Chapter 1: Real Numbers and Variable Expressions

Prep Test

1. 127.16
2. 49,743
3. 4517
4. 11,396
5. 24
6. 24
7. 4
8. 37
9. \( \frac{4}{10} \div \frac{2}{5} \)

Go Figure

Multiplying by numbers that end in zero will produce a zero at the end of the final answer. Since 10 and 20 are included in the list, they are two numbers that would produce a zero at the end of the number. Also, multiplying 5 and 6 produces 30, and multiplying 2 and 15 also produces 30. So there are 4 zeros at the end of the product of the first 20 natural numbers.

Section 1.1

Concept Review 1.1

1. Sometimes true
   \[ |0| = 0 \]
   which is not a positive number.

3. Never true
   The absolute value of a number cannot be less than zero.

5. Sometimes true
   The opposite of a positive number is a negative number. The opposite of a negative number is a positive number.

7. Always true

9. Always true

Objective 1.1.1 Exercises

1. The whole numbers are all the natural numbers and zero.
3. \(-2 > -5\)
5. \(-16 < 1\)
7. \(3 > -7\)
9. \(0 > -3\)
11. \(-42 < 27\)
13. \(21 > -34\)
15. \(-27 > -39\)
17. \(-131 < 101\)
19. \(\{1, 2, 3, 4, 5, 6, 7, 8\}\)
21. \(\{1, 2, 3, 4, 5, 6, 7, 8\}\)
23. \(\{-6, -5, -4, -3, -2, -1\}\)
25. \(-7 < 2\)
   \(0 < 2\)
   \(2 = 2\)
   \(5 > 2\)
   The element 5 is greater than 2.
27. \(-23 < -8\)
   \(-18 < -8\)
   \(-8 = -8\)
   \(0 > -8\)
   The elements –23 and –18 are less than –8.
29. \(-35 < -10\)
   \(-13 < -10\)
   \(21 > -10\)
   \(37 > -10\)
   The elements 21 and 37 are greater than –10.
31. \(-52 < 0\)
   \(-46 < 0\)
   \(0 = 0\)
   \(39 > 0\)
   \(58 > 0\)
   The elements –52, –46, and 0 are less than or equal to 0.
33. \(-23 < -17\)
   \(-17 = -17\)
   \(0 > -17\)
   \(4 > -17\)
   \(29 > -17\)
   The elements –17, 0, 4, and 29 are greater than or equal to –17.
35. \(1 < 5\)
   \(2 < 5\)
   \(3 < 5\)
   \(4 < 5\)
   \(5 = 5\)
   \(6 > 5\)
   \(7 > 5\)
   \(8 > 5\)
   \(9 > 5\)
   The elements 5, 6, 7, 8, and 9 are greater than or equal to 5.
Chapter 1: Real Numbers and Variable Expressions

37.\[-10 < -4\]
\[-9 < -4\]
\[-8 < -4\]
\[-7 < -4\]
\[-6 < -4\]
\[-5 < -4\]
\[-4 = -4\]
\[-3 > -4\]
\[-2 > -4\]
\[-1 > -4\]
The elements \(-10, -9, -8, -7, -6, \text{ and } -5\) are less than \(-4\).

Objective 1.1.2 Exercises

39. The additive inverse of a number is the opposite of the number. The sum of any number and its additive inverse is zero.

41.\[-22\]

43. \[31\]

45. \[168\]

47. \[-630\]

49. \[-(-18) = 18\]

51. \[-(49) = -49\]

53. \[|6| = 16\]

55. \[|-12| = 12\]

57. \[|29| = -29\]

59. \[|-14| = -14\]

61. \[|0| = 0\]

63. \[|-34| = -34\]

65. a. \[-(-8) = 8\]
\[-(-5) = 5\]
\[-(-2) = 2\]
\[-(1) = -1\]
\[-(3) = -3\]

b. \[|-8| = 8\]
\[|-5| = 5\]
\[|-2| = 2\]
\[|1| = 1\]
\[|3| = 3\]

67. \[|83| > |58|\]

69. \[|3| < |-52|\]

71. \[|68| > |-42|\]

73. \[|43| < |-61|\]

Applying Concepts 1.1

75. \[-19, -|-8|, -|5|, 6\]

77. \[-22, -(-3), |-14|, |-2|\]

79. a. Strategy
- From the given table, find the wind-chill factor with a temperature of 5ºF and a 20-mph wind and the wind-chill factor with a temperature of 10ºF and a 15-mph wind.
- Compare the wind-chill factors.

Solution
The wind-chill factor with a temperature of 5ºF and a 20-mph wind is \(-31º\).
The wind-chill factor with a temperature of 10ºF and a 15-mph wind is \(-18º\).
\[-31 < -18\]
The 5º temperature with the 20-mph wind feels colder.

b. Strategy
- From the given table, find the wind-chill factor with a temperature of –25ºF and a 10-mph wind and the wind-chill factor with a temperature of –15ºF and a 20-mph wind.
- Compare the wind-chill factors.

Solution
The wind-chill factor with a temperature of –25ºF and a 10-mph wind is –52º.
The wind-chill factor with a temperature of –15ºF and a 20 mph wind is –60º.
\[-52 > -60\]
The –15º temperature with the 20-mph wind feels colder

81. –4 and 4
83. –3 and 11

85. negative
87. 0
89. true

91. Some examples of English words that are used as variables are it, he, she, them, that, and those.

Section 1.2

Concept Review 1.2

1. Sometimes true
The sum of two negative integers is less than either integer being added.

3. Always true

5. Always true

7. Never true
\[4(-8) = -32\]

9. Never true
\[8 - 4 \neq 4 - 8\]

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Section 1.2

Objective 1.2.1 Exercises

1. Students should rephrase the rule for adding two integers with the same sign: To add two integers with the same sign, add the absolute values of the numbers. Then attach the sign of the addends.

3. \(-3 + (-8) = -11\)

5. \(-4 + (-5) = -9\)

7. \(6 + (-9) = -3\)

9. \(-6 + 7 = 1\)

11. \(2 + (-3) + (-4) = -1 + (-4) = -5\)

13. \(-3 + (-12) + (-15) = -15 + (-15) = -30\)

15. \(-17 + (-3) + 29 = -20 + 29 = 9\)

17. \(-3 + (-8) + 12 = -11 + 12 = 1\)

19. \(13 + (-22) + 4 + (-5) = -9 + 4 + (-5) = -5 + (-5) = -10\)

21. \(-22 + 10 + 2 + (-18) = -12 + 2 + (-18) = -10 + (-18) = -28\)

23. \(-126 + (-247) + (-358) + 339 = -373 + (-358) + 339 = -731 + 339 = -392\)

Objective 1.2.2 Exercises

25. Students should include in their description that “minus” refers to the operation of subtraction, while “negative” refers to the sign of a number.

27. \(16 - 8 = 16 + (-8) = 8\)

29. \(7 - 14 = 7 + (-14) = -7\)

31. \(3 + (-4) = 3 + 4 = 7\)

33. \((-4) + (-2) = -4 + 2 = -2\)

35. \(-12 - 16 = -12 + (-16) = -28\)

37. \(4 - 5 - 12 = 4 + (-5) + (-12) = -1 + (-12) = -13\)

39. \(-12 + (-3) + (-15) = -12 + 3 + 15 = -9 + 15 = 6\)

41. \(13 - 7 - 15 = 13 + (-7) + (-15) = 6 + (-15) = -9\)

43. \(-30 - (-65) - 29 - 4 = -30 + 65 + (-29) + (-4) = 35 + (-29) + (-4) = 6 + (-4) = 2\)

45. \(-16 - 47 - 63 - 12 = -16 + (-47) + (-63) + (-12) = -63 + (-63) + (-12) = -126 + (-12) = -138\)

47. \(-47 - (-67) - 13 - 15 = -47 + 67 + (-13) + (-15) = 20 + (-13) + (-15) = 7 + (-15) = -8\)

Objective 1.2.3 Exercises

49. Students should rephrase the rule for multiplying two integers with the same sign: To multiply two integers with the same sign, multiply the absolute values of the factors; the product is positive.

51. a. The operation in the expression \(8(-7)\) is multiplication. There is no operation symbol between the 8 and the left parentheses.

b. The operation in the expression \(8 - 7\) is subtraction. There is a space before and after the minus sign. 7 is subtracted from 8.

c. The operation in the expression \(8 - (-7)\) is subtraction. There is a space before and after the minus sign. -7 is subtracted from 8.

d. The operation in the expression \(-xy\) is multiplication. The \(x\) and \(y\) are right next to each other with no sign in between.

e. The operation in the expression \(x(-y)\) is multiplication. There is no operation symbol between the \(x\) and left parentheses.

f. The operation in the expression \(-x - y\) is subtraction. There is a space before and after the minus sign. \(y\) is subtracted from \(-x\).

