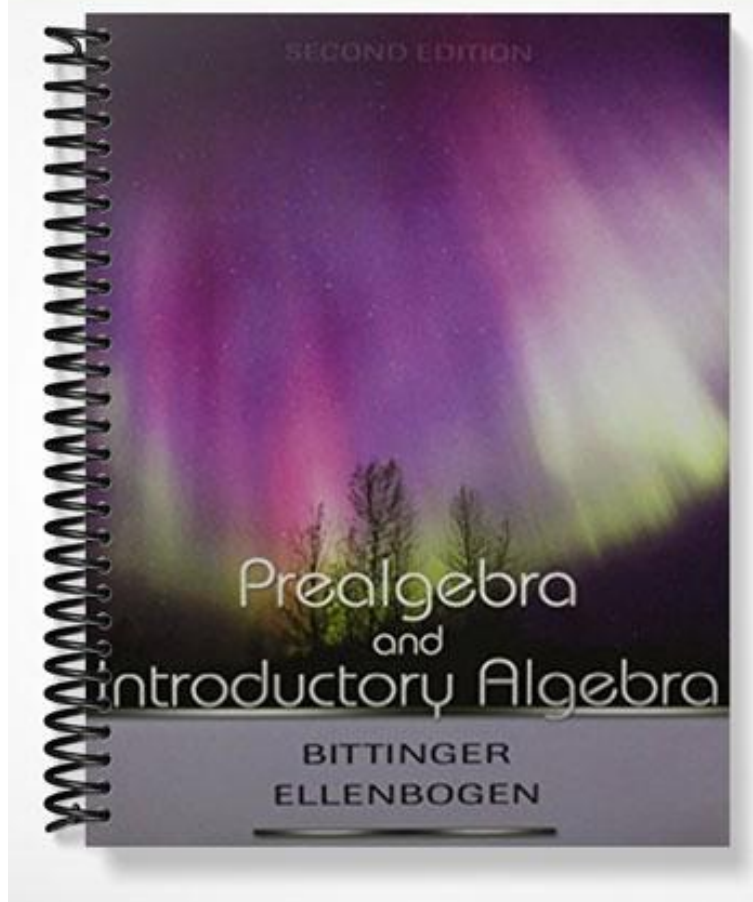


SOLUTIONS MANUAL



Chapter 2

Introduction to Integers and Algebraic Expressions

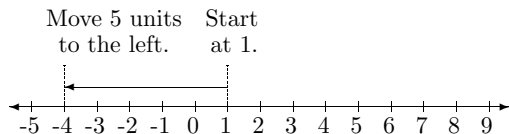
Exercise Set 2.1

2. 950,000,000; -460
4. -3; 128
6. -2438; -8000
8. -1286; 14,410
10. $7 > 0$
12. $-7 < 0$
14. $6 > -6$
16. $-1 > -7$
18. $-5 < -3$
20. $-5 > -11$
22. $-6 < -5$
24. 11
26. 4
28. 36
30. 54
32. 79
34. $-(-6) = 6$
36. $-(6) = -6$
38. $-(-1) = 1$
40. $-(50) = -50$
42. $-(-73) = 73$
44. $-(-7) = 7$
46. $-(10) = -10$
48. $-(-14) = 14$
50. $-(0) = 0$
52. $-(-53) = 53$
54. $-(-(-8)) = -8$
56. $-(-3) = 3$
58. $-(-(-19)) = -19$
60. $-(-0) = 0$
62. $-(-73) = 73$
64. $-(-(-37)) = -37$
66. $-|-92| = -92$
68. $-|-729| = -729$
70. $-|-1| = -1$
72. $-| -(-3) | = -|3| = -3$
73. *Discussion and Writing Exercise.* No; when x is a negative number or 0, $-x$ is nonnegative. For example, when x is -3 , $-x = -(-3) = 3$ and when x is 0, $-x = -(0) = 0$.
74. *Discussion and Writing Exercise.* To find $-x$ we reflect x to the opposite side of 0. From there, to find $-(-x)$ we reflect $-x$ to the opposite side of 0 which brings us back to x . Thus, $-(-x) = x$.
76. $5^3 = 5 \cdot 5 \cdot 5 = 125$
78.
$$\begin{array}{r} 300 \cdot x = 1200 \\ \frac{300 \cdot x}{300} = \frac{1200}{300} \\ x = 4 \end{array}$$
80.
$$\begin{array}{r} 50 \\ \times 31 \\ \hline 50 \\ 1500 \\ \hline 1550 \end{array}$$
82. $7(9 - 3) = 7(6) = 42$
83. *Discussion and Writing Exercise.* If $a > b$ is true, then a lies to the right of b on the number line. If we reflect a and b to the other side of 0 we have $-a$ and $-b$ and it follows that $-b$ lies to the right of $-a$, so it is true that $-b > -a$.
84. *Discussion and Writing Exercise.* No; when $x = 0$, $|x| = |0| = 0$.
86. Answers may vary. On many scientific calculators you would first find the product and then use the $+/-$ key.
- $$\boxed{4} \boxed{3} \boxed{8} \boxed{\times} \boxed{9} \boxed{7} \boxed{=} \boxed{+/-}$$
88. $|4| = 4$ and $|-7| = 7$, so $|4| < |-7|$.
90. $-|3| = -(3) = -3$
92. $-|-2| = -(2) = -2$
94. The numbers whose distance from 0 is 7 are -7 and 7 . These are the solutions of $|x| = 7$.

96. $-(-x) = x$
 $-(-(-x)) = -(x) = -x$
 $-(-(-(-x))) = -(-x) = x$

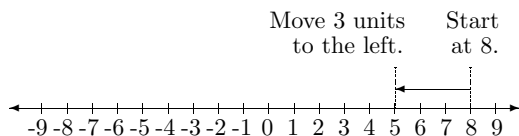
Exercise Set 2.2

2. $1 + (-5)$



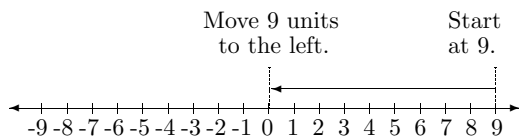
$1 + (-5) = -4$

4. $8 + (-3)$



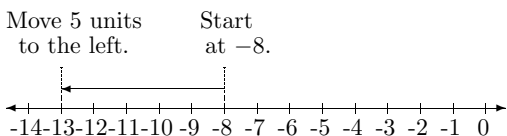
$8 + (-3) = 5$

6. $9 + (-9)$



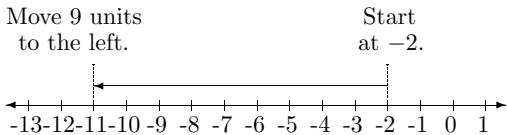
$9 + (-9) = 0$

8. $-8 + (-5)$



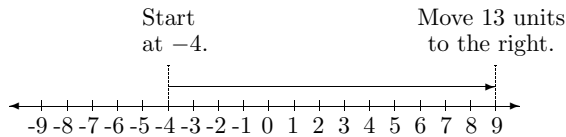
$-8 + (-5) = -13$

10. $-2 + (-9)$



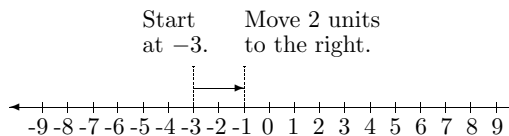
$-2 + (-9) = -11$

12. $-4 + 13$



$-4 + 13 = 9$

14. $-3 + 2$



$-3 + 2 = -1$

16. -10

18. -24

20. 0

22. 0

24. 7

26. 0

28. -43

30. -19

32. 0

34. -11

36. 1

38. -3

40. -2

42. 11

44. -34

46. -7

48. -10

50. -20

52. 6

54. 0

56. -33

58. 0

60. $23 + (-5) + 4 = 18 + 4 = 22$

62. $40 + (-8) + 5 = 32 + 5 = 37$

64. $-25 + 25 + (-9) = 0 + (-9) = -9$

66. $63 + (-18) + 12 = 45 + 12 = 57$

68. $-35 + (-63) + 35 = -35 + 35 + (-63) = 0 + (-63) = -63$

70. $75 + (-14) + (-17) + (-5) = 75 + (-36) = 39$

72. $27 + (-54) + (-32) + 65 + 46 =$
 $27 + 65 + 46 + (-54) + (-32) = 138 + (-86) = 52$

74. $35 + (-51) + 29 + 51 + (-35) = 35 + (-35) + (-51) + 51 + 29 =$
 $0 + 0 + 29 = 29$

75. *Discussion and Writing Exercise.* Answers may vary. If we think of the addition on a number line, we start at a negative number and move to the left. This always brings us to a point on the negative portion of the number line.

