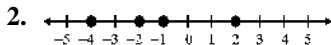# Chapter 2

Section 2.1 Practice Exercises

1. **a.** If 0 represents the surface of the earth, then 3805 below the surface of the earth is −3805.

    b. If zero degrees Fahrenheit is represented by 0°F, then 85 degrees below zero Fahrenheit is represented by −85°F.

2.

3. **a.** $0 > -5$ since 0 is to the right of −5 on a number line.

    b. $-3 < 3$ since −3 is to the left of 3 on a number line.

    c. $-7 > -12$ since −7 is to the right of −12 on a number line.

4. **a.** $|-6| = 6$ because −6 is 6 units from 0.

    b. $|4| = 4$ because 4 is 4 units from 0.

    c. $|-12| = 12$ because −12 is 12 units from 0.

5. **a.** The opposite of 14 is −14.

    b. The opposite of −9 is −(−9) or 9.

6. **a.** $-|-7| = -7$

    b. $-|4| = -4$

    c. $-(-12) = 12$

7. $-|x| = -|-6| = -6$

8. The planet with the highest average daytime surface temperature is the one that corresponds to the bar that extends the furthest in the positive direction (upward). Venus has the highest average daytime surface temperature.

Vocabulary, Readiness & Video Check 2.1

1. The numbers ...−3, −2, −1, 0, 1, 2, 3, ... are called <u>integers</u>.

2. Positive numbers, negative numbers, and zero together are called <u>signed</u> numbers.

3. The symbols "<" and ">" are called <u>inequality symbols</u>.

4. Numbers greater than 0 are called <u>positive</u> numbers while numbers less than 0 are called <u>negative</u> numbers.

5. The sign "<" means <u>is less than</u> and ">" means <u>is greater than</u>.

6. On a number line, the greater number is to the <u>right</u> of the lesser number.

7. A number's distance from 0 on the number line is the number's <u>absolute value</u>.

8. The numbers −5 and 5 are called <u>opposites</u>.

9. number of feet a miner works underground

10. The tick marks are labeled with the integers.

11. 0 will always be greater than any of the <u>negative</u> integers.

12. 8; $|8| = 8$ also.

13. A negative sign can be translated into the phrase "<u>opposite of</u>."

14. Eyre

Exercise Set 2.1

2. If 0 represents the surface of the water, then 25 feet below the surface of the water is −25.

4. If 0 represents sea level, then 282 feet below sea level is −282.

6. If 0 represents 0 degrees Fahrenheit, then 134 degrees above zero is +134.

8. If 0 represents the surface of the ocean, then 14,040 below the surface of the ocean is −14,040.

10. If 0 represents a loss of $0, then a loss of $555 million is −555 million.

12. If 0 represents 0° Celsius, then 10° below 0° Celsius is −10. Since 5° below 0° Celsius is −5 and −10 is less than −5, −10 (or 10° below 0° Celsius) is cooler.

14. If 0 represents a decrease of 0%, then a 23 percent decrease is −23.

16.

18.

20.

22.
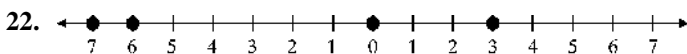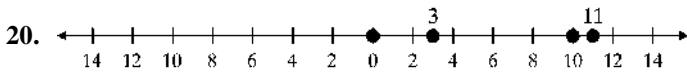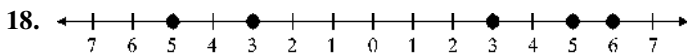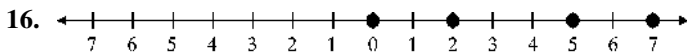
24. $-8 < 0$ since −8 is to the left of 0 on a number line.

26. $-12 < -10$ since −12 is to the left of −10 on a number line.

28. $-27 > -29$ since −27 is to the right of −29 on a number line.

30. $13 > -13$ since 13 is to the right of −13 on a number line.

32. $|7| = 7$ since 7 is 7 units from 0 on a number line.

34. $|-19| = 19$ since −19 is 19 units from 0 on a number line.

36. $|100| = 100$ since 100 is 100 units from 0 on a number line.

38. $|-10| = 10$ since −10 is 10 units from 0 on a number line.

40. The opposite of 8 is negative 8.
$-(8) = -8$

42. The opposite of negative 6 is 6.
$-(-6) = 6$

44. The opposite of 123 is negative 123.
$-(123) = -123$

46. The opposite of negative 13 is 13.
$-(-13) = 13$

48. $|-11| = 11$

50. $-|43| = -43$

52. $-|-18| = -18$

54. $-(-27) = 27$

56. $-(-14) = 14$

58. $-|-29| = -29$

60. $-|x| = -|-8| = -8$

62. $-|-x| = -|-10| = -10$

64. $|x| = |32| = 32$

66. $|-x| = |-1| = 1$

68. $-4 > -17$ since -4 is to the right of -17 on a number line.

70. $|-8| = 8$
$|-4| = 4$
Since $8 > 4$, $|-8| > |-4|$.

72. $-|17| = -17$
$-(-17) = 17$
Since $-17 < 17$, $-|17| < -(-17)$.

74. $|-24| = 24$
$-(-24) = 24$
Since $24 = 24$, $|-24| = -(-24)$.

76. $-45 < 0$ since -45 is to the left of 0 on a number line.

78. $|-45| = 45$
$|0| = 0$
Since $45 > 0$, $|-45| > |0|$.

80. $-|-8| = -8$
$-|-4| = -4$
Since $-8 < -4$, $-|-8| < -|-4|$.

82. $-(-38) = 38$
Since $-22 < 38$, $-22 < -(-38)$.

84. If the number is -13, then the absolute value of -13 is 13 and the opposite of -13 is 13.

86. If the opposite of a number is 90, then the number is -90 and its absolute value is 90.

88. The 'bar' that is equal to 0 corresponds to Lake Maracaibo, so Lake Maracaibo has an elevation at sea level.

90. The bar that extends second to the farthest in the negative direction corresponds to Lake Eyre, so Lake Eyre has the second lowest elevation.

92. The smallest number on the graph is $-269°C$, which corresponds to helium.

94. The number on the graph closest to $+300°C$ is $280°C$, which corresponds to phosphorus.

96. $9 + 0 = 9$

98.
$$\begin{array}{r} 20 \\ + 15 \\ \hline 35 \end{array}$$

100.
$$\begin{array}{r} {\scriptstyle 1} \\ 362 \\ 37 \\ + \ 90 \\ \hline 489 \end{array}$$

102. $|10| = 10$, $2^3 = 8$, $-|-5| = -5$, and $-(-4) = 4$, so the numbers in order from least to greatest are $-|-5|$, $-(-4)$, 2^3, $|10|$.

104. $1^4 = 1$, $-(-3) = 3$, $-|7| = -7$, and $|-20| = 20$, so the numbers in order from least to greatest are $-|7|$, 1^4, $-(-3)$, $|-20|$.

106. $3^3 = 27$, $-|-11| = -11$, $-(-10) = 10$, $-4 = -4$, $-|2| = -2$, so the numbers in order from least to greatest are $-|-11|$, -4, $-|2|$, $-(-10)$, and 3^3.

108. a. $|0| = 0$; since $0 < 4$, then $|0| > 4$ is false.

   b. $|-4| = 4$; since $4 = 4$, then $|-4| > 4$ is false.

   c. $|5| = 5$; since $5 > 4$, then $|5| > 4$ is true.

   d. $|-100| = 100$; since $100 > 4$, then $|-100| > 4$ is true.

110. $(-|-(-7)|) = (-|7|) = -7$

112. False; consider 0, where $|0| = 0$ and 0 is not positive.

114. True; zero is always less than a positive number since it is to the left of it on a number line.

116. No; $b > a$ because b is to the right of a on the number line.

118. answers may vary

120. no; answers may vary

Section 2.2 Practice Exercises

1.

$$5 + (-1) = 4$$

2.

$$-6 + (-2) = -8$$

3.

$$-8 + 3 = -5$$
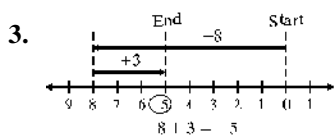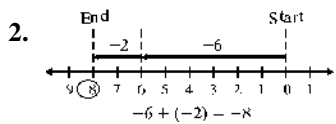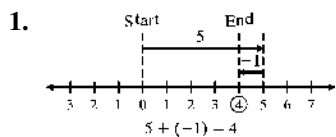
4. $|-3| + |-19| = 3 + 19 = 22$
The common sign is negative, so
$(-3) + (-19) = -22$.

5. $-12 + (-30) = -42$

6. $9 + 4 = 13$

7. $|-1| = 1, |26| = 26$, and $26 - 1 = 25$
$26 > 1$, so the answer is positive.
$-1 + 26 = 25$

8. $|2| = 2, |-18| = 18$, and $18 - 2 = 16$
$18 > 2$, so the answer is negative.
$2 + (-18) = -16$

9. $-54 + 20 = -34$

10. $7 + (-2) = 5$

11. $-3 + 0 = -3$

12. $18 + (-18) = 0$

13. $-64 + 64 = 0$

14. $6 + (-2) + (-15) = 4 + (-15) = -11$

15. $5 + (-3) + 12 + (-14) = 2 + 12 + (-14)$
$$= 14 + (-14)$$
$$= 0$$

16. $x + 3y = -6 + 3(2) = -6 + 6 = 0$

17. $x + y = -13 + (-9) = -22$

18. Temperature at 8 a.m. $= -7 + (+4) + (+7)$
$$= -3 + (+7)$$
$$= 4$$
The temperature was 4°F at 8 a.m.

Calculator Explorations

1. $-256 + 97 = -159$

2. $811 + (-1058) = -247$

3. $6(15) + (-46) = 44$

4. $-129 + 10(48) = 351$

5. $-108,650 + (-786,205) = -894,855$

6. $-196,662 + (-129,856) = -326,518$

Vocabulary, Readiness & Video Check 2.2

1. If n is a number, then $-n + n = \underline{0}$.

2. Since $x + n = n + x$, we say that addition is <u>commutative</u>.

3. If a is a number, then $-(-a) = \underline{a}$.

4. Since $n + (x + a) = (n + x) + a$, we say that addition is <u>associative</u>.

5. Negative; the numbers have different signs and the sign of the sum is the same as the sign of the number with the larger absolute value, −6.

