Thinking Mathematically 8th edition Blitzer Solutions Manual

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INSTRUCTOR'S SOLUTIONS MANUAL

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THINKING MATHEMATICALLY

EIGHTH EDITION

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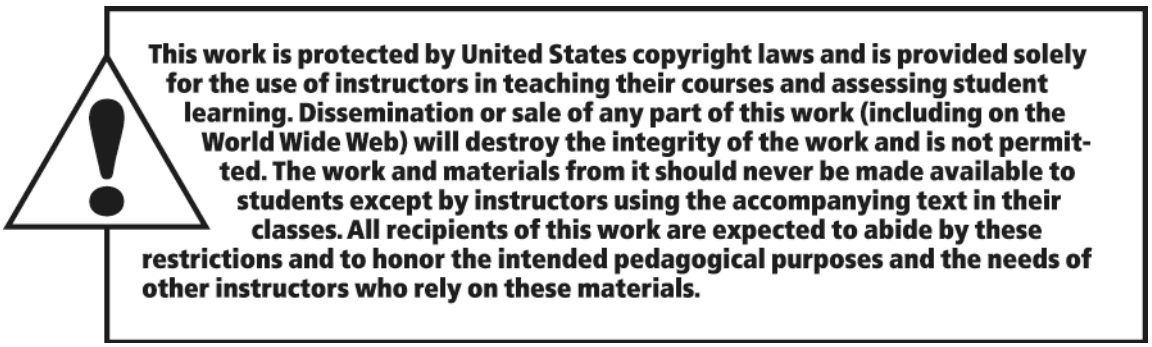
Pearson



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Chapter 1
Problem Solving and Critical Thinking

Check Points 1.1

1. Counterexamples will vary. Example: $40 \times 40 = 1600$

2. a. Add 6 each time.
$3 + 6 = 9$
$9 + 6 = 15$
$15 + 6 = 21$
$21 + 6 = 27$
$27 + 6 = 33$
3, 9, 15, 21, 27, 33

b. Multiply by 5 each time.
$2 \times 5 = 10$
$10 \times 5 = 50$
$50 \times 5 = 250$
$250 \times 5 = 1250$
2, 10, 50, 250, 1250

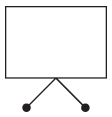
c. Cycle multiplying by 2, 3, 4.
$3 \times 2 = 6$
$6 \times 3 = 18$
$18 \times 4 = 72$
$72 \times 2 = 144$
$144 \times 3 = 432$
$432 \times 4 = 1728$
$1728 \times 2 = 3456$
6, 18, 72, 144, 432, 1728, 3456

d. Cycle adding 8, adding 8, subtracting 14.
$1 + 8 = 9$
$9 + 8 = 17$
$17 - 14 = 3$
$3 + 8 = 11$
$11 + 8 = 19$
$19 - 14 = 5$
$5 + 8 = 13$
$13 + 8 = 21$
$21 - 14 = 7$
9, 17, 3, 11, 19, 5, 13, 21, 7

3. a. Starting with the third number, each number is the sum of the previous two numbers, $29 + 47 = 76$

b. Starting with the second number, each number one less than twice the previous number, $2(129) - 1 = 257$

4. The shapes alternate between rectangle and triangle.
The number of little legs cycles from 1 to 2 to 3 and then back to 1.
Therefore the next figure will be a rectangle with 2 little legs.



5. a. Conjecture based on results: The original number is doubled.

Select a number.	4	10	0	3
Multiply the number by 4.	$4 \times 4 = 16$	$10 \times 4 = 40$	$0 \times 4 = 0$	$3 \times 4 = 12$
Add 6 to the product.	$16 + 6 = 22$	$40 + 6 = 46$	$0 + 6 = 6$	$12 + 6 = 18$
Divide this sum by 2.	$22 \div 2 = 11$	$46 \div 2 = 23$	$6 \div 2 = 3$	$18 \div 2 = 9$
Subtract 3 from the quotient.	$11 - 3 = 8$	$23 - 3 = 20$	$3 - 3 = 0$	$9 - 3 = 6$
Summary of results:	$4 \rightarrow 8$	$10 \rightarrow 20$	$0 \rightarrow 0$	$3 \rightarrow 6$

b. Select a number: n
Multiply the number by 4: $4n$
Add 6 to the product: $4n + 6$
Divide this sum by 2: $\frac{4n+6}{2} = \frac{4n}{2} + \frac{6}{2} = 2n + 3$
Subtract 3 from the quotient: $2n + 3 - 3 = 2n$

Concept and Vocabulary Check 1.1

C1. counterexample

C2. deductive

C3. inductive

C4. true

Exercise Set 1.1

1. Counterexamples will vary. Example: President Obama was younger than 65 at the time of his inauguration.

2. Counterexamples will vary. Example: Beyoncé Knowles is a singer who appears in movies.

3. Counterexamples will vary. Example: 3 multiplied by itself is 9, which is not even.

4. Counterexamples will vary. Example: 100 is a three-digit number and $100 + 100 = 200$, which is not a four-digit number.

5. Counterexamples will vary. Example: Adding 1 to the numerator and denominator of $\frac{1}{2}$ results in $\frac{2}{3}$ which is not equal to $\frac{1}{2}$.

6. Counterexamples will vary. Example: $8 - 3 = 5,$ which is odd, but 8 and 3 are not both odd.

7. Counterexamples will vary. Example: When -1 is added to itself, the result is -2, which is less than -1.

8. Counterexamples will vary. Example: When 1 is divided by $-2,$ the result is $-\frac{1}{2}$, which is greater than -2.

9. Pattern: Add 4
$24 + 4 = 28$
8, 12, 16, 20, 24, <u>28</u>

10. Pattern: Add 5
$39 + 5 = 44$
19, 24, 29, 34, 39, <u>44</u>

11. Pattern: Subtract 5
$17 - 5 = 12$
37, 32, 27, 22, 17, <u>12</u>

12. Pattern: Subtract 4
$17 - 4 = 13$
33, 29, 25, 21, 17, <u>13</u>

13. Pattern: Multiply by 3
$243 \times 3 = 729$
3, 9, 27, 81, 243, <u>729</u>

14. Pattern: Multiply by 4
$512 \times 4 = 2048$
2, 8, 32, 128, 512, <u>2048</u>

15. Pattern: Multiply by 2
$16 \times 2 = 32$
1, 2, 4, 8, 16, $\underline{32}$

16. Pattern: Multiply by 5
$125 \times 5 = 625$
1, 5, 25, 125, $\underline{625}$

17. Pattern: 1 alternates with numbers that are multiplied by 2
$16 \times 2 = 32$
1, 4, 1, 8, 1, 16, 1, $\underline{32}$

18. Pattern: 1 alternates with numbers that are increased by 3
$10 + 3 = 13$
1, 4, 1, 7, 1, 10, 1, $\underline{13}$

19. Pattern: Subtract 2
$-4 - 2 = -6$
$4, 2, 0, -2, -4, \underline{-6}$

20. Pattern: Subtract 3
$-6 - 3 = -9$
$6, 3, 0, -3, -6, \underline{-9}$

21. Pattern: Add 4 to the denominator
$$\frac{1}{18+4} = \frac{1}{22}$$
$$\frac{1}{2}, \frac{1}{6}, \frac{1}{10}, \frac{1}{14}, \frac{1}{18}, \underline{\frac{1}{22}}$$

22. Pattern: Add 1 to the denominator
$$\frac{1}{5+1} = \frac{1}{6}$$
$$1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \underline{\frac{1}{6}}$$

23. Pattern: Multiply the denominator by 3
$$\frac{1}{27 \times 3} = \frac{1}{81}$$
$$1, \frac{1}{3}, \frac{1}{9}, \frac{1}{27}, \underline{\frac{1}{81}}$$

24. Pattern: Multiply the denominator by 2
$$\frac{1}{8 \times 2} = \frac{1}{16}$$
$$1, \frac{1}{2}, \frac{1}{4}, \frac{1}{8}, \underline{\frac{1}{16}}$$

25. Pattern: The second number is obtained by adding 4 to the first number. The third number is obtained by adding 5 to the second number. The number being added to the previous number increases by 1 each time. $33 + 9 = \underline{42}$

26. Pattern: The second number is obtained by adding 3 to the first number. The third number is obtained by adding 4 to the second number. The number being added to the previous number increases by 1 each time. $27+8=\underline{35}$

27. Pattern: The second number is obtained by adding 3 to the first number. The third number is obtained by adding 5 to the second number. The number being added to the previous number increases by 2 each time. $38+13=\underline{51}$

28. Pattern: The second number is obtained by adding 3 to the first number. The third number is obtained by adding 5 to the second number. The number being added to the previous number increases by 2 each time. $37+13=\underline{50}$

29. Pattern: Starting with the third number, each number is the sum of the previous two numbers. $27+44=\underline{71}$

30. Pattern: Starting with the third number, each number is the sum of the previous two numbers. $19+31=\underline{50}$

31. Pattern: Cycle by adding 5, adding 5, then subtracting 7. $13+5=\underline{18}$

32. Pattern: Cycle by adding 6, adding 6, then subtracting 10. $13+6=\underline{19}$

33. Pattern: The second number is obtained by multiplying the first number by 2. The third number is obtained by subtracting 1 from the second number. Then multiply by 2 and then subtract 1, repeatedly. $34-1=\underline{33}$

34. Pattern: The second number is obtained by multiplying the first number by 3. The third number is obtained by subtracting 1 from the second number. Then multiply by 3 and then subtract 1, repeatedly. $123-1=\underline{122}$

35. Pattern: Divide by -4

$-1\div(-4)=\dfrac{1}{4}$

$64,\ -16,\ 4,\ -1,\ \underline{\dfrac{1}{4}}$

36. Pattern: Divide by -5

$-1\div(-5)=\dfrac{1}{5}$

$125,\ -25,\ 5,\ -1,\ \underline{\dfrac{1}{5}}$

37. Pattern: The second value of each pair is 4 less than the first.

$3-4=-1$

$(6,2),(0,-4),(7\frac{1}{2},3\frac{1}{2}),(2,-2),(3,\underline{-1})$

38. Pattern: The second value of each pair is the square of the first.

$\left(-\frac{4}{7}\right)^2=\frac{16}{49}$

$\left(\frac{2}{3},\frac{4}{9}\right),\left(\frac{1}{5},\frac{1}{25}\right),(7,49),\left(-\frac{5}{6},\frac{25}{36}\right),\left(-\frac{4}{7},\underline{\frac{16}{49}}\right)$

39. The figure cycles from square to triangle to circle and then repeats. So the next figure is 

40. The figure rotates $90°$ counterclockwise. So the next figure is 

41. The pattern is to add one more letter to the previous figure and use the next consecutive letter in the alphabet. So the next figure is

d	d	d
d	d	

42. The figure alternates from triangle to square and gains one line on the bottom. The next figure is  .

43. a. Conjecture based on results: The original number is doubled.

