CHAPTER 1: REVIEW OF REAL NUMBERS

CHAPTER 1 PREP TEST

1. $\frac{5}{12}+\frac{7}{30}=\frac{25}{60}+\frac{14}{60}=\frac{39}{60}=\frac{13}{20}$

2. $\frac{8}{15}-\frac{7}{20}=\frac{32}{60}-\frac{21}{60}=\frac{11}{60}$

3. $\frac{2}{9}$

4. $\frac{4}{15}\div\frac{2}{5}=\frac{4}{15}\cdot\frac{5}{2}=\frac{2}{3}$

5. 44.405

6. 73.63

7. 7.446

8. 54.06

9. i, iii, iv

10. **a.** $\frac{1}{2}=0.5$ C

b. $\frac{7}{10}=0.7$ D

c. $\frac{3}{4}=0.75$ A

d. $\frac{89}{100}=0.89$ B

SECTION 1.1

CONCEPT CHECK

1. –14: c, e
9: a, b, c, d
0: b, c
53: a, b, c, d
7.8: none
–626: c, e

2. 31: a, b, c, d
–45: c, e
–2: c, e
9.7: none
8600: a, b, c, d
$\frac{1}{2}$: none

3. $-\frac{15}{2}$: b, d
0: a, b, d
–3: a, b, d
π: c, d
$2.\overline{33}$: b, d
4.232232223: c, d
$\frac{\sqrt{5}}{4}$: c, d
$\sqrt{7}$: c, d

4. –17: a, b, d
0.3412: b, d
$\frac{3}{\pi}$: c, d
–1.010010001: c, d
$\frac{27}{91}$: b, d
$6.1\overline{2}$: b, d

5. A terminating decimal is a decimal number that has a finite number of decimal places – for example, 0.75.

6. A repeating decimal is a decimal number that has a block of digits that repeats with no other digits between the repeating blocks; an example is $8.454545\ldots = 8.\overline{45}$.

7. The additive inverse of a number is the number that is the same distance from zero on the number line, but which is on the opposite side of zero.

8. The absolute value of a number is a measure of its distance from zero on the number line.

9. The union of two sets will contain all the elements that are in either set. The intersection of the two sets will contain only the elements that are in both sets.

10. $\{x \mid x < 5\}$ does not include the value 5, but $\{x \mid x \leq 5\}$ does include the value 5.

Objective 1.1.1 Exercises

11. A number such as 0.63633633363333…, whose decimal notation neither ends nor repeats, is an example of an irrational number.

12. The additive inverse of a negative number is a positive number.

13. $y \in \{1, 3, 5, 7, 9\}$ is read "y is an element of the set $\{1, 3, 5, 7, 9\}$."

14. In symbols the phrase "the opposite of the absolute value of n" is $-|n|$.

15. –27

16. 3

17. $-\frac{3}{4}$

18. $-\sqrt{17}$

19. 0

20. π

21. $\sqrt{33}$

22. 1.23

23. 91

24. $\frac{2}{3}$

25. Replace x with each element in the set and determine whether the inequality is true.
$x < 5$
$-3 < 5$ True
$0 < 5$ True
$7 < 5$ False
The inequality is true for –3 and 0.

26. Replace z with each element in the set and determine whether the inequality is true.
$z > -2$
$-4 > -2$ False
$-1 > -2$ True
$4 > -2$ True
The inequality is true for –1 and 4.

27. Replace y with each element in the set and determine whether the inequality is true.
$y > -4$
$-6 > -4$ False
$-4 > -4$ False
$7 > -4$ True
The inequality is true for 7.

28. Replace x with each element in the set and determine whether the inequality is true.
$x < -3$
$-6 < -3$ True
$-3 < -3$ False
$3 < -3$ False
The inequality is true for –6.

29. Replace w with each element in the set and determine whether the inequality is true.
$w \le -1$
$-2 \le -1$ True
$-1 \le -1$ True
$0 \le -1$ False
$1 \le -1$ False
The inequality is true for –2 and –1.

30. Replace p with each element in the set and determine whether the inequality is true.
$p \ge 0$
$-10 \ge 0$ False
$-5 \ge 0$ False
$0 \ge 0$ True
$5 \ge 0$ True
The inequality is true for 0 and 5.

31. Replace b with each element in the set and evaluate the expression.
$-b$
$-(-9) = 9$
$-(0) = 0$
$-(9) = -9$

32. Replace a with each element in the set and evaluate the expression.
$-a$
$-(-3) = 3$
$-(-2) = 2$
$-(0) = 0$

33. Replace c with each element in the set and evaluate the expression.
$|c|$
$|-4| = 4$
$|0| = 0$
$|4| = 4$

34. Replace q with each element in the set and evaluate the expression.
$|q|$
$|-3| = 3$
$|0| = 0$
$|7| = 7$

35. Replace m with each element in the set and evaluate the expression.
$-|m|$
$-|-6| = -6$
$-|-2| = -2$
$-|0| = 0$
$-|1| = -1$
$-|4| = -4$

36. Replace x with each element in the set and evaluate the expression.
$-|x|$
$-|-5| = -5$
$-|-3| = -3$
$-|0| = 0$
$-|2| = -2$
$-|5| = -5$

37. Yes, negative real numbers are numbers such that $-x > 0$.

38. No

Objective 1.1.2 Exercises

39. Two ways to write the set of natural numbers less than five are {1, 2, 3, 4} and $\{n \mid n < 5,\ n \in \text{natural numbers}\}$. The first way uses the roster method, and the second way uses set-builder notation.

40. The symbol for "union" is $\cup$. The symbol for "intersection" is $\cap$.

41. The symbol ∞ is called the infinity symbol.

42. Replace each question mark with "includes" or "does not include" to make the following statement true. The set [–4, 7) includes the number –4 and does not include the number 7.

43. {–2, –1, 0, 1, 2, 3, 4}

44. {–3, –2, –1}

45. {2, 4, 6, 8, 10, 12}

46. {1, 3, 5, 7, 9, 11, 13}

47. {3, 6, 9, 12, 15, 18, 21, 24, 27, 30}

48. {–20, –16, –12, –8, –4}

49. {–35, –30, –25, –20, –15, –10, –5}

50. {6, 12, 18, 24, 30, 36}

51. $\{x \mid x > 4,\ x \text{ is an integer}\}$ or

$\{x|x > 4, x \in integers\}$

52. $\{x \mid x < -2,\ x \text{ is an integer}\}$ or

$\{x|x < -2, x \in integers\}$

53. $\{x \mid x \geq -2\}$

54. $\{x \mid x \leq 2\}$

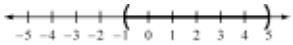
55. $\{x \mid 0 < x < 1\}$

56. $\{x \mid -2 < x < 5\}$

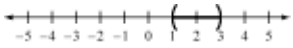
57. $\{x \mid 1 \leq x \leq 4\}$

58. $\{x \mid 0 \leq x \leq 2\}$

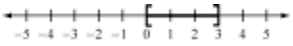
59. $\{x \mid -1 < x < 5\}$



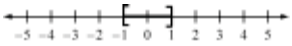
60. $\{x \mid 1 < x < 3\}$



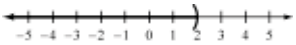
61. $\{x \mid 0 \leq x \leq 3\}$



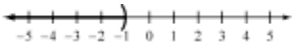
62. $\{x \mid -1 \leq x \leq 1\}$



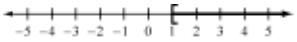
63. $\{x \mid x < 2\}$



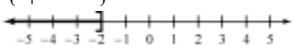
64. $\{x \mid x < -1\}$



65. $\{x \mid x \geq 1\}$



66. $\{x \mid x \leq -2\}$



67. $\{x \mid 0 < x < 8\}$

68. $\{x \mid -2 < x < 4\}$

69. $\{x \mid -5 \leq x \leq 7\}$

70. $\{x \mid 3 \leq x \leq 4\}$

71. $\{x \mid -3 \leq x < 6\}$

72. $\{x \mid 4 < x \leq 5\}$

73. $\{x \mid x \leq 4\}$

74. $\{x \mid x < -2\}$

75. $\{x \mid x > 5\}$

76. $\{x \mid x \geq -2\}$

77. (–2, 4)

78. (0, 3)

79. [–1, 5]

80. [0, 3]

81. (–∞, 1)

82. (–∞, 6]

83. [–2, 6)

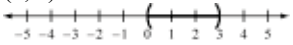
84. [3, ∞)

85. (–∞, ∞)

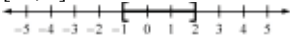
86. (–1, ∞)

87. (–2, 5)

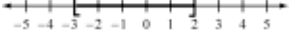
88. (0, 3)



89. [–1, 2]

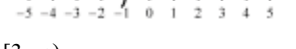


90. [–3, 2]