53. \(14 \cdot 3 = 42\)

55. \(5(-4) = -20\)

57. \(-8(2) = -16\)

59. \((-5)(-5) = 25\)

61. \((-7)(0) = 0\)

63. \(-24 \cdot 3 = -72\)

65. \(6(-17) = -102\)

67. \(-4(-35) = 140\)

69. \(5 \cdot 7(-2) = 35(-2) = -70\)
71. \((-9)(-9)(2) = 81(2) = 162\)
73. \(-5(8)(-3) = -40(-3) = 120\)
75. \(-1(4)(-9) = -4(-9) = 36\)
77. \(4(-4) \cdot 6(-2) = -16 \cdot 6(-2) = -96(-2) = 192\)
79. \(9(-4) \cdot 3(1) = -36 \cdot 3(1) = -108(1) = -108\)
81. \(-6(-5)(12)(0) = 30(12)(0) = 360(0) = 0\)

Objective 1.2.4 Exercises

83. \(3(-12) = -36\)
85. \(-5(11) = -55\)
87. \(12 ÷ (-6) = -2\)
89. \((-72) ÷ (-9) = 8\)
91. \(0 ÷ (-6) = 0\)
93. \(45 ÷ (-5) = -9\)
95. \(-36 ÷ 4 = -9\)
97. \(-81 ÷ (-9) = 9\)
99. \(72 ÷ (-3) = -24\)
101. \(-60 ÷ 5 = -12\)
103. \(78 ÷ (-6) = -13\)
105. \(-72 ÷ 4 = -18\)
107. \(-114 ÷ (-6) = 19\)
109. \(-130 ÷ (-5) = 26\)
111. \(-132 ÷ (-12) = 11\)
113. \(-182 ÷ 14 = -13\)
115. \(143 ÷ 11 = 13\)

Objective 1.2.5 Exercises

117. Strategy
To find the temperature, add the rise in temperature (9º) to the original temperature (−6º).

Solution
\(-6 + 9 = 3\)
The temperature is 3ºC.

119. Strategy
To find the difference, subtract the low temperature (−4ºC) from the high temperature (10ºC).

Solution
\(10 - (-4) = 10 + 4 = 14\)
The difference is 14ºC.

121. Strategy
To find the difference, subtract the temperature at which mercury freezes (−39ºC) from the temperature at which mercury boils (360ºC).

Solution
\(360 - (-39) = 360 + 39 = 399\)
The difference is 399ºC.

123. Strategy
To find the difference, subtract the elevation of the Caspian Sea (−28 m) from the elevation of Mt. Elbrus (5634 m).

Solution
\(5634 - (-28) = 5634 + 28 = 5662\)
The difference in elevation is 5662 m.

125. Strategy
To find the difference, subtract the elevation of the Qattara Depression (−133 m) from the elevation of Mt. Kilimanjaro (5895 m).

Solution
\(5895 - (-133) = 5895 + 133 = 6028\)
The difference in elevation is 6028 m.

127. Strategy
To find the difference, subtract the elevation of the Dead Sea (−400 m) from the elevation of Mt. Everest (8848 m).

Solution
\(8848 - (-400) = 8848 + 400 = 9248\)
The difference in elevation is 9248 m.

129. Strategy
To find the average daily high temperature:
• Add the seven temperature readings.
• Divide by 7.

Solution
\(-8 + (-9) + 6 + 7 + (-2) + (-14) + (-1) = -17 + 6 + 7 + (-2) + (-14) + (-1) = -11 + 7 + (-2) + (-14) + (-1) = -4 + (-2) + (-14) + (-1) = -6 + (-14) + (-1) = -20 + (-1) = -21 \div 7 = -3\)
The average daily high temperature was −3ºC.
131. Strategy
To find the drop in temperature, subtract the lower temperature from the higher temperature.

Solution
$44 - (-56) = 45 + 56$
$= 100$

The temperature dropped 100°F.

133. Strategy
To find the drop in temperature, subtract the lower temperature at 30,000 ft (–48°F) from the higher temperature at 20,000 ft (–12°F).

Solution
$-12 - (-48) = 36$

The temperature dropped 36°F.

135. Strategy
To find the score:
• Multiply the number of correct answers by 7.
• Multiply the number of incorrect answers by –3.
• Multiply the number of questions left blank by –1.
• Add the results.

Solution
$(17)(7) = 119$
$(8)(-3) = -24$
$(2)(-1) = -2$

$119 + (-24) + (-2) = 93$

The student’s score was 93.

137. Strategy
To calculate the 5-day moving average, determine the average of the stock for days 1 through 5, days 2 through 6, days 3 through 7, and so on.

Solution

- **Days 1–5**
  $(-20) + (-20) + (-50) + (-20) + (-10) = -120$
  $\frac{-120}{5} = -24$

- **Days 2–5**
  $(-20) + (-50) + (-20) + (-10) + 30 = -70$
  $\frac{-70}{5} = -14$

- **Days 3–7**
  $(-50) + (-20) + (-10) + 30 + (-10) = -60$
  $\frac{-60}{5} = -12$

- **Days 4–8**
  $(-20) + (-10) + 30 + (-10) + 30 = 20$
  $\frac{20}{5} = 4$

- **Days 5–9**
  $(-10) + 30 + (-10) + 30 + 0 = 40$
  $\frac{40}{5} = 8$

- **Days 6–10**
  $30 + (-10) + 30 + 0 + 50 = 100$
  $\frac{100}{5} = 20$

The 5-day moving average is –24, –14, –12, 4, 8, and 20.

**Applying Concepts 1.2**

139. $|3 - (-4)| = 7|1| = 7$

141. $|8 - 2| = |-3| = 3$

143. –4, –9, –14

145. –16, 4, –1

147. 5436
149. a. $|3 + 4| = |3| + |4|$
   $|7| = 3 + 4$
   $7 = 7$
   True

   b. $|3 - 4| = |3| - |4|$
   $|-1| = 3 - 4$
   $1 = -1$
   False

   c. $|4 + 3| = |4| + |3|$
   $|7| = 4 + 5$
   $7 = 7$
   True

   d. $|4 - 3| = |4| - |3|$
   $|1| = 4 - 3$
   $1 = 1$
   True

151. For a, b, and c, if $x = 3$ and $y = -2$,

   a. $|x + y| \leq |x| + |y|$
   $|3 + (-2)| \leq |3| + |-2|$
   $|1| \leq 3 + 2$
   $1 \leq 5$
   True

   b. $|x + y| = |x| + |y|$
   $|3 + (-2)| = |3| + |-2|$
   $|1| = 3 + 2$
   $1 \neq 5$
   False

   c. $|x + y| \geq |x| + |y|$
   $|3 + (-2)| \geq |3| + |-2|$
   $|1| \geq 3 + 2$
   $1 \neq 5$
   False

   The answer is a.

153. No. For example, the difference between 10 and $-8$ is 18, which is greater than both 10 and $-8$.

155. For any division problem, the quotient times the divisor equals the dividend. For example, $18 \div 3 = 6$ because $6 \times 3 = 18$. For the division problem $4 \div 0 = ?$, the corresponding multiplication is $? \times 0 = 4$. But there is no number whose product with 0 is 4 because the product of a number and zero is 0. Therefore, division by zero is undefined.

Section 1.3

Concept Review 1.3

1. Never true
   The rule for multiplying fractions is to multiply the numerators and multiply the denominators.

3. Sometimes true
   $\frac{1}{3}$ is a rational number and is represented by the repeating decimal $0.\bar{3}$

5. Always true

7. Never true
   To write a decimal as a percent, multiply by 100 and write the percent sign.

9. Always true

Objective 1.3.1 Exercises

1. $\frac{3}{4} \div \frac{100}{0.000}$
   $-\frac{9}{10}$
   $-\frac{9}{10}$
   $-\frac{9}{10}$
   $-\frac{9}{10}$

3. $\frac{4}{3} \div \frac{0}{0.000}$
   $-\frac{8}{20}$
   $-\frac{20}{0}$
   $-\frac{1}{4} = 0.25$

5. $\frac{5}{3} \div \frac{0}{0.000}$
   $-\frac{20}{0}$
   $0$
   $\frac{2}{5} = 0.4$

7. $\frac{6}{3} \div \frac{0.000}{0.16}$
   $-\frac{6}{40}$
   $-\frac{36}{40}$
   $-\frac{36}{4}$
   $\frac{1}{6} = 0.16$

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Section 1.3

9. \[ \frac{0.125}{8} \]
   \[\begin{array}{r}
   -8 \\
   -16 \\
   -40 \\
   0
   \end{array}\]
   \[\frac{1}{8} = 0.125\]

11. \[ \frac{0.222}{9} \]
   \[\begin{array}{r}
   -18 \\
   -18 \\
   -18 \\
   2
   \end{array}\]
   \[\frac{2}{9} = 0.222\]