6. Negative; the numbers have the same sign—both are negative—and we keep this common sign in the sum.

7. The diver's current depth is 231 feet below the surface.

Exercise Set 2.2

2.

$-6 + (-5) = -11$

4.

$10 + (-3) = 7$

6.

$9 + (-4) = 5$
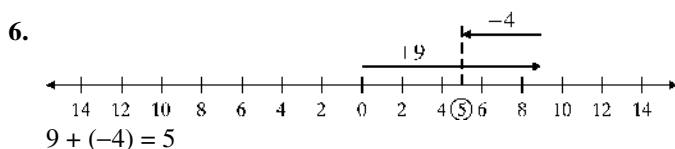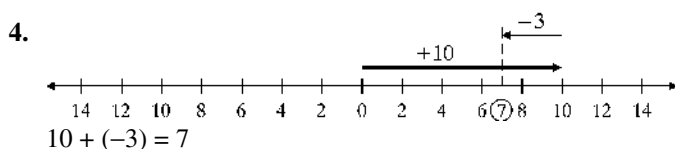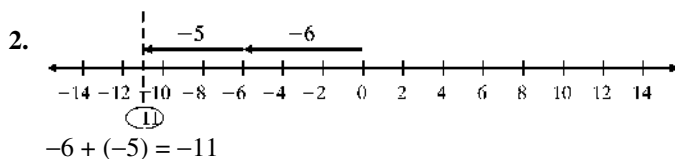
8. $15 + 42 = 57$

10. $|-5| + |-4| = 5 + 4 = 9$
The common sign is negative, so $-5 + (-4) = -9$.

12. $-62 + 62 = 0$

14. $|8| - |-3| = 8 - 3 = 5$
$8 > 3$, so the answer is positive.
$8 + (-3) = 5$

16. $-8 + 0 = -8$

18. $|-9| - |5| = 9 - 5 = 4$
$9 > 5$, so the answer is negative.
$5 + (-9) = -4$

20. $|-6| + |-1| = 6 + 1 = 7$
The common sign is negative, so $-6 + (-1) = -7$.

22. $|-23| + |-23| = 23 + 23 = 46$
The common sign is negative, so $-23 + (-23) = -46$.

24. $|-400| + |-256| = 400 + 256 = 656$
The common sign is negative, so $-400 + (-256) = -656$.

26. $|24| - |-10| = 24 - 10 = 14$
$24 > 10$, so the answer is positive.
$24 + (-10) = 14$

28. $|-8| - |4| = 8 - 4 = 4$
$8 > 4$, so the answer is negative.
$-8 + 4 = -4$

30. $|-89| - |37| = 89 - 37 = 52$
$89 > 37$, so the answer is negative.
$-89 + 37 = -52$

32. $|62| - |-32| = 62 - 32 = 30$
$62 > 32$, so the answer is positive.
$-32 + 62 = 30$

34. $|-375| - |325| = 375 - 325 = 50$
$375 > 325$, so the answer is negative.
$325 + (-375) = -50$

36. $|-56| + |-33| = 56 + 33 = 89$
The common sign is negative, so
$-56 + (-33) = -89$.

38. $-1 + 5 + (-8) = 4 + (-8) = -4$

40. $-103 + (-32) + (-27) = -135 + (-27) = -162$

42. $18 + (-9) + 5 + (-2) = 9 + 5 + (-2)$
$= 14 + (-2)$
$= 12$

44. $34 + (-12) + (-11) + 213 = 22 + (-11) + 213$
$= 11 + 213$
$= 224$

46. $-12 + (-3) + (-5) = -15 + (-5) = -20$

48. $-35 + (-12) = -47$

50. $3 + (-23) + 6 = -20 + 6 = -14$

52. $-100 + 70 = -30$

54. $(-45) + 22 + 20 = -23 + 20 = -3$

56. $-87 + 0 = -87$

58. $-16 + 6 + (-14) + (-20) = -10 + (-14) + (-20)$
$= -24 + (-20)$
$= -44$

60. $x + y = -1 + (-29) = -30$

62. $3x + y = 3(7) + (-11) = 21 + (-11) = 10$

64. $3x + y = 3(13) + (-17) = 39 + (-17) = 22$

66. The sum of -30 and 15 is $-30 + 15 = -15$.

68. The sum of -49, -2, and 40 is
$-49 + (-2) + 40 = -51 + 40 = -11$.

70. $0 + (-248) + 8 + (-16) + (-28) + 32$
$= -248 + 8 + (-16) + (-28) + 32$
$= -240 + (-16) + (-28) + 32$
$= -256 + (-28) + 32$
$= -284 + 32$
$= -252$
The diver's final depth is 252 meters below the surface.

72. Since $-7 < -2$, Dufner won Round 2.

74. The bar for 2001 has a height of -25, so the net income in 2001 was $-\$25,000,000$.

76. $3496 + 8240 + 25,922 = 37,658$
The total net income for the years 2007, 2009, and 2011 was $\$37,658,000,000$.

78. $14 + (-5) + (-8) + 7 = 9 + (-8) + 7 = 1 + 7 = 8$
Her total score was 8.

80. $-10,412 + (-1786) + 15,395 + 31,418$
$= -12,198 + 15,395 + 31,418$
$= 3197 + 31,418$
$= 34,615$
The net income for all the years shown is $\$34,615$.

82. $-45 + 3 = -42$
Pennsylvania's all-time record low temperature is $-42°F$.

84. $-10,924 + 3245 = -7679$
The depth of the Aleutian Trench is -7679 meters.

86. $91 - 0 = 91$

88.
$$\begin{array}{r} 400 \\ -\ 18 \\ \hline 382 \end{array}$$

90. answers may vary

92. $-4 + 14 = 10$

94. $-15 + (-17) = -32$

96. True

98. True

100. answers may vary

Section 2.3 Practice Exercises

1. $13 - 4 = 13 + (-4) = 9$

2. $-8 - 2 = -8 + (-2) = -10$

3. $11 - (-15) = 11 + 15 = 26$

4. $-9 - (-1) = -9 + 1 = -8$

5. $6 - 9 = 6 + (-9) = -3$

6. $-14 - 5 = -14 + (-5) = -19$

7. $-3 - (-4) = -3 + 4 = 1$

8. $-15 - 6 = -15 + (-6) = -21$

9. $\begin{aligned} -6 - 5 - 2 - (-3) &= -6 + (-5) + (-2) + 3 \\ &= -11 + (-2) + 3 \\ &= -13 + 3 \\ &= -10 \end{aligned}$

10. $\begin{aligned} 8 + (-2) - 9 - (-7) &= 8 + (-2) + (-9) + 7 \\ &= 6 + (-9) + 7 \\ &= -3 + 7 \\ &= 4 \end{aligned}$

11. $x - y = -5 - 13 = -5 + (-13) = -18$

12. $3y - z = 3(9) - (-4) = 27 + 4 = 31$

13. $29{,}028 - (-1312) = 29{,}028 + 1312 = 30{,}340$
Mount Everest is 30,340 feet higher than the Dead Sea.

Vocabulary, Readiness & Video Check 2.3

1. It is true that $a - b = \underline{a + (-b)}$.   b

2. The opposite of n is $\underline{-n}$.   a

3. To evaluate $x - y$ for $x = -10$ and $y = -14$, we replace x with -10 and y with -14 and evaluate $\underline{-10 - (-14)}$.   d

4. The expression $-5 - 10$ equals $\underline{-5 + (-10)}$.   c

5. additive inverse

6. $-3 + 4 + (23) + (-10)$; all the subtraction operations are rewritten as additions in one step rather than changing one operation at a time as you work from left to right.

7. to follow the order of operations

8. The warmest temperature is 265°F warmer than the coldest temperature.

Exercise Set 2.3

2. $-6 - (-6) = -6 + 6 = 0$

4. $15 - 12 = 15 + (-12) = 3$

6. $2 - 5 = 2 + (-5) = -3$

8. $12 - (-12) = 12 + 12 = 24$

10. $-25 - (-25) = -25 + 25 = 0$

12. $-2 - 42 = -2 + (-42) = -44$

14. $8 - 9 = 8 + (-9) = -1$

16. $17 - 63 = 17 + (-63) = -46$

18. $844 - (-20) = 844 + 20 = 864$

20. $-5 - 8 = -5 + (-8) = -13$

22. $-12 - (-5) = -12 + 5 = -7$

24. $16 - 45 = 16 + (-45) = -29$

26. $-22 - 10 = -22 + (-10) = -32$

28. $-8 - (-13) = -8 + 13 = 5$

30. $-50 - (-50) = -50 + 50 = 0$

32. $-35 + (-11) = -46$

34. $4 - 21 = 4 + (-21) = -17$

36. $-105 - 68 = -105 + (-68) = -173$

38. $86 - 98 = 86 + (-98) = -12$

40. $8 - 4 - 1 = 8 + (-4) + (-1) = 4 + (-1) = 3$

42. $\begin{aligned} 30 - 18 - 12 &= 30 + (-18) + (-12) \\ &= 12 + (-12) \\ &= 0 \end{aligned}$

44. $-10 - 6 - (-9) = -10 + (-6) + 9 = -16 + 9 = -7$

46. $\begin{aligned} -15 + (-8) - 4 &= -15 + (-8) + (-4) \\ &= -23 + (-4) \\ &= -27 \end{aligned}$

48. $23 - (-17) + (-9) = 23 + 17 + (-9)$
$\qquad\qquad\qquad\quad = 40 + (-9)$
$\qquad\qquad\qquad\quad = 31$

50. $-(-9) - 14 + (-23) = 9 + (-14) + (-23)$
$\qquad\qquad\qquad\qquad = -5 + (-23)$
$\qquad\qquad\qquad\qquad = -28$

52. $-6 - (-8) + (-12) - 7 = -6 + 8 + (-12) + (-7)$
$\qquad\qquad\qquad\qquad\quad = 2 + (-12) + (-7)$
$\qquad\qquad\qquad\qquad\quad = -10 + (-7)$
$\qquad\qquad\qquad\qquad\quad = -17$

54. $5 + (-18) - (-21) - 2 = 5 + (-18) + 21 + (-2)$
$\qquad\qquad\qquad\qquad\quad = -13 + 21 + (-2)$
$\qquad\qquad\qquad\qquad\quad = 8 + (-2)$
$\qquad\qquad\qquad\qquad\quad = 6$

56. $x - y = -7 - 1 = -7 + (-1) = -8$

58. $x - y = 9 - (-2) = 9 + 2 = 11$

60. $2x - y = 2(8) - (-10) = 16 + 10 = 26$

62. $2x - y = 2(14) - (-12) = 28 + 12 = 40$

64. The temperature in November is 3°F and in December is −4°F.
$3 - (-4) = 3 + 4 = 7$
The difference is 7°F.

66. The month with the warmest temperature is July, 63°F, and the month with the coldest temperature is January, −8°F.
$63 - (-8) = 63 + 8 = 71$
The difference is 71°F.

