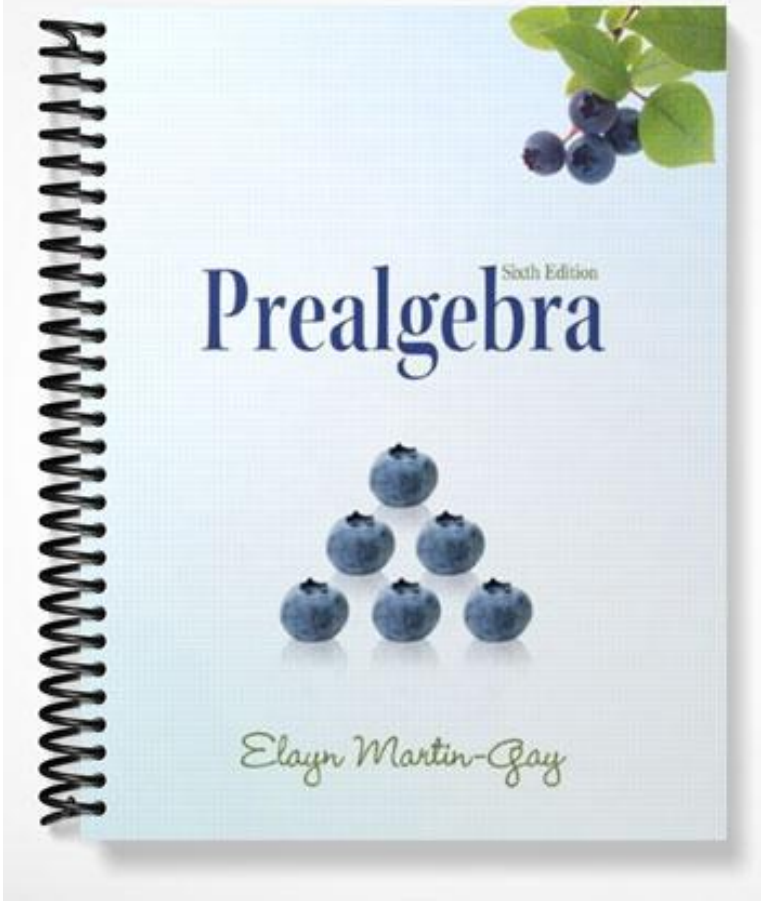
SOLUTIONS MANUAL



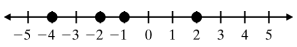
Chapter 2

Section 2.1

Practice Problems

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 temperature is the one that corresponds to the bar that extends the furthest in the positive direction (upward). Venus has the highest average temperature.

Vocabulary and Readiness Check

1. The numbers ...−3, −2, −1, 0, 1, 2, 3, ... are called integers.

2. Positive numbers, negative numbers, and zero, together are called signed numbers.

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

4. Numbers greater than 0 are called positive numbers while numbers less than 0 are called negative numbers.

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

6. On a number line, the greater number is to the right of the lesser number.

7. A number's distance from 0 on the number line is the number's absolute value.

8. The numbers −5 and 5 are called opposites.

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 a gain of 0 yards, then a gain of 28 yards is +28.

8. If 0 represents a fall of 0 points, then a fall of 213 points is −213.

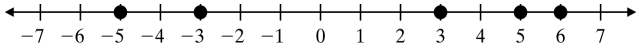
10. If 0 represents an income of $0, then an income of $1224 million is +1224 million.

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.

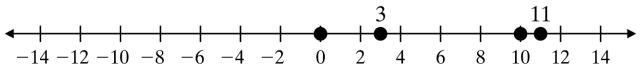
14. If 0 represents a decrease of 0%, then an 18 percent decrease is −18.

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.

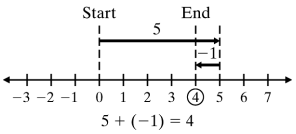
118. answers may vary

120. no; answers may vary

Section 2.2

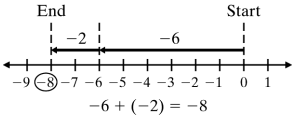
Practice Problems

1.