76. *Discussion and Writing Exercise.* The student is confusing the absolute values of the numbers with the numbers themselves.

$$\begin{array}{r}
 12 \ 10 \\
 5 \ 2 \ 0 \ 14 \\
 78. \quad \cancel{0} \ \cancel{3} \ \cancel{1} \ \cancel{4} \\
 \hline
 -2 \ 6 \ 8 \ 9 \\
 \hline
 3 \ 6 \ 2 \ 5
 \end{array}$$

$$\begin{array}{r}
 12 \ 11 \ 10 \\
 3 \ 2 \ 1 \ 0 \ 13 \\
 80. \quad \cancel{4} \ \cancel{3}, \ \cancel{2} \ \cancel{1} \ \cancel{3} \\
 \hline
 -1 \ 9, \ 8 \ 7 \ 6 \\
 \hline
 2 \ 3, \ 3 \ 3 \ 7
 \end{array}$$

82. Since the digit to the right of the hundreds place is 4 or lower, the hundreds digit remains as 7. Then we change all digits to the right of hundreds to zeros. The result is 700.

$$\begin{array}{r}
 2 \\
 \frac{1}{5} \ 6 \\
 84. \quad \times 4 \ 2 \\
 \hline
 1 \ 1 \ 2 \\
 2 \ 2 \ 4 \ 0 \\
 \hline
 2 \ 3 \ 5 \ 2
 \end{array}$$

86. Since the digit to the right of the tens place is 5 or higher, we round 9 tens to 10 tens. This requires us to change 4 hundreds to 5 hundreds and 9 tens to 0 tens. Then we change the digit to the right of tens to zero. The result is 3500.

87. *Discussion and Writing Exercise.* Find the difference in their distances from 0. If the negative integer is farther from 0, the answer is negative. If the positive integer is farther from 0, the answer is positive.

88. *Discussion and Writing Exercise.* The associative and commutative laws allow us to group the positive integers together and the negative integers together and add them separately. They also allow us to group opposites together and add them.

90. $| -32 | + (-|15|) = 32 + (-15) = 17$

92. Use a calculator.
 $497 + (-3028) = -2531$

94. Use a calculator.
 $-7623 + 4839 = -2784$

96. If $-x$ is negative, it is the reflection of a positive number x across 0 on the number line. Thus, $-x$ is negative for all positive numbers x .

98. If $n = m$ and n is negative, then m is also negative and $-n$ and $-m$ are both positive. Thus, $-n + (-m)$, the sum of two positive numbers, is positive.

100. If n is positive and m is greater than n , then m is also positive. Thus $n + m$, the sum of two positive numbers, is positive.

Exercise Set 2.3

2. -5

4. -9

6. 2

8. 0

10. -5

12. 26

14. 2

16. 0

18. 0

20. 8

22. -11

24. 16

26. -16

28. -6

30. -1

32. 11

34. -23

36. -2

38. -25

40. 1

42. -9

44. 11

46. -45

48. -81

50. -52

52. 121

54. 0

56. -10

58. $-5 - (-8) + 3 - (-7) = -5 + 8 + 3 + 7 = 13$

60. $-43 - (-19) - (-21) + 25 = -43 + 19 + 21 + 25$
 $= -43 + 65$
 $= 22$

$$\begin{aligned}
 62. \quad & 39 + (-88) - 29 - (-83) \\
 & = 39 + (-88) + (-29) + 83 \\
 & = 39 + 83 + (-88) + (-29) \\
 & = 122 + (-117) \\
 & = 5
 \end{aligned}$$

$$\begin{aligned}
 64. \quad & 84 + (-99) + 44 - (-18) - 43 \\
 & = 84 + (-99) + 44 + 18 + (-43) \\
 & = 84 + 44 + 18 + (-99) + (-43) \\
 & = 146 + (-142) \\
 & = 4
 \end{aligned}$$

$$\begin{aligned}
 66. \quad & 14 - (-50) + 20 - (-32) = 14 + 50 + 20 + 32 \\
 & = 116
 \end{aligned}$$

$$\begin{aligned}
 68. \quad & 81 - (-20) - 14 - (-50) + 53 \\
 & = 81 + 20 + (-14) + 50 + 53 \\
 & = 81 + 20 + 50 + 53 + (-14) \\
 & = 204 + (-14) \\
 & = 190
 \end{aligned}$$

70. We subtract the first page number from the final page number.

$$37 - 29 = 8$$

James wrote 8 pages.

$$72. \quad \$128.95 - \$476.89 = -\$347.94$$

Laura now owes \$347.94 on her credit card.

74. The integer 16 corresponds to advancing the recording 16 sec, and the integer -25 corresponds to reversing the recording 25 sec. We add to find the resulting reading.

$$16 + (-25) = -9$$

The recorder will display a reading of -9 .

76. The integer 3 corresponds to 3 over par, and the integer -2 corresponds to 2 under par. We subtract the original average score from the improved score.

$$-2 - 3 = -5$$

Cedric's average score decreased 5 strokes.

78. The integer -8 corresponds to reversing the disc 8 min, and the integer 11 corresponds to advancing the disc 11 min.

$$0 + (-8) + 11 = 3$$

The counter reads 3 min.

80. We add the elevation at the base to the height of the mountain.

$$-19,684 + 33,480 = 13,796.$$

The peak is 13,796 ft above sea level.

82. We subtract the lower elevation from the higher elevation:

$$-8648 - (-11,033) = 2385$$

The difference in elevation is 2385 m.

84. We first subtract the cost of the tolls from the original balance.

$$13 - 25 = -12$$

Then we subtract the cost of the fines and fees from the new balance.

$$-12 - 85 = -97$$

The Murrays would be \$97 in debt.

85. *Discussion and Writing Exercise.* Answers will vary. Clara has \$123 in charges on her credit card. After she makes a payment of \$120 and then charges an additional \$12, what is her credit card debt?

86. *Discussion and Writing Exercise.* Yes; consider $m - (-n)$ where both m and n are positive. Then $m - (-n) = m + n$. Now $m + n$, the sum of two positive numbers, is positive.

$$\begin{array}{r}
 88. \quad 72 \\
 \times 68 \\
 \hline
 576 \\
 4320 \\
 \hline
 4896
 \end{array}$$

$$\begin{array}{r}
 90. \quad 143 \\
 \times 29 \\
 \hline
 1287 \\
 2860 \\
 \hline
 4147
 \end{array}$$

$$92. \quad 24 \cdot 12 \text{ oz} = 288 \text{ oz}$$

$$\begin{aligned}
 94. \quad & 45 \div (2^2 + 11) = 45 \div (4 + 11) \\
 & = 45 \div 15 \\
 & = 3
 \end{aligned}$$

$$96. \quad (13 - 2)(13 + 2) = 11 \cdot 15 = 165$$

97. *Discussion and Writing Exercise.* The commutative law was used to write the negative addends together, followed by the positive addends.

98. *Discussion and Writing Exercise.* No; for example, $(10 - 5) - 2 = 5 - 2 = 3$, but $10 - (5 - 2) = 10 - 3 = 7$.

100. Use a calculator.

$$23,011 - (-60,432) = 83,443$$

102. False; $0 - 3 \neq 3$.

104. True

106. False; $3 - 3 = 0$, but $3 \neq -3$.

108. x is the number we add to -48 to get -15 . If we think of starting at -48 on the number line and moving to -15 , we move 33 units to the right, so $x = 33$.

110. a) We add the values of the cards:

$$-1 + (-1) + 1 + 1 + 1 + (-1) + (-1) + 0 + (-1) + (-1) + 1 = -2$$

b) Since the final count on the sequence of cards is negative, the player has a winning edge.