68. $134 - (-80) = 134 + 80 = 214$
Therefore, 134°F is 214°F warmer than −80°F.

70. $93 - 18 - 26 = 93 + (-18) + (-26)$
$\qquad\qquad\qquad = 75 + (-26)$
$\qquad\qquad\qquad = 49$
She owes $49 on her account.

72. $13{,}796 - (-21{,}857) = 13{,}796 + 21{,}857 = 35{,}653$
The difference in elevation is 35,653 feet.

74. $-384 - (-505) = -384 + 505 = 121$
The difference in elevation is 121 feet.

76. $-236 - (-505) = -236 + 505 = 269$
The difference in elevation is 269 feet.

78. $512 - (-92) = 512 + 92 = 604$
The difference in elevation is 604 feet.

80. $-52 - (-92) = -52 + 92 = 40$
The difference in elevation is 40 feet.

82. $845 - (-162) = 845 + 162 = 1007$
The difference in temperature is 1007°F.

84. $1165 - 3878 = 1165 + (-3878) = -2713$
The trade balance was −2713 million barrels.

86. The difference of −3 and a number is $-3 - x$.

88. Add a number and −36 is $x + (-36)$.

90. $\dfrac{96}{3} = 32$

$$\begin{array}{r} 32 \\ 3\overline{)\,96\,} \\ \underline{-9} \\ 06 \\ \underline{-6} \\ 0 \end{array}$$

92.
$$\begin{array}{r} 51 \\ \times\ 89 \\ \hline 459 \\ 4080 \\ \hline 4539 \end{array}$$

94. answers may vary

96. $-4 - 8 = -4 + (-8) = -12$

98. $-3 - (-10) = -3 + 10 = 7$

100. $|-12| - |-5| = 12 - 5 = 12 + (-5) = 7$

102. $|-8| - |8| = 8 - 8 = 0$

104. $|-23| - |-42| = 23 - 42 = 23 + (-42) = -19$

106. $|-2 - (-6)| = |-2 + 6| = |4| = 4$
$|-2| - |-6| = 2 - 6 = 2 + (-6) = -4$
Since $4 \neq -4$, the statement is false.

108. no; answers may vary

Section 2.4 Practice Exercises

1. $-3 \cdot 8 = -24$

2. $-5(-2) = 10$

3. $0 \cdot (-20) = 0$

4. $10(-5) = -50$

5. $8(-6)(-2) = -48(-2) = 96$

6. $(-9)(-2)(-1) = 18(-1) = -18$

7. $(-3)(-4)(-5)(-1) = 12(-5)(-1) = -60(-1) = 60$

8. $(-2)^4 = (-2)(-2)(-2)(-2)$
$$= 4(-2)(-2)$$
$$= -8(-2)$$
$$= 16$$

9. $-8^2 = -(8 \cdot 8) = -64$

10. $\dfrac{42}{-7} = -6$

11. $-16 \div (-2) = 8$

12. $\dfrac{-80}{10} = -8$

13. $\dfrac{-6}{0}$ is undefined.

14. $\dfrac{0}{-7} = 0$

15. $xy = 5 \cdot (-8) = -40$

16. $\dfrac{x}{y} = \dfrac{-12}{-3} = 4$

17. total score $= 4 \cdot (-13) = -52$
The card player's total score was −52.

Vocabulary, Readiness & Video Check 2.4

1. The product of a negative number and a positive number is a <u>negative</u> number.

2. The product of two negative numbers is a <u>positive</u> number.

3. The quotient of two negative numbers is a <u>positive</u> number.

4. The quotient of a negative number and a positive number is a <u>negative</u> number.

5. The product of a negative number and zero is <u>0</u>.

6. The quotient of 0 and a negative number is <u>0</u>.

7. The quotient of a negative number and 0 is <u>undefined</u>.

8. When a negative sign is involved in an expression with an exponent, parentheses tell you whether or not the exponent applies to the negative sign. In Example 3, $(-3)^2$, the exponent applies to everything within the parentheses, so −3 is squared; in Example 4, -3^2, the exponent does *not* apply to the sign and only 3 is squared.

9. We can find out about sign rules for division because we know sign rules for <u>multiplication</u>.

10. That *ab* means *a · b*.

11. The phrase "lost four yards" in the example translates to the negative number −4.

Exercise Set 2.4

2. $5(-3) = -15$

4. $-7(-2) = 14$

6. $-9(7) = -63$

8. $-6(0) = 0$

10. $-2(3)(-7) = -6(-7) = 42$

12. $-8(-3)(-3) = 24(-3) = -72$

14. $2(-5)(-4) = -10(-4) = 40$

16. $3(0)(-4)(-8) = 0$

18. $-2(-1)(3)(-2) = 2(3)(-2) = 6(-2) = -12$

20. $-2^4 = -(2)(2)(2)(2) = -4(2)(2) = -8(2) = -16$

22. $(-1)^4 = (-1)(-1)(-1)(-1)$
$$= 1(-1)(-1)$$
$$= -1(-1)$$
$$= 1$$

24. $-4^3 = -(4 \cdot 4 \cdot 4) = -64$

26. $(-3)^2 = (-3)(-3) = 9$

28. $90 \div (-9) = -10$

30. $\dfrac{56}{-8} = -7$

32. $\dfrac{-32}{4} = -8$

34. $\dfrac{-13}{0}$ is undefined.

36. $\dfrac{0}{-15} = 0$

38. $\dfrac{-24}{-12} = 2$

40. $0(-100) = 0$

42. $-6 \cdot 2 = -12$

44. $-12(13) = -156$

46. $-9(-5) = 45$

48. $-7(-5)(-3) = 35(-3) = -105$

50. $(-5)^2 = (-5)(-5) = 25$

52. $-\dfrac{30}{5} = -6$

54. $-\dfrac{49}{7} = -7$

56. $-15 \div 3 = -5$

58. $6(-5)(-2) = -30(-2) = 60$

60. $-20 \cdot 5 \cdot (-5) \cdot (-3) = -100 \cdot (-5) \cdot (-3)$
$$= 500 \cdot (-3)$$
$$= -1500$$

62. $\dfrac{0}{-14} = 0$

64. $\dfrac{63}{-9} = -7$

66. $480 \div (-8) = \dfrac{480}{-8} = -60$

68. $\dfrac{-36}{-3} = 12$

70. $-2^3 = -(2 \cdot 2 \cdot 2) = -8$

72. $(-11)^2 = (-11)(-11) = 121$

74. $-1(2)(7)(-3) = -2(7)(-3) = -14(-3) = 42$

76. $(-1)^{33} = -1,$ since there are an odd number of factors.

78. $-2(-2)(-3)(-2) = 4(-3)(-2) = -12(-2) = 24$

80.
$$\begin{array}{r} 56 \\ \times\ 43 \\ \hline 168 \\ 2240 \\ \hline 2408 \end{array}$$
$-56 \cdot 43 = -2408$

82.
$$\begin{array}{r} 23 \\ \times\ 70 \\ \hline 1610 \end{array}$$
$70 \cdot (-23) = -1610$

84. $ab = 5(-1) = -5$

86. $ab = (-8)(8) = -64$

88. $ab = (-9)(-6) = 54$

90. $\dfrac{x}{y} = \dfrac{9}{-3} = -3$

92. $\dfrac{x}{y} = \dfrac{0}{-5} = 0$

94. $\dfrac{x}{y} = \dfrac{-10}{-10} = 1$

96. $xy = 20 \cdot (-5) = -100$
$$\dfrac{x}{y} = \dfrac{20}{-5} = -4$$

98. $xy = -3 \cdot 0 = 0$

$\dfrac{x}{y} = \dfrac{-3}{0}$ is undefined.

100. $-63 \div (-3) = 21$
The quotient of -63 and -3 is 21.

102. $\begin{array}{r} 49 \\ \times\ 5 \\ \hline 245 \end{array}$

$-49(5) = -245$
The product of -49 and 5 is -245.

104. The quotient of -8 and a number is $\dfrac{-8}{x}$ or $-8 \div x$.

106. The sum of a number and -12 is $x + (-12)$.

108. The difference of a number and -10 is $x - (-10)$.

110. Multiply a number by -17 is $x \cdot (-17)$ or $-17x$.

112. A loss of \$400 is represented by -400.
$7 \cdot (-400) = -2800$
His total loss was \$2800.

114. A drop of 5 degrees is represented by -5.
$6 \cdot (-5) = -30$
The total drop in temperature was 30 degrees.

116. $-1 \cdot (-39) = 39$
The melting point of rubidium is $39°C$.

118. $-11 \cdot (-70) = 770$
The melting point of strontium is $770°C$.

120. $\dfrac{-30,000}{3} = -10,000$

The expected loss for each month would be $10,000$ shipments or $-10,000$ shipments per month.

122. a. $405 - 30 = 375$
There were about 375 more California Condors in 2012 than in 1987. This is a change of 375 condors.

b. This is a period of 25 years.

$\dfrac{375}{25} = 15$

$\begin{array}{r} 15 \\ 25\overline{)\,375} \\ \underline{-25} \\ 125 \\ \underline{-125} \\ 0 \end{array}$

The average change was 15 California Condors per year.

124. $3 \cdot (7 - 4) + 2 \cdot 5^2 = 3 \cdot 3 + 2 \cdot 5^2$
$= 3 \cdot 3 + 2 \cdot 25$
$= 9 + 2 \cdot 25$
$= 9 + 50$
$= 59$

126. $12 \div (4 - 2) + 7 = 12 \div 2 + 7 = 6 + 7 = 13$

128. $-9(-11) = 99$

130. $-4 + (-3) + 21 = -7 + 21 = 14$

132. $-16 - (-2) = -16 + 2 = -14$

134. The product of an even number of negative numbers is positive, so the product of ten negative numbers is positive.

136. $(-1)^{50}$ and $(-7)^{20}$ are positive since there are an even number of factors. Note that $(-7)^{20} > (-1)^{50}$ since $(-1)^{50} = 1$.