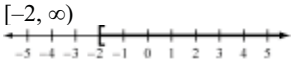
91. (–∞, 3]

92. (–∞, –1)



93. [3, ∞)

94. $[-2, \infty)$



95. $A \cup B = \{1, 2, 4, 6, 9\}$; $A \cap B = \{4\}$

96. $A \cup B = \{-1, 0, 1, 2\}$; $A \cap B = \{0,1\}$

97. $A \cup B = \{2, 3, 5, 8, 9, 10\}$; $A \cap B = \varnothing$

98. $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8\}$; $A \cap B = \varnothing$

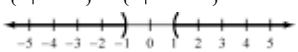
99. $A \cup B = \{-4, -2, 0, 2, 4, 8\}$; $A \cap B = \{0,4\}$

100. $A \cup B = \{-3, -2, -1, 0, 1\}$; $A \cap B = \{-2,-1\}$

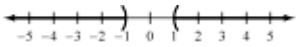
101. $A \cup B = \{1, 2, 3, 4, 5\}$; $A \cap B = \{3,4,5\}$

102. $A \cup B = \{0, 1, 2, 3, 4, 5\}$; $A \cap B = \{2,4\}$

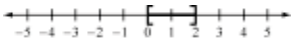
103. $\{x|x>1\} \cup \{x|x<-1\}$



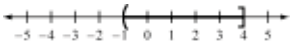
104. $\{x|x \le 2\} \cup \{x|x>4\}$



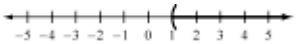
105. $\{x|x \le 2\} \cap \{x|x \ge 0\}$



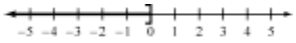
106. $\{x|x>-1\} \cup \{x|x \le 4\}$



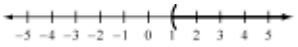
107. $\{x|x>1\} \cap \{x|x \ge -2\}$



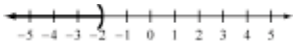
108. $\{x|x<4\} \cap \{x|x \le 0\}$



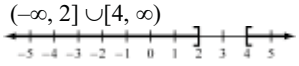
109. $\{x|x>2\} \cup \{x|x>1\}$



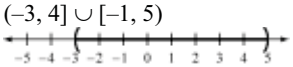
110. $\{x|x<-2\} \cup \{x|x<-4\}$



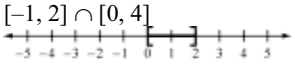
111. $(-\infty, 2] \cup [4, \infty)$



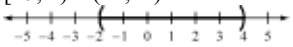
112. $(-3, 4] \cup [-1, 5)$



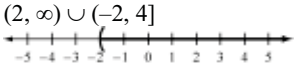
113. $[-1, 2] \cap [0, 4]$



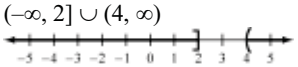
114. $[-5, 4) \cap (-2, \infty)$



115. $(2, \infty) \cup (-2, 4]$



116. $(-\infty, 2] \cup (4, \infty)$



117. iii

118. ii

Applying Concepts 1.1

119. $A \cup B$ is
$\{x|-1 \le x \le 1\} \cup \{x|0 \le x \le 1\} = \{x|-1 \le x \le 1\} = A$

120. $A \cup A$ is set A.

121. $B \cap B$ is set B.

122. $A \cup C$ is $\{x|-1 \le x \le 1\}$, which is set A.

123. $A \cap R$ is $\{x|-1 \le x \le 1\}$, which is set A.

124. $C \cap R$ is $\{x|-1 \le x \le 0\}$, which is set C.

125. $B \cup R$ is the set of real numbers, R.

126. $A \cup R$ is the set of real numbers, R.

127. $R \cup R$ is the set R.

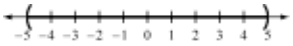
128. $R \cap \varnothing$ is the empty set $\varnothing$.

129. $B \cap C$ is $\{x|0 \le x \le 1\} \cap \{x|-1 \le x \le 0\}$, which contains only the number 0.

130. $-3 > x > 5$ means the numbers that are less than -3 and greater than 5. There is no number that is both less than -3 and greater than 5. Therefore, this is incorrect.

131.

132.



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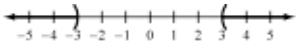
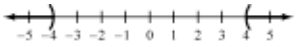


134.



135. The answer is ii and iii. For example:

i. $\dfrac{5-4}{3-2} \le 0$

$1 \le 0$

False

ii. $\dfrac{2-3}{5-4} \le 0$

$-1 \le 0$

True

iii. $\dfrac{5-4}{2-3} \le 0$

$-1 \le 0$

True

iv. $\frac{4-5}{2-3} \le 0$

$1 \le 0$

False

Projects or Group Activities 1.1

136. $E^c = \{1,3,5,7,9\}$

137. $E^c = \{1,4, 6, 8,9\}$

138. $E^c = \{\text{even natural numbers}\}$

139. $E^c = \{\text{irrational numbers}\}$

140. a. $E \cup E^c = U$

b. $E \cap E^c = \varnothing$

SECTION 1.2

Concept Check

1. **a.** Students should paraphrase the rule: Add the absolute values of the numbers, then attach the sign of the addends.

b. Students should paraphrase the rule: Find the absolute value of each number, subtract the smaller of the two numbers from the larger, then attach the sign of the number with the larger absolute value.

2. The word *minus* refers to the operation of subtraction, and the word *negative* indicates a number that is less than zero.

3. No, for example -5 + (-3) = -8

4. If the product of two numbers is positive, both numbers would be negative or both numbers would be positive

5. If quotient of two numbers is negative, one number must be positive and one must be negative.

6. Yes. For instance -3 – (-7) = -3 + 7 = 4

7. If the product of two numbers is zero, at least one of the numbers is zero.

8. 3^7

9. $(-5)^6$

10. $-2 \cdot 5 \; ? \; (8-2) \cdot 5$

$-10 \; ? \; 6 \cdot 5$

$-10 \; ? \; 30$

$-10 < 30$

Objective 1.2.1 Exercises

11. Rewrite subtraction as addition of the opposite

-8 – (-3)

-8 + 3 = -5

12. $63 \div -9 = \frac{63}{-9} = -7$

13. Negative because only the 7 would be raised to the 8^{th} power.

14. -4^5 negative, only 4 raised to the 5^{th} power

$(-4)^5$ negative, -4 multiplied together an odd number (5) of times

-4^6 negative, only 4 raised to the 6^{th} power

$(-4)^6$ positive, -4 multiplied together an even number (6) of times

15. 2 – (-7) = 2+7 = 9

16. 192 ÷ (-32) = -6

17. 14 + (-26) = -12

18. (-10)(-27) = 270

19. 29 + (-2) = 27

20. 24 – (-2) = 24 + 2 = 26

21. (-8)(29) = -232

22. (-16)(32) = -512

23. (-20)(2) = -40

24. 210 ÷ (-30) = -7

25. -16 + 33 = 17

26. -140 ÷ (-28) = 5

27. 13 + (-29) = -16

28. (-28)(32) = -896

29. -21-6 = -21 + (-6) = -27

30. -16 – 35 = -16 + (-35) = -51

31. (-30)(-3) = 90

32. 34 + (-6) = 28

33. -4 + (-8) = -12

34. (-5)(12)= -60

35. 48 ÷ -12 = -4

36. 2 – 5 = -3

37. -23 – (41) = -23 + (-41) = -64

38. $\frac{-65}{-5} = 13$

39. 17 – 21 = -4

40. -27 + 9 = -18

41. -42 + 16 or 16 + (-42) = -26

42. -4-14=-18

43. -33-21 = -54

44. -21 + (-15) = -36

45. $5^3 = 5 \cdot 5 \cdot 5 = 125$

46. $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

47. $-2^3 = -(2 \cdot 2 \cdot 2) = -8$

48. $-4^3 = -(4 \cdot 4 \cdot 4) = -64$

49. $(-5)^3 = (-5)(-5)(-5) = -125$

50. $(-8)^2 = (-8)(-8) = 64$

51. $2^2 \cdot 3^4 = (2)(2) \cdot (3)(3)(3)(3) = 4 \cdot 81 = 324$

52. $4^2 \cdot 3^3 = (4)(4) \cdot (3)(3)(3) = 16 \cdot 27 = 432$

53. $-2^2 \cdot 3^2 = -(2)(2) \cdot (3)(3) = -4 \cdot 9 = -36$

54. $-3^2 \cdot 5^3 = -(3)(3) \cdot (5)(5)(5) = -9 \cdot 125 = -1125$

55. $(-2)^3 \cdot (-3)^2 = (-2)(-2)(-2) \cdot (-3)(-3)$
$= -8 \cdot 9$
$= -72$

56. $(-4)^3 \cdot (-2)^3 = (-4)(-4)(-4) \cdot (-2)(-2)(-2)$
$= -64 \cdot (-8)$
$= 512$

57. **a.** 567 + (–812) is negative

b. –259 – (–327) is positive

c. The product of four positive numbers and three negative numbers is negative.

d. The product of three positive numbers and four negative numbers is positive.