Exercise Set 2.4

2. -21
4. -49
6. -24
8. -72
10. 16
12. 72
14. 24
16. 72
18. -120
20. 200
22. -123
24. -43
26. 0
28. 0
30. $(-7) \cdot (-4) \cdot (-1) = 28 \cdot (-1) = -28$
32. $9(-2)(-6)7 = 9 \cdot 12 \cdot 7 = 108 \cdot 7 = 756$
34. $(-2)(-5)(-3)(-5) = 10 \cdot 15 = 150$
36. $-6(-5)(-9) = 30(-9) = -270$
38. $19(-7)(-8)0 \cdot 6 = 0$
40. $(-5)6(-4)5 = -30(-20) = 600$
42. $(-8)^2 = (-8)(-8) = 64$
44. $(-2)^4 = (-2)(-2)(-2)(-2) = 4 \cdot 4 = 16$
46. $(-1)^5 = (-1)(-1)(-1)(-1)(-1) = 1 \cdot 1 \cdot (-1) = 1 \cdot (-1) = -1$
48. $(-2)^6 = (-2)(-2)(-2)(-2)(-2)(-2) = 4 \cdot 4 \cdot 4 = 16 \cdot 4 = 64$
50. $-10^4 = -1 \cdot 10^4 = -1 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = -1 \cdot 100 \cdot 100 = -1 \cdot 10,000 = -10,000$
52. $(-1)^{13} = (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) \cdot (-1) = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot (-1) = 1 \cdot 1 \cdot 1 \cdot 1 \cdot (-1) = 1 \cdot (-1) = -1$
54. $-2^6 = -1 \cdot 2^6 = -1 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = -1 \cdot 4 \cdot 4 \cdot 4 = -4 \cdot 16 = -64$
56. $-2^5 = -1 \cdot 2^5 = -1 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = -2 \cdot 4 \cdot 4 = -8 \cdot 4 = -32$
58. $(-6)^8$ is read “negative six to the eighth power.”
60. -5^4 is read “the opposite of five to the fourth power.”
61. *Discussion and Writing Exercise.* $(-9)^{10}$ is the product of an even number of negative integers, so it is positive.

62. *Discussion and Writing Exercise.* 9^{10} is a product of positive numbers, so it is positive; then -9^{10} is the opposite of a positive number, so it is negative.

64. 60,000,000

66.
$$\begin{array}{r} \frac{2}{3} \cdot 4 \\ \times 75 \\ \hline 170 \\ 2380 \\ \hline 2550 \end{array}$$

68.
$$\begin{aligned} & 2 \cdot 5^2 - 3 \cdot 2^3 \div (3 + 3^2) \\ &= 2 \cdot 5^2 - 3 \cdot 2^3 \div (3 + 9) \\ &= 2 \cdot 5^2 - 3 \cdot 2^3 \div 12 \\ &= 2 \cdot 25 - 3 \cdot 8 \div 12 \\ &= 50 - 24 \div 12 \\ &= 50 - 2 \\ &= 48 \end{aligned}$$

70. $2880 \div 12 = 240$ cartons

72. $50 \div 16 = 3$ R 2, so 4 trips will be required.

73. *Discussion and Writing Exercise.* Both numbers are negative, so the one with the larger base is larger. Thus, $(-3)^{79}$ is larger than $(-5)^{79}$.

74. *Discussion and Writing Exercise.* If a is negative and x is an odd number, then a^x is negative.

76.
$$\begin{aligned} & (-2)^3 \cdot [(-1)^{29}]^{46} \\ &= (-2)^3 \cdot [-1]^{46} \\ &= -8 \cdot 1 \\ &= -8 \end{aligned}$$

78.
$$\begin{aligned} & -5^2(-1)^{29} \\ &= -1 \cdot 5^2(-1)^{29} \\ &= -1 \cdot 5^2 \cdot (-1) \\ &= -1 \cdot 25 \cdot (-1) \\ &= -25 \cdot (-1) \\ &= 25 \end{aligned}$$

80.
$$\begin{aligned} & |-12(-3)^2 - 5^3 - 6^2 - (-5)^2| \\ &= |-12 \cdot 9 - 125 - 36 - 25| \\ &= |-108 - 125 - 36 - 25| \\ &= |-294| \\ &= 294 \end{aligned}$$

82. Use a calculator.
 $-53^2 = -2809$

84. Use a calculator.
 $(-23)^4 = 279,841$

86. Use a calculator.
 $(-49 + 34)^3 = -3375$

88. Use a calculator.

$$(-17)^4(129 - 133)^5 = -85,525,504$$

90. The integer -95 corresponds to the elevation of 95 m below the surface. At a rate of 7 meters per minute, in 9 min the diver rises $7 \cdot 9$ m. We have:

$$\begin{aligned} -95 + 7 \cdot 9 &= -95 + 63 \\ &= -32 \end{aligned}$$

The diver's new elevation is 32 m below the surface, or -32 m.

92. (a) If $-mn$ is positive, then mn is negative so m and n must have different signs.

(b) If $-mn$ is zero, then at least one of m and n must be zero.

(c) If $-mn$ is negative, then mn is positive so m and n must have the same sign.

Exercise Set 2.5

2. -5

4. -2

6. 11

8. 7

10. -2

12. -50

14. -16

16. 21

18. 0

20. 29

22. -31

24. Undefined

26. -17

28. -23

$$\begin{aligned} 30. \quad 5 - (2 \cdot 3 - 7) &= 5 - (6 - 7) \\ &= 5 - (-1) \\ &= 5 + 1 \\ &= 6 \end{aligned}$$

$$\begin{aligned} 32. \quad (8 - 2)(3 - 9) &= 6(-6) \\ &= -36 \end{aligned}$$

$$\begin{aligned} 34. \quad 10 \cdot 20 - 15 \cdot 24 &= 200 - 360 \\ &= -160 \end{aligned}$$

$$\begin{aligned} 36. \quad 2^4 + 2^2 - 10 &= 16 + 4 - 10 \\ &= 20 - 10 \\ &= 10 \end{aligned}$$

$$\begin{aligned} 38. \quad 4^3 + 10 \cdot 20 + 8^2 - 23 &= 64 + 10 \cdot 20 + 64 - 23 \\ &= 64 + 200 + 64 - 23 \\ &= 264 + 64 - 23 \\ &= 328 - 23 \\ &= 305 \end{aligned}$$

$$\begin{aligned} 40. \quad 5^3 + 4 \cdot 9 - (8 + 9 \cdot 3) &= 5^3 + 4 \cdot 9 - (8 + 27) \\ &= 5^3 + 4 \cdot 9 - 35 \\ &= 125 + 4 \cdot 9 - 35 \\ &= 125 + 36 - 35 \\ &= 161 - 35 \\ &= 126 \end{aligned}$$

$$\begin{aligned} 42. \quad \frac{100 - 6^2}{(-5)^2 - 3^2} &= \frac{100 - 36}{25 - 9} \\ &= \frac{64}{16} \\ &= 4 \end{aligned}$$

$$\begin{aligned} 44. \quad 10(-5) \div 1(-1) &= -50 \div 1(-1) \\ &= -50(-1) \\ &= 50 \end{aligned}$$

$$\begin{aligned} 46. \quad 14 \div 2(-6) + 7 &= 7(-6) + 7 \\ &= -42 + 7 \\ &= -35 \end{aligned}$$

$$\begin{aligned} 48. \quad 9 \cdot 0 \div 5 \cdot 4 &= 0 \div 5 \cdot 4 \\ &= 0 \cdot 4 \\ &= 0 \end{aligned}$$

$$\begin{aligned} 50. \quad (2 - 5)^2 \div (-9) &= (-3)^2 \div (-9) \\ &= 9 \div (-9) \\ &= -1 \end{aligned}$$

$$\begin{aligned} 52. \quad 3 - 3^2 &= 3 - 9 \\ &= -6 \end{aligned}$$

$$54. \quad 30 + (-5)^3 = 30 + (-125) = -95$$

$$\begin{aligned} 56. \quad 5 + 6^2 \div 3 \cdot 2^2 &= 5 + 36 \div 3 \cdot 4 \\ &= 5 + 12 \cdot 4 \\ &= 5 + 48 \\ &= 53 \end{aligned}$$