13. \[ \frac{0.4545}{11} \]
   \[\begin{array}{r}
   -44 \\
   -55 \\
   -44 \\
   -55 \\
   5
   \end{array}\]
   \[\frac{5}{11} = 0.45\]

15. \[ \frac{0.5833}{12} \]
   \[\begin{array}{r}
   -60 \\
   -96 \\
   -36 \\
   -36 \\
   4
   \end{array}\]
   \[\frac{7}{12} = 0.583\]

17. \[ \frac{0.266}{15} \]
   \[\begin{array}{r}
   -30 \\
   -90 \\
   -90 \\
   10
   \end{array}\]
   \[\frac{4}{15} = 0.26\]

19. \[ \frac{0.4375}{16} \]
   \[\begin{array}{r}
   -64 \\
   -48 \\
   -112 \\
   0
   \end{array}\]
   \[\frac{7}{16} = 0.4375\]

21. \[ \frac{0.24}{25} \]
   \[\begin{array}{r}
   -50 \\
   -100 \\
   0
   \end{array}\]
   \[\frac{6}{25} = 0.24\]

23. \[ \frac{0.225}{40} \]
   \[\begin{array}{r}
   -80 \\
   -80 \\
   -200 \\
   0
   \end{array}\]
   \[\frac{9}{40} = 0.225\]

25. \[ \frac{0.68181}{22} \]
   \[\begin{array}{r}
   -132 \\
   -176 \\
   -176 \\
   18
   \end{array}\]
   \[\frac{15}{22} = 0.681\]
27. \[ \frac{11}{24} = 0.4583 \]

29. \[ \frac{33}{35} = 0.9429 \]

31. \[ \frac{3}{37} = 0.081081 \]

Objective 1.3.2 Exercises

33. \[ \frac{5}{3} + \frac{1}{2} = \frac{8}{12} + \frac{6}{12} = \frac{14}{12} = \frac{7}{6} \]

35. \[ \frac{5}{8} - \frac{3}{4} = \frac{5}{8} - \frac{6}{8} = \frac{-1}{8} \]

37. \[ \frac{6}{13} + \frac{17}{26} = \frac{12}{26} + \frac{17}{26} = \frac{29}{26} = \frac{1}{26} \]

41. \[ \frac{-5}{8} - \left( \frac{-11}{12} \right) = \frac{5}{8} + \frac{11}{12} = \frac{75}{24} + \frac{22}{24} = \frac{97}{24} \]

43. \[ \frac{1}{2} - \frac{2}{3} + \frac{1}{6} = \frac{3}{6} - \frac{4}{6} + \frac{1}{6} = \frac{1}{6} \]

45. \[ \frac{-5}{16} + \frac{3}{4} - \frac{7}{8} = \frac{-5}{16} + \frac{12}{16} = \frac{-1}{16} \]

47. \[ \frac{3}{8} - \left( \frac{7}{12} \right) = \frac{3}{8} + \frac{7}{12} = \frac{9 + 14}{24} = \frac{23}{24} \]

49. \[ \frac{2}{3} + \frac{1}{2} = \frac{4}{6} + \frac{3}{6} = \frac{7}{6} \]

51. \[ \frac{5}{8} - \left( \frac{-5}{12} \right) + \frac{1}{3} = \frac{5}{8} + \frac{5}{12} + \frac{1}{3} = \frac{15 + 10 + 8}{24} = \frac{33}{24} \]

53. \[ \frac{-7}{9} + \frac{14}{15} + \frac{8}{21} = \frac{-245 + 294 + 120}{315} + \frac{315}{315} = \frac{169}{315} \]

55. \[ \frac{32.1 + 6.7}{38.8} = 0.8319 \]

57. \[ \frac{13.092 - 6.9}{6.192} = 1.092 \]

59. \[ \frac{5.43 + 7.925}{13.355} = 0.407 \]

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Section 1.3

61. \[
\frac{8.546}{3.87} = \frac{1.3}{4}
\]
\[
-3.87 + 8.546 = 4.676
\]
63. \[
2.09 - 6.72 - 5.4 = -4.63 - 5.4
\]
\[
= -10.03
\]
65. \[
-18.39 + 4.9 - 23.7 = -13.49 - 23.7
\]
\[
= -37.19
\]
67. \[
-3.07 - (-2.97) - 17.4 = -3.07 + 2.97 - 17.4
\]
\[
= -0.10 - 17.4
\]
\[
= -17.5
\]
69. \[
317.09 - 46.902 + 583.0714
\]
\[
= 270.188 + 583.0714
\]
\[
= 853.2594
\]

Objective 1.3.3 Exercises

71. \[
\frac{\left(\frac{3}{4}\right)}{1.2} = \frac{\left(\frac{3}{4}\right)}{1.2}
\]
\[
= \frac{1.3}{4} = \frac{1.3}{2} = \frac{3}{2}
\]
73. \[
\left(\frac{3}{8}\right)\left(\frac{4}{15}\right) = \left(\frac{3}{8}\right)\left(\frac{4}{15}\right)
\]
\[
= \frac{1.1}{1} = \frac{1}{1}
\]
75. \[
\left(\frac{1}{2}\right)\left(\frac{3}{4}\right) = \left(\frac{1}{2}\right)\left(\frac{3}{4}\right)
\]
\[
= \frac{3}{2} = \frac{3}{2}
\]
77. \[
\frac{3}{8} \div \frac{3}{4} = \frac{3}{8} \div \frac{3}{4}
\]
\[
= \frac{3}{2} \cdot \frac{3}{2} = \frac{3}{2} \cdot \frac{3}{2}
\]
79. \[
-\frac{5}{12} \div \frac{15}{32} = \left(-\frac{5}{12}\right) \div \left(\frac{15}{32}\right)
\]
\[
= \left(-\frac{5}{12}\right) \div \left(\frac{15}{32}\right)
\]
\[
= \left(-\frac{5}{12}\right) \div \left(\frac{15}{32}\right)
\]
\[
= \frac{8}{9}
\]
81. \[
\frac{-\frac{4}{9}}{\frac{6}{3}} = \frac{-\frac{4}{9}}{\frac{6}{3}}
\]
\[
\frac{4}{9} \cdot \frac{2}{3} = \frac{4}{9} \cdot \frac{2}{3}
\]
\[
= \frac{4}{9} \cdot \frac{2}{3} = \frac{4}{9} \cdot \frac{2}{3}
\]
83. \[
\frac{3.47}{1.2} = \frac{3.47}{1.2}
\]
\[
= \frac{1.2}{6.94}
\]
\[
\frac{4.146}{4.146}
\]
\[
(1.2)(3.47) = 4.164
\]
85. \[
\frac{1.89}{2.3} = \frac{1.89}{2.3}
\]
\[
\frac{567}{378}
\]
\[
\frac{4.347}{-1.89(-2.3) = 4.347}
\]
87. \[
\frac{1.06}{3.8} = \frac{1.06}{3.8}
\]
\[
\frac{848}{-215}
\]
\[
\frac{4.028}{-1.89(-3.8) = 4.028}
\]
89. \[
\frac{(1.2)(-0.5)(3.7) = -0.6(3.7)}{1.75}
\]
\[
= -2.22
\]
91. \[
\frac{(-0.8)(3.006)(-5.1) = (-2.4084)(-5.1)}{12.26448}
\]
93. \[
\frac{0.747}{-119}
\]
\[
\frac{80}{-68}
\]
\[
\frac{120}{-119}
\]
\[
\frac{1}{-1.27 \div (-1.7) = 0.75}
\]
95. \[
-354.2086 + 0.1719 = -2060.55
\]
97. \[
(-3.92) \div (-45.008) \approx 0.09
\]

Objective 1.3.4 Exercises

99. a. To convert a decimal to a percent, multiply the decimal by 100%.

b. To convert a percent to a decimal, remove the percent sign and multiply by 0.01.