58. **a.** The quotient $\frac{0}{-91}$ is zero.

b. The quotient $-416 \div 52$ is negative.

c. The quotient $-\frac{693}{-99}$ is positive.

d. The quotient $-87 \div 0$ is undefined.

Objective 1.2.2 Exercises

59. $5^2 - (10 \div 2)^3 \div 5 = 5^2 - (\underline{5})^3 \div 5$
$= \underline{25} - \underline{125} \div 5$
$= 25 - \underline{25}$
$= \underline{0}$

60. We need an Order of Operations Agreement to ensure that there is only one way in which an expression can be correctly simplified.

61. $27 - 12 \div 3 - 5^2$

$27 - 12 \div 3 - (5)(5)$

$27 - 4 - 25$

$23 - 25 = -2$

62. $-3 \cdot 2^3 - 5(1-7)$

$-3 \cdot 2^3 - 5(-6)$

$-3 \cdot (2)(2)(2)\ -5(-6)$

$-3 \cdot 8\ -5(-6)$

$-24 - (-30)$

$-24 + 30 = 6$

63. $15 - 3^2(5-7) \div 6$

$15 - 3^2(-2) \div 6$

$15 - (3)(3)(-2) \div 6$

$15 - 9(-2) \div 6$

$15 - (-18) \div 6$

$15 - (-3)$

$15 + 3 = 18$

64. $5 - 3(8 \div 4)^2 = 5 - 3(2)^2 = 5 - 3(4) = 5 - 12 = -7$

65. $4^2 - (5-2)^2 \cdot 3 = 4^2 - (3)^2 \cdot 3$
$= 16 - 9 \cdot 3$
$= 16 - 27$
$= -11$

66. $16-\dfrac{2^2-5}{3^2+2}=16-\dfrac{4-5}{9+2}$
$=16-\dfrac{-1}{11}$
$=16+\dfrac{1}{11}$
$=\dfrac{177}{11}$

67. $5[(2-4)\cdot 3-2]=5[(-2)\cdot 3-2]$
$=5[-6-2]$
$=5[-8]$
$=-40$

68. $2[(16\div 8)-(-2)]+4=2[2-(-2)]+4$
$=2[2+2]+4$
$=2[4]+4$
$=8+4$
$=12$

69. $16-4\left(\dfrac{8-2}{3-6}\right)\div\dfrac{1}{2}=16-4\left(\dfrac{6}{-3}\right)\div\dfrac{1}{2}$
$=16-4(-2)\div\dfrac{1}{2}$
$=16-(-8)\div\dfrac{1}{2}$
$=16-(-8)\cdot 2$
$=16-(-16)$
$=16+16$
$=32$

70. $25\div 5\left(\dfrac{16+8}{-2^2+8}\right)-5=25\div 5\left(\dfrac{16+8}{-4+8}\right)-5$
$=25\div 5\left(\dfrac{24}{4}\right)-5$
$=25\div 5(6)-5$
$=5(6)-5$
$=30-5$
$=25$

71. $6[3-(-4+2)\div 2]=6[3-(-2)\div 2]$
$=6[3-(-1)]$
$=6[3+1]$
$=6[4]$
$=24$

72. $12-4[2-(-3+5)-8]=12-4[2-(2)-8]$
$=12-4[-8]$
$=12-(-32)$
$=12+32$
$=44$

73. $2(8-11)-12\div 3\div 4+18\cdot 3\div 6$
$=2(-3)-12\div 3\div 4+18\cdot 3\div 6$
$=-6-12\div 3\div 4+18\cdot 3\div 6$
$=-6-4\div 4+18\cdot 3\div 6$
$=-6-1+18\cdot 3\div 6$
$=-6-1+54\div 6$
$=-6-1+9$
$=-7+9$
$=2$

74. $-3(5-9)^3\div 4\cdot(-2)$
$=-3(-4)^3\div 4\cdot(-2)$
$=-3(-64)\div 4\cdot(-2)$
$=192\div 4\cdot(-2)$
$=48\cdot(-2)$
$=-96$

75. $6-4\cdot 3-18\div(-3)^2$
$=6-4\cdot 3-18\div 9$
$=6-12-18\div 9$
$=6-12-2$
$=-6-2$
$=-8$

76. $-9-2[4-(3-8)^2]\div 7-4$
$=-9-2[4-(-5)^2]\div 7-4$
$=-9-2[4-25]\div 7-4$
$=-9-2[-21]\div 7-4$
$=-9+42\div 7-4$
$=-9+6-4$
$=-3-4$
$=-7$

77. $5+3[52+4(2-5)^3]^2$

$= 5+3[52+4(-3)^3]^2$

$= 5+3[52+4(-27)]^2$

$= 5+3[52 - 108]^2$

$= 5 +3[56]^2$

$= 5 +3(3136)$

$= 5 + 9408$

$= 9413$

78. $-3(5-8)^3 + (19-7) \div (1-3)$

$= -3(-3)^3 + 12 \div -2$

$= -3(-27) - 6$

$= 81 - 6$

$= 75$

79. $28 \div (7-9)^2 \cdot (1-3)^4 \div 14$

$= 28 \div (-2)^2 \cdot (-2)^4 \div 14$

$= 28 \div 4 \cdot 16 \div 14$

$= 7 \cdot 16 \div 14$

$= 112 \div 14$

$= 8$

80. $\frac{9-4^2}{(6-7)^5} - \frac{3(5-7)^2}{2-2\cdot 7}$

$= \frac{9-4^2}{(-1)^5} - \frac{3(-2)^2}{2-2\cdot 7}$

$= \frac{9-16}{-1} - \frac{3(4)}{2-2\cdot 7}$

$= \frac{-7}{-1} - \frac{12}{2-14}$

$= \frac{-7}{-1} - \frac{12}{-12}$

$= 7 - (-1)$

$= 7 + 1$

$= 8$

81. $\frac{15-19}{-2^2} \cdot \frac{3(2-7)^2}{3\cdot 2-1} \div \frac{3\cdot 2-2^4}{10-4\cdot 3}$

$= \frac{15-19}{-2^2} \cdot \frac{3(-5)^2}{3\cdot 2-1} \div \frac{3\cdot 2-2^4}{10-4\cdot 3}$

$= \frac{15-19}{-4} \cdot \frac{3\cdot 25}{3\cdot 2-1} \div \frac{3\cdot 2-16}{10-4\cdot 3}$

$= \frac{-4}{-4} \cdot \frac{75}{6-1} \div \frac{6-16}{10-12}$

$= \frac{-4}{-4} \cdot \frac{75}{5} \div \frac{-10}{-2}$

$= 1 \cdot 15 \div 5$

$= 15 \div 5$

$= 3$

82. iii

$32 + 32 \div 4 - 2^3 = 32 + 32 \div 4 - 8 = 32 + 8 - 8$

83. **ii**

$8^2 - 2^2(5-3)^3 = 8^2 - 2^2(2)^3 = 64 - 4(8)$

Applying Concepts 1.2

84. $11^{22} = 81,402,749,386,839,761,113,321$
The tens digit is 2.

85. $7^{18} = 1,628,413,597,910,449$
The ones digit is 9.

86. $5^{33} = 116,415,321,826,934,814,453,125$
The last two digits are 25.

87. 5^{234} has over 150 digits. The last three are 625.

88. $(2^3)^4 = 2^{12} = 4096$
$2^{(3^4)} = 2^{81} = 2,417,851,639,229,258,349,412,352$
They do not equal each other, and the second expression is larger.

89. Find b^c. Then find $a^{(b^c)}$.

Projects or Group Activities 1.2

90. Abundant, $1+2+4+5+10 = 22 > 20$

91. Perfect, $1+ 2+4+7+14 = 28 = 28$

92. Deficient, example $3^2=9$, $1+3 = 4 < 9$

SECTION 1.3

Concept Check

1. The least common multiple (LCM) of 2 or more numbers is the smallest number that is a multiple of all the numbers. When adding fractions, the LCM of all the denominators is the least common denominator these numbers will have.
2. The greatest common factor (GCF) of 2 or more numbers is the greatest number that divides evenly into all numbers. When simplifying fractions, you divide both top and bottom by the GCF for the two numbers.
3. Yes, all integers are rational numbers because they can be written as fractions by writing the number with a denominator of 1. Example: 7 = 7/1.
4. $\frac{2}{3}$ and -2.34 are not integers but are rational.
5. Yes, the smallest positive integer = 1

   No, positive rational numbers continue to grow forever.
6. No, zero does not have a reciprocal.