$$\begin{aligned} 58. \quad 20 + 4^3 \div (-8) &= 20 + 64 \div (-8) \\ &= 20 - 8 \\ &= 12 \end{aligned}$$

$$\begin{aligned} 60. \quad -7(3^4) + 18 &= -7(81) + 18 \\ &= -567 + 18 \\ &= -549 \end{aligned}$$

$$\begin{aligned} 62. \quad 8[(6 - 13) - 11] &= 8[-7 - 11] \\ &= 8[-18] \\ &= -144 \end{aligned}$$

$$\begin{aligned} 64. \quad 256 + (-32) \div (-4) &= 256 + 8 \\ &= 264 \end{aligned}$$

$$\begin{aligned} 66. \quad |8 - 7 - 9| \cdot 2 + 1 &= |1 - 9| \cdot 2 + 1 \\ &= |-8| \cdot 2 + 1 \\ &= 8 \cdot 2 + 1 \\ &= 16 + 1 \\ &= 17 \end{aligned}$$

$$\begin{aligned}
 68. \quad 9 - |5 - 7|^3 &= 9 - |-2|^3 \\
 &= 9 - 2^3 \\
 &= 9 - 8 \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
 70. \quad &\frac{4 \div 2 \cdot 4^2 - 3 \cdot 2}{(7 - 4)^3 - 2 \cdot 5 - 4} \\
 &= \frac{4 \div 2 \cdot 16 - 3 \cdot 2}{3^3 - 2 \cdot 5 - 4} \\
 &= \frac{2 \cdot 16 - 6}{27 - 2 \cdot 5 - 4} \\
 &= \frac{32 - 6}{27 - 10 - 4} \\
 &= \frac{26}{17 - 4} \\
 &= \frac{26}{13} \\
 &= 2
 \end{aligned}$$

$$\begin{aligned}
 72. \quad &\frac{5 \cdot 6^2 \div (2^2 \cdot 5) - 7^2}{3^2 - 4^2 - (-2)^3 - 2} \\
 &= \frac{5 \cdot 6^2 \div (4 \cdot 5) - 7^2}{9 - 16 - (-8) - 2} \\
 &= \frac{5 \cdot 6^2 \div 20 - 7^2}{9 - 16 + 8 - 2} \\
 &= \frac{5 \cdot 36 \div 20 - 49}{-7 + 8 - 2} \\
 &= \frac{180 \div 20 - 49}{1 - 2} \\
 &= \frac{9 - 49}{-1} \\
 &= \frac{-40}{-1} \\
 &= 40
 \end{aligned}$$

$$\begin{aligned}
 74. \quad \frac{(3 - 5)^2 - (7 - 13)}{(2 - 5)3 + 2 \cdot 4} &= \frac{(-2)^2 - (-6)}{-3 \cdot 3 + 2 \cdot 4} \\
 &= \frac{4 - (-6)}{-3 \cdot 3 + 2 \cdot 4} \\
 &= \frac{4 - (-6)}{-9 + 8} \\
 &= \frac{10}{-1} \\
 &= -10
 \end{aligned}$$

$$\begin{aligned}
 76. \quad \frac{-16 \cdot 28 \div 2^2}{5 \cdot 25 - 5^3} &= \frac{-16 \cdot 28 \div 4}{5 \cdot 25 - 125} \\
 &= \frac{-448 \div 4}{125 - 125} \\
 &= \frac{-112}{0}
 \end{aligned}$$

Since division by 0 is undefined, this expression is undefined.

77. *Discussion and Writing Exercise.* $17 \div 0$ is the number that, when multiplied by 0, gives 17. But any number multiplied by 0 is 0, not 17. Thus, $17 \div 0$ is undefined.

78. *Discussion and Writing Exercise.* Since $19 > 17$, then $19^2 - 17^2$ is positive. Similarly, since $16 < 18$, then $16^2 - 18^2$ is negative. Now we have a positive number divided by a negative number, so the quotient is negative.

$$80. \quad 7 \cdot 6 = 42 \text{ chairs}$$

$$82. \quad 378 \div 14 = 27 \text{ gallons}$$

$$84. \quad 7 \cdot 8 = 56 \text{ g per bag; } 12 \cdot 56 = 672 \text{ g}$$

86. $24 \div 5 = 4 \text{ R } 4$, so each person will receive 4 lozenges and 4 lozenges will remain.

87. *Discussion and Writing Exercise.* Ty is probably interpreting the calculation as $8 - (3^2 + 1)$.

88. *Discussion and Writing Exercise.* Bryn is probably interpreting the calculation as $(13 - 10)/(2 - 5)$.

$$\begin{aligned}
 90. \quad \frac{7^3 \cdot 9 - 6^2 \cdot 8 + 4^3 \cdot 6}{5^2 - 25} &= \frac{343 \cdot 9 - 36 \cdot 8 + 64 \cdot 6}{25 - 25} \\
 &= \frac{3087 - 288 + 384}{0}
 \end{aligned}$$

This expression is undefined.

$$\begin{aligned}
 92. \quad &\frac{(7 - 8)^{37}}{7^2 - 8^2} \cdot (98 - 7^2 \cdot 2) \\
 &= \frac{(-1)^{37}}{49 - 64} \cdot (98 - 49 \cdot 2) \\
 &= \frac{-1}{-15} \cdot (98 - 98) \\
 &= \frac{-1}{-15} \cdot 0 \\
 &= 0
 \end{aligned}$$

$$\begin{aligned}
 94. \quad \frac{195 + (-15)^3}{195 - 7 \cdot 5^2} &= \frac{195 - 3375}{195 - 7 \cdot 25} \\
 &= \frac{195 - 3375}{195 - 175} \\
 &= \frac{-3180}{20} \\
 &= -159
 \end{aligned}$$

96. Use a calculator.

$$9^3 - 36^3/12^2 + 9^2 = 486$$

$$98. \quad \left(\left[\boxed{1} \boxed{6} \boxed{x^2} \boxed{-} \boxed{2} \boxed{4} \boxed{\times} \boxed{2} \boxed{3} \right] \boxed{\div} \left(\boxed{3} \boxed{\times} \boxed{4} \boxed{+} \boxed{5} \boxed{x^2} \right) \boxed{=}$$

100. Entering the given keystrokes and then pressing $\boxed{=}$, we get 2.

102. $-n$ is negative and $-m$ is positive, so $\frac{-n}{-m}$ is the quotient of a negative and a positive number and, thus, is negative.

104. n and $-m$ are both positive, so $\frac{n}{-m}$ is the quotient of two positive numbers and, thus, is positive. Then $-\left(\frac{n}{-m}\right)$ is the opposite of a positive number and, thus, is negative.