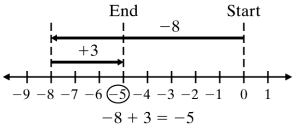
$5 + (-1) = 4$

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.
$$\begin{aligned} 5+(-3)+12+(-14) &= 2+12+(-14) \\ &= 14+(-14) \\ &= 0 \end{aligned}$$

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

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

18.
$$\begin{aligned} \text{Temperature at 8 a.m.} &= -7+(+4)+(+7) \\ &= -3+(+7) \\ &= 4 \end{aligned}$$
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 and Readiness Check

1. If n is a number, then $-n + n =$ 0.

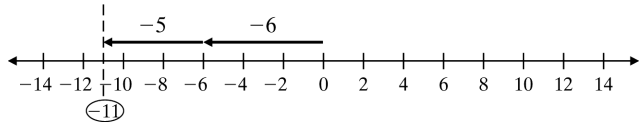
2. Since $x + n = n + x$, we say that addition is commutative.

3. If a is a number, then $-(-a) =$ a.

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

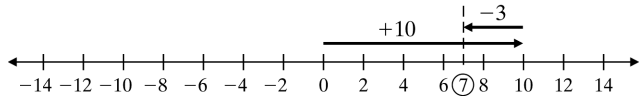
Exercise Set 2.2

2.



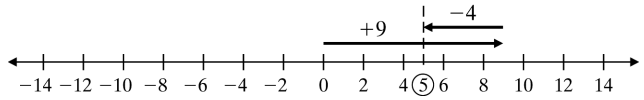
$-6 + (-5) = -11$

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 feet below the surface.

72. Since $-2 < +1$, Stanford won Round 3.

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

76. The net incomes shown are -25, 69, 1328, and 3496. The total is
$-25 + 69 + 1328 + 3496 = 4868$
The total net income for the years shown is \$4,868,000,000.

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. $-27 + 10 = -17$
Georgia's all-time record low temperature was $-17°$F.

84. $-8605 + 1070 = -7535$
The depth of the Cayman Trench is -7535 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 Problems

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 and Readiness Check

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

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. $$\begin{aligned} 23-(-17)+(-9) &= 23+17+(-9) \\ &= 40+(-9) \\ &= 31 \end{aligned}$$

50. $$\begin{aligned} -(-9)-14+(-23) &= 9+(-14)+(-23) \\ &= -5+(-23) \\ &= -28 \end{aligned}$$

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

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

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 2°F and in December is −6°F.
$2-(-6)=2+6=8$
The difference is 8°F.

66. The month with the warmest temperature is July, 62°F, and the month with the coldest temperature is January, −10°F.
$62-(-10)=62+10=72$
The difference is 72°F.

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

70. $93-18-26=93+(-18)+(-26)$
$=75+(-26)$
$=49$
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. $330-(-162)=330+162=492$
The difference in temperature is 492°F.

84. $511-1241=511+(-1241)=-730$
The trade balance was −730 million barrels.

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

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

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

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

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

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 Problems

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. $\frac{42}{-7} = -6$

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

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

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

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

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

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

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

Vocabulary and Readiness Check

1. The product of a negative number and a positive number is a negative number.

2. The product of two negative numbers is a positive number.

3. The quotient of two negative numbers is a positive number.

4. The quotient of a negative number and a positive number is a negative number.

5. The product of a negative number and zero is 0.

6. The quotient of 0 and a negative number is 0.

7. The quotient of a negative number and 0 is undefined.

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. $\frac{56}{-8} = -7$

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

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

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

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

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. $-\frac{30}{5} = -6$

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

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. $\frac{0}{-14} = 0$

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

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

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

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

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. $\frac{x}{y} = \frac{9}{-3} = -3$

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

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

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

98. $xy = -3 \cdot 0 = 0$
$\frac{x}{y} = \frac{-3}{0}$ is undefined.

100. $\frac{-63}{-3} = 21$
The quotient of -63 and -3 is 21.

102.
$$\begin{array}{r} 49 \\ \times\ 5 \\ \hline 245 \end{array}$$
$-49 \cdot 5 = -245$
The product of -49 and 5 is -245.