Select a number.	4	10	0	3
Multiply the number by 4.	$4\times4=16$	$10\times4=40$	$0\times4=0$	$3\times4=12$
Add 8 to the product.	$16+8=24$	$40+8=48$	$0+8=8$	$12+8=20$
Divide this sum by 2.	$24\div2=12$	$48\div2=24$	$8\div2=4$	$20\div2=10$
Subtract 4 from the quotient.	$12-4=8$	$24-4=20$	$4-4=0$	$10-4=6$
Summary of results:	$4\rightarrow8$	$10\rightarrow20$	$0\rightarrow0$	$3\rightarrow6$

b. $4n$

$4n+8$

$$\frac{4n+8}{2}=\frac{4n}{2}+\frac{8}{2}=2n+4$$

$2n+4-4=2n$

44. a. Conjecture based on results: The result is always 2.

Select a number.	4	10	0	3
Multiply the number by 3.	$4\times3=12$	$10\times3=30$	$0\times3=0$	$3\times3=9$
Add 6 to the product.	$12+6=18$	$30+6=36$	$0+6=6$	$9+6=15$
Divide this sum by 3.	$18\div3=6$	$36\div3=12$	$6\div3=2$	$15\div3=5$
Subtract the original from the quotient.	$6-4=2$	$12-10=2$	$2-0=2$	$5-3=2$
Summary of results:	$4\rightarrow2$	$10\rightarrow2$	$0\rightarrow2$	$3\rightarrow2$

b. $3n$

$3n+6$

$$\frac{3n+6}{3}=\frac{3n}{3}+\frac{6}{3}=n+2$$

$n+2-n=2$

45. a. Conjecture based on results: The result is always 3.

Select a number.	4	10	0	3
Add 5 to the number.	$4+5=9$	$10+5=15$	$0+5=5$	$3+5=8$
Double the result.	$9\times2=18$	$15\times2=30$	$5\times2=10$	$8\times2=16$
Subtract 4.	$18-4=14$	$30-4=26$	$10-4=6$	$16-4=12$
Divide the result by 2.	$14\div2=7$	$26\div2=13$	$6\div2=3$	$12\div2=6$
Subtract the original number.	$7-4=3$	$13-10=3$	$3-0=3$	$6-3=3$
Summary of results:	$4\rightarrow3$	$10\rightarrow3$	$0\rightarrow3$	$3\rightarrow3$

b. $n+5$

$2(n+5)=2n+10$

$2n+10-4=2n+6$

$\frac{2n+6}{2}=\frac{2n}{2}+\frac{6}{2}=n+3$

$n+3-n=3$

46. a. Conjecture based on results: The result is always 5.

Select a number.	4	10	0	3
Add 3 to the number.	$4+3=7$	$10+3=13$	$0+3=3$	$3+3=6$
Double the result.	$7\times 2=14$	$13\times 2=26$	$3\times 2=6$	$6\times 2=12$
Add 4.	$14+4=18$	$26+4=30$	$6+4=10$	$12+4=16$
Divide the result by 2.	$18\div 2=9$	$30\div 2=15$	$10\div 2=5$	$16\div 2=8$
Subtract the original number.	$9-4=5$	$15-10=5$	$5-0=5$	$8-3=5$
Summary of results:	4 → 5	10 → 5	0 → 5	3 → 5

b. $n+3$

$2(n+3)=2n+6$

$2n+6+4=2n+10$

$\frac{2n+10}{2}=\frac{2n}{2}+\frac{10}{2}=n+5$

$n+5-n=5$

47. Using inductive reasoning we predict $1+2+3+4+5+6=\frac{6\times 7}{2}$.

Arithmetic verifies this result: 21 = 21

48. Using inductive reasoning we predict $3+6+9+12+15+18=\frac{18\times 7}{2}$.

Arithmetic verifies this result: 63 = 63

49. Using inductive reasoning we predict $1+3+5+7+9+11=6\times 6$.
Arithmetic verifies this result: 36 = 36

50. Using inductive reasoning we predict $5\cdot 9+(5+9)=59$.

Arithmetic verifies this result:

$5\cdot 9+(5+9)=59$

$5\cdot 9+(14)=59$

$45+(14)=59$

$59=59$

51. Using inductive reasoning we predict $98765\times 9+3=888{,}888$.

Arithmetic verifies this result:

$98765\times 9+3=888{,}888$

$888{,}885+3=888{,}888$

$888{,}888=888{,}888$

52. Using inductive reasoning we predict $54321 \times 9 - 1 = 488,888$.
Arithmetic verifies this result:
$54321 \times 9 - 1 = 488,888$
$488,889 - 1 = 488,888$
$488,888 = 488,888$

53. The first multiplier increases by 33.
132 + 33 = 165
The second multiplier is 3367.
The product increases by 111,111.
165 × 3367 = 555,555 is correct.

54. The pattern implies we should attach a 6 to the right of the first multiplier. The second multiplier is always 8. The pattern implies we should add 6 to that product to obtain 987,654.
123,456 × 8 + 6 = 987,654 is correct.

55. b; The resulting exponent is always the first exponent added to twice the second exponent.

56. c; The resulting exponent is always half the sum of the three exponents.

57. deductive; The specific value was based on a general formula.

58. inductive; The general conclusion for all HMO patients was based on specific observations.

59. inductive; The general conclusion for all full-time four-year colleges was based on specific observations.

60. deductive; The specific grade was based on a general course policy.

61. **a.** 1, 3, 6, 10, 15, and 21 are followed by
21 + 7 = 28
28 + 8 = 36
36 + 9 = 45
45 + 10 = 55
55 + 11 = 66
1, 3, 6, 10, 15, 21, 28, 36, 45, 55, and 66.

b. 4 – 1 = 3
9 – 4 = 5
16 – 9 = 7
25 – 16 = 9
The successive differences increase by 2.
25 + 11 = 36
36 + 13 = 49
49 + 15 = 64
64 + 17 = 81
81 + 19 = 100

c. The successive differences are 4, 7, and 10. Since these differences are increasing by 3 each time. The next five numbers will be found by using differences of 13, 16, 19, 22, and 25.
22 + 13 = 35
35 + 16 = 51
51 + 19 = 70
70 + 22 = 92
92 + 25 = 117

d. If a triangular number is multiplied by 8 and then 1 is added to the product, a square number is obtained.

62. Each row begins and ends with 1. Other numbers are the sum of the two values that are diagonally above.

```
                1
              1   1
            1   2   1
          1   3   3   1
        1   4   6   4   1
      1   5   10  10  5   1
```

63 - 65. Answers will vary.

66. does not make sense; Explanations will vary. Sample explanation: Such conclusions would be certain.

67. makes sense

68. makes sense

69. does not make sense; Explanations will vary. Sample explanation: Such conclusions cannot be made about the future as people and technology change over time.

70. The pattern suggests that the compatible expression is the square of the first number minus twice the product of the two numbers, plus the square of the second number.

$(11-7)^2 = 121-154+49$

71. a. The sums are all 30:

16	3	11
5	10	15
9	17	4

b. The sums are all 36:

17	5	14
9	12	15
10	19	7

c. For any values of a, b, and c, the sums of all rows, all columns, and both diagonals are the same.

d. The sums of the expressions in each row, each column, and each diagonal is $3a$.

e. Finding each sum verifies the conjecture that they are all $3a$.
First row: $(a+b)+(a-b-c)+(a+c)=3a$
Second row: $(a-b+c)+(a)+(a+b-c)=3a$
Third row: $(a-c)+(a+b+c)+(a-b)=3a$
First Column: $(a+b)+(a-b+c)+(a-c)=3a$
Second Column: $(a-b-c)+(a)+(a+b+c)=3a$
Third Column: $(a+c)+(a+b-c)+(a-b)=3a$
First Diagonal: $(a+b)+(a)+(a-b)=3a$
Second Diagonal: $(a-c)+(a)+(a+c)=3a$

72. Answers will vary. Possible answer: 5, 10, 15 or 5, 10, 20.

$5 \times 1 = 5$ $\qquad 5\times 2^0 = 5$

$5 \times 2 = 10$ $\qquad 5\times 2^1 = 10$

$5 \times 3 = 15$ $\qquad 5\times 2^2 = 20$

73. a. The result is a three- or four- digit number in which the thousands and hundreds places represent the month of the birthday and the tens and ones places represent the day of the birthday.

b. $5[4(5M+6)+9]+D-165$
$= 5[20M+24+9]+D-165$
$= 5[20M+33]+D-165$
$= 100M+165+D-165$
$= 100M+D$

74. a. $6 \times 6 = 36$
$66 \times 66 = 4356$
$666 \times 666 = 443{,}556$
$6666 \times 6666 = 44{,}435{,}556$

b. An additional digit of 6 is attached to the numbers being multiplied. An additional digit of 4 is attached to the left of the result and an additional digit of 5 is placed between the 3 and the 6.

c. $66666 \times 66666 = 4{,}444{,}355{,}556$
$666{,}666 \times 666{,}666 = 444{,}443{,}555{,}556$

d. Inductive reasoning; it uses an observed pattern and draws conclusions from that pattern.