Exercise Set 2.6

2. $39 \cdot 2 = 78¢$
4. $\frac{18}{2} = 9$
6. $\frac{5 \cdot 15}{-25} = \frac{75}{-25} = -3$
8. $\frac{72}{2} = 36$ yr
10. $9 - 2 \cdot 3 = 9 - 6 = 3$
12. $3(2 + 4) = 3(6) = 18$
14. $3 \cdot 2 + 3 \cdot 4 = 6 + 12 = 18$
16. $4 \cdot 6 - 4 \cdot 1 = 24 - 4 = 20$
18. $4(6 - 1) = 4 \cdot 5 = 20$
20. $\frac{49 \cdot 10^2}{10} = \frac{49 \cdot 100}{10} = \frac{4900}{10} = 490$ m
22. $(2 + 3)^2 = 5^2 = 25$
24. $8 \cdot 17 + 8(-17) = 136 + (-136) = 0$
26. $\frac{5(50 - 32)}{9} = \frac{5 \cdot 18}{9} = \frac{90}{9} = 10$
28. $(-2)^6 - (-2) = 64 + 2 = 66$
30. $-\frac{7}{x}, \frac{-7}{x}$
32. $\frac{-3}{r}, \frac{3}{-r}$
34. $-\frac{u}{5}, \frac{u}{-5}$
36. $-\frac{23}{m}, \frac{23}{-m}$
38. $\frac{-a}{b} = \frac{-40}{5} = -8;$
 $\frac{a}{-b} = \frac{40}{-5} = -8;$
 $-\frac{a}{b} = -\frac{40}{5} = -8$
40. $\frac{-a}{b} = \frac{-56}{7} = -8;$
 $\frac{a}{-b} = \frac{56}{-7} = -8;$
 $-\frac{a}{b} = -\frac{56}{7} = -8$
42. $(-2x)^2 = (-2 \cdot 3)^2 = (-6)^2 = 36;$
 $-2x^2 = -2(3)^2 = -2 \cdot 9 = -18$
44. $2x^2 = 2(5)^2 = 2 \cdot 25 = 50;$
 $2x^2 = 2(-5)^2 = 2 \cdot 25 = 50$
46. $x^6 = 2^6 = 64;$
 $x^6 = (-2)^6 = 64$
48. $x^5 = 3^5 = 243;$
 $x^5 = (-3)^5 = -243$
50. $1^7 = 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 \cdot 1 = 1;$
 $(-1)^7 = (-1)(-1)(-1)(-1)(-1)(-1)(-1) = -1$
52. $7x + 7y$
54. $6a + 6$
56. $3x - 18$
58. $4(1 - y) = 4 \cdot 1 - 4 \cdot y = 4 - 4y$
60. $54m + 63$
62. $20x + 32 + 12p$
64. $-9y + 63$
66. $2x + 8$
68. $16x - 40y - 64z$
70. $-6a - 12b + 6c$
72. $45x - 5y + 40z$
74. $63a - 28b + 21c - 7d$
75. *Discussion and Writing Exercise.* No; if x and y have different signs then $\frac{x}{y}$ is negative and $-\frac{x}{y}$ is positive.
76. *Discussion and Writing Exercise.* No; if $x = 0$, then $-x^2 = 0$.
78.
$$\begin{array}{r} 2 \\ 5 3 \\ \times 1 7 \\ \hline 3 7 1 \\ 5 3 0 \\ \hline 9 0 1 \end{array}$$
80.
$$\begin{array}{r} 9 9 4 \\ 3 \overline{) 2982} \\ \underline{2700} \\ 282 \\ \underline{270} \\ 12 \\ \underline{12} \\ 0 \end{array}$$
82. 12 in. $- 7$ in. $= 5$ in.
84. Price of wings: $3 \cdot \$12 = \36
Price of nachos: $3 \cdot \$9 = \27
Total price: $\$36 + \$27 = \$63$
85. *Discussion and Writing Exercise.* x^2 is nonnegative for all values of x . Then ax^2 is nonnegative when a is nonnegative, or for $a \geq 0$.
86. *Discussion and Writing Exercise.* Ted probably added before evaluating the exponential expression.
88. Use a calculator.
 $24^2 - 24 \cdot 6^2 \div 2 \cdot 6 = -2016$

90. Use a calculator.

$$18^2 - 23(-21) + (-21)^3 = -8454$$

92. Use a calculator.

$$(-8)^3(-6) - (-8)^2(-6)^2 + (-8)(-6)^3 = 2496$$

$$\begin{aligned} 94. \quad x^{1492} - x^{1493} &= (-1)^{1492} - (-1)^{1493} \\ &= 1 - (-1) \\ &= 1 + 1 \\ &= 2 \end{aligned}$$

$$\begin{aligned} 96. \quad 5a^{3a-4} &= 5 \cdot 2^{3 \cdot 2 - 4} \\ &= 5 \cdot 2^{6-4} \\ &= 5 \cdot 2^2 \\ &= 5 \cdot 4 \\ &= 20 \end{aligned}$$

$$98. \quad 59 \boxed{\times} 17 \boxed{+} 59 \boxed{\times} 8 = 1475$$

100. False; $2^3 = 8$; but $-2^3 = -8$.

102. True

103. *Discussion and Writing Exercise.* No; consider Exercise 26 where we found that a temperature of 10 degrees Celsius corresponds to a Fahrenheit temperature of 50 degrees. When $F = 2 \cdot 50$, or 100, we have a Celsius temperature of

$$\frac{5(100 - 32)}{9} = \frac{5 \cdot 68}{9} = \frac{340}{9} = 37 \text{ R } 7$$

This is not twice 10 degrees, so the Celsius temperature is not doubled.

Exercise Set 2.7

2. $4x - 6y + 7z = 4x + (-6y) + 7z$

The terms are $4x$, $-6y$, and $7z$.

4. $7rs + 4s - 5 = 7rs + 4s + (-5)$

The terms are $7rs$, $4s$, and -5 .

6. $4a^3b + ab^2 - 9b^3 = 4a^3b + ab^2 + (-9b^3)$

The terms are $4a^3b$, ab^2 , and $-9b^3$.

8. $16a$

10. $-15x$

12. $10a - 5b$

14. $38x - 4$

16. $-7 + 3a + 6b$

18. $4x + 5y + 5$

20. $3x + 2y + 2$

22. $12y^3 - 3z$

24. $11a^5 + 5b^4$

26. $2a^2 + 8a^3 + 5$

28. $7xy + 6y^2 - 1$

30. $4a^2b - 3ab^2 + 2ab$

32. $-4x^4 + 6y^4 + 8x^4y^4$

34. $x^6 - y^5 + 3x^6y$

36. $P = 4s$
 $P = 4 \cdot 5 \text{ in.}$
 $P = 20 \text{ in.}$

38. Perimeter = $4 \text{ mm} + 6 \text{ mm} + 7 \text{ mm}$
 $= (4 + 6 + 7) \text{ mm}$
 $= 17 \text{ mm}$

40. Perimeter = $4 \text{ m} + 4 \text{ m} + 4 \text{ m} + 5 \text{ m} + 1 \text{ m}$
 $= (4 + 4 + 4 + 5 + 1) \text{ m}$
 $= 18 \text{ m}$

42. $P = 2l + 2w = 2 \cdot 78 \text{ ft} + 2 \cdot 36 \text{ ft}$
 $= 156 \text{ ft} + 72 \text{ ft} = 228 \text{ ft}$

44. The penalty area is a rectangle with length 44 yd and width 18 yd.

$$\begin{aligned} P &= 2l + 2w = 2 \cdot 27 \text{ ft} + 2 \cdot 18 \text{ ft} \\ &= 54 \text{ ft} + 36 \text{ ft} = 90 \text{ ft} \end{aligned}$$

46. $P = 2 \cdot (l + w) = 2 \cdot (3 \text{ ft} + 4 \text{ ft}) = 14 \text{ ft}$

48. $P = 4s = 4 \cdot 2 \text{ m} = 8 \text{ m}$

50. $P = 4s = 4 \cdot 12 \text{ yd} = 48 \text{ yd}$

52. $P = 2l + 2w = 2 \cdot 40 \text{ ft} + 2 \cdot 35 \text{ ft} = 150 \text{ ft}$

53. *Discussion and Writing Exercise.* Algebraic expressions that have the same value for all possible replacements are equivalent.

54. *Discussion and Writing Exercise.* Yes; a square with side s can be considered to be a rectangle with length s and width s .

56. $700 - 490 = 210$

58. $(9 - 7)^4 - 3^2 = 2^4 - 3^2$
 $= 16 - 9$
 $= 7$

60. $27 \div 3(2 + 1) = 27 \div 3 \cdot 3$
 $= 9 \cdot 3$
 $= 27$

62. $30 - 4^2 \div 8 \cdot 2 = 30 - 16 \div 8 \cdot 2$
 $= 30 - 2 \cdot 2$
 $= 30 - 4$
 $= 26$

64. $19 = x + 6$
 $19 - 6 = x$
 $13 = x$

66. $50 = 2t$

$$\frac{50}{2} = t$$

$$25 = t$$

67. *Discussion and Writing Exercise.* The perimeter of a square with side s is given by $P = 4s$. The perimeter of a square with side $2s$ is $4 \cdot 2s = 8s = 2 \cdot 4s = 2P$, so doubling the length of a square's side doubles the perimeter.

68. *Discussion and Writing Exercise.* We use the distributive law "in reverse" when we combine like terms. See Example 5 in this section of the text.