104. The quotient of -8 and a number is $\frac{-8}{x}$ 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. $\frac{-38,732}{4} = -9683$
The expected net income for each quarter would be −$9683 million.

122. a. $335 - 27 = 308$
There were 308 more California Condors in 2009 than in 1987. This is a change of 308 condors.

b. This is a period of 22 years.

$$\frac{308}{22} = 14 \qquad 22\overline{)\,308}$$

$$\begin{array}{r} 14 \\ 22\overline{)\,308} \\ \underline{-22} \\ 88 \\ \underline{-88} \\ 0 \end{array}$$

The average change was 14 California Condors per year.

124. $$\begin{aligned} 3 \cdot (7-4) + 2 \cdot 5^2 &= 3 \cdot 3 + 2 \cdot 5^2 \\ &= 3 \cdot 3 + 2 \cdot 25 \\ &= 9 + 2 \cdot 25 \\ &= 9 + 50 \\ &= 59 \end{aligned}$$

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. $\begin{aligned} -4+(-8)-16-(-9) &= -4+(-8)+(-16)+9 \\ &= -12+(-16)+9 \\ &= -28+9 \\ &= -19 \end{aligned}$

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 Problems

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. $\begin{aligned} 30+50+(-4)^3 &= 30+50+(-64) \\ &= 80+(-64) \\ &= 16 \end{aligned}$

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

8. $\begin{aligned} 2(2-9)+(-12)-3 &= 2(-7)+(-12)-3 \\ &= -14+(-12)-3 \\ &= -26-3 \\ &= -29 \end{aligned}$

9. $\begin{aligned} (-5)\cdot|-8|+(-3)+2^3 &= (-5)\cdot 8+(-3)+2^3 \\ &= (-5)\cdot 8+(-3)+8 \\ &= -40+(-3)+8 \\ &= -43+8 \\ &= -35 \end{aligned}$

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

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
$= \dfrac{\text{sum of numbers}}{\text{number of numbers}}$
$= \dfrac{15+(-1)+(-11)+(-14)+(-16)+(-14)+(-1)}{7}$
$= \dfrac{-42}{7}$
$= -6$
The average of the temperatures is −6°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 and Readiness Check

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

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

3. The average 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? addition

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

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

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

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

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. $|12 - 19| \div 7 = |-7| \div 7 = 7 \div 7 = 1$

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

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

42.
$$\begin{aligned} |3-15| \cdot (-4) \div (-16) &= |-12| \cdot (-4) \div (-16) \\ &= 12 \cdot (-4) \div (-16) \\ &= -48 \div (-16) \\ &= 3 \end{aligned}$$

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

46.
$$\begin{aligned} 3 \cdot (8-3) + (-4) - 10 &= 3 \cdot (5) + (-4) - 10 \\ &= 15 + (-4) - 10 \\ &= 11 - 10 \\ &= 1 \end{aligned}$$

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.
$$\begin{aligned} -3(4-8)^2 + 5(14-16)^3 &= -3(-4)^2 + 5(-2)^3 \\ &= -3(16) + 5(-8) \\ &= -48 + (-40) \\ &= -88 \end{aligned}$$

56.
$$\begin{aligned} &12 - [7 - (3-6)] + (2-3)^3 \\ &= 12 - [7 - (-3)] + (2-3)^3 \\ &= 12 - (7+3) + (-1)^3 \\ &= 12 - 10 + (-1) \\ &= 2 + (-1) \\ &= 1 \end{aligned}$$

58.
$$\begin{aligned} \frac{10(-1) - (-2)(-3)}{2[-8 \div (-2-2)]} &= \frac{-10-6}{2[-8 \div (-4)]} \\ &= \frac{-16}{2(2)} \\ &= \frac{-16}{4} \\ &= -4 \end{aligned}$$

60.
$$\begin{aligned} -2[6 + 4(2-8)] - 25 &= -2[6 + 4(-6)] - 25 \\ &= -2[6 + (-24)] - 25 \\ &= -2(-18) - 25 \\ &= 36 - 25 \\ &= 11 \end{aligned}$$