75. a. $3367 \times 3 = 10101$
$3367 \times 6 = 20202$
$3367 \times 9 = 30303$
$3367 \times 12 = 40404$

b. The first multiplier is always 3367. The second multipliers are successive multiples of 3. The product increases by 10101.

c. $3367 \times 15 = 50505$
$3367 \times 18 = 60606$

d. Inductive reasoning; it uses an observed pattern and draws conclusions from that pattern.

Check Points 1.2

1. a. The digit to the right of the billions digit is 5 or greater. Thus, add 1 to the billions digit and replace all the digits to the right with zeroes. 7,843,169,634 rounded to the nearest billion is 8,000,000,000.

b. The digit to the right of the ten millions digit is less than 5. Thus, replace all the digits to the right with zeroes. 7,843,169,634 rounded to the nearest ten-million is 7,840,000,000.

2. a. The digit to the right of the tenths digit is less than 5. Thus, 3.141593 rounded to the nearest tenth is 3.1.

b. The digit to the right of the ten-thousandths digit is greater than 5. Thus, 3.141593 rounded to the nearest ten-thousandth is 3.1416.

3. a.
$$\begin{aligned}&\$3.40+\$2.25+\$5.60+\$5.40+\$3.40\\&\qquad\qquad+\$2.85+3.95\\&\approx \$3+\$2+\$6+\$5+\$3+\$3+4\\&\approx \$26\end{aligned}$$

b. The given bill is not reasonable. It is too high.

4. a. Round \$52 per hour to \$50 per hour and assume 40 hours per week.
$$\frac{40\text{ hours}}{\text{week}}\times\frac{\$50}{\text{hour}}=\frac{\$2000}{\text{week}}$$
The architect's salary is $\approx$ \$2000 per week.

b. Round 52 weeks per year to 50 weeks per year.
$$\frac{\$2000}{\text{week}}\times\frac{50\text{ weeks}}{\text{year}}=\frac{\$100,000}{\text{year}}$$
The architect's salary is $\approx \$100,000$ per year.

5. a. 0.48×2148.72

b. $0.5\times 2100=1050$
Your family spent approximately \$1050 on heating and cooling last year.

6. a. The yearly increase in life expectancy can be approximated by dividing the change in life expectancy by the change in time from 1950 to 2020. $\dfrac{81.9-71.1}{2020-1950}=\dfrac{10.8}{70}\approx 0.15$ yr for each subsequent birth year.

b. $\overbrace{71.1}^{\text{life expectancy in 1950}}+\overbrace{0.15}^{\text{yearly increase}}\left(\overbrace{2050-1950}^{\text{number of years from 1950 to 2050}}\right)$
$$\begin{aligned}&=71.1+0.15(100)\\&=71.1+15\\&=86.1\text{ yr}\end{aligned}$$

7. a. about 22%

b. The greatest rate of increase in the percentage of college students who smoked cigarettes can be found by identifying the portion of the graph with the largest upward slope. This occurs between 1994 and 1998.

c. Approximately 24% of college students smoked cigarettes in 1982 and 1994.

d. 2020 was the year in which the least percentage of college students smoked cigarettes. The percentage that year was 8%.

8. a. The yearly increase in tuition and fees can be approximated by dividing the change in tuition and fees by the change in time from 2000 to 2020. $\frac{\$32,769-\$14,616}{2020-2000}=\frac{\$18,153}{20}\approx\$908$

b. $T=\overbrace{14,616}^{\text{Cost in 2000}}+\overbrace{908}^{\text{yearly increase}}x$

c. 2030 is 30 years after 2000. Thus, $T=14,616+908x$
$=14,616+908(30)$
$=\$41,856$

A Brief Review 1.2: Percents

1. 0.99

2. 0.07

3. 0.124

4. 0.003

5. 1.23

6. $A=0.05\cdot1000$

7. $45=0.10\cdot B$

8. $12=P\cdot60$

Concept and Vocabulary Check 1.2

C1. estimation

C2. circle graph

C3. mathematical model

C4. true

C5. true

C6. false

Exercise Set 1.2

1. a. 39,512,200

b. 39,512,000

c. 39,510,000

d. 39,500,000

e. 40,000,000

f. 40,000,000

2. a-f. Answers will vary depending upon state chosen.

3. 2.718

4. 2.7183

5. 2.71828

6. 2.718282

7. 2.718281828

8. 2.7182818285

9. $350 + 600 = 950$
Actual answer of 955 compares reasonably well

10. $250 + 800 = 1050$
Actual answer of 1045 compares reasonably well

11. $9 + 1 + 19 = 29$
Actual answer of 29.23 compares quite well

12. $8 + 3 + 24 = 35$
Actual answer of 35.34 compares quite well

13. $32 - 11 = 21$
Actual answer of 20.911 compares quite well

14. $46 - 15 = 31$
Actual answer of 30.893 compares quite well

15. $40 \times 6 = 240$
Actual answer of 218.185 compares not so well

16. $80 \times 7 = 560$
Actual answer of 512.98 compares not so well

17. $0.8 \times 400 = 320$
Actual answer of 327.06 compares reasonably well

18. $0.7 \times 200 = 140$
Actual answer of 141.37 compares quite well

19. $48 \div 3 = 16$
Actual answer of 16.49 compares quite well

20. $55 \div 5 = 11$
Actual answer of 11.62 compares quite well

21. 30% of 200,000 is 60,000
Actual answer of 59,920.96 compares quite well

22. 40% of 300,000 is 120,000
Actual answer of 122,432.52 compares reasonably well

23. $\$3.47 + \$5.89 + \$19.98 + \$2.03 + \$11.85 + \$0.23$
$\approx \$3 + \$6 + \$20 + \$2 + \$12 + \$0$
$\approx \$43$

24. $\$4.23 + \$7.79 + \$28.97 + \$4.06 + \$13.03 + \$0.74$
$\approx \$4 + \$8 + \$29 + \$4 + \$13 + \$1$
$\approx \$59$

25. Round \$19.50 to \$20 per hour.
40 hours per week
(40 × \$20) per week = \$800/week
Round 52 weeks to 50 weeks per year.
50 weeks per year
(50 × \$800) per year = \$40,000
\$19.50 per hour ≈ \$40,000 per year

26. Round \$29.85 to \$30 per hour.
40 hours per week
(40 × \$30) per week = \$1200/week
Round 52 weeks to 50 weeks per year.
50 weeks per year
(50 × \$1200) per year = \$60,000
\$29.85 per hour ≈ \$60,000 per year

27. Round the \$605 monthly payment to \$600.
3 years is 36 months.
Round the 36 months to 40 months.
\$600 × 40 months = \$24,000 total cost.
\$605 monthly payment for 3 years ≈ \$24,000 total cost.

28. Round the \$415 monthly payment to \$400.
4 years is 48 months.
Round the 48 months to 50 months.
\$400 × 50 months = \$20,000 total cost.
\$415 monthly payment for 3 years ≈ \$20,000 total cost.

29. Round the raise of \$310,000 to \$300,000.
Round the 294 professors to 300.
\$300,000 ÷ 300 professors = \$1000 per professor.
\$310,000 raise ≈ \$1000 per professor.

30. Round the raise of \$310,000 to \$300,000.
Round the 196 professors to 200.
\$300,000 ÷ 200 professors = \$1500 per professor.
\$310,000 raise ≈ \$1500 per professor.

31. Round \$61,500 to \$60,000 per year.
Round 52 weeks per year to 50 weeks per year.
50 weeks × 40 hours per week = 2000 hours
\$60,000 ÷ 2000 hours = \$30 per hour
\$61,500 per year ≈ \$30 per hour

32. Round \$38,950 to \$40,000 per year.
Round 52 weeks per year to 50 weeks per year.
50 weeks × 40 hours per week = 2000 hours
\$40,000 ÷ 2000 hours = \$20 per hour
\$38,950 per year ≈ \$20 per hour

33. $80 \times 365 \times 24 = 700{,}800$ hr

34. $40 \times 365 \times 24 = 350{,}400$ hr

35. $\dfrac{0.2 \times 100}{0.5} = \dfrac{20}{0.5} = 40$
Actual answer of 42.03 compares quite reasonable.

36. $\dfrac{0.5 \times 90}{0.25} = \dfrac{45}{0.25} = 180$
Actual answer of 169.62 compares somewhat reasonable.

37. The given information suggests \$30 would be a good estimate per cell phone cover.
$\$30 \times 10 = \$300$ which is closest to choice b.

38. The given information suggests \$7 would be a good estimate per phone charging cables.
$\$7 \times 10 = \$70$ which is closest to choice c.

39. The given information suggests 65 mph would be a good rate estimate and 3.5 would be a good time estimate.
$65 \times 3.5 = 227.5$ which is closest to choice c.

40. The given information suggests 45 mph would be a good rate estimate and 3.5 would be a good time estimate.
$45 \times 3.5 = 157.5$ which is closest to choice b.

41. The given information suggests you can count 1 number per second.
$\dfrac{10000}{60 \times 60} \approx 2.77$ or 3 hours

42. The given information suggests you can count 1 number per second.
$\dfrac{1{,}000{,}000}{60 \times 60 \times 24} \approx 11.57$ or 12 days

43. $\approx 0.10 \times 16{,}000{,}000 = 1{,}600{,}000$
10% of 16,000,000 is 1,600,000 high school teenagers.

44. $\approx 0.20 \times 16{,}000{,}000 = 3{,}200{,}000$
20% of 16,000,000 is 3,200,000 high school teenagers.

45. **a.** about 85 people per 100

b. $(85 - 23) \times 87 \approx 5400$

46. **a.** about 66 people per 100

b. $(66 - 27) \times 72 \approx 2800$

47. **a.** $\dfrac{17 - 36}{2019 - 2003} = \dfrac{-19}{16} \approx -1.2$
The annual loss is about 1.2%.

b. $P = 36 - 1.2x$

c. $P = 36 - 1.2x$
$= 36 - 1.2(20)$
$= 12$
In 2023 the percentage will be approximately 12%.