$(-1)^{55}$ and $(-7)^{23}$ are negative since there are an odd number of factors. Note that $(-7)^{23} < (-1)^{55}$ since $(-1)^{55} = -1$.

$0^{15} = 0$
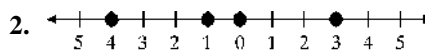The numbers from least to greatest are $(-7)^{23},\ (-1)^{55},\ 0^{15},\ (-1)^{50},\ (-7)^{20}$.

138. answers may vary

Integrated Review

1. Let 0 represent $0°F$. Then 50 degrees below zero is represented by -50 and 122 degrees above zero is represented by $+122$ or 122.

2.

3. $0 > -10$ since 0 is to the right of -10 on a number line.

4. $-4 < 4$ since -4 is to the left of 4 on a number line.

5. $-15 < -5$ since -15 is to the left of -5 on a number line.

6. $-2 > -7$ since -2 is to the right of -7 on a number line.

7. $|-3| = 3$ because -3 is 3 units from 0.

8. $|-9| = 9$ because -9 is 9 units from 0.

9. $-|-4| = -4$

10. $-(-5) = 5$

11. The opposite of 11 is -11.

12. The opposite of -3 is $-(-3) = 3$.

13. The opposite of 64 is -64.

14. The opposite of 0 is $-0 = 0$.

15. $-3 + 15 = 12$

16. $-9 + (-11) = -20$

17. $-8(-6)(-1) = 48(-1) = -48$

18. $-18 \div 2 = -9$

19. $65 + (-55) = 10$

20. $1000 - 1002 = 1000 + (-1002) = -2$

21. $53 - (-53) = 53 + 53 = 106$

22. $-2 - 1 = -2 + (-1) = -3$

23. $\dfrac{0}{-47} = 0$

24. $\dfrac{-36}{-9} = 4$

25. $-17 - (-59) = -17 + 59 = 42$

26. $-8 + (-6) + 20 = -14 + 20 = 6$

27. $\dfrac{-95}{-5} = 19$

28. $-9(100) = -900$

29. $-12 - 6 - (-6) = -12 + (-6) + 6 = -18 + 6 = -12$

30. $-4 + (-8) - 16 - (-9) = -4 + (-8) + (-16) + 9$
$$= -12 + (-16) + 9$$
$$= -28 + 9$$
$$= -19$$

31. $\dfrac{-105}{0}$ is undefined.

32. $7(-16)(0)(-3) = 0$ (since one factor is 0)

33. Subtract -8 from -12 is
$-12 - (-8) = -12 + 8 = -4$.

34. The sum of -17 and -27 is $-17 + (-27) = -44$.

35. The product of -5 and -25 is $-5(-25) = 125$.

36. The quotient of -100 and -5 is $\dfrac{-100}{-5} = 20$.

37. Divide a number by -17 is $\dfrac{x}{-17}$ or $x \div (-17)$.

38. The sum of -3 and a number is $-3 + x$.

39. A number decreased by -18 is $x - (-18)$.

40. The product of -7 and a number is $-7 \cdot x$ or $-7x$.

41. $x + y = -3 + 12 = 9$

42. $x - y = -3 - 12 = -3 + (-12) = -15$

43. $2y - x = 2(12) - (-3) = 24 - (-3) = 24 + 3 = 27$

44. $3y + x = 3(12) + (-3) = 36 + (-3) = 33$

45. $5x = 5(-3) = -15$

46. $\dfrac{y}{x} = \dfrac{12}{-3} = -4$

Section 2.5 Practice Exercises

1. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

2. $-2^4 = -(2)(2)(2)(2) = -16$

3. $3 \cdot 6^2 = 3 \cdot (6 \cdot 6) = 3 \cdot 36 = 108$

4. $\dfrac{-25}{5(-1)} = \dfrac{-25}{-5} = 5$

5. $\dfrac{-18+6}{-3-1} = \dfrac{-12}{-4} = 3$

6. $30+50+(-4)^3 = 30+50+(-64)$
$\qquad\qquad\qquad = 80+(-64)$
$\qquad\qquad\qquad = 16$

7. $-2^3+(-4)^2+1^5 = -8+16+1 = 8+1 = 9$

8. $2(2-9)+(-12)-3 = 2(-7)+(-12)-3$
$\qquad\qquad\qquad\qquad = -14+(-12)-3$
$\qquad\qquad\qquad\qquad = -26-3$
$\qquad\qquad\qquad\qquad = -29$

9. $(-5)\cdot|-8|+(-3)+2^3 = (-5)\cdot 8+(-3)+2^3$
$\qquad\qquad\qquad\qquad\quad = (-5)\cdot 8+(-3)+8$
$\qquad\qquad\qquad\qquad\quad = -40+(-3)+8$
$\qquad\qquad\qquad\qquad\quad = -43+8$
$\qquad\qquad\qquad\qquad\quad = -35$

10. $-4[-6+5(-3+5)]-7 = -4[-6+5(2)]-7$
$\qquad\qquad\qquad\qquad\qquad = -4[-6+10]-7$
$\qquad\qquad\qquad\qquad\qquad = -4(4)-7$
$\qquad\qquad\qquad\qquad\qquad = -16-7$
$\qquad\qquad\qquad\qquad\qquad = -23$

11. $x^2 = (-15)^2 = (-15)(-15) = 225$

$-x^2 = -(-15)^2 = -(-15)(-15) = -225$

12. $5y^2 = 5(4)^2 = 5(16) = 80$

$5y^2 = 5(-4)^2 = 5(16) = 80$

13. $x^2+y = (-6)^2+(-3) = 36+(-3) = 33$

14. $4-x^2 = 4-(-8)^2 = 4-64 = -60$

15. average
$= \dfrac{\text{sum of numbers}}{\text{number of numbers}}$
$= \dfrac{17+(-1)+(-11)+(-13)+(-16)+(-13)+2}{7}$
$= \dfrac{-35}{7}$
$= -5$
The average of the temperatures is $-5°$F.

Calculator Explorations

1. $\dfrac{-120-360}{-10} = 48$

2. $\dfrac{4750}{-2+(-17)} = -250$

3. $\dfrac{-316+(-458)}{28+(-25)} = -258$

4. $\dfrac{-234+86}{-18+16} = 74$

Vocabulary, Readiness & Video Check 2.5

1. To simplify $-2 \div 2 \cdot (3)$, which operation should be performed first? <u>division</u>

2. To simplify $-9 - 3 \cdot 4$, which operation should be performed first? <u>multiplication</u>

3. The <u>average</u> of a list of numbers is $\dfrac{\text{sum of numbers}}{\textit{number} \text{ of numbers}}$.

4. To simplify $5[-9 + (-3)] \div 4$, which operation should be performed first? <u>addition</u>

5. To simplify $-2 + 3(10 - 12) \cdot (-8)$, which operation should be performed first? <u>subtraction</u>

6. To evaluate $x - 3y$ for $x = -7$ and $y = -1$, replace x with -7 and y with -1 and evaluate <u>$-7 - 3(-1)$</u>.

7. A fraction bar means divided by and it is a grouping symbol.

8. To make sure that the entire value of -2, including the sign, is squared.

9. Finding the average is a good application of both order of operations and adding and dividing integers.

Exercise Set 2.5

2. $-2^4 = -(2)(2)(2)(2) = -16$

4. $(-2)^4 = (-2)(-2)(-2)(-2) = 16$

6. $5 \cdot 2^3 = 5 \cdot 8 = 40$

8. $10 - 23 - 12 = -13 - 12 = -25$

10. $-8 + 4(3) = -8 + 12 = 4$

12. $7(-6) + 3 = -42 + 3 = -39$

14. $-12 + 6 \div 3 = -12 + 2 = -10$

16. $5 + 9 \cdot 4 - 20 = 5 + 36 - 20$
$\qquad\qquad\quad = 41 - 20$
$\qquad\qquad\quad = 21$

18. $\dfrac{20 - 15}{-1} = \dfrac{5}{-1} = -5$

20. $\dfrac{88}{-8 - 3} = \dfrac{88}{-11} = -8$

22. $7(-4) - (-6) = -28 + 6 = -22$

24. $[9 + (-2)]^3 = [7]^3 = 343$

26. $7 \cdot 6 - 6 \cdot 5 + (-10) = 42 - 6 \cdot 5 + (-10)$
$\qquad\qquad\qquad\qquad = 42 - 30 + (-10)$
$\qquad\qquad\qquad\qquad = 12 + (-10)$
$\qquad\qquad\qquad\qquad = 2$

28. $7 - (-5)^2 = 7 - 25 = -18$

30. $\left|-3 + 7\right| \cdot 7^2 = \left|4\right| \cdot 7^2 = 4 \cdot 7^2 = 4 \cdot 49 = 196$

32. $10 \cdot 5^3 + 7 = 10 \cdot 125 + 7 = 1250 + 7 = 1257$

34. $8^2 - (5 - 2)^4 = 8^2 - 3^4 = 64 - 81 = -17$

36. $\left|12 - 19\right| \div 7 = \left|-7\right| \div 7 = 7 \div 7 = 1$

38. $-(-2)^3 = -(-8) = 8$

40. $(2 - 7)^2 \div (4 - 3)^4 = (-5)^2 \div 1^4 = 25 \div 1 = 25$

42. $\left|3 - 15\right| \cdot (-4) \div (-16) = \left|-12\right| \cdot (-4) \div (-16)$
$\qquad\qquad\qquad\qquad\quad = 12 \cdot (-4) \div (-16)$
$\qquad\qquad\qquad\qquad\quad = -48 \div (-16)$
$\qquad\qquad\qquad\qquad\quad = 3$

44. $(-20 - 5) \div 5 - 15 = (-25) \div 5 - 15 = -5 - 15 = -20$

46. $3 \cdot (8 - 3) + (-4) - 10 = 3 \cdot (5) + (-4) - 10$
$\qquad\qquad\qquad\qquad\qquad = 15 + (-4) - 10$
$\qquad\qquad\qquad\qquad\qquad = 11 - 10$
$\qquad\qquad\qquad\qquad\qquad = 1$