Objective 1.3.1 Exercises

7. The LCM of 8, 28, and 7 is 56.

   $\frac{5}{8}=\frac{35}{56}, -\frac{1}{28}=-\frac{2}{56}, \frac{2}{7}=\frac{16}{56}$
8. The reciprocal of $-\frac{8}{27}$ is $-\frac{27}{8}$.

   To find the quotient of two fractions, take the reciprocal of the second fraction and find the product.

   $$\frac{2}{3}\div\left(-\frac{8}{27}\right)=\frac{2}{3}\left(-\frac{27}{8}\right)=-\frac{54}{24}=-\frac{9}{4}$$
9. $$\frac{4}{5}\left(-\frac{2}{5}\right)=\frac{-8}{25}$$
10. $$-\frac{23}{2}+\frac{5}{2}=\frac{-18}{2}=-9$$
11. $$-\frac{35}{3}-\left(-\frac{3}{5}\right)=-\frac{35}{3}+\frac{3}{5}=-\frac{175}{15}+\frac{9}{15}=-\frac{166}{15}$$
12. $$-\frac{3}{14}\left(-\frac{4}{3}\right)=\frac{12}{42}=\frac{2}{7}$$
13. $$-\frac{15}{8}\div\left(-\frac{14}{3}\right)=-\frac{15}{8}\left(-\frac{3}{14}\right)=\frac{45}{112}$$
14. $$-\frac{13}{3}-\frac{19}{6}=-\frac{26}{6}-\frac{19}{6}=-\frac{45}{6}=-\frac{15}{2}$$
15. $$\frac{8}{19}+\left(-\frac{17}{2}\right)=\frac{8}{19}-\frac{17}{2}=$$

    $$\frac{16}{38}-\frac{323}{38}=-\frac{307}{38}$$
16. $$\frac{39}{5}+\left(-\frac{37}{9}\right)=\frac{39}{5}-\frac{37}{9}=$$

    $$\frac{351}{45}-\frac{185}{45}=-\frac{166}{45}$$
17. $$\left(-\frac{3}{2}\right)^4=\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)=\frac{81}{16}$$
18. $$-\frac{14}{3}\left(\frac{30}{13}\right)=-\frac{420}{39}=-\frac{140}{13}$$
19. $$\left(-\frac{9}{2}\right)^3=\left(-\frac{9}{2}\right)\left(-\frac{9}{2}\right)\left(-\frac{9}{2}\right)=-\frac{729}{8}$$
20. $$-\frac{14}{3}\left(-\frac{11}{14}\right)=\frac{154}{42}=\frac{11}{3}$$
21. $$-\frac{9}{16}-\frac{35}{2}=-\frac{9}{16}-\frac{280}{16}=-\frac{289}{16}$$
22. $$-\frac{15}{7}-\frac{15}{2}=-\frac{30}{14}-\frac{105}{14}=-\frac{135}{14}$$
23. $$-\frac{11}{6}+\left(-\frac{9}{2}\right)=-\frac{11}{6}-\frac{9}{2}$$

    $$-\frac{11}{6}-\frac{27}{6}=-\frac{38}{6}=-\frac{19}{3}$$
24. $$-\frac{1}{3}\div\frac{33}{16}=-\frac{1}{3}\left(\frac{16}{33}\right)=-\frac{16}{99}$$
25. $$\frac{8}{3}\left(-\frac{8}{7}\right)=-\frac{64}{21}$$
26. $$\left(-\frac{5}{3}\right)^3=\left(-\frac{5}{3}\right)\left(-\frac{5}{3}\right)\left(-\frac{5}{3}\right)=-\frac{125}{27}$$
27. $$\frac{9}{2}+\left(-\frac{3}{5}\right)=\frac{9}{2}-\frac{3}{5}=\frac{45}{10}-\frac{6}{10}=\frac{39}{10}$$
28. $$-\frac{39}{4}+\frac{19}{5}=-\frac{-195}{20}+\frac{76}{20}=-\frac{119}{20}$$

29. $\frac{33}{2} \div \left(-\frac{31}{20}\right) = \frac{33}{2}\left(-\frac{20}{31}\right) = -\frac{660}{62} = -\frac{330}{31}$

30. $\frac{19}{4} - \left(-\frac{12}{11}\right) = \frac{19}{4} + \frac{12}{11} =$
$\frac{209}{44} + \frac{48}{44} = \frac{257}{44}$

31. $\left(-\frac{1}{10}\right)^2 = \left(-\frac{1}{10}\right)\left(-\frac{1}{10}\right) = \frac{1}{100}$

32. $-\frac{25}{2} - \frac{14}{19} = -\frac{475}{38} - \frac{28}{38} = -\frac{503}{38}$

33. $\frac{6}{7} \div \left(-\frac{7}{5}\right) = \frac{6}{7}\left(-\frac{5}{7}\right) = -\frac{30}{49}$

34. $\frac{29}{14} \div \left(-\frac{38}{3}\right) = \frac{29}{14}\left(-\frac{3}{38}\right) = -\frac{87}{532}$

35. $\frac{27}{11}\left(-\frac{5}{2}\right) = -\frac{135}{22}$

36. $\left(-\frac{2}{5}\right)^3 = \left(-\frac{2}{5}\right)\left(-\frac{2}{5}\right)\left(-\frac{2}{5}\right) = -\frac{8}{125}$

37. $-\frac{3}{4} + \frac{5}{6} = -\frac{18}{24} + \frac{20}{24} = \frac{2}{24} = \frac{1}{12}$

38. $-\frac{11}{15} + \frac{2}{3} = -\frac{11}{15} + \frac{10}{15} = -\frac{1}{15}$

39. $-\frac{11}{12} - \frac{13}{18} = -\frac{33}{36} - \frac{26}{36} = -\frac{59}{36}$

40. $\left(-\frac{15}{16}\right)\left(\frac{8}{3}\right) = -\frac{120}{48} = -\frac{5}{2}$

41. $-\frac{4}{5} - \frac{2}{3} = -\frac{12}{15} - \frac{10}{15} = -\frac{22}{15}$

42. $\frac{8}{9} - \frac{5}{6} = \frac{16}{18} - \frac{15}{18} = \frac{1}{18}$

43. $\frac{5}{8} \div \left(-\frac{7}{5}\right) = \frac{5}{8}\left(-\frac{5}{7}\right) = -\frac{25}{56}$

44. $-\frac{8}{3} + \left(-\frac{32}{11}\right) = -\frac{8}{3} - \frac{32}{11}$
$-\frac{88}{33} - \frac{96}{33} = -\frac{184}{33}$

45. $-\frac{5}{8} + \frac{13}{12} = -\frac{15}{24} + \frac{26}{24} = \frac{11}{2}$

46. $-\frac{7}{9} - \left(-\frac{5}{6}\right) = -\frac{7}{9} + \frac{5}{6}$
$-\frac{14}{18} + \frac{15}{18} = \frac{1}{18}$

47. No. For instance, there is no integer between 2 and 3.

48. Yes, add the two numbers and divide by 2.

Objective 1.3.2 Exercises

49. Fractions

50. $\frac{3}{\frac{1}{2}} = 3 \div \frac{1}{2}$

51. $-\frac{3}{4} \div \frac{5}{8} \cdot \left(-\frac{10}{11}\right) = -\frac{3}{4} \cdot \frac{8}{5} \cdot \left(-\frac{10}{11}\right)$
$= -\frac{24}{20} \cdot \left(-\frac{10}{11}\right) = \frac{240}{220} = \frac{12}{11}$

52. $\frac{1}{2} \div \left(-\frac{4}{5}\right) \div \frac{8}{9} = \frac{1}{2}\left(-\frac{5}{4}\right) \div \frac{8}{9} = -\frac{5}{8} \div \frac{8}{9}$
$= -\frac{5}{8}\left(\frac{9}{8}\right) = -\frac{45}{64}$

53. $\left(\frac{2}{3} - \frac{5}{6}\right)^2 - \frac{5}{12} = \left(\frac{4}{6} - \frac{5}{6}\right)^2 - \frac{5}{12}$
=
$\left(-\frac{1}{6}\right)^2 - \frac{5}{12} = \frac{1}{36} - \frac{5}{12} = \frac{1}{36} - \frac{15}{36} = -\frac{14}{36}$
$= -\frac{7}{18}$

54. $\frac{3}{4} - \frac{5}{3}\left(-\frac{5}{4}\right) = \frac{3}{4} + \frac{25}{12} = \frac{9}{12} + \frac{25}{12} = \frac{34}{12} = \frac{17}{6}$