48. **a.** $\dfrac{41 - 54}{2019 - 2003} = \dfrac{-13}{16} \approx -0.8$
The annual loss is about 0.8%.

b. $P = 54 - 0.8x$

c. $P = 54 - 0.8x$
$= 54 - 0.8(20)$
$= 38$
In 2023 the percentage will be approximately 38%.

49. **a.** The percent body fat in 45-year-old females is about 37%.

b. The percent body fat in females reaches a maximum at age 55 of about 38%

c. Females have 34% body fat at age 25.

50. a. The percent body fat in 25-year-old males is about 23%.

b. The percent body fat in males reaches a maximum at age 65 of about 26%

c. Males have 24% body fat at age 35.

51. a. $\frac{401-310}{2015-1950}=\frac{91}{65}\approx 1.4$ ppm per year

b. $C=310+1.4x$

c. 2050 is 100 years after 1950.
$C=310+1.4(100)=450$ ppm

52. a. $\frac{58.44-56.98}{2015-1950}=\frac{1.46}{65}\approx 0.02\ ^\circ F$

b. $T=56.98+0.02x$

c. 2050 is 100 years after 1950.
$T=56.98+0.02(100)=58.98\ ^\circ F$

53 - 65. Answers will vary.

66. makes sense

67. does not make sense; Explanations will vary. Sample explanation: Very large numbers and very small numbers often must be estimated when using a calculator.

68. makes sense

69. does not make sense; Explanations will vary. Sample explanation: Some mathematical models can break down over time.

70. Since there are infinitely many digits, the digits can not be reversed.

71. a

72. d

73. b

74. c

75. $20\times 16\times 50=16{,}000$ hours.

$\frac{16{,}000}{24}\approx 667$ days

$\frac{667}{365}\approx 1.8$ yr

76. Round days in a year to 400.

$$\frac{\$1{,}000{,}000{,}000}{\$1000/\text{day}}=1{,}000{,}000 \text{ days}$$
$$\approx \frac{1{,}000{,}000 \text{ days}}{400 \text{ days/year}}$$
$$\approx 2500 \text{ years}$$

Check Points 1.3

1. The amount of money given to the cashier is unknown.

2. Step 1: Understand the problem.
Bottles: 128 ounces costs $5.39
Boxes: a 9-pack of 6.75 ounce boxes costs $3.15
We must determine whether bottles or boxes are the better value.
Step 2: Devise a plan.
Dividing the cost by the number of ounces will give us the cost per ounce. We will need to multiply 9 by 6.75 to determine the total number of ounces the boxes contain. The lower cost per ounce is the best value.
Step 3: Carry out the plan and solve the problem.
Unit price for the bottles: $\frac{\$5.39}{128 \text{ ounces}} \approx \$0.042$ per ounce
Unit price for the boxes: $\frac{\$3.15}{9 \times 6.75 \text{ ounces}} = \frac{\$3.15}{60.75 \text{ ounces}} \approx \$0.052$ per ounce Bottles have a lower price per ounce and are the better value.
Step 4: Look back and check the answer.
This answer satisfies the conditions of the problem.

3. Step 1: Understand the problem.
We are given the cost of the computer, the amount of cash paid up front, and the amount paid each month. We must determine the number of months it will take to finish paying for the computer.
Step 2: Devise a plan.
Subtract the amount paid in cash from the cost of the computer. This results in the amount still to be paid. Because the monthly payments are $45, divide the amount still to be paid by 45. This will give the number of months required to pay for the computer.
Step 3: Carry out the plan and solve the problem.
The balance is $\$980 - \$350 = \$630$. Now divide the $630 balance by $45, the monthly payment.
$$\$630 \div \frac{\$45}{\text{month}} = \$630 \times \frac{\text{month}}{\$45} = \frac{630 \text{ months}}{45} = 14 \text{ months}.$$
Step 4: Look back and check the answer.
This answer satisfies the conditions of the problem. 14 monthly payments at $45 each gives $14 \times \$45 = \$630$. Adding in the up front cash payment of $350 gives us $\$630 + \$350 = \$980$. $980 is the cost of the computer.

4. Step 1: Understand the problem.
The total change must always be 30 cents. One possible coin combination is six nickels. Another is three dimes. We need to count all such combinations.
Step 2: Devise a plan.
Make a list of all possible coin combinations. Begin with the coins of larger value and work toward the coins of smaller value.
Step 3: Carry out the plan and solve the problem.

Quarters	Dimes	Nickels
1	0	1
0	3	0
0	2	2
0	1	4
0	0	6

There are 5 combinations.
Step 4: Look back and check the answer.
Check to see that no combinations are omitted, and that those given total 30 cents. Also double-check the count.

5. Step 1: Understand the problem.
We must determine the number of jeans/T-shirt combinations that we can make.
For example, one such combination would be to wear the blue jeans with the beige shirt.
Step 2: Devise a plan.

Each pair of jeans could be matched with any of the three shirts. We will make a tree diagram to show all combinations.
Step 3: Carry out the plan and solve the problem.

JEANS	T-SHIRT	COMBINATIONS
Blue jeans	Beige shirt	Blue jeans-Beige shirt
	Yellow shirt	Blue jeans-Yellow shirt
	Blue shirt	Blue jeans-Blue shirt
Black jeans	Beige shirt	Black jeans-Beige shirt
	Yellow shirt	Black jeans-Yellow shirt
	Blue shirt	Black jeans-Blue shirt

There are 6 different outfits possible.
Step 4: Look back and check the answer.
Check to see that no combinations are omitted, and double-check the count.

6. Step 1: Understand the problem.
There are many possible ways to visit each city once and then return home. We must find a route that costs less than $1460.
Step 2: Devise a plan.
From city *A* fly to the city with the cheapest available flight. Repeat this until all cities have been visited and then fly home. If this cost is above $1460 then use trial and error to find other alternative routes.
Step 3: Carry out the plan and solve the problem.
A to *D* costs $185, *D* to *E* costs $302, *E* to *C* costs $165, *C* to *B* costs $305, *B* back to *A* costs $500
$185 + $302 + $165 + $305 + $500 = $1457
The route *A*, *D*, *E*, *C*, *B*, *A* costs less than $1460
Step 4: Look back and check the answer.
This answer satisfies the conditions of the problem.

Trick Questions 1.3

1. The farmer has 12 sheep left since all but 12 sheep died.

2. All 12 months have [at least] 28 days.

3. The doctor and brother are brother and sister.

4. You should light the match first.

Concept and Vocabulary Check 1.3

C1. understand

C2. devise a plan

C3. false

C4. false

Exercise Set 1.3

1. The price of the computer is needed.

2. The weight of the steak is needed.

3. The number of words per page is needed.

4. The amount of the payments is needed.

5. Weekly salary is unnecessary information.
$212 - 200 = 12$ items sold in excess of 200
$12 \times \$15 = \$180$ extra is received.

6. Tire weight is unnecessary information.
$4 \times (\$42 + \$2.50) = 4 \times \$44.50 = \$178.00$
$\$250 - \$178 = \$72$ remaining after purchase.

7. How much the attendant was given is not necessary.
There were 5 hours of parking.
1st hour is \$2.50
4 hours at \$0.50/hr

$$\$2.50 + (4 \times \$0.50) = \$2.50 + \$2.00$$
$$= \$4.50$$

\$4.50 was charged.

8. The width of the house is not necessary.
$90 \text{ feet} = 15 \times 6 \text{ feet}$
The line representing the length is 15 inches.

9. **a.** Step 1: Understand the problem.
Box #1: 15.3 ounces costs \$3.37
Box #2: 24 ounces costs \$4.59
We must determine whether Box #1 or Box #2 is the better value.
Step 2: Devise a plan.
Dividing the cost by the number of ounces will give us the cost per ounce. The lower cost per ounce is the best value.
Step 3: Carry out the plan and solve the problem.

$$\text{Unit price for Box \#1: } \frac{\$3.37}{15.3 \text{ ounces}} \approx \$0.22 \text{ per ounce}$$

$$\text{Unit price for Box \#2: } \frac{\$4.59}{24 \text{ ounces}} \approx \$0.19 \text{ per ounce}$$

The cereal that is 24 ounces for \$4.59 is the better value.
Step 4: Look back and check the answer.
This answer satisfies the conditions of the problem.

b. Unit price for Box #1: \$0.22 per ounce

$$\text{Unit price for Box \#2: } \frac{\$4.59}{24 \text{ ounces}} \times \frac{16 \text{ ounces}}{\text{pound}} \approx \$3.06 \text{ per pound}$$

c. No, explanations will vary.

10. a. Step 1: Understand the problem.
Jar #1: 12 ounces costs $2.25
Jar #2: 18 ounces costs $3.24
We must determine whether Jar #1 or Jar #2 is the better value.
Step 2: Devise a plan.
Dividing the cost by the number of ounces will give us the cost per ounce. The lower cost per ounce is the best value.
Step 3: Carry out the plan and solve the problem.
Unit price for Jar #1:
$\frac{\$2.25}{12 \text{ ounces}} \approx \$0.19$ per ounce
Unit price for Jar #2:
$\frac{\$3.24}{18 \text{ ounces}} \approx \$0.18$ per ounce
The honey that is 18 ounces for $3.24 is the better value.
Step 4: Look back and check the answer.
This answer satisfies the conditions of the problem.

b. Unit price for Jar #1: $0.19 per ounce
Unit price for Jar #2:
$\frac{\$3.24}{18 \text{ ounces}} \times \frac{32 \text{ ounces}}{\text{quart}} \approx \$5.76$ per quart

c. No, explanations will vary.

11. Step 1: Comparing two yearly salaries
Step 2:
Convert the second person's wages to yearly salary.
Step 3:
The person that earns $3750/month earns $12 \times \$3750 = \$45{,}000$/year. The person that earns $48,000/year gets $3000 more per year.
Step 4:
It appears to satisfy the conditions of the problem.