48. $(4 - 12) \cdot (8 - 17) = (-8) \cdot (-9) = 72$

50. $(-4 \div 4) - (8 \div 8) = (-1) - (1) = -2$

52. $(11 - 3^2)^3 = (11 - 9)^3 = 2^3 = 8$

54. $-3(4 - 8)^2 + 5(14 - 16)^3 = -3(-4)^2 + 5(-2)^3$
$\qquad\qquad\qquad\qquad\qquad\qquad = -3(16) + 5(-8)$
$\qquad\qquad\qquad\qquad\qquad\qquad = -48 + (-40)$
$\qquad\qquad\qquad\qquad\qquad\qquad = -88$

56. $12 - [7 - (3 - 6)] + (2 - 3)^3$
$\quad = 12 - [7 - (-3)] + (2 - 3)^3$
$\quad = 12 - (7 + 3) + (-1)^3$
$\quad = 12 - 10 + (-1)$
$\quad = 2 + (-1)$
$\quad = 1$

58. $\dfrac{10(-1) - (-2)(-3)}{2[-8 \div (-2 - 2)]} = \dfrac{-10 - 6}{2[-8 \div (-4)]}$
$\qquad\qquad\qquad\qquad\quad = \dfrac{-16}{2(2)}$
$\qquad\qquad\qquad\qquad\quad = \dfrac{-16}{4}$
$\qquad\qquad\qquad\qquad\quad = -4$

60. $-2[6 + 4(2 - 8)] - 25 = -2[6 + 4(-6)] - 25$
$\qquad\qquad\qquad\qquad\qquad = -2[6 + (-24)] - 25$
$\qquad\qquad\qquad\qquad\qquad = -2(-18) - 25$
$\qquad\qquad\qquad\qquad\qquad = 36 - 25$
$\qquad\qquad\qquad\qquad\qquad = 11$

62. $x - y - z = -2 - 4 - (-1)$
$\qquad\qquad\quad = -2 - 4 + 1$
$\qquad\qquad\quad = -6 + 1$
$\qquad\qquad\quad = -5$

64. $5x - y + 4z = 5(-2) - 4 + 4(-1)$
$\qquad\qquad\qquad = -10 - 4 + (-4)$
$\qquad\qquad\qquad = -14 + (-4)$
$\qquad\qquad\qquad = -18$

66. $x^2 + z = (-2)^2 + (-1) = 4 + (-1) = 3$

68. $\dfrac{4x}{y} = \dfrac{4(-2)}{4} = \dfrac{-8}{4} = -2$

70. $z^2 = (-4)^2 = 16$

72. $-x^2 = -(-3)^2 = -9$

74. $3x^2 = 3(-3)^2 = 3(9) = 27$

76. $3 - z^2 = 3 - (-4)^2 = 3 - 16 = -13$

78. $3z^2 - x = 3(-4)^2 - (-3) = 3(16) + 3 = 48 + 3 = 51$

80. average $= \dfrac{-18 + (-8) + (-1) + (-1) + 0 + 4}{6}$

$= \dfrac{-24}{6}$

$= -4$

82. average $= \dfrac{-40 + (-20) + (-10) + (-15) + (-5)}{5}$

$= \dfrac{-90}{5}$

$= -18$

84. The two lowest scores are -12 and -5.
$-5 - (-12) = -5 + 12 = 7$
The difference between the two lowest scores is 7.

86. average $= \dfrac{-12 + (-5) + (-1) + 6}{4} = \dfrac{-12}{4} = -3$

The average of the scores is -3.

88. no; answers may vary

90. $90 \div 45 = 2$

92. $45 + 90 = 135$

94. $3 + 5 + 3 + 5 = 16$
The perimeter is 16 centimeters.

96. $17 + 23 + 32 = 72$
The perimeter is 72 meters.

98. $(7 \cdot 3 - 4) \cdot 2 = (21 - 4) \cdot 2 = 17 \cdot 2 = 34$

100. $2 \cdot (8 \div 4 - 20) = 2 \cdot (2 - 20) = 2 \cdot (-18) = -36$

102. answers may vary

104. answers may vary

106. $(-17)^6 = (-17)(-17)(-17)(-17)(-17)(-17)$
$= 24{,}137{,}569$

108. $3x^2 + 2x - y = 3(-18)^2 + 2(-18) - 2868$
$= 3(324) + (-36) - 2868$
$= 972 + (-36) - 2868$
$= 936 - 2868$
$= -1932$

110. $5(ab + 3)^b = 5(-2 \cdot 3 + 3)^3$
$= 5(-6 + 3)^3$
$= 5(-3)^3$
$= 5(-27)$
$= -135$

Section 2.6 Practice Exercises

1. $\quad -4x - 3 = 5$
$\quad -4(-2) - 3 \overset{?}{=} 5$
$\qquad\quad 8 - 3 \overset{?}{=} 5$
$\qquad\qquad\quad 5 = 5$ True
Since $5 = 5$ is true, -2 is a solution of the equation.

2. $\quad y - 6 = -2$
$\quad y - 6 + 6 = -2 + 6$
$\qquad\quad y = 4$
Check: $y - 6 = -2$
$\qquad\quad 4 - 6 \overset{?}{=} -2$
$\qquad\qquad -2 = -2$ True
The solution is 4.

3. $\quad -2 = z + 8$
$\quad -2 - 8 = z + 8 - 8$
$\quad -10 = z$
Check: $-2 = z + 8$
$\qquad\quad -2 \overset{?}{=} -10 + 8$
$\qquad\quad -2 = -2$ True
The solution is -10.

4. $x = -2 + 90 + (-100)$
$x = 88 + (-100)$
$x = -12$
The solution is -12.

5. $3y = -18$

$$\frac{3y}{3} = \frac{-18}{3}$$

$$\frac{3}{3} \cdot y = \frac{-18}{3}$$

$$y = -6$$

Check: $3y = -18$

$3(-6) \stackrel{?}{=} -18$

$-18 = -18$ True

The solution is -6.

6. $-32 = 8x$

$$\frac{-32}{8} = \frac{8x}{8}$$

$$\frac{-32}{8} = \frac{8}{8} \cdot x$$

$$-4 = x$$

Check: $-32 = 8x$

$-32 \stackrel{?}{=} 8(-4)$

$-32 = -32$ True

The solution is -4.

7. $-3y = -27$

$$\frac{-3y}{-3} = \frac{-27}{-3}$$

$$\frac{-3}{-3} \cdot y = \frac{-27}{-3}$$

$$y = 9$$

Check: $-3y = -27$

$-3 \cdot 9 \stackrel{?}{=} -27$

$-27 = -27$ True

The solution is 9.

8. $\dfrac{x}{-4} = 7$

$$-4 \cdot \frac{x}{-4} = -4 \cdot 7$$

$$\frac{-4}{-4} \cdot x = -4 \cdot 7$$

$$x = -28$$

Check: $\dfrac{x}{-4} = 7$

$$\frac{-28}{-4} \stackrel{?}{=} 7$$

$$7 = 7$$ True

The solution is -28.

Vocabulary, Readiness & Video Check 2.6

1. A combination of operations on variables and numbers is called an <u>expression</u>.

2. A statement of the form "expression = expression" is called an <u>equation</u>.

3. An <u>equation</u> contains an equal sign (=) while an <u>expression</u> does not.

4. An <u>expression</u> may be simplified and evaluated while an <u>equation</u> may be solved.

5. A <u>solution</u> of an equation is a number that when substituted for a variable makes the equation a true statement.

6. <u>Equivalent</u> equations have the same solution.

7. By the <u>addition</u> property of equality, the same number may be added to or subtracted from both sides of an equation without changing the solution of the equation.

8. By the <u>multiplication</u> property of equality, both sides of an equation may be multiplied or divided by the same nonzero number without changing the solution of the equation.

9. an equal sign

10. We can add the same number to both sides of an equation and we'll have an equivalent equation. Also, we can subtract the same number from both sides of an equation and have an equivalent equation.

11. To check a solution, we go back to the <u>original</u> equation, replace the variable with the proposed solution, and see if we get a <u>true</u> statement.

Exercise Set 2.6

2. $y - 16 = -7$

$9 - 16 \stackrel{?}{=} -7$

$-7 = -7$ True

Since $-7 = -7$ is true, 9 is a solution of the equation.

4. $a + 23 = -16$

$-7 + 23 \stackrel{?}{=} -16$

$16 = -16$ False

Since $16 = -16$ is false, -7 is not a solution of the equation.

6. $-3k = 12 - k$
$-3(-6) \overset{?}{=} 12 - (-6)$
$18 \overset{?}{=} 12 + 6$
$18 = 18$ True
Since $18 = 18$ is true, -6 is a solution of the equation.

8. $2(b-3) = 10$
$2(1-3) \overset{?}{=} 10$
$2(-2) \overset{?}{=} 10$
$-4 = 10$ False
Since $-4 = 10$ is false, 1 is not a solution of the equation.

10. $f + 4 = -6$
$f + 4 - 4 = -6 - 4$
$f = -10$
Check: $f + 4 = -6$
$-10 + 4 \overset{?}{=} -6$
$-6 = -6$ True
The solution is -10.

12. $s - 7 = -15$
$s - 7 + 7 = -15 + 7$
$s = -8$
Check: $s - 7 = -15$
$-8 - 7 \overset{?}{=} -15$
$-15 = -15$ True
The solution is -8.

14. $1 = y + 7$
$1 - 7 = y + 7 - 7$
$-6 = y$
Check: $1 = y + 7$
$1 \overset{?}{=} -6 + 7$
$1 = 1$ True
The solution is -6.

16. $-50 + 40 - 5 = z$
$-10 - 5 = z$
$-15 = z$
Check: $-50 + 40 - 5 = z$
$-50 + 40 - 5 \overset{?}{=} -15$
$-10 - 5 \overset{?}{=} -15$
$-15 = -15$ True
The solution is -15.

18. $6y = 48$
$\dfrac{6y}{6} = \dfrac{48}{6}$
$\dfrac{6}{6} \cdot y = \dfrac{48}{6}$
$y = 8$
Check: $6y = 48$
$6(8) \overset{?}{=} 48$
$48 = 48$ True
The solution is 8.

20. $-2x = 26$
$\dfrac{-2x}{-2} = \dfrac{26}{-2}$
$\dfrac{-2}{-2} \cdot x = \dfrac{26}{-2}$
$x = -13$
Check: $-2x = 26$
$-2(-13) \overset{?}{=} 26$
$26 = 26$ True
The solution is -13.

