be something near the answers given. All answers are approximate.

13. $205{,}123 \times 4002 \approx 200{,}000 \times 4000$
    $= 800{,}000{,}000$

14. $215.9 + 128.752 + 3.6 + 861 + 792$
    $\approx 200 + 100 + 0 + 900 + 800 = 2000$

15. 21% of $2095 \approx$ 20% of 2000
    $= 0.20 \times 2000 = 400$

16. Answers will vary.

17. $48 \text{ bricks} \times \$3.97 \approx 50 \times 4 = \$200$

18. 8% of $\$21{,}000 \approx$ 8% of 20,000
    $= 0.08 \times 20{,}000 = \$1600$

19. $\dfrac{1.1 \text{ mi}}{22 \text{ min}} \approx \dfrac{1 \text{ mi}}{20 \text{ min}} = \dfrac{3 \text{ mi}}{60 \text{ min}} = 3 \text{ mph}$

20. $\$2.49 + \$0.79 + \$1.89 + \$0.10 + \$2.19 + \$6.75$
    $\approx \$2 + \$1 + \$2 + \$0 + \$2 + \$7 = \$14.00$

21. $5 \text{ in.} = \dfrac{20}{4} \text{ in.} = 20\left(\dfrac{1}{4}\right) \text{ in.} = 20(0.1) \text{ mi}$
    $= 2 \text{ mi}$

22. Approximately $70°\text{F} - 30°\text{F} = 40°\text{F}$

23. Approximately $90°\text{F} - 80°\text{F} = 10°\text{F}$

24. 13 square units

25. Length: 1.75 in., 1.75(1.25) = 21.875 ≈ 22 ft
    Height: 0.625 in., 0.625(12.5) = 7.8125 ≈ 8 ft

26. $\$50 + \$40(12) = \$530$
    Savings: $\$530 - \$500 = \$30$

27. $4(\$1.99) = \$7.96$ for four six-packs
    Savings: $\$7.96 - \$4.99 = \$2.97$

28. Freemac: $\$15 \times 4 \times 2 = \$120$
    Sylvan: $\$25 \times 4 \text{ hours} = \$100$
    $\$120 - \$100 = \$20$
    Sylvan Rental is less expensive by $20.

29. Cost per person with 5 people: $\dfrac{\$445}{5} = \$89$
    Cost per person with 5 people: $\dfrac{\$510}{6} = \$85$
    Savings: $\$89 - \$85 = \$4$

30. a) $\dfrac{30 \text{ lb}}{2500 \text{ ft}^2} = \dfrac{x}{24{,}000 \text{ ft}^2}$
    $x = \dfrac{30 \times 24{,}000}{2500}$
    $x = 288 \text{ lb}$
    b) $\dfrac{150 \text{ lb}}{30 \text{ lb/bag}} = 5 \text{ bags};\ 5 \times 2500 = 12{,}500 \text{ ft}^2$

31. 10% of $\$1030 = 0.10 \times \$1030 = \$103$

$7 \times \$103 = \$721$

Savings: $\$721 - \$60 = \$661$

32. $\dfrac{1.5 \text{ mg}}{10 \text{ lb}} = \dfrac{x \text{ mg}}{52 \text{ lb}}$

$10x = 52(1.5)$

$\dfrac{10x}{10} = \dfrac{78}{10}$

$x = 7.8$ mg

33. $\$5500 - 0.30(\$5500) = \$5500 - \$1650 = \$3850$ take-home; 28% of $\$3850 = 0.28 \times \$3850 = \$1078$

34. 9 A.M. Eastern is 6 A.M. Pacific, from 6 A.M. Pacific to 1:35 P.M. Pacific is 7 hr 35 min, 7 hr 35 min − 50 min stop = 6 hr 45 min.

35. 3 P.M. − 4 hr = 11 A.M.; July 26, 11:00 A.M.

36. a) $\dfrac{65\,\text{mi}}{1\,\text{hr}} \times \dfrac{1.6\,\text{km}}{\text{mi}} = \dfrac{104\,\text{km}}{1\,\text{hr}} \approx 104\,\text{km/hr}$

b) $\dfrac{90\,\text{km}}{1\,\text{hr}} \times \dfrac{1\,\text{mi}}{1.6\,\text{km}} = \dfrac{90\,\text{mi}}{1.6\,\text{km}} \approx 56.25\,\text{mi/hr}$

37. Each figure has an additional two dots. To get the hundredth figure, 97 more figures must be drawn, $97(2) = 194$ dots added to the third figure. Thus, $194 + 7 = 201$.