101. \[
75\% = 75\left(\frac{1}{100}\right) = \frac{75}{100} = \frac{3}{4}
\]
\[
75\% = 75(0.01) = 0.75
\]
103. \[
50\% = 50\left(\frac{1}{100}\right) = \frac{50}{100} = \frac{1}{2}
\]
\[
50\% = 50(0.01) = 0.5
\]
105. \[
64\% = 64\left(\frac{1}{100}\right) = \frac{64}{100} = \frac{16}{25}
\]
\[
64\% = 64(0.01) = 0.64
\]
107. \[
175\% = 175\left(\frac{1}{100}\right) = \frac{175}{100} = \frac{3}{4}
\]
\[
175\% = 175(0.01) = 1.75
\]
109. \[
19\% = 19\left(\frac{1}{100}\right) = \frac{19}{100}
\]
\[
19\% = 19(0.01) = 0.19
\]

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111. \(5\% = \frac{5}{100} = \frac{5}{100} \times \frac{1}{20} = 0.05\)

113. \(450\% = 450 \times \frac{1}{100} = 4 \frac{1}{2}\)

115. \(8\% = \frac{8}{100} = \frac{2}{25}\)

117. \(11\frac{1}{9}\% = 11\frac{1}{9} \times \frac{1}{100} = \frac{1}{9}\)

119. \(31\frac{1}{4}\% = 31\frac{1}{4} \times \frac{1}{100} = \frac{5}{16}\)

121. \(\frac{1}{2}\% = \frac{1}{2} \times \frac{1}{100} = \frac{1}{200}\)

123. \(\frac{1}{4}\% = 6 \times \frac{1}{4} \times \frac{1}{100} = \frac{1}{16}\)

125. \(7.3\% = 7.3 \times 0.01 = 0.073\)

127. \(15.8\% = 15.8 \times 0.01 = 0.158\)

129. \(9.15\% = 9.15 \times 0.01 = 0.0915\)

131. \(18.23\% = 18.23 \times 0.01 = 0.1823\)

133. \(0.15 \times 0.15\% = 0.15\% = 0.15\%\)

135. \(0.05 \times 0.05\% = 0.05\% = 0.05\%\)

137. \(0.175 \times 0.175\% = 0.175\% = 0.175\%\)

139. \(1.15 \times 1.15\% = 1.15\% = 1.15\%\)

141. \(0.008 \times 0.008\% = 0.008\% = 0.008\%\)

143. \(0.065 \times 0.065\% = 0.065\% = 0.065\%\)

145. \(\frac{27}{50} = 0.54\% = 0.54\%\)

147. \(\frac{1}{3} = \frac{1}{3} \times \frac{100}{5} = 33.3\%\)

149. \(\frac{4}{9} = \frac{4}{9} \times \frac{100}{9} = 44.4\%\)

151. \(\frac{1}{2} = \frac{5}{10} = \frac{500}{2} = 25.0\%\)

153. \(\frac{3}{8} = \frac{3}{8} \times \frac{100}{8} = 37.5\%\)

155. \(\frac{5}{14} = \frac{5}{14} \times \frac{100}{14} = 35.7\%\)

157. \(\frac{1}{4} = \frac{5}{4} \times \frac{100}{4} = 125\%\)

159. \(\frac{5}{9} = \frac{14}{9} \times \frac{100}{9} = 155\frac{5}{9}\%\)

161. \(4\% = 4 \times \frac{1}{100} = \frac{1}{25}\)

163. \(40\% = 40 \times \frac{1}{100} = \frac{40}{100}\)

165. natural number, integer, positive integer, rational number, real number

167. rational number, real number

169. irrational number, real number

171. Strategy
To find the cost, add the cost for the first ounce ($0.37) and the cost for the remaining 3 1/2 ounces ($0.23 times 4).

Solution

\[0.37 + 0.23 	imes 4 = 0.37 + 0.92 = 1.29\]

The cost is $1.29.

173. Strategy
To find the difference in deficits, subtract the deficit in 1980 (–73.835) from the deficit in 1985 (–212.334).

Solution

\[–212.334 – (–73.835) = –138.499\]

The difference is $138.499 billion.

175. Strategy
To find how many times greater the deficit was, divide the deficit in 1985 (–212.334) by the deficit in 1975 (–53.242).

Solution

\[\frac{–212.334}{–53.242} \approx 4\]

The deficit in 1985 was 4 times greater than the deficit in 1975.
177. **Strategy**
   To find the average, add the values of each year and divide by 6.

**Solution**

\[
\begin{align*}
-163.899 + (-107.450) + (-21.940) + 69.246 + 79.263 + 117.305 &= 27.475 \\
\frac{27.475}{6} &= -4.579 	ext{ billion} = -4,579 \text{ million}
\end{align*}
\]

The average deficit is \(-4,579\) million.

179. The new fraction will be greater than \(\frac{2}{5}\).

For example, \(\frac{2 + 3}{5 + 3} = \frac{5}{8}\), and \(\frac{5}{8} > \frac{2}{5}\).

181. \(x + 0.06x = 1x + 0.06x = (1 + 0.06)x = 1.06x\)

183. **Strategy**
   To find the price, find a whole number less than 60 that divides evenly into 5459.

**Solution**

\[5459 \div 53 = 103\]

The price during the sale was \(53\text{¢}\).

185. Yes, we can find the average of \(a\) and \(b\), which would be \(c = \frac{a + b}{2}\).

187. Consider the following steps that can be used to divide two fractions.

\[
\begin{align*}
\frac{4}{7} \div \frac{5}{12} &= \frac{4}{7} \cdot \frac{12}{5} \\
&= \frac{4 \cdot 12}{7 \cdot 5} \\
&= \frac{48}{35}
\end{align*}
\]

The division of two fractions can be written as a fraction, with the dividend in the numerator and the divisor in the denominator. Multiply this fraction by the number 1 in the form of a fraction with the reciprocal of the divisor in both the numerator and denominator. To multiply these fractions, multiply the numerators and multiply the denominators. The result is a fraction with 1 in the denominator. Since any number divided by 1 is itself, we can rewrite the fraction without the denominator, which is the dividend multiplied by the reciprocal of the divisor.

**Section 1.4**

**Concept Review 1.4**

1. Never true
   \((-5)^2 = 25, \ -5^2 = -25, \ \text{and} \ - (5)^2 = -25\)

3. Never true
   In the expression \(3^8\), 3 is the base and 8 is the exponent.

5. Always true

7. Never true
   The order of Operations Agreement was adopted so that there could be no more than one correct answer to a problem.

9. Never true
   \((2^3)^2 = 64, \ 2^{3^2} = 512\)

**Objective 1.4.1 Exercises**

1. \(6^2 = 6 \cdot 6 = 36\)

3. \((-7)^2 = -(7 \cdot 7) = -49\)

5. \((-3)^2 = (-3)(-3) = 9\)

7. \((-3)^4 = (-3)(-3)(-3)(-3) = 81\)
9. \[
\left( \frac{1}{2} \right)^2 = \frac{1}{4}
\]

11. \[
(0.3)^2 = 0.09
\]

13. \[
\left( \frac{2}{3} \right)^2 \cdot 3^3 = \left( \frac{2}{3} \right)^2 \cdot 27 = \frac{8}{9} \cdot 27 = \frac{216}{9} = 24
\]

15. \[
(0.3)^2 \cdot 2^3 = (0.3)(0.3)(0.3) \cdot 2 \cdot 2 \cdot 2 = 0.027 \cdot 8 = 0.216
\]

17. \[
(-3)^2 - (-3) \cdot 2 = -3 \cdot 4 = -12
\]

19. \[
(-2)^3 = -8
\]

21. \[
2^3 \cdot 3^3 = 8 \cdot 27 = 216
\]

23. \[
(-7)^2 \cdot 3^2 = 49 \cdot 9 = 441
\]

25. \[
\left( \frac{2}{3} \right)^2 \cdot \frac{1}{4} = \frac{4}{9} \cdot \frac{1}{4} = \frac{1}{9}
\]

27. \[
8^3 \cdot (-3)^2 \cdot 5 = 512 \cdot 9 \cdot 5 = 23,040
\]

Objective 1.4.2 Exercises

29. Students should describe the steps in the Order of Operations Agreement:
   Step 1: Perform operations inside grouping symbols.
   Step 2: Simplify exponential expressions.
   Step 3: Do addition and subtraction as they occur from left to right.
   Step 4: Do multiplication and division as they occur from left to right.