22. $\dfrac{n}{11} = -5$
$11 \cdot \dfrac{n}{11} = 11 \cdot (-5)$
$\dfrac{11}{11} \cdot n = 11 \cdot (-5)$
$n = -55$
Check: $\dfrac{n}{11} = -5$
$\dfrac{-55}{11} \overset{?}{=} -5$
$-5 = -5$ True
The solution is -55.

24. $7y = -21$
$\dfrac{7y}{7} = \dfrac{-21}{7}$
$\dfrac{7}{7} \cdot y = \dfrac{-21}{7}$
$y = -3$
Check: $7y = -21$
$7 \cdot (-3) \overset{?}{=} -21$
$-21 = -21$ True
The solution is -3.

26. $\quad -9x = 0$

$$\frac{-9x}{-9} = \frac{0}{-9}$$

$$\frac{-9}{-9} \cdot x = \frac{0}{-9}$$

$$x = 0$$

Check: $\quad -9x = 0$

$$-9 \cdot 0 \stackrel{?}{=} 0$$

$$0 = 0 \quad \text{True}$$

The solution is 0.

28. $\quad -31x = -31$

$$\frac{-31x}{-31} = \frac{-31}{-31}$$

$$\frac{-31}{-31} \cdot x = \frac{-31}{-31}$$

$$x = 1$$

Check: $\quad -31x = -31$

$$-31 \cdot 1 \stackrel{?}{=} -31$$

$$-31 = -31 \quad \text{True}$$

The solution is 1.

30. $\quad 3y = -27$

$$\frac{3y}{3} = \frac{-27}{3}$$

$$\frac{3}{3} \cdot y = \frac{-27}{3}$$

$$y = -9$$

The solution is -9.

32. $\quad n - 4 = -48$

$$n - 4 + 4 = -48 + 4$$

$$n = -44$$

The solution is -44.

34. $\quad -36 = y + 12$

$$-36 - 12 = y + 12 - 12$$

$$-48 = y$$

The solution is -48.

36. $\quad \dfrac{x}{-9} = -9$

$$-9 \cdot \frac{x}{-9} = -9 \cdot (-9)$$

$$\frac{-9}{-9} \cdot x = -9 \cdot (-9)$$

$$x = 81$$

The solution is 81.

38. $z = -28 + 36$

$z = 8$

The solution is 8.

40. $\quad -11x = -121$

$$\frac{-11x}{-11} = \frac{-121}{-11}$$

$$\frac{-11}{-11} \cdot x = \frac{-121}{-11}$$

$$x = 11$$

The solution is 11.

42. $\quad \dfrac{n}{5} = -20$

$$5 \cdot \frac{n}{5} = 5 \cdot (-20)$$

$$\frac{5}{5} \cdot n = 5 \cdot (-20)$$

$$n = -100$$

The solution is -100.

44. $\quad -81 = 27x$

$$\frac{-81}{27} = \frac{27x}{27}$$

$$\frac{-81}{27} = \frac{27}{27} \cdot x$$

$$-3 = x$$

The solution is -3.

46. A number increased by -5 is $x + (-5)$.

48. The quotient of a number and -20 is $x \div (-20)$ or

$$\frac{x}{-20}.$$

50. -32 multiplied by a number is $-32 \cdot x$ or $-32x$.

52. Subtract a number from -18 is $-18 - x$.

54. $\quad n + 961 = 120$

$$n + 961 - 961 = 120 - 961$$

$$n = -841$$

The solution is -841.

56. $\quad \dfrac{y}{-18} = 1098$

$$-18 \cdot \frac{y}{-18} = -18 \cdot 1098$$

$$\frac{-18}{-18} \cdot y = -18 \cdot 1098$$

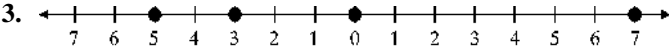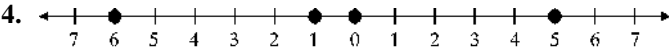$$y = -19,764$$

The solution is $-19,764$.

58. answers may vary

60. answers may vary

Chapter 2 Vocabulary Check

1. Two numbers that are the same distance from 0 on the number line but are on opposite sides of 0 are called <u>opposites</u>.

2. The <u>absolute value</u> of a number is that number's distance from 0 on a number line.

3. The <u>integers</u> are ..., −3, −2, −1, 0, 1, 2, 3, ...

4. The <u>negative</u> numbers are numbers less than zero.

5. The <u>positive</u> numbers are numbers greater than zero.

6. The symbols "<" and ">" are called <u>inequality symbols</u>.

7. A <u>solution</u> of an equation is a number that when substituted for a variable makes the equation a true statement.

8. The <u>average</u> of a list of numbers is $\dfrac{\text{sum of numbers}}{\textit{number} \text{ of numbers}}$.

9. A combination of operations on variables and numbers is called an <u>expression</u>.

10. A statement of the form "expression = expression" is called an <u>equation</u>.

11. The sign "<" means <u>is less than</u> and ">" means <u>is greater than</u>.

12. By the <u>addition</u> property of equality, the same number may be added to or subtracted from both sides of an equation without changing the solution of the equation.

13. By the <u>multiplication</u> property of equality, both sides of an equation may be multiplied or divided by the same nonzero number without changing the solution of the equation.

Chapter 2 Review

1. If 0 represents ground level, then 1572 feet below the ground is −1572.

2. If 0 represents sea level, then an elevation of 11,239 feet is +11,239.

3.

4.

5. $|-11| = 11$ since −11 is 11 units from 0 on a number line.

6. $|0| = 0$ since 0 is 0 units from 0 on a number line.

7. $-|8| = -8$

8. $-(-9) = 9$

9. $-|-16| = -16$

10. $-(-2) = 2$

11. $-18 > -20$ since −18 is to the right of −20 on a number line.

12. $-5 < 5$ since -5 is to the left of 5 on a number line.

13. $|-123| = 123$
$-|-198| = -198$
Since $123 > -198$, $|-123| > -|-198|$.

14. $|-12| = 12$
$-|-16| = -16$
Since $12 > -16$, $|-12| > -|-16|$.

15. The opposite of -18 is 18.
$-(-18) = 18$

16. The opposite of 42 is negative 42.
$-(42) = -42$

17. False; consider $a = 1$ and $b = 2$, then $1 < 2$.

18. True

19. True

20. True

21. $|y| = |-2| = 2$

22. $|-x| = |-(-3)| = |3| = 3$

23. $-|-z| = -|-(-5)| = -|5| = -5$

24. $-|-n| = -|-(-10)| = -|10| = -10$

25. The bar that extends the farthest in the negative direction corresponds to Elevator D, so Elevator D extends the farthest below ground.

26. The bar that extends the farthest in the positive direction corresponds to Elevator B, so Elevator B extends the highest above ground.

27. $|5| - |-3| = 5 - 3 = 2$
$5 > 3$, so the answer is positive.
$5 + (-3) = 2$

28. $|18| - |-4| = 18 - 4 = 14$
$18 > 4$, so the answer is positive.
$18 + (-4) = 14$

29. $|16| - |-12| = 16 - 12 = 4$
$16 > 12$, so the answer is positive.
$-12 + 16 = 4$

30. $|40| - |-23| = 40 - 23 = 17$
$40 > 23$, so the answer is positive.
$-23 + 40 = 17$

31. $|-8| + |-15| = 8 + 15 = 23$
The common sign is negative, so
$-8 + (-15) = -23$.

32. $|-5| + |-17| = 5 + 17 = 22$
The common sign is negative, so
$-5 + (-17) = -22$.

33. $|-24| - |3| = 24 - 3 = 21$
$24 > 3$, so the answer is negative.
$-24 + 3 = -21$

34. $|-89| - |19| = 89 - 19 = 70$
$89 > 19$, so the answer is negative.
$-89 + 19 = -70$

35. $15 + (-15) = 0$

36. $-24 + 24 = 0$

37. $|-43| + |-108| = 43 + 108 = 151$
The common sign is negative, so
$-43 + (-108) = -151$.

38. $|-100| + |-506| = 100 + 506 = 606$
The common sign is negative, so
$-100 + (-506) = -606$.

39. $-15 + (-5) = -20$
The temperature at 6 a.m. is $-20°C$.

40. $-127 + (-23) = -150$
The diver's current depth is -150 feet.

41. $-6 + (-9) + (-4) + (-2) = -15 + (-4) + (-2)$
$= -19 + (-2)$
$= -21$
His total score was -21.

42. $16 - 4 = 16 + (-4) = 12$
The team's score was 12.

43. $12 - 4 = 12 + (-4) = 8$

44. $-12 - 4 = -12 + (-4) = -16$

45. $-7 - 17 = -7 + (-17) = -24$

46. $7 - 17 = 7 + (-17) = -10$

47. $7 - (-13) = 7 + 13 = 20$

48. $-6 - (-14) = -6 + 14 = 8$

49. $16 - 16 = 16 + (-16) = 0$

50. $-16 - 16 = -16 + (-16) = -32$

51. $-12 - (-12) = -12 + 12 = 0$

52. $-5 - (-12) = -5 + 12 = 7$

53. $-(-5) - 12 + (-3) = 5 + (-12) + (-3)$
$$= -7 + (-3)$$
$$= -10$$

54. $-8 + (-12) - 10 - (-3) = -8 + (-12) + (-10) + 3$
$$= -20 + (-10) + 3$$
$$= -30 + 3$$
$$= -27$$

55. $600 - (-92) = 600 + 92 = 692$
The difference in elevations is 692 feet.

56. $142 - 125 + 43 - 85 = 142 + (-125) + 43 + (-85)$
$$= 17 + 43 + (-85)$$
$$= 60 + (-85)$$
$$= -25$$
The balance in his account is -25.

57. $85 - 99 = 85 + (-99) = -14$
You are -14 feet or 14 feet below ground at the end of the drop.

58. $66 - (-16) = 66 + 16 = 82$
The total length of the elevator shaft for Elevator C is 82 feet.

59. $|-5| - |-6| = 5 - 6 = 5 + (-6) = -1$
$5 - 6 = 5 + (-6) = -1$
$|-5| - |-6| = 5 - 6$ is true.

60. $|-5 - (-6)| = |-5 + 6| = |1| = 1$
$5 + 6 = 11$
Since $1 \neq 11$, the statement is false.