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; Since it doubles every second, the jar was half full 1 second earlier than 1 hour.

41. 6

42. Nothing. Each friend paid \$9 for a total of \$27; \$25 to the hotel, \$2 to the clerk. \$25 for the room + \$3 for each friend + \$2 for the clerk = \$30

43. Let x = the score on the fifth exam

$$\frac{93 + 88 + 81 + 86 + x}{5} = 80$$

$$\frac{348 + x}{5} = 80,$$

$$348 + x = 400,$$

$$x = 52$$

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

45. $6 \text{ cm} \times 6 \text{ cm} \times 6 \text{ cm} = 216 \text{ cm}^3$

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. $1 + 500 = 501$, $2 + 499 = 501$, … ; There are 250 such pairs and $250(501) = 125,250$.

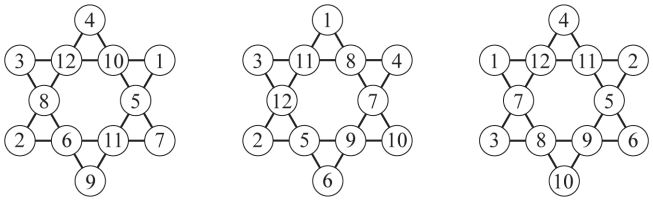
48. 4 green weigh the same as 8 blue, 2 yellow weigh the same as 5 blue, 2 white weigh the same as 3 blue, $8 + 5 + 3 = 16$ blue

49. There are 90 such numbers: 101, 111, 121, 131, 141, 151, 161, 171, 181, 191, 202,h …, 292, 303, …, 393, 404, …, 494, 505, …, 595, 606, …, 696, 707, …, 797, 808, …, 898, 919, …, 999.

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

51. 61 orange tiles will be required. The sixth figure will have 6 rows of 6 tiles and 5 rows of 5 tiles $(6\times 6+5\times 5=36+25=61)$.

52. Some possible answers are given below. There are other possibilities.



53. a) 2
    b) There are 3 choices for the first spot. Once that person is standing, there are 2 choices for the second spot and 1 for the third. Thus, $3\times 2\times 1=6$.
    c) $4\times 3\times 2\times 1=24$
    d) $5\times 4\times 3\times 2\times 1=120$
    e) $n(n-1)(n-2)\cdots 1,$ (or $n!$), where $n=$ the number of people in line.

Chapter Test

1. 26, 32, 38 (Add 6 to previous number.)

2. $\frac{1}{5}, \frac{1}{6}, \frac{1}{7}$ (Add 1 to the denominator of the previous number.)

3. a) The result is the original number plus 1.
   b) The result is the original number plus 1.
   c) Conjecture: The result will always be the original number plus 1.
   d) $n\to 5n\to 5n+10\to \frac{5n+10}{5}=\frac{5n}{5}+\frac{10}{5}=n+2\to n+2-1=n+1$

4. $0.51\times 96{,}000\approx 0.5\times 100{,}000=50{,}000$

5. $\frac{188{,}000}{0.11}\approx \frac{200{,}000}{0.1}\approx 2{,}000{,}000$

6. 9 square units

7. a) $\frac{130 \text{ lb}}{63 \text{ in.}}\approx 2.0635;\ \frac{2.0635}{63 \text{ in.}}=0.032754;$
   $0.032754\times 703\approx 23.03$
   b) He is in the at-risk range.

8. a) 325,000 visitors
   b) 100,000 visitors

9. $\$50.40-\$35.00=\$15.40;\ \frac{\$15.40}{\$0.20}=77$ miles

10. Since $\frac{\$15}{\$2.59} \approx 5.79$, a maximum of 5 six-packs can be purchased. There will be $\$15.00 - (5 \times \$2.59)$ $= \$15.00 - \$12.95 = \$2.05$ remaining, so $\frac{\$2.05}{\$0.80} = 2.5625$, or two additional individual cans can be purchased.

The following table was created using similar calculations for the other possible number of six-packs.

Six-packs	Individual cans	Number of cans
5	2	$6 \times 5 + 2 = 32$
4	5	$6 \times 4 + 5 = 29$
3	9	$6 \times 3 + 9 = 27$
2	12	$6 \times 2 + 12 = 24$
1	15	$6 \times 1 + 15 = 21$
0	18	$6 \times 0 + 18 = 18$

The maximum number of cans is 32.