62.
$$\begin{aligned} x - y - z &= -2 - 4 - (-1) \\ &= -2 - 4 + 1 \\ &= -6 + 1 \\ &= -5 \end{aligned}$$

64.
$$\begin{aligned} 5x - y + 4z &= 5(-2) - 4 + 4(-1) \\ &= -10 - 4 + (-4) \\ &= -14 + (-4) \\ &= -18 \end{aligned}$$

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.
$$\begin{aligned} \text{average} &= \frac{-18 + (-8) + (-1) + (-1) + 0 + 4}{6} \\ &= \frac{-24}{6} \\ &= -4 \end{aligned}$$

82.
$$\begin{aligned} \text{average} &= \frac{-40 + (-20) + (-10) + (-15) + (-5)}{5} \\ &= \frac{-90}{5} \\ &= -18 \end{aligned}$$

84. The two lowest scores are −11 and −7.
$-7 - (-11) = -7 + 11 = 4$
The difference between the two lowest scores is 4.

86. $\text{average} = \dfrac{-11+0+3+8}{4} = \dfrac{0}{4} = 0$
The average of the scores is 0.

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 Problems

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

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

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

4. $10x = -2 + 9x$
$10x - 9x = -2 + 9x - 9x$
$x = -2$
Check: $10x = -2 + 9x$
$10(-2) \stackrel{?}{=} -2 + 9(-2)$
$-20 \stackrel{?}{=} -2 + (-18)$
$-20 = -20$ True
The solution is –2.

5. $3y = -18$
$\dfrac{3y}{3} = \dfrac{-18}{3}$
$\dfrac{3}{3} \cdot y = \dfrac{-18}{3}$
$y = -6$
Check: $3y = -18$
$3(-6) \stackrel{?}{=} -18$
$-18 = -18$ True
The solution is –6.

6. $-32 = 8x$
$\dfrac{-32}{8} = \dfrac{8x}{8}$
$\dfrac{-32}{8} = \dfrac{8}{8} \cdot x$
$-4 = x$
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. $\frac{x}{-4} = 7$

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

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

$x = -28$

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

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

$7 = 7$ True

The solution is –28.

Vocabulary and Readiness Check

1. A combination of operations on variables and numbers is called an expression.

2. A statement of the form "expression = expression" is called an equation.

3. An equation contains an equal sign (=) while an expression does not.

4. An expression may be simplified and evaluated while an equation may be solved.

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

6. Equivalent equations have the same solution.

7. By the addition 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 multiplication property of equality, the same nonzero number may be multiplied or divided by both sides of an equation without changing the solution of the equation.

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. $-3k = 12 - k$

$-3(-6) \stackrel{?}{=} 12 - (-6)$

$18 \stackrel{?}{=} 12 + 6$

$18 = 18$ True

Since 18 = 18 is true, –6 is a solution of the equation.

8. $2(b - 3) = 10$

$2(1 - 3) \stackrel{?}{=} 10$

$2(-2) \stackrel{?}{=} 10$

$-4 = 10$ 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: $f + 4 = -6$

$-10 + 4 \stackrel{?}{=} -6$

$-6 = -6$ True

The solution is –10.

12. $s - 7 = -15$

$s - 7 + 7 = -15 + 7$

$s = -8$

Check: $s - 7 = -15$

$-8 - 7 \stackrel{?}{=} -15$

$-15 = -15$ True

The solution is –8.

14. $1 = y + 7$

$1 - 7 = y + 7 - 7$

$-6 = y$

Check: $1 = y + 7$

$1 \stackrel{?}{=} -6 + 7$

$1 = 1$ True

The solution is –6.

16. $14z = 13z - 15$

$14z - 13z = 13z - 13z - 15$

$1z = -15$

$z = -15$

Check: $14z = 13z - 15$

$14(-15) \stackrel{?}{=} 13(-15) - 15$

$-210 \stackrel{?}{=} -195 - 15$

$-210 = -210$ True

The solution is -15.