31. \[
2^3 \cdot 3 = 8 \cdot 3 = 24
\]

33. \[
16 - 32 \div 2^3 = 16 - 32 \div 8 = 16 - 4 = 12
\]

35. \[
8 - (-3)^2 - (-2) = 8 - 9 - (-2) = 8 - 9 + 2 = -1 + 2 = 1
\]

37. \[
14 - 2^2 - 3 = 14 - 4 - 3 = 7
\]

39. \[
-2^2 + 4[16 + (3 - 5)] = -4 + 4[18] = -4 + 4[2] = -4 + 8 = 4
\]

41. \[
24 \div \frac{3^2}{8 - 5} = 24 \div \frac{9}{3} = 24 \div 3 = 8
\]

43. \[
4 \cdot [16 - (7 - 1)] + 10 = 4 \cdot [15 + 10] = 4 \cdot 20 = 80
\]

45. \[
18 \div 9 - 8 + (3) = 2 - 8 + 3 = 5
\]

47. \[
4(-8) \div [2(7 - 3)^2] = 4(-8) \div [2(16)] = 4(-8) \div 32 = -32 \div 32 = -1
\]

49. \[
16 - 4 \div \frac{3^3 - 7}{2^3 + 2} = 16 - 4 \div \frac{27 - 7}{8} = 16 - 4 \div \frac{20}{8} = 16 - 2.5 = 13.5
\]

51. \[
0.3(1.7 - 4.8) + (1.2)^2 = 0.3(-3.1) + 1.44 = -0.93 + 1.44 = 0.51
\]

53. \[
(1.65 - 1.05)^2 + 0.4 + 0.8 = (0.60)^2 + 0.4 + 0.8 = 0.36 + 0.4 + 0.8 = 0.9 + 0.8 = 1.7
\]
55. \[
\left(\frac{3}{4}\right)^2 - \left(\frac{1}{2}\right)^3 = \frac{9}{16} - \frac{1}{8} + \frac{3}{5} \\
= \frac{9}{16} - \frac{2}{16} + \frac{6}{16} \\
= \frac{11}{16} \\
= \frac{11}{16} - \frac{1}{8} + \frac{5}{5} \\
= \frac{15}{16} - \frac{2}{16} + \frac{10}{16} \\
= \frac{22}{16} = \frac{11}{8} \\
= 1.375
\]

Applying Concepts 1.4

57. \((-1.1)^2 > (0.9)^2\) because \(1.21 > 0.81\)

59. \((0.9)3 < 1\) because \(0.729 < 1\)

61. \[1 + 33 + 4 = 1 + 8 + 27 + 64 = 36 + 64 = 100\]

63. \([-2]^2 + (-4)^2 + (-6)^2 = 4 + 16 + 36 + 64 = 20 + 36 + 64 = 56 + 64 = 120\]

65. \[10^8 = 6,000,000 \implies 100,000,000 \div 6,000,000 = 1.6\]

It will take the computer approximately 17 s to do the additions.

67. \[34^1 = 34\]
\[34^2 = 1156\]
\[34^3 = 39,304\]
\[34^4 = 1,336,336\]
\[34^5 = 45,435,424\]

Even powers of 34 have 6 in the ones digit. 34 has a 6 in the ones digit.

69. \[27^1 = 27\]
\[27^2 = 729\]
\[27^3 = 19,683\]
\[27^4 = 531,441\]
\[27^5 = 14,348,907\]
\[27^6 = 387,420,489\]
\[27^6 = 27 \cdot 27 \cdot 27 \cdot 27 \cdot 27 \cdot 27\]
\[27^6 \text{ has a 1 in the ones digit.}\]
\[27^6 \text{ has a 9 in the ones digit.}\]

Section 1.5

Concept Review

1. Never true

The Commutative Property of Addition states that two terms can be added in either order and the sum will be the same.

3. Always true

5. Always true

7. Never true

\[3(x + 4) = 3x + 12\] is the correct application of the Distributive Property.

Objective 1.5.1 Exercises

1. To “evaluate a variable expression” means to substitute the given values of the variables into the variable expression and then to use the Order of Operations Agreement to simplify the resulting expression.

3. \[b^2 - c^2 = 9 - 16 = -7\]

5. \[a^2 + b^2 = 4 + 9 = 13\]

7. \[(b - a)^2 + 4c = 1^2 + 4(-4) = 1 + (-16) = -15\]

9. \[5ab \div 6 - 3bc = \frac{5(2)(3)}{6} - 3(-4)(3) = \frac{30}{6} - (-36) = 5 + 36 = 41\]

11. \[(b + d)^2 - 4a = (4 + 3)^2 - 4(-2) = 7^2 - 4(-2) = 49 + 8 = 57\]

13. \[(d - a)^2 + 5 = [3 - (-2)]^2 + 5 = [3 + 2]^2 + 5 = 5^2 + 5 = 25 + 5 = 5\]

15. \[b^2 - 2b + 4 = 2(4 + 4) = 16 - 8 + 4 = 8 + 4 = 12\]

17. \[\frac{bd}{a} \div c = \frac{4(3)}{2} \div (-1) = \frac{12}{-2} \div (-1) = -6 \div (-1) = 6\]
19. $2(b+c) − 2a$
   \[2[4 + (-1)] − 2(-2) = 2(3) − 2(-2) = 6 − (-4) = 10\]

21. $4ac + (2a)^2$
   \[4(-2)(-1) + [2(-2)]^2 = 4(-2)(-1) + (-4)^2 = 4(-2)(-1) + 16 = 8 + 16 = 24\]

23. $c^2 − ab$
   \[(-0.8)^2 − (2.7)(-1.6) = 0.64 − (-4.32) = 0.64 + 4.32 = 4.96\]

25. $\frac{b^3}{c} − 4a$
   \[\frac{(-1.6)^3}{-0.8} − 4(2.7) = \frac{-4.096}{-0.8} - 4(2.7) = 5.12 - 10.8 = -5.68\]

27. Strategy
   To find the volume, use the formula for the volume of a cylinder.
   Solution
   \[V = \pi r^2 h\]
   \[V = \pi (1.25^2)(5.25) = 25.8\]
   The volume is approximately 25.8 in$^3$.

29. Strategy
   To find the area, use the formula for the area of a trapezoid.
   Solution
   \[A = \frac{1}{2} h(b_1 + b_2)\]
   \[A = \frac{1}{2} (6.75)(17.5 + 10.25) = \frac{1}{2} (6.75)(27.75) = 93.7\text{ cm}^2\]
   The area is approximately 93.7 cm$^2$.

31. Strategy
   To find the volume, use the formula for the volume of a cylinder.
   \[r = \frac{1}{2} d = \frac{1}{2} (7) = 3.5\]
   Solution
   \[V = \pi r^2 h\]
   \[V = \pi (3.5)^2(12.6) = 484.9\]
   The volume is approximately 484.9 m$^3$.

33. $3x^2 − 4x − 5 = 3(2)^2 − 4(-2) − 5$
   \[= 3(4) + 8 − 5 = 12 + 3 = 15 = a\]
   \[3a − 4 = 3(15) - 4 = 45 − 4 = 41\]

Objective 1.5.2 Exercises

35. 2
37. 5
39. 6
41. 8
43. The Inverse Property of Addition
45. The Commutative Property of Addition
47. The Commutative Property of Multiplication
49. The Associative Property of Multiplication

51. Like terms are variable terms with the same variable part. Constant terms are also like terms. Examples of like terms are $4x$ and $-9x$. Examples of terms that are not like terms are $4x^2$ and $-9x$. The terms $4$ and $9$ are also like terms; $4$ and $-4x$ are not.

53. $3x, 5x$

Objective 1.5.3 Exercises

55. $-12a + 17a = 5a$
57. $5ab − 7ab = -2ab$
59. $-12xy + 17xy = 5xy$
61. $-3ab + 3ab = 0$
63. \[-\frac{1}{2} x - \frac{1}{3} x = \frac{3}{6} x - \frac{2}{6} x = \frac{1}{6} x\]
65. \[\frac{3}{8} x^2 - \frac{5}{12} x^2 = \frac{9}{24} x^2 - \frac{10}{24} x^2 = -\frac{1}{24} x^2\]
67. $3x + 5x + 3x = 11x$
69. $5a - 3a + 5a = 7a$
71. $-5x^2 - 12x^2 + 3x^2 = -14x^2$
73. $7x - 8x + 3y = -x + 3y$
75. $7x - 3y + 10x = 17x - 3y$
77. $3a - 7b - 5a + b = -2a - 6b$
79. $3x - 8y - 10x + 4x = -3x - 8y$
81. $x^2 - 7x - 5x^2 + 5x = -4x^2 - 2x$

Objective 1.5.4 Exercises

83. $4(3x) = 12x$
85. \(-3(7a) = -21a\)
87. \(-2(3y) = 6y\)
89. \((4x)2 = 8x\)
91. \(3a(-2) = -6a\)
93. \((-3b)(-4) = 12b\)
95. \(-5(3x^2) = -15x^2\)
97. \(\frac{1}{3}(3x^2) = x^2\)
99. \(\frac{1}{8}(8x) = x\)
101. \(-\frac{1}{7}(-7n) = n\)
103. \(\frac{12x}{5} \left(\frac{5}{12}\right) = x\)
105. \((-10n) \left(\frac{1}{10}\right) = n\)
107. \(\frac{1}{7}(14x) = 2x\)
109. \(-\frac{1}{8}(16x) = -2x\)
111. \(-\frac{5}{8}(24a^2) = -15a^2\)
113. \(-\frac{3}{4}(-8y) = 6y\)