70. $3(a - 7) + 7(a + 4) = 3a - 21 + 7a + 28 = 10a + 7$

72. $7(2 - 5x) + 3(x - 8) = 14 - 35x + 3x - 24 = -10 - 32x$

74. $3(4 - 2x) + 5(9x - 3y + 1) = 12 - 6x + 45x - 15y + 5 = 17 + 39x - 15y$

76. Find the amount of lace required:

$$6 \cdot 4 \cdot 5 \text{ ft} + 6 \cdot 4 \cdot 7 \text{ ft} = 288 \text{ ft}$$

Find the number of yards in 288 ft:

$$288 \div 3 = 96$$

Finally, find the cost of 96 yd of trim:

$$96 \cdot \$1.95 = \$187.20$$

78. Length of box: $3 \cdot 72 \text{ mm} = 216 \text{ mm}$

Width of box: $2 \cdot 72 \text{ mm} = 144 \text{ mm}$

$$P = 2 \cdot (l + w) = 2 \cdot (216 \text{ mm} + 144 \text{ mm}) = 720 \text{ mm}$$

Exercise Set 2.8

2. $6 + 4x - 5 = 4x + 1$, so $4x + 1$ and $6 + 4x - 5$ are equivalent expressions.

4. $7t = 14 \quad 4t = 8$

$$t = 2 \quad t = 2$$

$7t = 14$ and $4t = 8$ are equivalent equations.

6. $r - 7 + r = 2r - 7$, so $2r - 7$ and $r - 7 + r$ are equivalent expressions.

8. $t + 4 = 19 \quad t - 6 = 9$

$$t = 15 \quad t = 15$$

$t + 4 = 19$ and $t - 6 = 9$ are equivalent equations.

10. $2x = -14 \quad x - 2 = -9$

$$x = -7 \quad x = -7$$

$2x = -14$ and $x - 2 = -9$ are equivalent equations.

12. $4(x - 7) = 4x - 28$ and $3x - 28 + x = 4x - 28$, so $4(x - 7)$ and $3x - 28 + x$ are equivalent expressions.

14. $x - 5 = -7$

$$x - 5 + 5 = -7 + 5$$

$$x = -2$$

16. $x - 7 = 5$

$$x - 7 + 7 = 5 + 7$$

$$x = 12$$

18. $x + 9 = -3$

$$x + 9 - 9 = -3 - 9$$

$$x = -12$$

20. $t + 5 = 13$

$$t + 5 - 5 = 13 - 5$$

$$t = 8$$

22. $-9 = x + 3$

$$-9 - 3 = x + 3 - 3$$

$$-12 = x$$

24. $17 = n - 6$

$$17 + 6 = n - 6 + 6$$

$$23 = n$$

26. $3 = 17 + x$

$$3 - 17 = 17 - 17 + x$$

$$-14 = x$$

28. $-7 + t = -7$

$$-7 + t + 7 = -7 + 7$$

$$t = 0$$

30. $-8t = 40$

$$\frac{-8t}{-8} = \frac{40}{-8}$$

$$t = -5$$

32. $3x = 24$

$$\frac{3x}{3} = \frac{24}{3}$$

$$x = 8$$

34. $64 = -2t$

$$\frac{64}{-2} = \frac{-2t}{-2}$$

$$-32 = t$$

36. $-5n = -65$

$$\frac{-5n}{-5} = \frac{-65}{-5}$$

$$n = 13$$

38. $-x = 83$

$$-1 \cdot x = 83$$

$$\frac{-1 \cdot x}{-1} = \frac{83}{-1}$$

$$x = -83$$

40. $-2x = 0$

$$\frac{-2x}{-2} = \frac{0}{-2}$$

$$x = 0$$

$$\begin{aligned}
 42. \quad -x &= -475 \\
 -1 \cdot x &= -475 \\
 \frac{-1 \cdot x}{-1} &= \frac{-475}{-1} \\
 x &= 475
 \end{aligned}$$

$$\begin{aligned}
 44. \quad n(-6) &= -42 \\
 \frac{n(-6)}{-6} &= \frac{-42}{-6} \\
 n &= 7
 \end{aligned}$$

$$\begin{aligned}
 46. \quad 3t &= -45 \\
 \frac{3t}{3} &= \frac{-45}{3} \\
 t &= -15
 \end{aligned}$$

$$\begin{aligned}
 48. \quad x + 9 &= -15 \\
 x + 9 - 9 &= -15 - 9 \\
 x &= -24
 \end{aligned}$$

$$\begin{aligned}
 50. \quad -13 &= x - 4 \\
 -13 + 4 &= x - 4 + 4 \\
 -9 &= x
 \end{aligned}$$

$$\begin{aligned}
 52. \quad -42 &= -x \\
 -1(-42) &= -1(-x) \\
 42 &= x
 \end{aligned}$$

$$\begin{aligned}
 54. \quad 7 + t &= -18 \\
 7 + t - 7 &= -18 - 7 \\
 t &= -25
 \end{aligned}$$

$$\begin{aligned}
 56. \quad -34 &= x + 10 \\
 -34 - 10 &= x + 10 - 10 \\
 -44 &= x
 \end{aligned}$$

$$\begin{aligned}
 58. \quad -48 &= x(-12) \\
 \frac{-48}{-12} &= \frac{x(-12)}{-12} \\
 4 &= x
 \end{aligned}$$

$$\begin{aligned}
 60. \quad -135 &= -9t \\
 \frac{-135}{-9} &= \frac{-9t}{-9} \\
 15 &= t
 \end{aligned}$$

$$\begin{aligned}
 62. \quad 7x - 3 &= 25 \\
 7x - 3 + 3 &= 25 + 3 \\
 7x &= 28 \\
 \frac{7x}{7} &= \frac{28}{7} \\
 x &= 4
 \end{aligned}$$

$$\begin{aligned}
 64. \quad 3t + 5 &= 26 \\
 3t + 5 - 5 &= 26 - 5 \\
 3t &= 21 \\
 \frac{3t}{3} &= \frac{21}{3} \\
 t &= 7
 \end{aligned}$$

$$\begin{aligned}
 66. \quad 8a + 3 &= -37 \\
 8a + 3 - 3 &= -37 - 3 \\
 8a &= -40 \\
 \frac{8a}{8} &= \frac{-40}{8} \\
 a &= -5
 \end{aligned}$$

$$\begin{aligned}
 68. \quad 3x - 5 &= -35 \\
 3x - 5 + 5 &= -35 + 5 \\
 3x &= -30 \\
 \frac{3x}{3} &= \frac{-30}{3} \\
 x &= -10
 \end{aligned}$$

$$\begin{aligned}
 70. \quad -4t + 3 &= -17 \\
 -4t + 3 - 3 &= -17 - 3 \\
 -4t &= -20 \\
 \frac{-4t}{-4} &= \frac{-20}{-4} \\
 t &= 5
 \end{aligned}$$

$$\begin{aligned}
 72. \quad -7x - 4 &= -46 \\
 -7x - 4 + 4 &= -46 + 4 \\
 -7x &= -42 \\
 \frac{-7x}{-7} &= \frac{-42}{-7} \\
 x &= 6
 \end{aligned}$$

$$\begin{aligned}
 74. \quad -x - 6 &= 8 \\
 -x - 6 + 6 &= 8 + 6 \\
 -x &= 14 \\
 -1(-x) &= -1 \cdot 14 \\
 x &= -14
 \end{aligned}$$

$$\begin{aligned}
 76. \quad 9 &= 4x - 7 \\
 9 + 7 &= 4x - 7 + 7 \\
 16 &= 4x \\
 \frac{16}{4} &= \frac{4x}{4} \\
 4 &= x
 \end{aligned}$$

$$\begin{aligned}
 78. \quad 33 &= 5 - 4x \\
 33 - 5 &= 5 - 4x - 5 \\
 28 &= -4x \\
 \frac{28}{-4} &= \frac{-4x}{-4} \\
 -7 &= x
 \end{aligned}$$

$$\begin{aligned}
 80. \quad 12 &= 7 - x \\
 12 - 7 &= 7 - x - 7 \\
 5 &= -x \\
 -1 \cdot 5 &= -1(-x) \\
 -5 &= x
 \end{aligned}$$

81. Discussion and Writing Exercise. The equations $-5x = 13$ and $-5x + 5 = 13 + 5$ are equivalent, by the addition principle, so it is not wrong for Eva to add 5 to both sides of the equation. However, the goal in solving the equation is to isolate x on one side of the equation and adding 5 to both sides does not accomplish this. Eva should divide both sides by -5 to isolate x .