12. Step 1:
Find the car's mileage for one year, and gas usage.
Step 2:
Subtract beginning odometer reading from ending reading.
Step 3:
37,364 miles – 25,124 miles = 12,240 miles
$\frac{12{,}240 \text{ miles}}{24 \text{ mpg}} = 510$ gallons
Step 4:
It satisfies the conditions of the problem.

13. Step 1:
Find the difference between two options.
Step 2:
Compute total costs and compare two figures.
Step 3:
iTunes: 2 new plus 7 other movies,
$2(\$4.99) + 7(\$1.99) = \$23.91$.
Amazon Prime: $\$8.99 + 12.99 = \$21.98$ per month.
$\$23.91 - \$21.98 = \$1.93$
Amazon Prime would be $1.93 less.
Step 4:
It satisfies the conditions of problem.

14. Step 1:
Find the sum of costs of each service.
Step 2:
Compute total costs.
Step 3:
Amazon Prime: $\$8.99 + 12.99 = \$21.98$ per month.
Vudu: $\$19.99 \times 2 = \$39.98$
Total: $\$21.98 + 39.98 = \$61.96$
Step 4:
It satisfies the conditions of problem.

15. a. $\frac{3250 \text{ mg/day}}{500 \text{ mg/pill}} = 6.5$ pills per day
$= 6$ pills per day limit

b. First find mg from 3 Tylenol pills:
$3 \times 500 \text{ mg} = 1500 \text{ mg}$
Next, subtract that result from the daily maximum:
$3250 \text{ mg} - 1500 \text{ mg} = 1750 \text{ mg}$
Finally, calculate the number of NyQuil pills that could be taken:
$\frac{1750 \text{ mg remaining}}{325 \text{ mg/pill}} \approx 5.38$ pills remaining
$= 5$ pill limit

16. a. $\frac{3250 \text{ mg/day}}{325 \text{ mg/pill}} = 10$ pills per day

b. First find mg from 4 NyQuil pills:
$4 \times 325 \text{ mg} = 1500 \text{ mg}$
Next, subtract that result from the daily maximum:
$3250 \text{ mg} - 1500 \text{ mg} = 1750 \text{ mg}$
Finally, calculate the number of Tylenol pills that could be taken:
$\frac{1750 \text{ mg remaining}}{500 \text{ mg/pill}} = 3.5$ pills remaining
$= 3$ pill limit

17. Step 1:
Find the difference between two methods of payment.
Step 2:
Compute total costs and compare two figures.
Step 3:
By spreading purchase out, the total comes to:
$100 + 14($50) = $100 + $700 = $800
$800 – $750 = $50 saved by paying all at once
Step 4:
It satisfies the conditions of problem.

18. Step 1: Determine which team won.
Step 2: Compile point totals and compare.
Step 3:
Bulldogs: $34 \times 2 + 13 = 68 + 13 = 81$ points
Panthers: $38 \times 2 + 8 = 76 + 8 = 84$ points
Panthers won by 3 points
Step 4:
It satisfies the conditions of the problem.

19. Step 1:
Determine profit on goods sold.
Step 2:
Find total cost of buying product and comparing with gross sales.
Step 3:
Purchased: ($65 per dozen)(6 dozen) = $390
Sold: 6 dozen = 72 kickstands
$\frac{72}{3} = 24$ groups of 3 at $20 per group.
$24 \times \$20 = \$480$
$480 – $390 = $90 profit
Step 4:
It satisfies the conditions of the problem.

20. Step 1: Determine profit.
Step 2:
Determine cost of purchase and compare with gross sales.
Step 3:
Bought:
($0.95/dozen)(15 dozen) = $14.25
Sold:
15 dozen = 180 pens
$\frac{180}{4} = 45$ packs
$45 \text{ packs} \times \$2.25 = \$101.25$
Profit = $101.25 – $14.25 = $87
Step 4:
It satisfies the conditions of the problem.

21. Step 1: Determine profit for ten-day period.
Step 2: Compare totals.
Step 3:
(200 slices)($1.50) = $300 for pizza
(85 sandwiches)($2.50) = $212.50 for sandwiches
For 10 day period:
Gross: $10(\$300) + 10(\$212.50) = \$3000 + \$2125.00$
$= \$5125.00$
Expenses: 10($60) = $600
Profit: $5125.00 – $600 = $4525
Step 4:
It satisfies the conditions of the problem.

22. Step 1: Determine how much was earned over two-week period.
Step 2: Compute each week's earnings and total.
Step 3:
1st week:
(40 hours)($8.15 per hour) + (2 hours)($8.15 + $2.20)
= $326 + (2 hours)($10.35)
= $326 + $20.70
= $346.70
2nd week:
(40 hours)($8.15 per hour) + (5 hours)($10.35)
= $326 + $51.75
= $377.75
Total is $346.70 + $377.75 = $724.45
Step 4:
It satisfies the conditions of problem.

23. Step 1:
Compute total rental cost.
Step 2:
Add rental cost and mileage cost to get total cost.
Step 3:
Rental costs:
(2 day)($39.95 per day) = $79.90
Mileage: (120 miles)($1.19) = $142.80
Total: $79.90 + $142.80 = $222.70
Step 4:
It satisfies the conditions of problem.

24. Step 1:
We are trying to figure out an annual budget and see how much is left to buy stock and how many shares of stock.
Step 2:
Determine annual earnings and compare with budget.
Step 3:
Salary:
(12 months/year)($2750/month) = $33,000
Expenses:
$4800 + $8200 + $3750 + $4250 + $3000
= $24,000
Available to buy stocks:
$33,000 – $24,000 = $9000
Number of stocks: $\frac{\$9000}{\$375 / \text{share}} = 24$ shares
Step 4:
It satisfies the conditions of problem.

25. Step 1:
A round trip was made; we need to determine how much was walked or ridden.
Step 2:
Add up the totals walked and ridden and compare.
Step 3:
It is 5 miles between the homes or a 10 mile round trip. The first 3 were covered with the bicycle, leaving 7 miles covered by walking.
7 miles – 3 miles = 4 miles more that was walked.
Step 4:
It satisfies the conditions of the problem.

26. Step 1:
Determine the profit on goods sold.
Step 2:
Determine the cost of obtaining product and compare with gross sales.
Step 3:
Cost:
200 containers at $0.75 apiece = $150
Cost = $150
Gross sales: (150 containers)($1.25) = $187.50
50 containers returned for $0.50 refund:
50($0.50) = $25.00
Total received: $187.50 + $25.00 = $212.50
Total Profit: $212.50 – $150.00 = $62.50
Step 4:
It satisfies the conditions of the problem.

27. Step 1:
Determine profit by comparing expenses with gross sales.
Step 2:
Calculate expenses and gross sales and compare.
Step 3:
Expense:
(25 chargers)($30) = $750
Gross Sales:
(22 chargers)($35.00) = $770
The storeowner receives $30 – $2 = $28 for each returned chargers.
(3 chargers)($28) = $84

Total Income:
$770 + $84 = $854
Profit=Income–Expenses
=$854–$750
=$104
Step 4:
It satisfies the conditions of the problem.

28. When the drivers meet for lunch they have been traveling for 2 hours and 24 minutes or 2.4 hours.
The car from New York City has traveled
(2.4 hours)(55 miles per hour) = 132 miles.
The car from D.C. has traveled
(2.4 hours)(45 miles per hour) = 108 miles.

29. The car depreciates at
$\frac{23,000 - 2700}{7} = \$2900$ per year .
$23,000 - 3(2900) = \$14,300$

30. The car depreciates at
$\frac{34,800 - 8550}{7} = \$3750$ per year .
$34,800 - 3(3750) = \$23,550$

31. Use a list.

2 Quarters	3 Dimes	5 Nickels
1	2	0
1	1	2
1	0	4
0	3	3
0	2	5

There are 5 ways.

32. Use a list.

Pennies	Nickels	Dimes
25	0	0
20	1	0
15	2	0
15	0	1
10	3	0
10	1	1
5	4	0
5	2	1
5	0	2
0	5	0
0	3	1
0	1	2

There are 12 ways.

33. Make a list of all possible selections:
Watson/Clooney, Watson/DiCaprio,
Watson/Lawrence,
Clooney/DiCaprio, Clooney/Lawrence,
DiCaprio/Lawrence
There are 6 ways.

34. Make a list of all possible selections:
Gates/Winfrey, Gates/Zuckerberg, Gates/Clinton,
Gates/Curry,
Winfrey/Zuckerberg, Winfrey/Clinton,
Winfrey/Curry,
Zuckerberg/Clinton, Zuckerberg/Curry,
Clinton/Curry,
There are 10 ways.

35. Use a list.

Pennies	Nickels	Dimes
21	0	0
16	1	0
11	2	0
11	0	1
6	3	0
6	1	1
1	4	0
1	2	1
1	0	2

There are 9 ways.

36. Use a list.

Pennies	Nickels	Dimes	Quarters
26	0	0	0
21	1	0	0
16	2	0	0
16	0	1	0
11	3	0	0
11	1	1	0
6	4	0	0
6	2	1	0
6	0	2	0
1	5	0	0
1	3	1	0
1	1	2	0
1	0	0	1

There are 13 ways.

37. Use a list.

1 pt	5 pt	10-pt	Total
3	0	0	3
2	1	0	7
1	2	0	11
2	0	1	12
0	3	0	15
1	1	1	16
0	2	1	20
1	0	2	21
0	1	2	25
0	0	3	30

There are 10 different totals.

38. Answers will vary. An example is 61, 9, 7, 23.

39. The average expense is

$$\frac{42+10+26+32+30}{5} = \$28$$

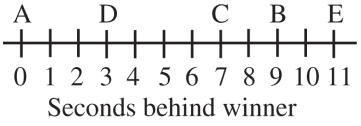
Thus, B owes \$18 and C owes \$2, A is owed \$14, D is owed \$4, and E is owed \$2.
To resolve these discrepancies, B should give A \$14 and give D \$4, while C should give E \$2.