**Objective 1.5.5 Exercises**

115. \(-(x + 2) = -x - 2\)
117. \(2(4x - 3) = 8x - 6\)
119. \(-2(a + 7) = -2a - 14\)
121. \(-3(2y - 8) = -6y + 24\)
123. \((5 - 3b)^2 = 35 - 21b\)
125. \(-3(3 - 5x) = -9 + 15x\)
127. \(3(5x^2 + 2x) = 15x^2 + 6x\)
129. \(-2(-y + 9) = 2y - 18\)
131. \(-(-3x - 6)5 = -15x - 30\)
133. \(-(-3x^2 - 14) = -6x^2 - 28\)
135. \(-3(2y^2 - 7) = -6y^2 + 21\)
137. \(-(-6a^2 - 7b^2) = -6a^2 + 7b^2\)
139. \(4(x^2 - 3x + 5) = 4x^2 - 12x + 20\)
141. \(-3(y^2 - 3y - 7) = -3y^2 + 9y + 21\)

143. \(4(-3a^2 - 5a + 7) = -12a^2 - 20a + 28\)

**Objective 1.5.6 Exercises**

145. \(6a - (5a + 7) = 6a - 5a - 7 = a - 7\)
147. \(10 - (11x - 3) = 10 - 11x + 3 = -11x + 13\)
149. \(-8 - (12 + 4y) = -8 - 12 - 4y = -4y - 4\)
151. \(2(x - 4) - 4(x + 2) = 2x - 8 - 4x - 8\)
153. \(6(2y - 3(3 - 2y)) = 12y - 42 - 9 + 6y\)
155. \(2(a + b) - (a - 3b) = 2a + 4b - a + 3b\)
157. \(2\left[x + 2(x + 7)\right] = 2\left[x + 2x + 14\right]\)
159. \(-5[2x + 3(5 - x)] = -5[2x + 15 - 3x]\)
161. \(-2[3x - (5x - 2)] = -2[3x - 5x + 2]\)
163. \(-7x + 3(3 - 2x)\)  
165. \(4a - 2[2b - (b - 2a)] + 3b\)
167. \(5y - 2(y - 3x) + 2(7x - y)\)

**Applying Concepts 1.5**

169. \(\frac{1}{3}(3x + y) - \frac{2}{3}(6x - y) = x + \frac{1}{3}y - 4x + \frac{2}{3}y\)
171. \(a. \quad 0\)
\(b. \quad -1, 1\)

173. Examples of two operations that occur in everyday experience that are not commutative are (1) unlocking the car door and starting the car and (2) taking a shower and drying oneself off.
Section 1.6
Concept Review 1.6

1. Never true
   “Five less than n” is translated as \( n - 5 \).

3. Never true
   The other number can be expressed as \( 12 - x \).

5. Always true

7. Never true
   “Five times the sum of \( x \) and \( y \)” is written as \( 5(x + y) \). “The sum of five times \( x \) and \( y \)” is written as \( 5x + y \).

Objective 1.6.1 Exercises

1. \( d \) less than 19
   \[
   19 - d
   \]

3. \( r \) decreased by 12
   \[
   r - 12
   \]

5. \( a \) multiplied by 28
   \[
   28a
   \]

7. 5 times the difference between \( n \) and 7
   \[
   5(n - 7)
   \]

9. \( y \) less the product of 3 and \( y \)
   \[
   y - 3y
   \]

11. the product of −6 and \( b \)
   \[
   -6b
   \]

13. 4 divided by the difference between \( p \) and 6
   \[
   \frac{4}{p - 6}
   \]

15. the quotient of 9 less than \( x \) and twice \( x \)
   \[
   \frac{x - 9}{2x}
   \]

17. 21 less than the product of \( x \) and −4
   \[
   -4x - 21
   \]

19. the ratio of 8 more than \( d \) to \( d \)
   \[
   \frac{d + 8}{d}
   \]

21. three-eighths of the sum of \( t \) and 15
   \[
   \frac{3}{8}(t + 15)
   \]

23. \( w \) increased by the quotient of 7 and \( w \)
   \[
   \frac{7}{w}
   \]

25. \( d \) increased by the difference between 16 times \( d \) and 3
   \[
   d + (16d - 3)
   \]

27. the unknown number: \( n \)
   \[
   \frac{n}{19}
   \]

29. the unknown number: \( n \)
   \[
   n + 40
   \]

31. the unknown number: \( n \)
   the difference between the number and ninety:
   \[
   n - 90
   \]
   \[
   (n - 90)^2
   \]

33. the unknown number: \( n \)
   four-ninths of the number:
   \[
   \frac{4}{9} n
   \]
   \[
   \frac{4}{9} n + 20
   \]

35. the unknown number: \( n \)
   ten more than the number:
   \[
   n + 10
   \]
   \[
   n(n + 10)
   \]

37. the unknown number: \( n \)
   the product of seven and the number:
   \[
   7n
   \]
   \[
   7n + 14
   \]

39. the unknown number: \( n \)
   the sum of the number and two:
   \[
   \frac{12}{n + 2}
   \]

41. the unknown number: \( n \)
   the sum of the number and one:
   \[
   n + 1
   \]
   \[
   \frac{2}{n + 1}
   \]

43. the unknown number: \( n \)
   the quotient of the number and fifty:
   \[
   \frac{n}{50}
   \]
   \[
   \frac{60 - n}{50}
   \]

45. the unknown number: \( n \)
   the square of the number:
   \[
   n^2
   \]
   \[
   3n
   \]
   \[
   n^2 + 3n
   \]

47. the unknown number: \( n \)
   three more than the number:
   \[
   n + 3
   \]
   \[
   (n + 3)^3 + n^3
   \]

49. the unknown number: \( n \)
   the square of the number:
   \[
   n^2
   \]
   \[
   \frac{1}{4} n
   \]
   \[
   n^2 - \frac{1}{4} n
   \]

51. the unknown number: \( n \)
   twice the number:
   \[
   2n
   \]
   \[
   \frac{7}{n}
   \]
   \[
   2n - \frac{7}{n}
   \]
53. the unknown number: \( n \)
   the cube of the number: \( n^3 \)
   the product of twelve and the number: \( 12n \)
   \( n^3 - 12n \)

Objective 1.6.2 Exercises

55. the unknown number: \( n \)
   the total of the number and ten: \( n + 10 \)
   \( n + (n + 10) = n + n + 10 \)
   \( = 2n + 10 \)

57. the unknown number: \( n \)
   the difference between nine and the number:
   \( 9 - n \)
   \( n - (9 - n) = n - 9 + n \)
   \( = 2n - 9 \)

59. the unknown number: \( n \)
   one-fifth of the number: \( \frac{1}{5} n \)
   three-eighths of the number: \( \frac{3}{8} n \)
   \( \frac{1}{5} n - \frac{3}{8} n = \frac{8n}{40} - \frac{15n}{40} \)
   \( = -\frac{7}{40} n \)

61. the unknown number: \( n \)
   the total of the number and nine: \( n + 9 \)
   \( (n + 9) + 4 = n + 9 + 4 \)
   \( = n + 13 \)

63. the unknown number: \( n \)
   three times the number: \( 3n \)
   the sum of three times the number and 40:
   \( 3n + 40 \)
   \( 2(3n + 40) = 6n + 80 \)

65. the unknown number: \( n \)
   the product of five and the number: \( 5n \)
   \( 7(5n) = 35n \)

67. the unknown number: \( n \)
   seventeen times the number: \( 17n \)
   twice the number: \( 2n \)
   \( 17n + 2n = 19n \)

69. the unknown number: \( n \)
   the product of the number and twelve: \( 12n \)
   \( n + 12n = 13n \)

71. the unknown number: \( n \)
   the square of the number: \( n^2 \)
   the sum of the square of the number and four:
   \( n^2 + 4 \)
   \( 3(n^2 + 4) = 3n^2 + 12 \)

73. the unknown number: \( n \)
   sixteen times the number: \( 16n \)
   the sum of sixteen times the number and four:
   \( 16n + 4 \)
   \( \frac{3}{4}(16n + 4) = 12n + 3 \)

75. the unknown number: \( n \)
   the sum of the number and 9: \( n + 9 \)
   \( 16 - (n + 9) = 16 - n - 9 \)
   \( = -n + 7 \)

77. the unknown number: \( n \)
   four times the number: \( 4n \)
   the quotient of four times the number and two:
   \( \frac{4n}{2} \)
   \( \frac{4n}{2} + 5 = 2n + 5 \)

79. the unknown number: \( n \)
   the total of the number and eight: \( n + 8 \)
   \( 6(n + 8) = 6n + 48 \)

81. the unknown number: \( n \)
   the sum of the number and two: \( n + 2 \)
   \( 7 - (n + 2) = 7 - n - 2 \)
   \( = -n + 5 \)

83. the unknown number: \( n \)
   six times the number: \( 6n \)
   the sum of the number and six times the number:
   \( n + 6n \)
   \( \frac{1}{3}(n + 6n) = \frac{1}{3}(7n) = \frac{7n}{3} \)

85. the unknown number: \( n \)
   the cube of the number: \( n^3 \)
   eight increased by the cube of the number: \( 8 + n^3 \)
   twice the cube of the number: \( 2n^3 \)
   \( (8 + n^3) + 2n^3 = 8 + n^3 + 2n^3 \)
   \( = 3n^3 + 8 \)