11. $3 \text{ cuts} \times \frac{2.5 \text{ min}}{1 \text{ cut}} = 7\frac{1}{2} = 7.5 \text{ min}$

12. $10 \times \frac{3}{4} = 10 \times 0.75 = 7.5 \text{ miles}$

13. $\$12.75 \times 40 = \$510$

$\$12.75 \times 1.5 \times 10 = \$191.25$

$\$510 + \$191.25 = \$701.25$

$\$652.25 - \$701.25 = -\$49.00$

She was underpaid by $49.00.

14.

40	15	20
5	25	45
30	35	10

15. Mary drove the first 15 miles at 60 mph which took $\frac{15}{60} = \frac{1}{4}$ hour and drove the second 15 miles at 30 mph took $\frac{15}{30} = \frac{1}{2}$ hour for a total time of $\frac{3}{4}$ hour, or 45 minutes. If she drove the entire 30 miles at 45 mph, the trip would take $\frac{30}{45} = \frac{2}{3}$ hour, or 40 minutes, which is less than $\frac{3}{4}$ hour.

16. $\frac{6\text{lb}}{2\text{lb}} = 3$; $3 \times \frac{1}{2}\text{tsp} = \frac{3}{2}\text{tsp}$ or $1\frac{1}{2}\text{tsp} = \frac{1}{2}$ tbsp

17. Area of lawn including walkway: $(10+2) \times (12+2) = 12 \times 14 = 168\,\text{m}^2$

Area of lawn only: $10 \times 12 = 120\,\text{m}^2$

Area of walkway: $168 - 120 = 48\,\text{m}^2$

18. 243 jelly beans; $260 - 17 = 243$, $234 + 9 = 243$, and $274 - 31 = 243$

19. a) $3 \times \$3.99 = \$11.97$

b) $9(\$1.75 \times 0.75) = 11.8125 \approx \$11.81$

c) $\$11.97 - \$11.81 = \$0.16$; Using the coupon is least expensive by $0.16.

20. $4 \times 3 \times 2 \times 1 = 24$; The first position can hold any of four letters, the second any of the three remaining letters, and so on.

Chapter Two: Sets

Section 2.1: Set Concepts

1. Set
2. Ellipsis
3. Description, Roster form, Set-builder notation
4. Finite
5. Infinite
6. Equivalent
7. Equal
8. Cardinal
9. Empty or null
10. $\{\ \}, \varnothing$
11. Not well defined, "best" is interpreted differently by different people.
12. Not well defined, "most interesting" is interpreted differently by different people.
13. Well defined, the contents can be clearly determined.
14. Well defined, the contents can be clearly determined.
15. Well defined, the contents can be clearly determined.
16. Not well defined, "most interesting" is interpreted differently by different people.
17. Infinite, the number of elements in the set is not a natural number.
18. Finite, the number of elements in the set is a natural number.
19. Infinite, the number of elements in the set is not a natural number.
20. Infinite, the number of elements in the set is not a natural number.
21. Infinite, the number of elements in the set is not a natural number.
22. Finite, the number of elements in the set is a natural number.
23. $\{\text{Hawaii}\}$
24. $\{\text{January, June, July}\}$
25. $\{11,12,13,14,\ldots,177\}$
26. $C = \{4\}$
27. $B = \{2, 4, 6, 8, \ldots\}$
28. $\{\ \}$ or $\varnothing$
29. $\{\ \}$ or $\varnothing$
30. $\{\text{Idaho, Oregon}\}$
31. $E = \{14, 15, 16, 17, \ldots, 84\}$
32. $\{\text{Alaska, Hawaii}\}$
33. {Google Play Games, Pokémon Go}
34. {ApplsLoading}
35. {Solitaire by MobilityWare, Candy Crush Soda Saga, ApplsLoading}
36. $\{\ \}$ or $\varnothing$
37. $\{2015, 2016, 2017, 2018\}$
38. $\{2011, 2012, 2013, 2014\}$
39. $\{\ \}$ or $\varnothing$
40. $\{2013, 2014\}$
41. $B = \{x \mid x \in N \text{ and } 6 < x < 15\}$ or $B = \{x \mid x \in N \text{ and } 7 \le x \le 14\}$
42. $A = \{x \mid x \in N \text{ and } x < 10\}$ or $A = \{x \mid x \in N \text{ and } x \le 9\}$
43. $C = \{x \mid x \in N \text{ and } x \text{ is a multiple of } 3\}$
44. $D = \{x \mid x \in N \text{ and } x \text{ is a multiple of } 5\}$
45. $E = \{x \mid x \in N \text{ and } x \text{ is odd}\}$
46. $A = \{x \mid x \text{ is Independence Day}\}$
47. $C = \{x \mid x \text{ is February}\}$