40. At 5 minutes between houses, it will take 30 minutes to walk all the way around.

41. Make a list of all possible orders:
TFFF, FTFF, FFTF, FFFT
The "True" could be written 1st, 2nd, 3rd, or 4th.
There are 4 ways.

42. Represent the 5 people as A, B, C, D, and E and make a list of all possible handshakes:
AB, AC, AD, AE, BC, BD, BE, CD, CE and DE.
There are 10 handshakes exchanged.

43. The order the racers finished was; Andy, Darnell, Caleb, Beth, Ella.

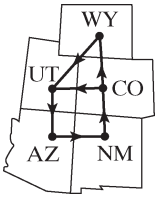


44. To determine a winner, seven teams must be eliminated. Since each game eliminates one team, this tournament will take seven games.

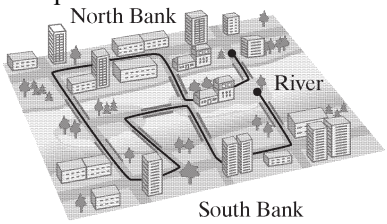
45. Home→Bank→Post Office→Dry Cleaners→Home will take 11.5 miles.

46. Home→Post Office→Dry Cleaners→Bank→Home will take 12.5 miles.

47. CO→WY→UT→AZ→NM→CO→UT



48. One possible route is indicated:



49. The problem states that the psychology major knocks on Jose's wall, and Jose's dorm is adjacent to Bob's dorm but not Tony's. Therefore Bob is the psychology major.

50. A minimum of 4 colors are needed.

51. a.

5	22	18
28	15	2
12	8	25

b.

4	9	8
11	7	3
6	5	10

52. a.

96	64	37	45
39	43	98	62
84	76	25	57
23	59	82	78

b.

69	46	73	54
93	34	89	26
48	67	52	75
32	95	28	87

53.

9	6	7
8	1	4
3	2	5

54.

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

55.

$$
\begin{array}{r}
156 \\
28\overline{)4368} \\
\underline{28} \\
156 \\
\underline{140} \\
168 \\
\underline{168} \\
0
\end{array}
$$

56 - 59. Answers will vary.

60. does not make sense; Explanations will vary. Sample explanation: Polya's four steps are a guide. They will not necessarily make the solution quick and/or easy.

61. makes sense

62. makes sense

63. does not make sense; Explanations will vary.
Sample explanation: When you are bogged down with a problem, it can often be helpful to stop working on it and return to it later.

64. A total of twenty 7s are needed.
Possible solution: Notice that the digit 7 will occur 10 times in the tens digit and 10 times in the ones digit.
An alternative solution would be to make a list of every instance of a seven; 7, 17, 27, 37, 47, 57, 67, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 87, 97; and then count the occurrences of the digit 7.

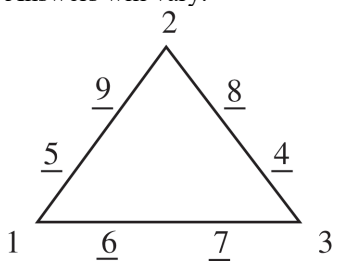
65. You should choose the dentist whose teeth show the effects of poor dental work because he took good care of the other dentist's teeth.

66. Use one plank diagonally across one corner of the square. Use the other plank to go from the first plank to the stone.

67. It is Friday. The first person is lying (as expected) because he told the truth on Thursday. The second is truthfully admitting that he lied the previous day.

68. The farmer can use the following strategy: Take the goat to the other side of the stream and return to get either the wolf or cabbage. The farmer should take that across the stream and bring the goat back to the original side. He then takes across the cabbage or wolf, whichever remains, and leaves it on the other side while he returns to get the goat.

69. Answers will vary.



70. Sudoku Puzzle solution:

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

71. There is no missing dollar; in the end the customers paid a total of \$27 of which \$25 went to the restaurant and \$2 was stolen by the server.

72. From the middle rung the firefighter went up 4, down 6, up 7, and up 4 to reach the top rung. This is a net climb of up 9. Since there are 9 rungs above the middle rung, there must also be 9 rungs below. 9 above + 9 below + 1 middle = 19 rungs.

73. Answers will vary. One method is to start by multiplying 30 by each state's fraction of the population.

State A: $30 \times \frac{275}{1890} \approx 4.365$ or 4

State B: $30 \times \frac{383}{1890} \approx 6.079$ or 6

State C: $30 \times \frac{465}{1890} \approx 7.381$ or 7

State D: $30 \times \frac{767}{1890} \approx 12.175$ or 12

Notice that 4, 6, 7, and 12 add to 29, so there is 1 more representative to be allocated. We could give this extra representative to state C because it had the largest decimal part (0.381). This leads to an allocation of state A: 4, state B: 6, state C: 8, and state D: 12.

Chapter 1 Review Exercises

1. Deductive; the specific conclusion about *Carrie* was based on a general statement about all Stephen King books.

2. Inductive; the general conclusion for this next book was based on past specific observations.

3. Pattern: Add 5
$19 + 5 = 24$
$4, 9, 14, 19, \underline{24}$

4. Pattern: Multiply by 2
$56 \times 2 = 112$
$7, 14, 28, 56, \underline{112}$

5. Pattern: Numbers added increase by 1
$1 + 2 = 3$
$3 + 3 = 6$
$6 + 4 = 10$
$10 + 5 = 15$
$15 + 6 = 21$
$1, 3, 6, 10, 15, \underline{21}$

6. Notice that $\frac{1}{2} = \frac{3}{6}$
Pattern: Add 1 to the denominator
$\frac{3}{7+1} = \frac{3}{8}$
$\frac{3}{4}, \frac{3}{5}, \frac{3}{6}, \frac{3}{7}, \underline{\frac{3}{8}}$ or
$\frac{3}{4}, \frac{3}{5}, \frac{1}{2}, \frac{3}{7}, \underline{\frac{3}{8}}$

7. Pattern: Divide by -2
$-5 \div (-2) = \frac{-5}{-2} = \frac{5}{2}$ or $2\frac{1}{2}$
$40, -20, 10, -5, \underline{\frac{5}{2}}$

8. Pattern: Subtract 60
$-140 - 60 = -200$
$40, -20, -80, -140, \underline{-200}$

9. Each number beginning with the third number is the sum of the previous two numbers. $16 + 26 = \underline{42}$

10. To get the second number, multiply the first number by 3. Then multiply the second number by 2 to get the third number. Then multiply by 3 and then by 2, repeatedly. $216 \times 2 = \underline{432}$

11. The pattern is alternating between square and circle while the line rotates $90°$ clockwise. The next figure is shown at right.

12. Using inductive reasoning we predict $2+4+8+16+32=64-2$.
Arithmetic verifies this result:
$2+4+8+16+32=64-2$
$62=62$

13. Using inductive reasoning we predict $444\div 12=37$.
Arithmetic verifies this result: $444\div 12=37$
$37=37$

14. a. Conjecture based on results: The result is the original number.

Select a number.	4	10	0	3
Double the number.	$4\times 2=8$	$10\times 2=20$	$0\times 2=0$	$3\times 2=6$
Add 4 to the product.	$8+4=12$	$20+4=24$	$0+4=4$	$6+4=10$
Divide this sum by 2.	$12\div 2=6$	$24\div 2=12$	$4\div 2=2$	$10\div 2=5$
Subtract 2 from the quotient.	$6-2=4$	$12-2=10$	$2-2=0$	$5-2=3$
Summary of results:	$4\rightarrow 4$	$10\rightarrow 10$	$0\rightarrow 0$	$3\rightarrow 3$

b. $2n$
$2n+4$
$\dfrac{2n+4}{2}=\dfrac{2n}{2}+\dfrac{4}{2}=n+2$
$n+2-2=n$

15. a. 923,187,500

b. 923,187,000

c. 923,200,000

d. 923,000,000

e. 900,000,000

16. a. 1.5

b. 1.51

c. 1.507

d. 1.5065917

17. $2+4+10=16$
Actual answer: 15.71
quite reasonable

18. $9\times 50=450$
Actual answer: 432.67
somewhat reasonable

19. $20 \div 4 = 5$
Actual answer: 4.79
quite reasonable

20. $0.60 \times 4000 = 2400$
Actual answer: 2397.0548
quite reasonable

21. $\$8.47 + \$0.89 + \$2.79 + \$0.14 + \$1.19 + \$4.76$
$\approx \$8 + \$1 + \$3 + \$0 + \$1 + \$5$
$\approx \$18$

22. Round 78 hours to 80, round \$9.95 to \$10.00.
$78 \times \$9.95 \approx 80 \times \$10$
$\approx \$800$

23. Round book price to \$1.00 each.
Round chair price to \$12.00 each.
Round plate price to \$15.00.
$(21 \times \$0.85) + (2 \times \$11.95) + \$14.65$
$\approx (21 \times \$1) + (2 \times \$12) + \$15$
$\approx \$21 + \$24 + \$15$
$\approx \$60$

24. 31% of 19,645,971 can be estimated as 30% of 20,000,000.
$0.3 \times 20,000,000 \approx 6,000,000$ students

25. The given information suggests \$900 would be a good estimate for weekly salary.
$\$900 \times 10 \times 4 = \$36,000$ which is choice b.

26. $60 \times 60 \times 24 = 86,400$ which is closest to choice c.

27. **a.** The Asian group exceeds 100. They have a population of about 122.

b. 30×33 million = 990 million

28. **a.** $\dfrac{36.0 - 6.0}{2019 - 1950} = \dfrac{30.0}{69} \approx 0.4$
average increase: 0.4% per year

b. $6.0 + 0.4(2030 - 1950) = 6.0 + 0.4(80) = 38$
About 38% of people 25 years of age and older will be college graduates in 2030.