87. the unknown number: \( n \)
   the difference between the number and six: \( n - 6 \)
   the sum of twelve more than the number: \( n + 12 \)
   \( (n - 6) + (n + 12) = n - 6 + n + 12 \)
   \( = 2n + 6 \)

89. the unknown number: \( n \)
   the difference between the number and twenty:
   \( n - 20 \)
   the sum of the number and nine: \( n + 9 \)
   \( (n - 20) + (n + 9) = n - 20 + n + 9 \)
   \( = 2n - 11 \)

91. the unknown number: \( n \)
   three less than the number: \( n - 3 \)
   the product of three less than a number and ten:
   \( (n - 3)10 \)
   \( 14 + (n - 3)10 = 14 + (10n - 30) \)
   \( = 14 + 10n - 30 \)
   \( = 10n - 16 \)

Objective 1.6.3 Exercises

93. Let \( x \) be one number; \( x \) and \( 18 - x \)

95. number of genes in the round worm genome: \( G \)
   number of genes in human: \( G + 11,000 \)
97. total number of Americans: \(N\)
   number of Americans who want spending on space exploration of Mars: \(\frac{3}{4}N\)

99. number of points awarded for a safety: \(s\)
    number of points awarded for a touchdown: \(3s\)

101. number of moons Jupiter has: \(m\)
     number of moons Saturn has: \(m + 9\)

103. pounds of pecans produced in Texas: \(p\)
     pounds of pecans produced in Alabama: \(\frac{1}{2}p\)

105. World population in 1980: \(p\)
     World population in 2050: \(2p\)

107. measure of the largest angle: \(L\)
     measure of the smallest angle: \(\frac{1}{2}L - 10\)

109. the number of nickels: \(n\)
     number of dimes: \(35 - n\)

111. number of hours of overtime worked: \(h\)
     employee’s weekly pay: \(720 + 27h\)

113. number of minutes of phone calls: \(m\)
     monthly cost of phone service: \(19.95 + 0.08m\)

Applying Concepts 1.6

115. length of wire: \(x\)
     length of side of square: \(\frac{1}{4}x\)

117. Two examples of the translation of \(5x + 8\) are “eight more than the product of five and a number” and “the sum of five times a number and eight.” Two examples of the translation of \(5(x + 8)\) are “five times the sum of a number and eight” or “the product of 5 and eight more than a number.”

119. Both of the expressions “the difference between \(x\) and 5” and “5 less than \(x\)” translate to \(x - 5\). However, in translating the two expressions from words, the word “difference” maintains the order in which the two quantities are subtracted, whereas the words “less than” reverse the order in which the two quantities are subtracted.

Chapter Review Exercises

1. \{1, 2, 3, 4, 5, 6\}
2. \(\frac{5}{8} = \frac{5}{8}(100\%) = \frac{500}{8}\% = 62.5\%\)
3. \(-4 = -4\)
4. \(16 - (-30) - 42 = 16 + 30 + (-42) = 46 + (-42) = 4\)
5. \(-561 + (-33) = 17\)
6. \(9)7.000 \rightarrow -6.3\)
   \(70 \rightarrow -6.3\)
   \(70 \leftarrow -6.3\)
   \(7\)
7. \(6.02 \times 0.89 = 5.418\)
   \(\frac{4816}{5.3578} = (6.02)(-0.89) = -5.3578\)
8. \(-10 + 2 + 6 = -8 + 2 + 6 = 4 + 2 + 6 = 2 + 6 = 8\)
9. \(0.672 = 0.672(100\%) = 67.2\%\)
10. \(79\frac{1}{2} = 79\frac{1}{2} = \frac{159}{2} \div \frac{150}{200} = 159\frac{1}{200}\)
11. \((-5)(-6)(3) = 30(3) = 90\)
12. \(12.920 - 6.039 = 6.881\)
13. \(\begin{align*}
-5 &\leq -3 \quad \text{true} \\
-3 &\leq -3 \quad \text{true} \\
0 &\leq -3 \quad \text{false} \\
-5 \text{ and } -3 &\text{ are less than or equal to } -3.
\end{align*}\)
14. \(7\% = 7(0.01) = 0.07\)
15. \(\begin{align*}
\frac{3}{4} \cdot (4)^2 &\cdot -\frac{3}{4} \cdot 4 \\
&= \frac{3}{4} \cdot 16 = \frac{3}{4} \cdot \frac{16}{4} \\
&= \frac{3 \cdot 2 \cdot 2 \cdot 2}{1 \cdot 1} = 12
\end{align*}\)
16. \(-2 > -40\)
17. \(\begin{align*}
-\frac{2}{3} + \frac{7}{15} &\cdot \frac{6}{15} + \frac{7}{15} \\
&= -\frac{6}{15} + \frac{7}{15} = \frac{-6 + 7}{15} = \frac{1}{15}
\end{align*}\)
18. \((-3)^3 \cdot 2^2 = -(3 \cdot 3 \cdot 3) \cdot (2 \cdot 2) = -27 \cdot 4 = -108\)

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Chapter Review Exercises

21. \[-1.329 \div 1.329 = 1 \]

22. \[-12 = 12 \]
\[-8 = 8 \]
\[-1 = 1 \]
\[-7 = -7 \]

b. \[-12 = 12 \]
\[-8 = 8 \]
\[-1 = 1 \]
\[7 = 7 \]

23. \[\sqrt[3]{0.02654} = 0.35 \]
\[-35 = 35 \]
\[-23 = 23 \]
\[-124 = 124 \]
\[-115 = 115 \]
\[-90 = 90 \]
\[-69 = 69 \]
\[27 = 27 \]
0.2654 \cdot (-0.023) = -11.5

24. \[(7 - 2)^2 - 5 - 3.4 = 5^2 - 5 - 3.4 \]
\[= 25 - 5 - 3.4 \]
\[= 25 - 5 - 12 \]
\[= 20 - 12 \]
\[= 8 \]

25. \[-12 + 8 + (-4) = -4 + (-4) \]
\[= -8 \]

26. \[-\frac{5}{8} + \frac{1}{6} = \frac{15}{24} + \frac{4}{24} \]
\[= \frac{-15 + 4}{24} = \frac{-11}{24} \]
\[= -\frac{11}{24} \]

27. \[\frac{4.890}{3.561} = 1.329 \]
\[-1.329 + 4.89 = 3.561 \]

28. \[-5 - 22 - (-13) - 19 - (-6) \]
\[= 5 + (-22) + 13 + (-19) + 6 \]
\[= -27 + 13 + (-19) + 6 \]
\[= -14 + (-19) + 6 \]
\[= -33 + 6 \]
\[= -27 \]

29. \[\left(\frac{1}{3}\right) \left(\frac{-4}{5}\right) \left(\frac{3}{8}\right) = \left(\frac{1}{3}\right) \left(\frac{-4}{5}\right) \left(\frac{3}{8}\right) \]
\[= \left(\frac{1}{3} \cdot \frac{-4}{5} \cdot \frac{3}{8}\right) \]
\[= \left(-\frac{1}{5} \cdot \frac{1}{2} \cdot \frac{1}{2}\right) \]
\[= \frac{-1}{10} \]

30. \[-43 < -34 \]

31. \[-7y^2 + 6y^2 - (-2y^2) = -7y^2 + 6y^2 + 2y^2 \]
\[= y^2 \]

32. \[(12x)\left(\frac{1}{4}\right) = 3x \]

33. \[5(2x + 4) - 3(x - 6) = 10x + 20 - 3x + 18 \]
\[= 7x + 38 \]

34. \[a^2 - 3b = 2^2 - 3 \]
\[= 4 - 3 \]
\[= 1 \]

35. \[9 \]

36. \[3[2x - 3(x - 2y)] + 3y = 3[2x - 3x + 6y] + 3y \]
\[= 3x + 6y + 3y \]
\[= 3x + 18y + 3y \]
\[= -3x + 21y \]

37. \[5(3 - 7b) = 15 - 35b \]

38. \[2x + \left[4 - (3x - 7)\right] = 2x + [4 - 3x + 7] \]
\[= 2x + [11 - 3x] \]
\[= 2x + 33 - 9x \]
\[= -7x + 33 \]

39. The Commutative Property of Multiplication

40. \[3(8 - 2x) = 24 - 6x \]

41. \[\frac{-2ab}{2b - a} = \frac{-2a(-4)(6)}{2(6) - (-4)} \]
\[= \frac{48}{12 + 4} \]
\[= \frac{12}{3} \]

42. \[(-3)(-12y) = 36y \]

43. \[4(3x - 2) - 7(x + 5) = 12x - 8 - 7x - 35 \]
\[= 5x - 43 \]

44. \[(16x)\left(\frac{1}{8}\right) = 2x \]