82. Discussion and Writing Exercise. The equations $x - 9 = -5$ and $x - 9 + 5 = -5 + 5$ are equivalent, by the addition principle, so it is not wrong for Gary to add 5 to both sides of the equation. However, the goal in solving the equation is to isolate x on one side of the equation and adding 5 to both sides does not accomplish this. He should add 9 to both sides to isolate x .

84. Terms are similar if they have the same variable factor(s).

86. Equations are equivalent if they have the same solutions.

88. A variable is a letter that can stand for various numbers.

90. We substitute for a variable when we replace it with a number.

91. Discussion and Writing Exercise. One way to use equivalent expressions to write equivalent equations is to set each equation equal to the same number.

92. Discussion and Writing Exercise.

$$2x + 8 = 24$$

$$\frac{2x + 8}{2} = \frac{24}{2}$$

$$\frac{2x}{2} + \frac{8}{2} = \frac{24}{2}$$

$$x + 4 = 12$$

$$x = 8$$

Thus, dividing both sides of the equation by 2 as a first step can lead to a solution.

94. $9 + x - 5 = 23$

$$x + 4 = 23$$

$$x + 4 - 4 = 23 - 4$$

$$x = 19$$

96. $(-9)^2 = 2^3t + (3 \cdot 6 + 1)t$

$$(-9)^2 = 2^3t + (18 + 1)t$$

$$(-9)^2 = 2^3t + 19t$$

$$81 = 8t + 19t$$

$$81 = 27t$$

$$\frac{81}{27} = \frac{27t}{27}$$

$$3 = t$$

98. $(-42)^3 = 14^2t$

$$-74,088 = 196t$$

$$\frac{-74,088}{196} = \frac{196t}{196}$$

$$-378 = t$$

100. $23^2 = x + 22^2$

$$529 = x + 484$$

$$529 - 484 = x + 484 - 484$$

$$45 = x$$

102. $248 = 24 - 32x$

$$248 - 24 = 24 - 32x - 24$$

$$224 = -32x$$

$$\frac{224}{-32} = \frac{-32x}{-32}$$

$$-7 = x$$

Chapter 2 Review Exercises

1. The integer 527 corresponds to having \$527 in an account; the integer -53 corresponds to a \$53 debt.

2. Since 0 is to the right of -5 , we have $0 > -5$.

3. Since -7 is to the left of 6, we have $-7 < 6$.

4. Since -4 is to the right of -19 , we have $-4 > -19$.

5. The distance from -39 to 0 is 39, so $|-39| = 39$.

6. The distance from 23 to 0 is 23, so $|23| = 23$.

7. The distance from 0 to 0 is 0, so $|0| = 0$.

8. When $x = -72$, $-x = -(-72) = 72$.

9. When $x = 59$, $-(-x) = -(-59) = 59$.

10. $-14 + 5$ The absolute values are 14 and 5. The difference is 9. The negative number has the larger absolute value, so the answer is negative. $-14 + 5 = -9$

11. $-5 + (-6)$

Add the absolute values: $5 + 6 = 11$

Make the answer negative: $-5 + (-6) = -11$

12. $14 + (-8)$ The absolute values are 14 and 8. The difference is 6. The positive number has the larger absolute value, so the answer is positive. $14 + (-8) = 6$

13. $0 + (-24) = -24$

When 0 is added to any number, that number remains unchanged.

14. $17 - 29 = 17 + (-29) = -12$

15. $9 - (-14) = 9 + 14 = 23$

16. $-8 - (-7) = -8 + 7 = -1$

17. $-3 - (-10) = -3 + 10 = 7$

18. $-3 + 7 + (-8)$

$$= -3 + (-8) + 7 \quad \text{Using a commutative law}$$

$$= -11 + 7$$

$$= -4$$

$$\begin{aligned}
 19. \quad & 8 - (-9) - 7 + 2 \\
 & = 8 + 9 + (-7) + 2 \\
 & = 19 + (-7) \quad \text{Adding the positive numbers} \\
 & = 12
 \end{aligned}$$

$$20. \quad -23 \cdot (-4) = 92$$

$$21. \quad 7(-12) = -84$$

$$\begin{aligned}
 22. \quad & 2(-4)(-5)(-1) \\
 & = -8 \cdot 5 \quad \text{Multiplying the first two numbers} \\
 & \quad \quad \quad \text{and the last two numbers} \\
 & = -40
 \end{aligned}$$

$$23. \quad 15 \div (-5) = -3 \quad \text{Check: } -3(-5) = 15$$

$$24. \quad \frac{-55}{11} = -5 \quad \text{Check: } -5 \cdot 11 = -55$$

$$25. \quad \frac{0}{7} = 0 \quad \text{Check: } 0 \cdot 7 = 0$$

$$\begin{aligned}
 26. \quad & 7 \div 1^2 \cdot (-3) - 4 \\
 & = 7 \div 1 \cdot (-3) - 4 \quad \text{Evaluating the exponential} \\
 & \quad \quad \quad \text{expression} \\
 & = 7 \cdot (-3) - 4 \quad \text{Dividing} \\
 & = -21 - 4 \quad \text{Multiplying} \\
 & = -25 \quad \text{Subtracting}
 \end{aligned}$$

$$\begin{aligned}
 27. \quad & (-3)|4 - 3^2| - 5 \\
 & = (-3)|4 - 9| - 5 \\
 & = (-3)|-5| - 5 \\
 & = -3 \cdot 5 - 5 \\
 & = -15 - 5 \\
 & = -20
 \end{aligned}$$

$$28. \quad 3a + b = 3 \cdot 4 + (-5) = 12 + (-5) = 7$$

$$\begin{aligned}
 29. \quad & \frac{-x}{y} = \frac{-30}{5} = -6 \\
 & \frac{x}{-y} = \frac{30}{-5} = -6 \\
 & -\frac{x}{y} = -\frac{30}{5} = -6
 \end{aligned}$$

$$30. \quad 4(5x + 9) = 4 \cdot 5x + 4 \cdot 9 = 20x + 36$$

$$31. \quad 3(2a - 4b + 5) = 3 \cdot 2a - 3 \cdot 4b + 3 \cdot 5 = 6a - 12b + 15$$

$$32. \quad 5a + 12a = (5 + 12)a = 17a$$

$$33. \quad -7x + 13x = (-7 + 13)x = 6x$$

$$\begin{aligned}
 34. \quad & 9m + 14 - 12m - 8 \\
 & = 9m - 12m + 14 - 8 \\
 & = (9 - 12)m + (14 - 8) \\
 & = -3m + 6
 \end{aligned}$$

$$\begin{aligned}
 35. \quad & P = 2l + 2w = 2 \cdot 10 \text{ in.} + 2 \cdot 8 \text{ in.} \\
 & = 20 \text{ in.} + 16 \text{ in.} = 36 \text{ in.}
 \end{aligned}$$

$$36. \quad P = 4s = 4 \cdot 25 \text{ cm} = 100 \text{ cm}$$

$$\begin{aligned}
 37. \quad & x - 9 = -17 \\
 & x - 9 + 9 = -17 + 9 \\
 & \quad \quad \quad x = -8
 \end{aligned}$$

The solution is -8 .

$$\begin{aligned}
 38. \quad & -4t = 36 \\
 & \frac{-4t}{-4} = \frac{36}{-4} \\
 & \quad \quad \quad t = -9
 \end{aligned}$$

The solution is -9 .

$$\begin{aligned}
 39. \quad & 13 = -x \\
 & -1 \cdot 13 = -1 \cdot (-x) \\
 & \quad \quad \quad -13 = x
 \end{aligned}$$

The solution is -13 .

$$\begin{aligned}
 40. \quad & 56 = 6x - 10 \\
 & 56 + 10 = 6x - 10 + 10 \\
 & \quad \quad \quad 66 = 6x \\
 & \frac{66}{6} = \frac{6x}{6} \\
 & \quad \quad \quad 11 = x
 \end{aligned}$$

The solution is 11 .

$$\begin{aligned}
 41. \quad & -x + 3 = -12 \\
 & -x + 3 - 3 = -12 - 3 \\
 & \quad \quad \quad -x = -15 \\
 & \frac{-x}{-1} = \frac{-15}{-1} \\
 & \quad \quad \quad x = 15
 \end{aligned}$$

The solution is 15 .

$$\begin{aligned}
 42. \quad & 18 = 4 - 2x \\
 & 18 - 4 = 4 - 2x - 4 \\
 & \quad \quad \quad 14 = -2x \\
 & \frac{14}{-2} = \frac{-2x}{-2} \\
 & \quad \quad \quad -7 = x
 \end{aligned}$$

The solution is -7 .