55. $-\frac{5}{16} \cdot \frac{8}{9} - \frac{5}{6} \div \frac{3}{4} = -\frac{40}{144} - \frac{5}{6} \div \frac{3}{4}$
$= -\frac{40}{144} - \frac{5}{6} \cdot \frac{4}{3} = -\frac{40}{144} - \frac{20}{18}$
$= -\frac{40}{144} - \frac{160}{144} = -\frac{200}{144} = -\frac{25}{18}$

56. $-\frac{9}{8}\left(\frac{5}{18} - \frac{3}{4}\right) + \frac{5}{8} = -\frac{9}{8}\left(\frac{10}{36} - \frac{27}{36}\right) + \frac{5}{8}$
$= -\frac{9}{8}\left(-\frac{17}{36}\right) + \frac{5}{8} = \frac{153}{288} + \frac{5}{8}$
(reduce fractions for smaller numbers)
$= \frac{17}{32} + \frac{5}{8} = \frac{17}{32} + \frac{20}{32} = \frac{37}{32}$

57. $\frac{1}{2} - \left(\frac{2}{3} \div \frac{5}{9}\right) + \frac{5}{6} = \frac{1}{2} - \left(\frac{2}{3} \cdot \frac{9}{5}\right) + \frac{5}{6}$
$= \frac{1}{2} - \left(\frac{18}{15}\right) + \frac{5}{6} = \frac{15}{30} - \frac{36}{30} + \frac{25}{30} = -\frac{21}{30} + \frac{25}{30}$
$= \frac{4}{30} = \frac{2}{15}$

58. $\frac{3}{4} \div \left[\frac{5}{8} - \frac{5}{12}\right] + 2 = \frac{3}{4} \div \left[\frac{15}{24} - \frac{10}{24}\right] + 2$
$= \frac{3}{4} \div \left[\frac{5}{24}\right] + 2 = \frac{3}{4} \cdot \frac{24}{5} + 2 = \frac{72}{20} + 2$
$= \frac{72}{20} + \frac{40}{20} = \frac{112}{20} = \frac{28}{5}$

59. $\frac{1}{6} - \frac{5}{4}\left(-\frac{7}{12} + \frac{1}{24}\right) = \frac{1}{6} - \frac{5}{4}\left(-\frac{14}{24} + \frac{1}{24}\right)$
$= \frac{1}{6} - \frac{5}{4}\left(-\frac{13}{24}\right) = \frac{1}{6} + \frac{65}{96} = \frac{16}{96} + \frac{65}{96}$

$= \frac{81}{96} = \frac{27}{32}$

60. $\frac{2}{3} - \left[\frac{3}{8} + \frac{5}{6}\right] \div \frac{3}{5} = \frac{2}{3} - \left[\frac{18}{48} + \frac{40}{48}\right] \div \frac{3}{5}$

$= \frac{2}{3} - \left[\frac{58}{48}\right] \div \frac{3}{5} = \frac{2}{3} - \frac{58}{48} \cdot \frac{5}{3} = \frac{2}{3} - \frac{290}{144}$

$= \frac{96}{144} - \frac{290}{144} = -\frac{194}{144} = -\frac{97}{72}$

61. $\left(-\frac{1}{2}\right)^3 \div \left(-\frac{3}{2} - \frac{1}{4}\right) - \frac{2}{3}$

$= \left(-\frac{1}{2}\right)^3 \div \left(-\frac{6}{4} - \frac{1}{4}\right) - \frac{2}{3}$

$= \left(-\frac{1}{2}\right)^3 \div \left(-\frac{7}{4}\right) - \frac{2}{3} = -\frac{1}{8} \div \left(-\frac{7}{4}\right) - \frac{2}{3}$

$= -\frac{1}{8} \cdot \left(-\frac{4}{7}\right) - \frac{2}{3} = \frac{4}{56} - \frac{2}{3}$

$= \frac{1}{14} - \frac{2}{3} = \frac{3}{42} - \frac{28}{42} = -\frac{25}{42}$

62. $\left(\frac{7}{8} - \frac{11}{12}\right) \div \left(\frac{3}{4} - \frac{4}{5}\right) - \frac{1}{2}\left(\frac{5}{8} - \frac{2}{3}\right)$

$= \left(\frac{21}{24} - \frac{22}{24}\right) \div \left(\frac{15}{20} - \frac{16}{20}\right) - \frac{1}{2}\left(\frac{15}{24} - \frac{16}{24}\right)$

$= \left(-\frac{1}{24}\right) \div \left(-\frac{1}{20}\right) - \frac{1}{2}\left(-\frac{1}{24}\right)$

$= -\frac{1}{24} \cdot \left(-\frac{20}{1}\right) - \frac{1}{2}\left(-\frac{1}{24}\right)$

$= \frac{20}{24} - \frac{1}{2}\left(-\frac{1}{24}\right)$

$= \frac{20}{24} + \frac{1}{48} = \frac{40}{48} + \frac{1}{48} = \frac{41}{48}$

63.

$$\frac{\frac{2}{3}}{\frac{4}{5}} = \frac{2}{3} \div \frac{4}{5} = \frac{2}{3} \cdot \frac{5}{4} = \frac{10}{12} = \frac{5}{6}$$

64.

$$\frac{-\frac{5}{6}}{\frac{2}{3}} = -\frac{5}{6} \div \frac{2}{3} = -\frac{5}{6} \cdot \frac{3}{2} = -\frac{15}{12} = -\frac{5}{4}$$

65.

$$\frac{\frac{2}{3} - \frac{5}{6}}{\frac{3}{4} - \frac{1}{2}} = \frac{12\left(\frac{2}{3}\right) - 12\left(\frac{5}{6}\right)}{12\left(\frac{3}{4}\right) - 12\left(\frac{1}{2}\right)}$$

$$= \frac{8 - 10}{9 - 6} = \frac{-2}{3}$$

66.

$$\frac{\frac{1}{8} - \frac{1}{12}}{\frac{2}{3} - \frac{3}{4}} =. \frac{24\left(\frac{1}{8}\right) - 24\left(\frac{1}{12}\right)}{24\left(\frac{2}{3}\right) - 24\left(\frac{3}{4}\right)}$$

$$= \frac{3 - 2}{16 - 18} = \frac{1}{-2}$$

67.

$$\frac{\frac{2}{3} - \left(\frac{1}{2}\right)^2}{\frac{5}{4}\left(\frac{1}{2} - \frac{3}{4}\right)} = \frac{\frac{2}{3} - \frac{1}{4}}{\frac{5}{4}\left(\frac{2}{4} - \frac{3}{4}\right)} = \frac{\frac{8}{12} - \frac{3}{12}}{\frac{5}{4}\left(-\frac{1}{4}\right)}$$

$$= \frac{\frac{5}{12}}{-\frac{5}{16}} = \frac{5}{12} \div -\frac{5}{16}$$

$$= \frac{5}{12} \cdot -\frac{16}{5} = -\frac{80}{60} = -\frac{4}{3}$$

68.

$$\frac{\left(\frac{2}{3} - \frac{3}{4}\right)^3}{\frac{3}{8}\left(\frac{5}{6} - \frac{5}{12}\right)} = \frac{\left(\frac{8}{12} - \frac{9}{12}\right)^3}{\frac{3}{8}\left(\frac{10}{12} - \frac{5}{12}\right)}$$

$$= \frac{\left(-\frac{1}{12}\right)^3}{\frac{3}{8}\left(\frac{5}{12}\right)} = \frac{-\frac{1}{1728}}{\frac{15}{96}}$$

$$= -\frac{1}{1728} \div \frac{15}{96} == \frac{1}{1728} \cdot \frac{96}{15}$$

$$= -\frac{96}{25920} = -\frac{1}{270}$$

69.

$$\frac{5}{8} - \frac{\frac{2}{3} + \frac{1}{4}}{\frac{5}{6} - \frac{7}{8}} = \frac{5}{8} - \frac{\frac{8}{12} + \frac{3}{12}}{\frac{20}{24} - \frac{21}{24}}$$

$$= \frac{5}{8} - \frac{\frac{11}{12}}{-\frac{1}{24}}$$

$$= \frac{5}{8} - \frac{11}{12} \div \left(-\frac{1}{24}\right) = \frac{5}{8} - \frac{11}{12} \cdot \left(-\frac{24}{1}\right)$$

$$= \frac{5}{8} + \frac{264}{12}$$

(reduce for smaller numbers)

$$= \frac{5}{8} + 22 = \frac{5}{8} + \frac{176}{8} = \frac{181}{8}$$

70.

$$\frac{1}{2} + \frac{\frac{5}{18} - \frac{7}{9}}{\frac{1}{2} + \frac{2}{3}} = \frac{1}{2} + \frac{\frac{5}{18} - \frac{14}{18}}{\frac{3}{6} + \frac{4}{6}}$$

$$= \frac{1}{2} + \frac{\frac{-9}{18}}{\frac{7}{6}}$$

$$= \frac{1}{2} - \frac{9}{18} \div \frac{7}{6} = \frac{1}{2} - \frac{1}{2} \cdot \frac{6}{7}$$

$$= \frac{1}{2} - \frac{6}{14}$$

$$= \frac{7}{14} - \frac{6}{14} = \frac{1}{14}$$

71.