61. $-3(-7) = 21$

62. $-6(3) = -18$

63. $-4(16) = -64$

64. $-5(-12) = 60$

65. $(-5)^2 = (-5)(-5) = 25$

66. $(-1)^5 = (-1)(-1)(-1)(-1)(-1) = -1$

67. $12(-3)(0) = 0$

68. $-1(6)(2)(-2) = -6(2)(-2) = -12(-2) = 24$

69. $-15 \div 3 = -5$

70. $\dfrac{-24}{-8} = 3$

71. $\dfrac{0}{-3} = 0$

72. $\dfrac{-46}{0}$ is undefined.

73. $\dfrac{100}{-5} = -20$

74. $\dfrac{-72}{8} = -9$

75. $\dfrac{-38}{-1} = 38$

76. $\dfrac{45}{-9} = -5$

77. A loss of 5 yards is represented by -5.
$(-5)(2) = -10$
The total loss is 10 yards.

78. A loss of $50 is represented by -50.
$(-50)(4) = -200$
The total loss is $200.

79. A debt of $1024 is represented by -1024.
$-1024 \div 4 = -256$
Each payment is $256.

80. A drop of 45 degrees is represented by -45.
$\dfrac{-45}{9} = -5$ or $-45 \div 9 = -5$
The average drop each hour is 5°F.

81. $(-7)^2 = (-7)(-7) = 49$

82. $-7^2 = -(7 \cdot 7) = -49$

83. $5 - 8 + 3 = -3 + 3 = 0$

84. $-3 + 12 + (-7) - 10 = 9 + (-7) - 10 = 2 - 10 = -8$

85. $-10 + 3 \cdot (-2) = -10 + (-6) = -16$

86. $5 - 10 \cdot (-3) = 5 - (-30) = 5 + 30 = 35$

87. $16 \div (-2) \cdot 4 = -8 \cdot 4 = -32$

88. $-20 \div 5 \cdot 2 = -4 \cdot 2 = -8$

89. $16 + (-3) \cdot 12 \div 4 = 16 + (-36) \div 4$
$$= 16 + (-9)$$
$$= 7$$

90. $-12 + 10 \div (-5) = -12 + (-2) = -14$

91. $4^3 - (8-3)^2 = 4^3 - (5)^2 = 64 - 25 = 39$

92. $(-3)^3 - 90 = -27 - 90 = -117$

93. $\dfrac{(-4)(-3) - (-2)(-1)}{-10 + 5} = \dfrac{12 - 2}{-5} = \dfrac{10}{-5} = -2$

94. $\dfrac{4(12 - 18)}{-10 \div (-2 - 3)} = \dfrac{4(-6)}{-10 \div (-5)} = \dfrac{-24}{2} = -12$

95. average $= \dfrac{-18 + 25 + (-30) + 7 + 0 + (-2)}{6}$
$$= \dfrac{-18}{6}$$
$$= -3$$

96. average $= \dfrac{-45 + (-40) + (-30) + (-25)}{4}$
$$= \dfrac{-140}{4}$$
$$= -35$$

97. $2x - y = 2(-2) - 1 = -4 - 1 = -5$

98. $y^2 + x^2 = 1^2 + (-2)^2 = 1 + 4 = 5$

99. $\dfrac{3x}{6} = \dfrac{3(-2)}{6} = \dfrac{-6}{6} = -1$

100. $\dfrac{5y - x}{-y} = \dfrac{5(1) - (-2)}{-1} = \dfrac{5 + 2}{-1} = \dfrac{7}{-1} = -7$

101. $2n - 6 = 16$
$2(-5) - 6 \overset{?}{=} 16$
$-10 - 6 \overset{?}{=} 16$
$\qquad -16 = 16$ False
Since $-16 = 16$ is false, -5 is not a solution of the equation.

102. $2(c - 8) = -20$
$2(-2 - 8) \overset{?}{=} -20$
$2(-10) \overset{?}{=} -20$
$\qquad -20 = -20$ True
Since $-20 = -20$ is true, -2 is a solution of the equation.

103. $n - 7 = -20$
$n - 7 + 7 = -20 + 7$
$\qquad n = -13$
The solution is -13.

104. $-5 = n + 15$
$-5 - 15 = n + 15 - 15$
$\qquad -20 = n$
The solution is -20.

105. $10x = -30$
$\dfrac{10x}{10} = \dfrac{-30}{10}$
$\dfrac{10}{10} \cdot x = \dfrac{-30}{10}$
$\qquad x = -3$
The solution is -3.

106. $-8x = 72$
$\dfrac{-8x}{-8} = \dfrac{72}{-8}$
$\dfrac{-8}{-8} \cdot x = \dfrac{72}{-8}$
$\qquad x = -9$
The solution is -9.

107. $-20 + 7 = y$
$\qquad -13 = y$
The solution is -13.

108. $x - 31 = -62$
$x - 31 + 31 = -62 + 31$
$\qquad x = -31$
The solution is -31.

109. $\dfrac{n}{-4} = -11$
$-4 \cdot \dfrac{n}{-4} = -4 \cdot (-11)$
$\dfrac{-4}{-4} \cdot n = -4 \cdot (-11)$
$\qquad n = 44$
The solution is 44.

110.
$$\frac{x}{-2} = 13$$
$$-2 \cdot \frac{x}{-2} = -2 \cdot 13$$
$$\frac{-2}{-2} \cdot x = -2 \cdot 13$$
$$x = -26$$
The solution is -26.

111.
$$n + 12 = -7$$
$$n + 12 - 12 = -7 - 12$$
$$n = -19$$
The solution is -19.

112.
$$n - 40 = -2$$
$$n - 40 + 40 = -2 + 40$$
$$n = 38$$
The solution is 38.

113.
$$-36 = -6x$$
$$\frac{-36}{-6} = \frac{-6x}{-6}$$
$$\frac{-36}{-6} = \frac{-6}{-6} \cdot x$$
$$6 = x$$
The solution is 6.

114.
$$-40 = 8y$$
$$\frac{-40}{8} = \frac{8y}{8}$$
$$\frac{-40}{8} = \frac{8}{8} \cdot y$$
$$-5 = y$$
The solution is -5.

115. $-6 + (-9) = -15$

116. $-16 - 3 = -16 + (-3) = -19$

117. $-4(-12) = 48$

118. $\dfrac{84}{-4} = -21$

119. $-76 - (-97) = -76 + 97 = 21$

120. $-9 + 4 = -5$

121. $-18 - 9 = -27$
The temperature on Friday was $-27°$C.

122. $-11 + 17 = 6$
The temperature at noon on Tuesday was $6°$C.

123. $12{,}923 - (-195) = 12{,}923 + 195 = 13{,}118$
The difference in elevations is 13,118 feet.

124. $-32 + 23 = -9$
His financial situation can be represented by -9.

125. $(3-7)^2 \div (6-4)^3 = (-4)^2 \div (2)^3 = 16 \div 8 = 2$

126.
$$3(4+2) + (-6) - 3^2 = 3(6) + (-6) - 3^2$$
$$= 3(6) + (-6) - 9$$
$$= 18 + (-6) - 9$$
$$= 12 - 9$$
$$= 3$$

127. $2 - 4 \cdot 3 + 5 = 2 - 12 + 5 = -10 + 5 = -5$

128. $4 - 6 \cdot 5 + 1 = 4 - 30 + 1 = -26 + 1 = -25$

129. $\dfrac{-|-14| - 6}{7 + 2(-3)} = \dfrac{-14 - 6}{7 + (-6)} = \dfrac{-20}{1} = -20$

130.
$$5(7-6)^3 - 4(2-3)^2 + 2^4 = 5(1)^3 - 4(-1)^2 + 2^4$$
$$= 5(1) - 4(1) + 16$$
$$= 5 - 4 + 16$$
$$= 1 + 16$$
$$= 17$$

131.
$$n - 9 = -30$$
$$n - 9 + 9 = -30 + 9$$
$$n = -21$$
The solution is -21.

132.
$$n + 18 = 1$$
$$n + 18 - 18 = 1 - 18$$
$$n = -17$$
The solution is -17.

133.
$$-4x = -48$$
$$\frac{-4x}{-4} = \frac{-48}{-4}$$
$$\frac{-4}{-4} \cdot x = \frac{-48}{-4}$$
$$x = 12$$
The solution is 12.

134. $9x = -81$

$$\frac{9x}{9} = \frac{-81}{9}$$

$$\frac{9}{9} \cdot x = \frac{-81}{9}$$

$$x = -9$$

The solution is -9.

135. $\dfrac{n}{-2} = 100$

$$-2 \cdot \frac{n}{-2} = -2 \cdot 100$$

$$\frac{-2}{-2} \cdot n = -2 \cdot 100$$

$$n = -200$$

The solution is -200.

136. $\dfrac{y}{-1} = -3$

$$-1 \cdot \frac{y}{-1} = -1(-3)$$

$$\frac{-1}{-1} \cdot y = -1 \cdot (-3)$$

$$y = 3$$

The solution is 3.

Chapter 2 Test

1. $-5 + 8 = 3$

2. $18 - 24 = 18 + (-24) = -6$

3. $5 \cdot (-20) = -100$

4. $-16 \div (-4) = 4$

5. $-18 + (-12) = -30$

6. $-7 - (-19) = -7 + 19 = 12$

7. $-5 \cdot (-13) = 65$

8. $\dfrac{-25}{-5} = 5$

9. $|-25| + (-13) = 25 + (-13) = 12$

10. $14 - |-20| = 14 - 20 = 14 + (-20) = -6$

11. $|5| \cdot |-10| = 5 \cdot 10 = 50$

12. $\dfrac{|-10|}{-|-5|} = \dfrac{10}{-5} = -2$

13. $-8 + 9 \div (-3) = -8 + (-3) = -11$

14. $-7 + (-32) - 12 + 5 = -7 + (-32) + (-12) + 5$
$$= -39 + (-12) + 5$$
$$= -51 + 5$$
$$= -46$$

15. $(-5)^3 - 24 \div (-3) = -125 - 24 \div (-3)$
$$= -125 - (-8)$$
$$= -125 + 8$$
$$= -117$$

16. $(5 - 9)^2 \cdot (8 - 2)^3 = (-4)^2 \cdot (6)^3 = 16 \cdot 216 = 3456$

17. $-(-7)^2 \div 7 \cdot (-4) = -49 \div 7 \cdot (-4) = -7 \cdot (-4) = 28$

18. $3 - (8 - 2)^3 = 3 - 6^3$
$$= 3 - 216$$
$$= 3 + (-216)$$
$$= -213$$

19. $\dfrac{4}{2} - \dfrac{8^2}{16} = \dfrac{4}{2} - \dfrac{64}{16} = 2 - 4 = 2 + (-4) = -2$