29. **a.** The woman's maximum heart rate was about 115 beats per minute. This occurred after about 10 minutes.

b. The woman's minimum heart rate was about 64 beats per minute. This occurred after about 8 minutes.

c. between 9 and 10 minutes

d. 9 minutes

30. **a.** $\dfrac{331.0 - 203.3}{2020 - 1970} = \dfrac{127.7}{50} \approx 2.6$ million per year

b. $p = 203.3 + 2.6x$

c. $p = 203.3 + 2.6(2030 - 1970) = 359.3$ million

31. The weight of the child is needed.

32. The unnecessary information is the customer giving the driver a $20 bill.
For a 6 mile trip, the first mile is $3.00, and the next 5 miles are $0.50/half-mile or $1.00/mile. The cost is
$3.00 + (5 × $1.00) = $3.00 + $5.00
= $8.00.

33. Pay-per-items :
$\$3.55(5)+\$2.49(3)=\$25.22$ for individual packaged items.
$\$8.99(2)+\$5.75(1)=\$23.73$ for multipacks.
Cost Difference:
$\$25.22-\$23.73=\$1.49$
You will save $1.49 purchasing all multipacks.

34. Total of $28 \times 2 = 56$ frankfurters would be needed. $\frac{56}{7}=8$. Therefore, 8 pounds would be needed.

35. Rental for 3 weeks at $175 per week is
3 × $175 = $525. Mileage for 1200 miles at $0.30 per mile is 1200 × $0.30 = $360. Total cost is $525 + $360 = $885.

36. 12-year Solar Cost :
$\$29,700+\$200(12)=\$32,100$
12-year Electric Cost :
$\$5500+\$1800(12)=\$27,100$
Cost Difference:
$\$32,100-\$27,100=\$5000$
Solar costs would be $5000 higher than electric.

37. The flight leaves Miami at 7:00 A.M. Pacific Standard Time. With a lay-over of 45 minutes, it arrives in San Francisco at 1:30 P.M. Pacific Standard Time, 6 hrs 30 min. – 45 min = 5 hours 45 minutes.

38. At steady decrease in value: $\frac{\$37,000-\$2600}{8 \text{ years}}=\frac{\$34,400}{8 \text{ years}}=\$4300/\text{year}$
After 5 years: $\$4300\times 5=\$21,500$ decrease in value
Value of car: $37,000 – $21,500 = $15,500

39. The machine will dispense 5, 10, and 20 dollar bills.

$5 bills	$10 bills	$20 bills
7	0	0
5	1	0
3	2	0
3	0	1
1	3	0
1	1	1

There are 6 combinations.

Chapter 1 Test

1. deductive

2. inductive

3. $0 + 5 = 5$
$5 + 5 = 10$
$10 + 5 = 15$
$15 + 5 = 20$
$0, 5, 10, 15, \underline{20}$

4. $\frac{1}{6 \times 2} = \frac{1}{12}$
$\frac{1}{12 \times 2} = \frac{1}{24}$
$\frac{1}{24 \times 2} = \frac{1}{48}$
$\frac{1}{48 \times 2} = \frac{1}{96}$
$\frac{1}{6}, \frac{1}{12}, \frac{1}{24}, \frac{1}{48}, \underline{\frac{1}{96}}$

5. $3367 \times 15 = 50,505$

6. The outer figure is always a square. The inner figure appears to cycle from triangle to circle to square. The line segments at the bottom alternate from two to one. The next shape is shown at right.

7. a. Conjecture based on results: The original number is doubled.

Select a number.	4	10	3
Multiply the number by 4.	$4 \times 4 = 16$	$10 \times 4 = 40$	$3 \times 4 = 12$
Add 8 to the product.	$16 + 8 = 24$	$40 + 8 = 48$	$12 + 8 = 20$
Divide this sum by 2.	$24 \div 2 = 12$	$48 \div 2 = 24$	$20 \div 2 = 10$
Subtract 4 from the quotient.	$12 - 4 = 8$	$24 - 4 = 20$	$10 - 4 = 6$
Summary of results:	$4 \rightarrow 8$	$10 \rightarrow 20$	$3 \rightarrow 6$

b. $4n$
$4n + 8$
$\frac{4n + 8}{2} = \frac{4n}{2} + \frac{8}{2} = 2n + 4$
$2n + 4 - 4 = 2n$

8. 3,300,000

9. 706.38

10. Round \$47.00 to \$50.00.
Round \$311.00 to \$310.00.
Round \$405.00 to \$410.00.
Round \$681.79 to \$680.00.
Total needed for expenses:
\$47.00 + \$311.00 + \$405.00
$\approx$ \$50.00 + \$310.00 + \$410.00
$\approx$ \$770.00
Additional money needed:
\$770.00 – \$681.79 $\approx$ \$770.00 – \$680.00
$\approx$ \$90

11. Round \$485,000 to \$500,000.
Round number of people to 20.

$$\frac{\$485,000}{19 \text{ people}} \approx \frac{\$500,000}{20 \text{ people}}$$

$$\approx \$25,000 \text{ per person}$$

12. $0.48992 \times 120 \approx 0.5 \times 120 \approx 60$

13. 11% of 512 billion can be estimated by 10% of 500 billion.
0.10×500 billion = 50 billion

14. $72,000 \div 30 = 2400$ which is choice a.

15. **a.** 2001; about 1275 discharges

b. 2010; about 275 discharges

c. They decreased at the greatest rate where the graph has the steepest downward slope. This occurred between 2001 and 2002

d. There were about 1000 discharges in 1997 under this policy.

16. **a.** $\frac{59\% - 27\%}{2019 - 1980} = \frac{32\%}{39} \approx 0.8\%$ per year

b. $p = 27 + 0.8x$

c. $p = 27 + 0.8(2030 - 1980) = 67\%$

17. For 3 hours:

Estes: \$9 per $\frac{1}{4}$ hour

$3 \times 4 = 12$ quarter-hours $\rightarrow 12 \times \$9 = \$108$

Ship and Shore: \$20 per $\frac{1}{2}$ hour

$3 \times 2 = 6$ half-hours $\rightarrow 6 \times \$20 = \$120$
Estes is a better deal by
\$120 – \$108 = \$12.00.

18. 20 round trips mean 40 one-way trips at \$11/trip.
(40 trips)(32 passengers)(\$11)
= \$14,080 in one day

19. \$960 – \$50 = \$910 remaining to pay

$$\frac{\$910}{\$35 \text{ per week}} = 26 \text{ weeks}$$

20. Belgium will have 160,000 more people.
Greece: $10,600,000 - 28,000(35) = 9,620,000$
Belgium: $10,200,000 - 12,000(35) = 9,780,000$
$9,780,000 - 9,620,000 = 160,000$

Chapter 2
Set Theory

Check Points 2.1

1. Set L is the set of the first six lowercase letters in the English alphabet.

2. M = {April, August}

3. O = {1, 3, 5, 7, 9}

4. a. not the empty set; Many numbers meet the criteria to belong to this set.

b. the empty set; No numbers meet the criteria, thus this set is empty

c. not the empty set; "nothing" is not a set.

d. not the empty set; This is a set that contains one element, that element is a set.

5. a. true; 8 is an element of the given set.

b. true; r is not an element of the given set.

c. false; {Monday} is a set and the set {Monday} is not an element of the given set.

6. a. A = {1, 2, 3}

b. B = {15, 16, 17, …}

c. O = {1, 3, 5, …}

7. a. {1, 2, 3, 4, ..., 199}

b. {51, 52, 53, 54, ..., 200}

8. a. $n(A) = 5$; the set has 5 elements

b. $n(B) = 1$; the set has only 1 element

c. $n(C) = 8$; Though this set lists only five elements, the three dots indicate 12, 13, and 14 are also elements.

d. $n(D) = 0$ because the set has no elements.

9. No, the sets are not equivalent. Set A has 4 distinct elements yet set B has only 3 distinct elements.

10. a. true; {O, L, D} = {D, O, L} because the sets contain exactly the same elements.

b. false; The two sets do not contain exactly the same elements.

Concept and Vocabulary Check 2.1

C1. roster; set builder

C2. empty; $\varnothing$

C3. is an element

C4. natural numbers

C5. cardinal; $n(A)$

C6. equivalent

C7. equal

Exercise Set 2.1

1. This is well defined and therefore it is a set.

2. This is well defined and therefore it is a set.

3. This is a matter of opinion and not well defined, thus it is not a set.

4. This is a matter of opinion and not well defined, thus it is not a set.

5. This is well defined and therefore it is a set.

6. This is well defined and therefore it is a set.

7. The set of known planets in our Solar System. Note to student: This exercise did not forget Pluto. In 2006, based on the requirement that a planet must dominate its own orbit, the International Astronomical Union removed Pluto from the list of planets.

8. The set of weekend days.

9. The set of months that begin with J.

10. The set of months that begin with A.

11. The set of natural numbers greater than 5.

12. The set of natural numbers greater than 8.

13. The set of natural numbers between 6 and 20, inclusive.

14. The set of natural numbers between 9 and 25, inclusive.

15. {winter, spring, summer, fall}

16. {April, June, September, November}

17. {September, October, November, December}

18. {e, f, g, h, i}

19. {1, 2, 3}

20. {1, 2, 3, 4, 5, 6}

21. {1, 3, 5, 7, 9, 11}

22. {2, 4, 6, 8}

23. {1, 2, 3, 4, 5}

24. {1, 2, 3, 4}

25. {6, 7, 8, 9, …}

26. {5, 6, 7, 8, …}

27. {7, 8, 9, 10}

28. {8, 9, 10, 11}

29. {10, 11, 12, 13, …, 79}

30. {15, 16, 17, 18, …, 59}}

31. {2}

32. {6}

33. not the empty set

34. not the empty set

35. empty set

36. empty set

37. not the empty set
Note that the number of women who served as U.S. president before 2020 is 0. Thus the number 0 is an element of the set.

38. not the empty set
Note that the number of living U.S. presidents born before 1200 is 0. Thus the number 0 is an element of the set.