18. $6y = 48$

$\frac{6y}{6} = \frac{48}{6}$

$\frac{6}{6} \cdot y = \frac{48}{6}$

$y = 8$

Check: $6y = 48$

$6(8) \stackrel{?}{=} 48$

$48 = 48$ True

The solution is 8.

20. $-2x = 26$

$\frac{-2x}{-2} = \frac{26}{-2}$

$\frac{-2}{-2} \cdot x = \frac{26}{-2}$

$x = -13$

Check: $-2x = 26$

$-2(-13) \stackrel{?}{=} 26$

$26 = 26$ True

The solution is -13.

22. $\frac{n}{11} = -5$

$11 \cdot \frac{n}{11} = 11 \cdot (-5)$

$\frac{11}{11} \cdot n = 11 \cdot (-5)$

$n = -55$

Check: $\frac{n}{11} = -5$

$\frac{-55}{11} \stackrel{?}{=} -5$

$-5 = -5$ True

The solution is -55.

24. $7y = -21$

$\frac{7y}{7} = \frac{-21}{7}$

$\frac{7}{7} \cdot y = \frac{-21}{7}$

$y = -3$

Check: $7y = -21$

$7 \cdot (-3) \stackrel{?}{=} -21$

$-21 = -21$ True

The solution is -3.

26. $-9x = 0$

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

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

$x = 0$

Check: $-9x = 0$

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

$0 = 0$ True

The solution is 0.

28. $-31x = -31$

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

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

$x = 1$

Check: $-31x = -31$

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

$-31 = -31$ True

The solution is 1.

30. $3y = -27$

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

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

$y = -9$

The solution is -9.

32. $n - 4 = -48$

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

$n = -44$

The solution is -44.

34. $-36 = y + 12$

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

$-48 = y$

The solution is -48.

36. $\frac{x}{-9} = -9$

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

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

$x = 81$

The solution is 81.

38. $17z = 16z + 8$

$17z - 16z = 16z - 16z + 8$

$1z = 8$

$z = 8$

The solution is 8.

40. $-11x = -121$

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

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

$x = 11$

The solution is 11.

42. $\frac{n}{5} = -20$

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

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

$n = -100$

The solution is −100.

44. $-81 = 27x$

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

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

$-3 = x$

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. $n + 961 = 120$

$n + 961 - 961 = 120 - 961$

$n = -841$

The solution is −841.

56. $\frac{y}{-18} = 1098$

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

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

$y = -19,764$

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 opposites.

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

3. The integers are ..., −3, −2, −1, 0, 1, 2, 3, ...

4. The negative numbers are numbers less than zero.

5. The positive numbers are numbers greater than zero.

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

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

8. The average of a list of numbers is $\frac{\text{sum of numbers}}{\textit{number of numbers}}$.

9. A combination of operations on variables and numbers is called an expression.

10. A statement of the form "expression = expression" is called an equation.

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

12. By the addition 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.

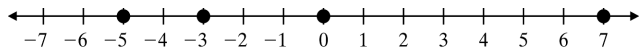
13. By the multiplication property of equality, the same nonzero number may be multiplied or divided by both sides of an equation without changing the solution of the equation.

Chapter 2 Review

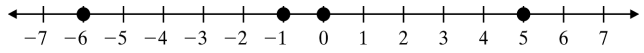
1. If 0 represents ground level, then 1572 feet below the ground is −1572.

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.
$$\begin{aligned} -6+(-9)+(-4)+(-2) &= -15+(-4)+(-2) \\ &= -19+(-2) \\ &= -21 \end{aligned}$$
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.
$$\begin{aligned} -(-5)-12+(-3) &= 5+(-12)+(-3) \\ &= -7+(-3) \\ &= -10 \end{aligned}$$

54.
$$\begin{aligned} -8+(-12)-10-(-3) &= -8+(-12)+(-10)+3 \\ &= -20+(-10)+3 \\ &= -30+3 \\ &= -27 \end{aligned}$$

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

56.
$$\begin{aligned} 142-125+43-85 &= 142+(-125)+43+(-85) \\ &= 17+43+(-85) \\ &= 60+(-85) \\ &= -25 \end{aligned}$$
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. $$\text{average} = \frac{-18+25+(-30)+7+0+(-2)}{6}$$
$$= \frac{-18}{6}$$
$$= -3$$

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

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

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

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

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

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

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

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

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

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

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

107. $9y = 8y - 13$
$9y - 8y = 8y - 8y - 13$
$1y = -13$
$y = -13$
The solution is -13.