$$\frac{1}{2} - \frac{\frac{17}{25}}{4 - \frac{3}{5}} + \frac{1}{5} = \frac{1}{2} - \frac{\frac{17}{25}}{\frac{20}{5} - \frac{3}{5}} + \frac{1}{5}$$

$$= \frac{1}{2} - \frac{\frac{17}{25}}{\frac{17}{5}} + \frac{1}{5}$$

$$= \frac{1}{2} - \frac{17}{25} \div \frac{17}{5} + \frac{1}{5}$$

$$= \frac{1}{2} - \frac{17}{25} \cdot \frac{5}{17} + \frac{1}{5} = \frac{1}{2} - \frac{85}{425} + \frac{1}{5} =$$

$$= \frac{1}{2} - \frac{1}{5} + \frac{1}{5} = \frac{5}{10} - \frac{2}{10} + \frac{2}{10} = \frac{5}{10} = \frac{1}{2}$$

72.

$$\frac{3}{4} + \frac{3 - \frac{7}{9}}{\frac{5}{6}} \cdot \frac{2}{3} = \frac{3}{4} + \frac{\frac{27}{9} - \frac{7}{9}}{\frac{5}{6}} \cdot \frac{2}{3}$$

$$= \frac{3}{4} + \frac{\frac{20}{9}}{\frac{5}{6}} \cdot \frac{2}{3} = \frac{3}{4} + \left(\frac{20}{9} \div \frac{5}{6}\right) \cdot \frac{2}{3}$$

$$= \frac{3}{4} + \left(\frac{20}{9} \cdot \frac{6}{5}\right) \cdot \frac{2}{3} = \frac{3}{4} + \left(\frac{120}{45}\right) \cdot \frac{2}{3}$$

$$= \frac{3}{4} + \left(\frac{8}{3}\right) \cdot \frac{2}{3} = \frac{3}{4} + \frac{16}{9} = \frac{27}{36} + \frac{64}{36} = \frac{91}{36}$$

73.

$$\frac{\frac{1 - 2 \cdot 3}{4(5 - 4)}}{\frac{3 - 5 \cdot 2}{3 \cdot 5 - 1}} = \frac{\frac{1 - 6}{4(1)}}{\frac{3 - 10}{15 - 1}}$$

$$= \frac{\frac{-5}{4}}{\frac{-7}{14}} = -\frac{5}{4} \div -\frac{7}{14} =$$

$$= -\frac{5}{4} \cdot -\frac{14}{7} = \frac{70}{28} = \frac{5}{2}$$

74.

$$\frac{\frac{3(2 - 5)}{-2(2 - 6)}}{\frac{1 - 3(2 - 5)}{2 \cdot 3 - 1}} = \frac{\frac{3(-3)}{-2(-4)}}{\frac{1 - 3(-3)}{6 - 1}} = \frac{\frac{-9}{8}}{\frac{1 + 9}{5}}$$

$$= \frac{\frac{-9}{8}}{\frac{10}{5}} = \frac{\frac{-9}{8}}{2}$$

$$= \frac{-9}{8} \div 2 = -\frac{9}{8} \cdot \frac{1}{2} = -\frac{9}{16}$$

75. i, ii, and iv

$$\frac{3}{\frac{1}{3}} = 3 \div \frac{1}{3} = 3 \cdot \frac{3}{1} = 9$$

$$\frac{\frac{1}{3}}{\frac{1}{3}} = \frac{1}{3} \div \frac{1}{3} = \frac{1}{3} \cdot \frac{3}{1} = \frac{3}{3} = 1$$

$$\frac{\frac{1}{3}}{3} = \frac{1}{3} \div 3 = \frac{1}{3} \cdot \frac{1}{3} = \frac{1}{9}$$

$$\frac{1}{\frac{1}{3}} = 1 \div \frac{1}{3} = 1 \cdot \frac{3}{1} = 3$$

76.

$$\frac{\frac{2}{5}}{\frac{1}{?}} = \frac{2}{5} \div \frac{1}{?} = \frac{2}{5} \cdot \frac{?}{1}$$

? needs to be a multiple of 5 so that the fraction will reduce to an integer.

Objective 1.3.3 Exercises

77.
$$\begin{array}{r} 0.625 \\ 8\overline{)5.000} \\ \underline{-48} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-40} \\ 0 \end{array}$$

78.
$$\begin{array}{r} 0.3125 \\ 16\overline{)5.0000} \\ \underline{-48} \\ 20 \\ \underline{-16} \\ 40 \\ \underline{-32} \\ 80 \\ \underline{-80} \\ 0 \end{array}$$

79.
$$\begin{array}{r} 0.166\ldots = 0.1\overline{6} \\ 6\overline{)1.000} \\ \underline{-6} \\ 40 \\ \underline{-36} \\ 40 \\ \underline{-36} \\ 4 \end{array}$$

80.
$$\begin{array}{r} 0.5833\ldots = 0.583 \\ 12\overline{)7.0000} \\ \underline{-60} \\ 100 \\ \underline{-96} \\ 40 \\ \underline{-36} \\ 40 \\ \underline{-36} \\ 4 \end{array}$$

81.
$$\begin{array}{r} 0.14545\ldots = 0.14\overline{5} \\ 55\overline{)8.00000} \\ \underline{-55} \\ 250 \\ \underline{-220} \\ 300 \\ \underline{-275} \\ 250 \\ \underline{-220} \\ 300 \\ \underline{-275} \\ 25 \end{array}$$

82.
$$\begin{array}{r} 0.1919\ldots = 0.\overline{19} \\ 99\overline{)19.0000} \\ \underline{-99} \\ 910 \\ \underline{-891} \\ 190 \\ \underline{-99} \\ 910 \\ \underline{-891} \\ 19 \end{array}$$

83.
$$\begin{array}{r} 0.23076923\ldots = 0.\overline{230769} \\ 13\overline{)3.00000000} \\ \underline{-26} \\ 40 \\ \underline{-39} \\ 10 \\ \underline{-0} \\ 100 \\ \underline{-91} \\ 90 \\ \underline{-78} \\ 120 \\ \underline{-117} \\ 30 \\ \underline{-26} \\ 40 \\ \underline{-39} \end{array}$$

84.
$$\begin{array}{r} 0.07692307\ldots = 0.\overline{076923} \\ 26\overline{)2.00000000} \\ \underline{-0} \\ 200 \end{array}$$

-182
180
-156
240
-234
60
-52
80
-78
20
-0
200
-182
18

85. 3
86. 4

87. 0.0015
-0.0027
-0.0012

88. 0.31
x (-0.1)
-0.031

89. -0.0008
+3.5
3.4992

90. 0.0022
x (-0.8)
-0.00176

91. 0.0003
- 0.39
-0.3897

92. 3.1 $\sqrt{-0.031}$

-.01
31 $\sqrt{-0.31}$
-0
31
-31
0

93. -0.024
x -0.019
216
240
0.000456

94. 0.0029
-0.003
-0.0001

95. -0.004$\sqrt{0.000072}$

-0.018
-4$\sqrt{0.072}$
-4
32
-32
0

96. -0.0009 $\sqrt{-0.000189}$

0.21
-9 $\sqrt{-1.89}$
-0
18
-18
09
-09
0

97. 4.5$\sqrt{-0.0585}$

-0.013
45$\sqrt{-0.585}$
-0
05
-00
58
-45
135
-135
0

98. 0.02
-0.40
-0.38

99. 3.8
x(-3.9)
342
+1140
-14.82

100. -3.5 $\sqrt{-0.091}$

0.026
-35 $\sqrt{-0.910}$
-0
09
-00
91
-70
210
-210
0

101. -0.0026
+0.028
0.0254

102. 2.7
+0.007
2.707

103. $0.016\sqrt{-0.000192}$

$$\begin{array}{r} 0.012 \\ 16\overline{)-0.192} \\ \underline{-00} \\ 19 \\ \underline{-16} \\ 32 \\ \underline{-32} \\ 0 \end{array}$$

104.
$$\begin{array}{r} -0.18 \\ \underline{-0.007} \\ 0.187 \end{array}$$

105. $0.4(1.2-2.3)^2+5.8$
$0.4(-1.1)^2+5.8$
0.4(1.21)+5.8
0.484+5.8
6.284

106. $5.4-(0.3)^2\div 0.09$
5.4-(0.09) ÷ 0.09
5.4-1
4.4

107. $1.75\div 0.25-(1.25)^2$
$1.75\div 0.25-1.5625$
7-1.5625
5.4375

108. $(3.5-4.2)^2-3.50\div 2.5$
$(-0.7)^2-3.50\div 2.5$
$0.49-3.50\div 2.5$
0.49-1.4
-0.91

109. $25.76\div(6.54\div 3.27)^2$
$25.76\div(6.54\div 3.27)^2$
$25.76\div(2)^2$
$25.76\div 4$
6.44

110. $(3.09-4.77)^2-4.07\cdot 3.66$
$(-1.68)^2-4.07\cdot 3.66$
2.8224-4.07· 3.66
2.8224-14.8962
-12.0738

111. No. 5/23 is a rational number, so its decimal representation either terminates or repeats.

112. No. By the Order of Opeartions Agreement, the correct expression to enter is (2/3)(3/4). The student must use the parentheses in order to get the correct answer.