39. empty set

40. empty set

41. empty set

42. empty set

43. not the empty set

44. not the empty set

45. not the empty set

46. not the empty set

47. true
3 is a member of the set.

48. true
6 is a member of the set.

49. true
12 is a member of the set.

50. true
10 is a member of the set.

51. false
5 is *not* a member of the set.

52. false
8 is *not* a member of the set.

53. true
11 is *not* a member of the set.

54. true.
17 is *not* a member of the set.

55. false
37 is a member of the set.

56. false
26 is a member of the set.

57. false
4 is a member of the set.

58. false
2 is *not* a member of the set.

59. true
13 is *not* a member of the set.

60. true
20 is *not* a member of the set.

61. false
16 is a member of the set.

62. false
19 is a member of the set.

63. false
The set {3} is *not* a member of the set.

64. false
The set {7} is *not* a member of the set.

65. true
–1 is *not* a natural number.

66. true
–2 is *not* a natural number.

67. $n(A) = 5$; There are 5 elements in the set.

68. $n(A) = 6$; There are 6 elements in the set.

69. $n(B) = 15$; There are 15 elements in the set.

70. $n(B) = 11$; There are 11 elements in the set.

71. $n(C) = 0$; There are *no* days of the week beginning with A.

72. $n(C) = 0$; There are no such months.

73. $n(D) = 1$; There is 1 element in the set.

74. $n(D) = 1$; There is 1 element in the set.

75. $n(A) = 4$; There is 4 elements in the set.

76. $n(A) = 3$; There is 3 elements in the set.

77. $n(B) = 5$; There is 5 elements in the set.

78. $n(B) = 7$; There is 7 elements in the set.

79. $n(C) = 0$; There are no elements in the set.

80. $n(C) = 0$; There are no elements in the set.

81. **a.** Not equivalent
The number of elements is not the same.

b. Not equal
The two sets contain different elements.

82. **a.** Equivalent
The number of elements is the same.

b. Not equal
The two sets contain different elements.

83. **a.** Equivalent
The number of elements is the same.

b. Not equal
The elements are not exactly the same.

84. **a.** Equivalent
The number of elements is the same.

b. Not equal
The elements are not exactly the same.

85. **a.** Equivalent
The number of elements is the same.

b. Equal
The elements are exactly the same.

86. **a.** Equivalent
Number of elements is the same.

b. Equal
The elements are exactly the same.

87. **a.** Equivalent
Number of elements is the same.

b. Not equal
The two sets contain different elements.

88. **a.** Equivalent
Number of elements is the same.

b. Not equal
The two sets contain different elements.

89. **a.** Equivalent
Number of elements is the same.

b. Equal
The elements are exactly the same.

90. **a.** Equivalent
Number of elements is the same.

b. Equal
The elements are exactly the same.

91. infinite

92. infinite

93. finite

94. finite

95. finite

96. finite

97. $\{x \mid x \in \mathbb{N} \text{ and } x \geq 61\}$

98. $\{x \mid x \in \mathbb{N} \text{ and } x \geq 36\}$

99. $\{x \mid x \in \mathbb{N} \text{ and } 61 \le x \le 89\}$

100. $\{x \mid x \in \mathbb{N} \text{ and } 36 \le x \le 59\}$

101. Answers will vary; an example is: $\{0, 1, 2, 3\}$ and $\{1, 2, 3, 4\}$.

102. Answers will vary; an example is: $\{x \mid x \in \mathbb{N} \text{ and } x < 5\}$ and $\{1, 2, 3, 4\}$.

103. Impossible. Equal sets have exactly the same elements. This would require that there also must be the same number of elements.

104. Answers will vary; an example is: $\{1\}$ and $\{1, 2\}$.

105. {Engineering, Accounting}

106. {Engineering}

107. {Journalism, Nursing, Philosophy}

108. {Nursing, Philosophy, Social Work}

109. { }

110. {Group 1, Group 2, Group 3, Group 4, Group 5, Group 6}

111. {Group 7}

112. {Group 1, Group 2, Group 3, Group 5, Group 6}

113. {12, 19}

114. {10, 14, 16}

115. {20, 21}

116. {20, 21, 22}

117. There is not a one-to-one correspondence. These sets are not equivalent.

118 - 123. Answers will vary.

124. makes sense

125. does not make sense; Explanations will vary. Sample explanation: The natural numbers do not include negative numbers. Since the temperature will be below zero, a set that includes negative numbers would be necessary.

126. does not make sense; Explanations will vary. Sample explanation: There is not a one-to-one correspondence for men because two ages sleep for 8.3 hours.

127. makes sense

128. false; Changes to make the statement true will vary. A sample change is: If two sets are equal, they must be equivalent.

129. false; Changes to make the statement true will vary. A sample change is: If a roster set contains three dots, it is finite if there is an ending value after the three dots.

130. false; Changes to make the statement true will vary. A sample change is: The cardinality of the empty set is 0.

131. true

132. true

133. false; Changes to make the statement true will vary. A sample change is: Though that set has many values, it is still a finite set.

134. false; Changes to make the statement true will vary. A sample change is: Some finite sets could have so many elements that it would take longer than a trillion years to count them.

135. false; Changes to make the statement true will vary. A sample change is: If 0 is removed from a set, it will lower the cardinality of that set by one.

136. This question contains a paradox. Sweeney Todd cannot shave himself because he does not shave any men who shave themselves. That suggests that $s \notin A$ which implies $s \in B$. However, if Sweeney Todd does not shave himself, the question states he shaves all such men who do not shave themselves. That suggests that he does shave himself, giving $s \in A$ which implies $s \notin B$. Therefore, paradoxically, s belongs and does not belong in both sets.

a. no

b. no

Check Points 2.2

1. a. $\not\subseteq$; because 6, 9, and 11 are not in set B.

b. $\subseteq$; because all elements in set A are also in set B.

c. $\subseteq$; because all elements in set A are also in set B.

2. a. Both $\subseteq$ and $\subset$ are correct.

b. Both $\subseteq$ and $\subset$ are correct.

3. Yes, the empty set is a subset of any set.

4. a. 16 subsets, 15 proper subsets
There are 4 elements, which means there are 2^4 or 16 subsets. There are $2^4 - 1$ proper subsets or 15.

b. 64 subsets, 63 proper subsets
There are 6 elements, which means there are 2^6 or 64 subsets. There are $2^6 - 1$ proper subsets or 63.

Concept and Vocabulary Check 2.2

C1. $A \subseteq B$; every element in set A is also an element in set B

C2. $A \subset B$; sets A and B are not equal

C3. the empty; subset

C4. 2^n

C5. $2^n - 1$

Exercise Set 2.2

1. $\subseteq$

2. $\subseteq$

3. $\not\subseteq$

4. $\not\subseteq$

5. $\not\subseteq$

6. $\not\subseteq$

7. $\not\subseteq$
Subset cannot be larger than the set.

8. $\not\subseteq$
Subset cannot be larger than the set.

9. $\subseteq$

10. $\subseteq$

11. $\not\subseteq$

12. $\not\subseteq$

13. $\subseteq$

14. $\subseteq$

15. $\not\subseteq$

16. $\not\subseteq$

17. $\subseteq$

18. $\subseteq$

19. both

20. both

21. $\subseteq$

22. $\subseteq$

23. neither

24. neither

25. both

26. both

27. both

28. both

29. $\subseteq$

30. $\subseteq$

31. both

32. both

33. both

34. neither

35. both

36. both

37. neither

38. neither

39. $\subseteq$

40. $\subseteq$

41. true

42. true

43. false
{Leonard} is a subset, not Leonard.

44. false
{Canada} is a subset, not Canada.

45. true

46. true

47. false
The symbol "$\varnothing$" is not a member of the set.

48. true

49. true

50. true

51. false
All elements of {1, 4} are members of {4, 1}

52. true

53. true

54. true

55. { } {Border Collie} {Poodle} {Border Collie, Poodle}

56. { } {Romeo} {Juliet} {Romeo, Juliet}

57. { } {t} {a} {b} {t, a} {t, b} {a, b} {t, a, b}

58. { } {I} {II} {III} {I, II} {I, III} {II, III} {I, II, III }

59. { } {0}

60. $\varnothing$

61. 16 subsets, 15 proper subsets
There are 4 elements, which means there are 2^4 or 16 subsets. There are $2^4 - 1$ proper subsets or 15.

62. 16 subsets, 15 proper subsets
There are 4 elements, which means there are 2^4 or 16 subsets. There are $2^4 - 1$ proper subsets or 15.

63. 64 subsets, 63 proper subsets
There are 6 elements, which means there are 2^6 or 64 subsets. There are $2^6 - 1$ proper subsets or 63.

64. 64 subsets, 63 proper subsets
There are 6 elements, which means there are 2^6 or 64 subsets. There are $2^6 - 1$ proper subsets or 63.

65. 128 subsets, 127 proper subsets
There are 7 elements, which means there are 2^7 or 128 subsets. There are $2^7 - 1$ proper subsets or 127.

66. 32 subsets, 31 proper subsets
There are 5 elements, which means there are 2^5 or 32 subsets. There are $2^5 - 1$ proper subsets or 31.

67. 8 subsets, 7 proper subsets
There are 3 elements, which means there are 2^3 or 8 subsets. There are $2^3 - 1$ proper subsets or 7.

68. 32 subsets, 31 proper subsets
There are 5 elements, which means there are 2^5 or 32 subsets. There are $2^5 - 1$ proper subsets or 31.

69. false; The set $\{1, 2, 3, ..., 1000\}$ has $2^{1000} - 1$ proper subsets.

70. false; The set $\{1, 2, 3, ..., 10{,}000\}$ has $2^{10{,}000} - 1$ proper subsets.

71. true

72. true

73. false; $\varnothing \subseteq \{\varnothing, \{\varnothing\}\}$

74. false; $\{\varnothing\} \subseteq \{\varnothing, \{\varnothing\}\}$

75. true

76. true

77. true