108. $6x - 31 = 7x$
$6x - 6x - 31 = 7x - 6x$
$-31 = 1x$
$-31 = x$
The solution is -31.

109. $\frac{n}{-4} = -11$
$-4 \cdot \frac{n}{-4} = -4 \cdot (-11)$
$\frac{-4}{-4} \cdot n = -4 \cdot (-11)$
$n = 44$
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. $\frac{84}{-4}=-21$

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

120. $-9+4=-5$

121. $-32+23=-9$
His financial situation can be represented by –$9.

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

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

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

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

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

$n = -200$

The solution is −200.

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

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

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

$y = 3$

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 $17x$.

b. Twice a number subtracted from 20 is $20 - 2x$.

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

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

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

35. $9x = 8x-4$
$9x-8x = 8x-8x-4$
$1x = -4$
$x = -4$
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.
$$\begin{array}{r} 3285 \\ -\ 272 \\ \hline 3013 \end{array}$$
Check:
$$\begin{array}{r} 3013 \\ +\ 272 \\ \hline 3285 \end{array}$$

13. Subtract 7257 from the radius of Jupiter.

$$\begin{array}{r} 43,441 \\ -\ 7\,257 \\ \hline 36,184 \end{array}$$

The radius of Saturn is 36,184 miles.

14. Subtract the cost of the camera from the amount in her account.

$$\begin{array}{r} 762 \\ -\ 237 \\ \hline 525 \end{array}$$

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.

$$\begin{array}{rcr} 4725 & \text{rounds to} & 4700 \\ -\ 2879 & \text{rounds to} & -\ 2900 \\ \hline & & 1800 \end{array}$$

18.

$$\begin{array}{rcr} 8394 & \text{rounds to} & 8000 \\ -\ 2913 & \text{rounds to} & -\ 3000 \\ \hline & & 5000 \end{array}$$

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.

$$\begin{array}{r} 631 \\ \times\ 125 \\ \hline 3\,155 \\ 12\,620 \\ 63\,100 \\ \hline 78,875 \end{array}$$

22.

$$\begin{array}{r} 299 \\ \times\ 104 \\ \hline 1\,196 \\ 29\,900 \\ \hline 31,096 \end{array}$$

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

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

c. $3\overline{)21}$ $\quad 7$ 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. $4\overline{)48}$ $\quad 12$ because $12 \cdot 4 = 48$.

25.

$$\begin{array}{r} 741 \\ 5\overline{)\,3705} \\ \underline{-35} \\ 20 \\ \underline{-20} \\ 05 \\ \underline{-5} \\ 0 \end{array}$$

Check:

$$\begin{array}{r} 741 \\ \times\ 5 \\ \hline 3705 \end{array}$$

26.

$$\begin{array}{r} 456 \\ 8\overline{)\,3648} \\ \underline{-32} \\ 44 \\ \underline{-40} \\ 48 \\ \underline{-48} \\ 0 \end{array}$$

Check:

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

27. $\text{number of cards for each person} = \text{number of cards} \div \text{number of friends}$
$= 238 \div 19$

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

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

28. $\text{Cost of each ticket} = \text{total cost} \div \text{number of tickets}$
$= 324 \div 36$

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

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. $\dfrac{6^2+4\cdot 4+2^3}{37-5^2} = \dfrac{36+4\cdot 4+8}{37-25}$
$= \dfrac{36+16+8}{12}$
$= \dfrac{60}{12}$
$= 5$

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. $3(4-7)+(-2)-5 = 3(-3)+(-2)-5$
$= -9+(-2)-5$
$= -11-5$
$= -16$

50. $4-8(7-3)-(-1) = 4-8(4)-(-1)$
$= 4-32-(-1)$
$= 4-32+1$
$= -28+1$
$= -27$