Applying Concepts 1.3

113. $2+\frac{2}{2-\frac{2}{2+1}}=2+\frac{2}{2-\frac{2}{3}}=2+\frac{2}{\frac{6}{3}-\frac{2}{3}}=2+\frac{2}{\frac{4}{3}}=$

$$2+2\div\frac{4}{3}=2+2\cdot\frac{3}{4}=2+\frac{6}{4}=\frac{4}{2}+\frac{3}{2}=\frac{7}{2}$$

114.

$$1+\cfrac{2}{3+\cfrac{4}{5+\cfrac{6}{7+8}}}$$

$$=1+\cfrac{2}{3+\cfrac{4}{5+\cfrac{6}{15}}}$$

$$=1+\cfrac{2}{3+\cfrac{4}{\frac{75}{15}+\frac{6}{15}}}=$$

$$=1+\cfrac{2}{3+\cfrac{4}{\frac{81}{15}}}$$

$$=1+\cfrac{2}{3+4\div\frac{81}{15}}$$

$$=1+\frac{2}{3+4\cdot\frac{15}{81}}$$

$$=1+\frac{2}{3+\frac{60}{81}}=1+\frac{2}{3+\frac{20}{27}}$$

$$=1+\frac{2}{\frac{81}{27}+\frac{20}{27}}$$

$$=1+\frac{2}{\frac{101}{27}}=1+2\div\frac{101}{27}$$

$$=1+2\cdot\frac{27}{101}=1+\frac{54}{101}$$

$$=\frac{101}{101}+\frac{54}{101}=\frac{155}{101}$$

115.

$$3-\frac{1}{3-\frac{1}{3-\frac{1}{3}}}=3-\frac{1}{3-\frac{1}{\frac{9}{3}-\frac{1}{3}}}=3-\frac{1}{3-\frac{1}{\frac{8}{3}}}$$

$$=3-\frac{1}{3-1\div\frac{8}{3}}$$

$$=3-\frac{1}{3-1\cdot\frac{3}{8}}=3-\frac{1}{3-\frac{3}{8}}=3-\frac{1}{\frac{24}{8}-\frac{3}{8}}$$

$$=3-\frac{1}{\frac{21}{8}}=3-1\div\frac{21}{8}=3-1\cdot\frac{8}{21}=3-\frac{8}{21}$$

$$=\frac{63}{21}-\frac{8}{21}=\frac{55}{21}$$

116.

$$\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-\frac{1}{1-\frac{1}{2}}}}=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-\frac{1}{\frac{2}{2}-\frac{1}{2}}}}=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}}}}$$

$$=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-1\div\frac{1}{2}}}$$

$$=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-1\cdot 2}}=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-2}}=\frac{1}{\frac{1}{2}-\frac{1}{\frac{1}{2}-\frac{4}{2}}}$$

$$=\frac{1}{\frac{1}{2}-\frac{1}{\frac{-3}{2}}}$$

$$=\frac{1}{\frac{1}{2}-1\div\frac{-3}{2}}$$

$$=\frac{1}{\frac{1}{2}-1\cdot\left(-\frac{2}{3}\right)}=\frac{1}{\frac{1}{2}+\frac{2}{3}}=\frac{1}{\frac{3}{6}+\frac{4}{6}}$$

$$=\frac{1}{\frac{7}{6}}=1\div\frac{7}{6}=1\cdot\frac{6}{7}=\frac{6}{7}$$

Projects or Group Activities 1.3

117. True

118. True

119. True

120. False; $\pi\left(\frac{1}{\pi}\right)=1$

121. False, $\pi+(-\pi)=0$

122. True

123. To find a number between two fractions, write equivalent fractions with common denominators and then select a number in between the two numerators.

For example:

$$\frac{1}{3}\ and\ \frac{1}{2}=\frac{4}{12}\ and\ \frac{6}{12}\ so\ \frac{5}{12}$$

is between the two.

SECTION 1.4

Concept Check

1. Addition, multiplication

2. Addition, multiplication

3. A

4. 1/c

5. Distributive Property

6. For instance, 3x and -4x

7. No, the variable parts are not the same.

8. Yes, they have the same variable parts.

$$\frac{2ca^2b^3}{3}=\frac{2}{3}ca^2b^3=\frac{2}{3}a^2b^3c$$

Objective 1.4.1 Exercises

9. The fact that two terms can be multiplied in either order is called the Commutative Property of Multiplication.

10. The fact that three or more addends can be added by grouping them in any order is called the Associative Property of Addition.

11. The Multiplication Property of Zero tells us that the product of a number and zero is zero.

12. The Addition Property of Zero tells us that the sum of a number and zero is the number.

13. $3 \cdot 4 = 4 \cdot 3$

14. $7 + 15 = 15 + 7$

15. $(3 + 4) + 5 = 3 + (4 + 5)$

16. $(3 \cdot 4) \cdot 5 = 3 \cdot (4 \cdot 5)$

17. **9.** $\frac{5}{0}$ is undefined.

18. $4 + 0 = 4$

19. $3(x + 2) = 3x + 6$

20. $5(y + 4) = 5y + 20$

21. **13.** $\frac{0}{-6} = 0$

22. $(x + y) + [-(x + y)] = 0$

23. **15.** $\frac{1}{mn}(mn) = 1$

24. $x \cdot 1 = x$

25. $2(3x) = (2 \cdot 3) \cdot x$

26. $ab + bc = bc + ab$

27. A Division Property of Zero

28. The Inverse Property of Addition

29. The Inverse Property of Multiplication

30. The Commutative Property of Multiplication

31. The Addition Property of Zero

32. The Associative Property of Addition

33. A Division Property of Zero

34. The Distributive Property

35. The Distributive Property

36. The Addition Property of Zero

37. The Associative Property of Multiplication

38. The Commutative Property of Addition

39. When the sum of a number n and its additive inverse is multiplied by the reciprocal of the number n, the result is zero.

40. When the product of a number n and its reciprocal is multiplied by the number n, the result is n.

Objective 1.4.2 Exercises

41. "Evaluate a variable expression" means replace the variable expression with a numerical value and simplify the resulting expression.

42. The value of a variable is a numerical value that replaces the variable wherever it appears in an expression. The value of a variable expression is the number to which the expression simplifies when the value of the variable is substituted into the expression and the expression is simplified.

43. $n^2|m-n|$ if n=-5 and m=-3

$= (-5)^2|-3-(-5)|$

$=(-5)^2|-3+5|$

$=(-5)^2|2|$

$=(25)(2)$

$=50$

44. The volume of a cone with height h and base of radius r is $V = \frac{1}{3}\pi r^2 h$. If $r = 2$ in. and $h = 3$ in., then the exact volume of the cone is $V = \frac{1}{3}\pi(\underline{2})^2(\underline{3}) = (\underline{4})\pi$ in. Use the π key on a calculator to approximate the volume to the nearest hundredth: $V \approx \underline{12.57}$ in^3.