43. Discussion and Writing Exercise. Equivalent expressions are expressions that have the same value when evaluated for various replacements of the variable(s). Equivalent equations are equations that have the same solution(s).

44. Discussion and Writing Exercise. A number's absolute value is the number itself if the number is nonnegative, and the opposite of the number if the number is negative. In neither case is the result less than the number itself, so "no," a number's absolute value is never less than the number itself.

45. Discussion and Writing Exercise. The notation " $-x$ " means "the opposite of x ." If x is a negative number, then $-x$ is a positive number. For example, if $x = -2$, then $-x = 2$.

46. Discussion and Writing Exercise. The expressions $(a - b)^2$ and $(b - a)^2$ are equivalent for all choices of a and b because $a - b$ and $b - a$ are opposites. When opposites are raised to an even power, the results are the same.

$$\begin{aligned} 47. \quad & 87 \div 3 \cdot 29^3 - (-6)^6 + 1957 \\ & = 87 \div 3 \cdot 24,389 - 46,656 + 1957 \\ & = 29 \cdot 24,389 - 46,656 + 1957 \\ & = 707,281 - 46,656 + 1957 \\ & = 660,625 + 1957 \\ & = 662,582 \end{aligned}$$

$$\begin{aligned} 48. \quad & 1969 + (-8)^5 - 17 \cdot 15^3 \\ & = 1969 + (-32,768) - 17 \cdot 3375 \\ & = 1969 + (-32,768) - 57,375 \\ & = -30,799 - 57,375 \\ & = -88,174 \end{aligned}$$

$$\begin{aligned} 49. \quad & \frac{113 - 17^3}{15 + 8^3 - 507} = \frac{113 - 4913}{15 + 512 - 507} \\ & = \frac{-4800}{527 - 507} \\ & = \frac{-4800}{20} \\ & = -240 \end{aligned}$$

50. $8 + x^3$ will be negative for all values of x for which x^3 is less than -8 . Thus, $8 + x^3$ will be negative for $x < -2$.

51. $|x| > x$ for all negative values of x , or for $x < 0$.

Chapter 2 Test

1. The integer -542 corresponds to selling 542 fewer shirts than expected; the integer 307 corresponds to selling 307 more shirts than expected.

2. Since -14 is to the right of -21 , we have $-14 > -21$.

3. The distance from -739 to 0 is 739, so $|-739| = 739$.

4. When $x = -19$, $-(-x) = -(-(-19)) = -(19) = -19$.

5. $6 + (-17)$ The absolute values are 6 and 17. The difference is 11. The negative number has the larger absolute value, so the answer is negative. $6 + (-17) = -11$

6. $-9 + (-12)$

Add the absolute values: $9 + 12 = 21$

Make the answer negative: $-9 + (-12) = -21$

7. $-8 + 17$ The absolute values are 8 and 17. The difference is 9. The positive number has the larger absolute value, so the answer is positive. $-8 + 17 = 9$

8. $0 - 12 = 0 + (-12) = -12$

When 0 is added to any number, that number remains unchanged.

$$9. \quad 7 - 22 = 7 + (-22) = -15$$

$$10. \quad -5 - 19 = -5 + (-19) = -24$$

$$11. \quad -8 - (-27) = -8 + 27 = 19$$

$$\begin{aligned} 12. \quad & 31 - (-3) - 5 + 9 \\ & = 31 + 3 + (-5) + 9 \\ & = 43 + (-5) \quad \text{Adding the positive numbers} \\ & = 38 \end{aligned}$$

$$13. \quad (-4)^3 = -4(-4)(-4) = 16(-4) = -64$$

$$14. \quad 27(-10) = -270$$

$$15. \quad -9 \cdot 0 = 0$$

$$16. \quad -72 \div (-9) = 8 \quad \text{Check: } 8(-9) = -72$$

$$17. \quad \frac{-56}{7} = -8 \quad \text{Check: } -8 \cdot 7 = -56$$

$$\begin{aligned} 18. \quad & 8 \div 2 \cdot 2 - 3^2 = 8 \div 2 \cdot 2 - 9 \\ & = 4 \cdot 2 - 9 \\ & = 8 - 9 \\ & = -1 \end{aligned}$$

$$\begin{aligned} 19. \quad & 29 - (3 - 5)^2 = 29 - (-2)^2 \\ & = 29 - 4 \\ & = 25 \end{aligned}$$

20. We subtract the lower temperature from the higher temperature.

$$-67 - (-81) = -67 + 81 = 14$$

The average high temperature is 14°F higher than the average low temperature.

21. We subtract the final mark from the first mark.

$$8 - (-15) = 8 + 15 = 23$$

Thus, 23 min of tape were rewind.

$$22. \quad \frac{a - b}{6} = \frac{-8 - 10}{6} = \frac{-18}{6} = -3$$

$$23. \quad 7(2x + 3y - 1) = 7 \cdot 2x + 7 \cdot 3y - 7 \cdot 1 = 14x + 21y - 7$$

$$\begin{aligned} 24. \quad & 9x - 14 - 5x - 3 = 9x - 5x - 14 - 3 \\ & = (9 - 5)x + (-14 - 3) \\ & = 4x - 17 \end{aligned}$$

$$25. \quad -7x = -35$$

$$\frac{-7x}{-7} = \frac{-35}{-7}$$

$$x = 5$$

The solution is 5.

$$26. \quad a + 9 = -3$$

$$a + 9 - 9 = -3 - 9$$

$$a = -12$$

The solution is -12 .

27. The amount of trim needed is given by the perimeter of the room, less the 3 ft width of the door, plus the lengths of the three sides of the door that will get trim.

$$\begin{aligned}\text{Perimeter of room: } P &= 2(l + w) \\ &= 2(14 \text{ ft} + 12 \text{ ft}) \\ &= 2(26 \text{ ft}) \\ &= 52 \text{ ft}\end{aligned}$$

Subtract the width of the door: $52 \text{ ft} - 3 \text{ ft} = 49 \text{ ft}$

Trim on door: $7 \text{ ft} + 3 \text{ ft} + 7 \text{ ft} = 17 \text{ ft}$

Total length of trim: $49 \text{ ft} + 17 \text{ ft} = 66 \text{ ft}$

28. $9 - 5[x + 2(3 - 4x)] + 14$
 $= 9 - 5[x + 6 - 8x] + 14$
 $= 9 - 5(-7x + 6) + 14$
 $= 9 + 35x - 30 + 14$
 $= 35x - 7$
29. $15x + 3(2x - 7) - 9(4 + 5x)$
 $= 15x + 6x - 21 - 36 - 45x$
 $= -24x - 57$
30. $49 \cdot 14^3 \div 7^4 + 1926^2 \div 6^2$
 $= 49 \cdot 2744 \div 2401 + 3,709,476 \div 36$
 $= 134,456 \div 2401 + 3,709,476 \div 36$
 $= 56 + 3,709,476 \div 36$
 $= 56 + 103,041$
 $= 103,097$
31. $3487 - 16 \div 4 \cdot 4 \div 2^8 \cdot 14^4$
 $= 3487 - 16 \div 4 \cdot 4 \div 256 \cdot 38,416$
 $= 3487 - 4 \cdot 4 \div 256 \cdot 38,416$
 $= 3487 - 16 \div 256 \cdot 38,416$
 $= 3487 - 2401$ Dividing and then multiplying
 $= 1086$