20. $\dfrac{-3(-2) + 12}{-1(-4 - 5)} = \dfrac{6 + 12}{-1(-9)} = \dfrac{18}{9} = 2$

21. $\dfrac{|25 - 30|^2}{2(-6) + 7} = \dfrac{|-5|^2}{-12 + 7} = \dfrac{(5)^2}{-5} = \dfrac{25}{-5} = -5$

22. $5(-8) - [6 - (2 - 4)] + (12 - 16)^2$
$$= 5(-8) - [6 - (-2)] + (12 - 16)^2$$
$$= 5(-8) - (6 + 2) + (-4)^2$$
$$= 5(-8) - 8 + (-4)^2$$
$$= 5(-8) - 8 + 16$$
$$= -40 - 8 + 16$$
$$= -48 + 16$$
$$= -32$$

23. $7x + 3y - 4z = 7(0) + 3(-3) - 4(2)$
$$= 0 + (-9) - 8$$
$$= -9 - 8$$
$$= -17$$

24. $10 - y^2 = 10 - (-3)^2 = 10 - 9 = 1$

25. $\dfrac{3z}{2y} = \dfrac{3(2)}{2(-3)} = \dfrac{6}{-6} = -1$

26. A descent of 22 feet is represented by −22.
$4(-22) = -88$
Mary is 88 feet below sea level.

27. $129 + (-79) + (-40) + 35 = 50 + (-40) + 35$
$$= 10 + 35$$
$$= 45$$
His new balance can be represented by 45.

28. Subtract the elevation of the Romanche Gap from the elevation of Mt. Washington.
$6288 - (-25{,}354) = 6288 + 25{,}354 = 31{,}642$
The difference in elevations is 31,642 feet.

29. Subtract the depth of the lake from the elevation of the surface.
$1495 - 5315 = 1495 + (-5315) = -3820$
The deepest point of the lake is 3820 feet below sea level.

30. $\text{average} = \dfrac{-12 + (-13) + 0 + 9}{4} = \dfrac{-16}{4} = -4$

31. a. The product of a number and 17 is $17 \cdot x$ or $17x$.

    b. A number subtracted from 20 is $20 - x$.

32. $-9n = -45$
$$\frac{-9n}{-9} = \frac{-45}{-9}$$
$$\frac{-9}{-9} \cdot n = \frac{-45}{-9}$$
$$n = 5$$
The solution is 5.

33. $\dfrac{n}{-7} = 4$
$$-7 \cdot \frac{n}{-7} = -7 \cdot 4$$
$$\frac{-7}{-7} \cdot n = -7 \cdot 4$$
$$n = -28$$
The solution is −28.

34. $x - 16 = -36$
$$x - 16 + 16 = -36 + 16$$
$$x = -20$$
The solution is −20.

35. $-20 + 8 + 8 = x$
$$-12 + 8 = x$$
$$-4 = x$$
The solution is −4.

Cumulative Review Chapters 1–2

1. The place value of 3 in 396,418 is hundred-thousands.

2. The place value of 3 in 4308 is hundreds.

3. The place value of 3 in 93,192 is thousands.

4. The place value of 3 is 693,298 is thousands.

5. The place value of 3 in 534,275,866 is ten-millions.

6. The place value of 3 in 267,301,818 is hundred-thousands.

7. a. $-7 < 7$ since −7 is to the left of 7 on a number line.

    b. $0 > -4$ since 0 is to the right of −4 on a number line.

    c. $-9 > -11$ since −9 is to the right of −11 on a number line.

8. a. $12 > -4$ since 12 is to the right of −4 on a number line.

    b. $-13 > -31$ since −13 is to the right of −31 on a number line.

    c. $-82 < 79$ since −82 is to the left of 79 on a number line.

9. $13 + 2 + 7 + 8 + 9 = (13 + 7) + (2 + 8) + 9$
$$= 20 + 10 + 9$$
$$= 39$$

10. $11 + 3 + 9 + 16 = (11 + 9) + (3 + 16) = 20 + 19 = 39$

11.
$$\begin{array}{r} 7826 \\ -\ \ 505 \\ \hline 7321 \end{array}$$
Check:
$$\begin{array}{r} 7321 \\ +\ \ 505 \\ \hline 7826 \end{array}$$

12.   3285
  − 272
  ―――――
    3013
  Check: 3013
       + 272
       ―――――
         3285

13. Subtract 7257 from the radius of Jupiter.
    43,441
  − 7 257
  ―――――
    36,184
The radius of Saturn is 36,184 miles.

14. Subtract the cost of the camera from the amount in her account.
    762
  − 237
  ―――――
    525
She will have $525 left in her account after buying the camera.

15. To round 568 to the nearest ten, observe that the digit in the ones place is 8. Since this digit is at least 5, we add 1 to the digit in the tens place. The number 568 rounded to the nearest ten is 570.

16. To round 568 to the nearest hundred, observe that the digit in the tens place is 6. Since this digit is at least 5, we add 1 to the digit in the hundreds place. The number 568 rounded to the nearest hundred is 600.

17.   4725   rounds to   4700
  − 2879   rounds to   − 2900
  ――――――――――――――――――――
                              1800

18.   8394   rounds to   8000
  − 2913   rounds to   − 3000
  ――――――――――――――――――――
                              5000

19. a. $5(6 + 5) = 5 \cdot 6 + 5 \cdot 5$

   b. $20(4 + 7) = 20 \cdot 4 + 20 \cdot 7$

   c. $2(7 + 9) = 2 \cdot 7 + 2 \cdot 9$

20. a. $5(2 + 12) = 5 \cdot 2 + 5 \cdot 12$

   b. $9(3 + 6) = 9 \cdot 3 + 9 \cdot 6$

   c. $4(8 + 1) = 4 \cdot 8 + 4 \cdot 1$

21.   631
  ×   125
  ―――――――
      3 155
    12 620
    63 100
  ―――――――
    78,875

22.   299
  ×   104
  ―――――――
      1 196
    29 900
  ―――――――
    31,096

23. a. $42 \div 7 = 6$ because $6 \cdot 7 = 42$.

   b. $\dfrac{64}{8} = 8$ because $8 \cdot 8 = 64$.

   c. $3\overline{)21}$ with 7 above, because $7 \cdot 3 = 21$.

24. a. $\dfrac{35}{5} = 7$ because $7 \cdot 5 = 35$.

   b. $64 \div 8 = 8$ because $8 \cdot 8 = 64$.

   c. $4\overline{)48}$ with 12 above, because $12 \cdot 4 = 48$.

25.
```
      741
   5) 3705
     −35
      ――
      20
     −20
      ――
      05
      −5
      ――
       0
```
Check: 741
       ×   5
       ―――――
         3705

26.
```
      456
   8) 3648
     −32
      ――
      44
     −40
      ――
      48
     −48
      ――
       0
```

Check: $\begin{array}{r} 456 \\ \times\ \ 8 \\ \hline 3648 \end{array}$

27. $\dfrac{\text{number of cards}}{\text{for each person}} = \dfrac{\text{number of}}{\text{cards}} \div \dfrac{\text{number of}}{\text{friends}}$

$\qquad\qquad = 238 \div 19$

$\begin{array}{r} 12 \text{ R } 10 \\ 19\overline{)\ 238} \\ \underline{-19} \\ 48 \\ \underline{-38} \\ 10 \end{array}$

Each friend will receive 12 cards. There will be 10 cards left over.

28. $\dfrac{\text{Cost of each}}{\text{ticket}} = \dfrac{\text{total}}{\text{cost}} \div \text{number of tickets}$

$\qquad\qquad = 324 \div 36$

$\begin{array}{r} 9 \\ 36\overline{)\ 324} \\ \underline{-324} \\ 0 \end{array}$

Each ticket cost \$9.

29. $9^2 = 9 \cdot 9 = 81$

30. $5^3 = 5 \cdot 5 \cdot 5 = 125$

31. $6^1 = 6$

32. $4^1 = 4$

33. $5 \cdot 6^2 = 5 \cdot 6 \cdot 6 = 180$

34. $2^3 \cdot 7 = 2 \cdot 2 \cdot 2 \cdot 7 = 56$

35. $\dfrac{7 - 2 \cdot 3 + 3^2}{5(2-1)} = \dfrac{7 - 2 \cdot 3 + 9}{5(1)} = \dfrac{7 - 6 + 9}{5} = \dfrac{10}{5} = 2$

36. $\dfrac{6^2 + 4 \cdot 4 + 2^3}{37 - 5^2} = \dfrac{36 + 4 \cdot 4 + 8}{37 - 25}$

$\qquad\qquad = \dfrac{36 + 16 + 8}{12}$

$\qquad\qquad = \dfrac{60}{12}$

$\qquad\qquad = 5$

37. $x + 6 = 8 + 6 = 14$

38. $5 + x = 5 + 9 = 14$

39. a. $|-9| = 9$ because -9 is 9 units from 0.

   b. $|8| = 8$ because 8 is 8 units from 0.

   c. $|0| = 0$ because 0 is 0 units from 0.

40. a. $|4| = 4$ because 4 is 4 units from 0.

   b. $|-7| = 7$ because -7 is 7 units from 0.

41. $-2 + 25 = 23$

42. $8 + (-3) = 5$

43. $2a - b = 2(8) - (-6) = 16 - (-6) = 16 + 6 = 22$

44. $x - y = -2 - (-7) = -2 + 7 = 5$

45. $-7 \cdot 3 = -21$

46. $5(-2) = -10$

47. $0 \cdot (-4) = 0$

48. $-6 \cdot 9 = -54$

49. $3(4 - 7) + (-2) - 5 = 3(-3) + (-2) - 5$

$\qquad\qquad\qquad\qquad = -9 + (-2) - 5$

$\qquad\qquad\qquad\qquad = -11 - 5$

$\qquad\qquad\qquad\qquad = -16$

50. $4 - 8(7 - 3) - (-1) = 4 - 8(4) - (-1)$

$\qquad\qquad\qquad\qquad = 4 - 32 - (-1)$

$\qquad\qquad\qquad\qquad = 4 - 32 + 1$

$\qquad\qquad\qquad\qquad = -28 + 1$

$\qquad\qquad\qquad\qquad = -27$