45. \[-3(2x^2 - 7y^2) = -6x^2 + 21y^2 \]
46. \[3(a - c) - 2ab = 3(2 - (-4)) - 2(2)(3)\]
   \[= 3(2 + 4) - 2(2)(3)\]
   \[= 3(6) - 2(2)(3)\]
   \[= 18 - 12\]
   \[= 6\]

47. \[2x - 3(x - 2) = 2x - 3x + 6\]
   \[= -x + 6\]

48. \[2a - (-3b) - 7a - 5b = 2a + 3b - 7a - 5b\]
   \[= -5a - 2b\]

49. \[-5(2x^2 - 3x + 6) = -10x^2 + 15x - 30\]

50. \[3x - 7y - 12x = -9x - 7y\]

51. \[3x + (-12y) - 5x - (-7y) = 3x - 12y - 5x + 7y\]
   \[= -2x - 5y\]

52. \[-\frac{5}{6}(-36b) = 30b\]

53. \[21\]

54. \[4x^2 + 9x - 6x^2 - 5x = -2x^2 + 4x\]

55. \[b \text{ decreased by the product of 7 and } b\]
   \[b - 7b\]

56. \[10 \text{ divided by the difference between } y \text{ and } 2\]
   \[\frac{10}{y - 2}\]

57. Strategy
   To find the temperature, add the rise in temperature (14º) to the original temperature (-6º).
   Solution
   \[-6 + 14 = 8\]
   The temperature was 8ºC.

58. Strategy
   To find the average low temperature:
   • Add the three temperature readings:
   • Divide by 3.
   Solution
   \[-8 + 7 + (-5) = -1 + (-5)\]
   \[= -6\]
   \[-6 + 3 = -2\]

59. Strategy
   To find the difference, subtract the low temperature (–44º) from the high temperature (62º).
   Solution
   \[62 - (-44) = 64 + 44\]
   \[= 106\]

60. Strategy
   To find the temperature, add the rise in temperature (7º) to the original temperature (-13º).
   Solution
   \[-13 + 7 = -6\]
   The temperature was -6ºC.

61. Strategy
   To find the difference, subtract the temperature on Pluto (-234º) from the temperature on Venus (480º).
   Solution
   \[480 - (-234) = 480 + 234\]
   \[= 714\]
   The difference is 714ºC.

62. the unknown number: \(n\)
   twice the number: \(2n\)
   the quotient of twice the number and sixteen: \(\frac{2n}{16}\)

63. the unknown number: \(n\)
   five times the number: \(5n\)
   the sum of two and five times the number: \(2 + 5n\)
   \[4(2 + 5n) = 8 + 20n\]

64. height of the triangle: \(h\)
   length of the base of the triangle: \(h + 15\)

65. amount of the mocha Java beans: \(b\)
   amount of the espresso beans: \(20 - b\)

Chapter Test

1. \[55% = 55\left(\frac{1}{100}\right) = \frac{55}{100} = \frac{11}{20}\]

2. \[-8 < -5 \text{ true}\]
   \[-6 < -5 \text{ true}\]
   \[-4 < -5 \text{ false}\]
   \[-2 < -5 \text{ false}\]
   \[-8 \text{ and } -6 \text{ are less than } -5\].

3. \[-9 - (-6) = -9 + 6\]
   \[= -3\]

4. \[\frac{15}{20}\]
   \[\frac{0.15}{\text{divided by } 3}\]
   \[\frac{0.15}{20} = \frac{3}{100}\]
   \[\frac{3}{20} = 0.15\]

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5. \( \frac{3}{4} \left( \frac{2}{21} \right) = \left( \frac{3}{4} \right) \left( \frac{2}{21} \right) \)
   \[ = \left( \frac{3 \cdot 2}{4 \cdot 21} \right) = \left( \frac{1 \cdot 1}{2 \cdot 2 \cdot 3 \cdot 7} \right) \]
   \[ = -\frac{1}{14} \]

6. \(-75 + 5 = -15\)

7. \( \left( \frac{2}{3} \right)^3 \cdot 3^2 = \left( \frac{2}{3} \right)^3 \left( \frac{2}{3} \right) \cdot 3^2 \)
   \[ = \frac{8}{27} \cdot 9 = \frac{8 \cdot 9}{27} = \frac{8}{3} \]

8. \(-7 + (-3) + 12 = -10 + 12 = 2\)

9. \(\{1, 2, 3, 4, 5, 6\}\)

10. \(1.59 = 1.59(100\%) = 159\%\)

11. \([-29] = 29\)

12. \(-47 > -68\)

13. \(-\frac{4}{9} \cdot \frac{5}{6} = \frac{8}{18} - \frac{15}{18} = \frac{8 + (-15)}{18} = \frac{-7}{18} = \frac{-23}{18} = \frac{-23}{18} \)

14. \(-\frac{5}{8} + \left( \frac{3}{4} \right) = \frac{5}{8} + \frac{3}{4} \frac{8}{3} = \frac{5 \cdot 4}{8 \cdot 3} + \frac{2 \cdot 3}{2 \cdot 3} = \frac{5}{6} \)

15. \(\frac{3}{13} - \frac{3}{13} = \frac{300}{13} \frac{\%}{\%} = 23.1\%\)

16. \(6.2\% = 6.2(0.01) = 0.062\)

17. \(13 - (-5) - 4 = 13 + 5 + (-4) = 18 + (-4) = 14\)

18. \(0.433 \times 3.00 = 3.00 \times 0.433 \)
   \[ = 120 \]
   \[ = 90 \]
   \[ = 90 \]
   \[ = 0.43 \]

19. \(2.7 \times 0.9 = 2.43\)
   \((-0.9)(2.7) = -2.43\)

20. \(15 + (-8) + (-19) = 7 + (-19) = -12\)

21. a. \(-(-17) = 17\)
    \(-(-6) = 6\)
    \(-(-5) = 5\)
    \(-(-9) = 9\)

   b. \([-17] = 17\)
    \([-6] = 6\)
    \([-5] = 5\)
    \([-9] = 9\)

22. \(\frac{18.354}{6.97} = \frac{11.384}{18.354 + 6.97 = -11.384}\)

23. \(-4(8)(-5) = -32(-5) = 160\)

24. \((9y)4 = 36y\)

25. \(7x + 5y - 3x - 8y = 4x - 3y\)

26. \(8n - (6 - 2n) = 8n - 6 + 2n = 10n - 6\)

27. The Multiplication Property of One

28. \(-4(-x + 10) = 4x - 40\)

29. \(\frac{2}{3} x^2 - \frac{7}{12} x^2 = \frac{8}{12} x^2 - \frac{7}{12} x^2 = \frac{1}{12} x^2\)

30. \((-10.x \left( \frac{2}{5} \right) = 4x\)

31. \((-4y^2 + 8)6 = -24y^2 + 48\)

32. 19

33. \(-3ab = \frac{-3}{2a+b} = \frac{-3}{2(-1)+4} = \frac{12}{2} = 6\)

34. \(5(x+y) - 8(x-y) = 5x + 5y - 8x + 8y = -3x + 13y\)

35. \(3(x^2 - 5x + 4) = 3x^2 - 15x + 12\)

36. \(4(b-a) + bc = 4(-3-2) + (-3)(4) = 4(-5) + (-3)(4) = -20 + (-12) = -32\)

37. \(6x - 3(y-7x) + 2(5x-y) = 6x - 3y + 21x + 10x - 2y = 37x - 5y\)

38. \(9(-4) + [2(8-5)^2] = 9(-4) + [2(3)^2] = 9(-4) + [2(9)] = 9(-4) + 18 = -36 + 18 = -2\)
Chapter 1: Real Numbers and Variable Expressions

39. Strategy
   To find the temperature, add the rise in temperature (12º) to the original temperature (–8º).
   Solution
   \[-8 + 12 = 4\]
   The temperature was 4ºC.

40. Strategy
   To find the average low temperature:
   • Add the four temperatures
   • Divide by 4.
   Solution
   \[-61 + (-58) + (-49) + (-24) = -192\]
   \[-192 ÷ 4 = -48\]
   The average low temperature was –48ºF.

41. the difference between the sum of \(a\) and \(b\) and the square of \(b\)
   \[(a + b) - b^2\]

42. the unknown number: \(n\)
   the sum of the number and nine: \(n + 9\)
   \[20(n + 9) = 20n + 180\]

43. the unknown number: \(n\)
   the difference between the number and three:
   \[n - 3\]
   two more than the number: \(n + 2\)
   \[(n - 3) + (n + 2) = n - 3 + n + 2\]
   \[= 2n - 1\]

44. the distance from Earth to the sun: \(d\)
   the distance from Neptune to the sun: 30\(d\)

45. the length of one piece of board: \(L\)
   the length of the other piece: \(9 - L\)