45. $ab + dc$

$(2)(3) + (-4)(-1) = 6 + 4 = 10$

46. $2ab - 3dc$

$$\begin{aligned} 2(2)(3) - 3(-4)(-1) &= 4(3) - 3(-4)(-1) \\ &= 12 - (-12)(-1) \\ &= 12 - 12 \\ &= 0 \end{aligned}$$

47. b-a(2c+d)

$= 3-2[2(-1)+(-4)]$

$=3-2[-2+(-4)]$

$=3-2(-6)$

$=3 + 12$

$= 15$

48. $b^2 - (d - c)^2$

$$\begin{aligned} 3^2 - [(-4) - (-1)]^2 &= 3^2 - [(-4) + 1]^2 \\ &= 3^2 - [-3]^2 \\ &= 9 - 9 \\ &= 0 \end{aligned}$$

49. $(b - 2a)^2 + c$

$$\begin{aligned} [3 - 2(2)]^2 + (-1) &= [3 - 4]^2 + (-1) \\ &= [-1]^2 + (-1) \\ &= 1 + (-1) \\ &= 0 \end{aligned}$$

50. $(b - d)^2 \div (b - d)$

$$\begin{aligned} [3 - (-4)]^2 \div [3 - (-4)] &= (3 + 4)^2 \div (3 + 4) \\ &= (7)^2 \div 7 \\ &= 49 \div 7 \\ &= 7 \end{aligned}$$

51. $(bc+a)^2 \div (d-b)$

$[(3)(-1)+2]^2 \div (-4-3) = [-3+2]^2 \div (-7)$

$= [-1]^2 \div (-7)$

$= -\frac{1}{7}$

52. $2d^2\text{-}a^2c^3$

$=2(-4)^2 - (2)^2(-1)^3$

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

$=32 + 4$

$= 36$

53. $b^2\text{-}4ac$

$=(3)^2\text{-}4(2)(-1)$

$= 9 + 8$

$= 17$

54.

$$\frac{a}{2b} - \frac{2c}{d} = \frac{2}{2(3)} - \frac{2(-1)}{-4}$$

$$= \frac{2}{6} - \frac{-2}{-4}$$

$$= \frac{1}{3} - \frac{1}{2} = \frac{2}{6} - \frac{3}{6} = \frac{-1}{6}$$

55. $\frac{3ac}{-4} - c^2$

$$\frac{3(2)(-1)}{-4} - (-1)^2 = \frac{6(-1)}{-4} - (-1)^2$$

$$= \frac{-6}{-4} - (-1)^2$$

$$= \frac{3}{2} - (-1)^2$$

$$= \frac{3}{2} - 1$$

$$= \frac{1}{2}$$

56.

$$\frac{a - \frac{1}{a}}{d + \frac{1}{d}} = \frac{2 - \frac{1}{2}}{-4 + \frac{1}{-4}} = \frac{\frac{4}{2} - \frac{1}{2}}{\frac{-16}{4} + \frac{-1}{4}}$$

$$= \frac{\frac{3}{2}}{\frac{-17}{4}} = \frac{3}{2} \cdot \frac{-4}{17} = \frac{-12}{34} = \frac{-6}{17}$$

57. $\dfrac{3b-5c}{3a-c}$

$$\frac{3(3)-5(-1)}{3(2)-(-1)} = \frac{9-(-5)}{6-(-1)} = \frac{9+5}{6+1} = \frac{14}{7} = 2$$

58. $\dfrac{2d-a}{b-2c}$

$$\frac{2(-4)-2}{3-2(-1)} = \frac{-8-2}{3-(-2)}$$

$$= \frac{-10}{3+2}$$

$$= \frac{-10}{5}$$

$$= -2$$

59. $\dfrac{a-d}{b+c}$

$$\frac{2-(-4)}{3+(-1)} = \frac{2+4}{3+(-1)} = \frac{6}{2} = 3$$

60. $|a^2+d|$

$$|2^2+(-4)| = |4+(-4)| = |0| = 0$$

61. $-a|a+2d|$

$$-2|2+2(-4)| = -2|2+(-8)|$$

$$= -2|-6|$$

$$= -2(6)$$

$$= -12$$

62. $d|b-2d|$

$$-4|3-2(-4)| = -4|3-(-8)|$$

$$= -4|3+8|$$

$$= -4|11|$$

$$= -4(11)$$

$$= -44$$

63. $\dfrac{2a-4d}{3b-c}$

$$\frac{2(2)-4(-4)}{3(3)-(-1)}=\frac{4-(-16)}{9-(-1)}$$
$$=\frac{4+16}{9+1}$$
$$=\frac{20}{10}$$
$$=2$$

64. $\dfrac{3d-b}{b-2c}$

$$\frac{3(-4)-3}{3-2(-1)}=\frac{-12-3}{3-(-2)}$$
$$=\frac{-15}{3+2}$$
$$=\frac{-15}{5}$$
$$=-3$$

65. $-3d \div \left|\dfrac{ab-4c}{2b+c}\right|$

$$-3(-4)\div\left|\frac{2(3)-4(-1)}{2(3)+(-1)}\right|=-3(-4)\div\left|\frac{6-(-4)}{6+(-1)}\right|$$
$$=-3(-4)\div\left|\frac{6+4}{6+(-1)}\right|$$
$$=-3(-4)\div\left|\frac{10}{5}\right|$$
$$=-3(-4)\div|2|$$
$$=-3(-4)\div 2$$
$$=12\div 2$$
$$=6$$

66. $-2bc+\left|\dfrac{bc+d}{ab-c}\right|$

$$-2(3)(-1)+\left|\frac{3(-1)+(-4)}{2(3)-(-1)}\right|=-2(3)(-1)+\left|\frac{-3+(-4)}{6-(-1)}\right|$$
$$=-2(3)(-1)+\left|\frac{-7}{6+1}\right|$$
$$=-2(3)(-1)+\left|\frac{-7}{7}\right|$$
$$=-2(3)(-1)+|-1|$$
$$=-2(3)(-1)+1$$
$$=-6(-1)+1$$
$$=6+1$$
$$=7$$

67. $2(d-b)\div(3a-c)$

$$2(-4-3)\div[3(2)-(-1)]=2(-7)\div[6-(-1)]$$
$$=2(-7)\div[6+1]$$
$$=2(-7)\div 7$$
$$=-14\div 7$$
$$=-2$$

68. $2d^3 + 4a^2b^3 = 2(-4)^3 + 4(2)^2(3)^3$

$= 2(-64) + 4(4)(27)$

$= -128 + 432$

$= 304$

69. $-d^2-c^3a$

$$-(-4)^2-(-1)^3(2)=-16-(-1)(2)$$
$$=-16+2$$
$$=-14$$

70. a^2c-d^3

$$(2)^2(-1)-(-4)^3=4(-1)-(-64)$$
$$=-4+64$$
$$=60$$

71. $-d^3+4ac$

$$-(-4)^3+4(2)(-1)=-(-64)+8(-1)$$
$$=64-8$$
$$=56$$

72. b^a

$3^2 = 9$

73. 4^{a^2}

$4^{2^2} = 4^4 = 256$

74. a^b

$2^3 = 8$

75. $V = LWH$

$V = (14)(10)(6)$

$V = 840$

The volume is 840 in^3.

76. $V = \frac{1}{3}\pi r^2 h \qquad r = \frac{1}{2}d = \frac{1}{2}(12) = 6$

$V = \frac{1}{3}\pi(6)^2 14$

$V = 168\pi$

$V \approx 527.79$

The volume is 168π ft^3.

The volume is approximately 527.79 ft^3.

77. $V = \frac{1}{3}s^2 h$

$V = \frac{1}{3}(3^2)5$

$V = 15$

The volume is 15 ft^2.

78. $V = s^3$

$V = 7.5^3$

$V = 421.875$

The volume is 421.875 m^3.

79. $V = \frac{4}{3}\pi r^3 \qquad r = \frac{1}{2}d = \frac{1}{2}(3) = 1.5$

$V = \frac{4}{3}\pi(1.5)^3$

$V = 4.5\pi$

$V \approx 14.14$

The volume is 4.5π cm^3.

The volume is approximately 14.14 cm^3.

80. $V = \pi r^2 h \qquad r = \frac{1}{2}d = \frac{1}{2}(8) = 4$

$V = \pi(4^2)8$

$V = 128\pi$

$V \approx 402.12$

The volume is 128π cm^3.

The volume is approximately 402.12 cm^3.

81. SA = $2LW + 2LH + 2WH$

SA = 2(5)(4) + 2(5)(3) l+ 2(4)(3)

SA = 40 + 30 + 24

SA = 94

The surface area is 94 m^2.

82. $\text{SA} = 6s^2$

$\text{SA} = 6(14^2)$

$\text{SA} = 1176$

The surface area is 1176 ft^2.

83. $\text{SA} = s^2 + 4\left(\frac{1}{2}\right)bh$

$\text{SA} = 4^2 + 2(4)(5)$

$\text{SA} = 16 + 40 = 56$

The surface area is 56 m^2.

84. $\text{SA} = 4\pi r^2 \qquad r = \frac{1}{2}d = \frac{1}{2}(2) = 1$

$\text{SA} = 4\pi(1^2)$

$\text{SA} = 4\pi$

$\text{SA} \approx 12.57$

The surface area is 4π cm^2.

The surface area is approximately 12.57 cm^2.

85. $\text{SA} = 2\pi r^2 + 2\pi rh$

$\text{SA} = 2\pi(6^2) + 2\pi(6)(2)$

$\text{SA} = 72\pi + 24\pi$

$\text{SA} = 96\pi$

$\text{SA} \approx 301.59$

The surface area is 96π in^2.

The surface area is approximately 301.59 in^2.

86. $\text{SA} = \pi r^2 + \pi rl \qquad r = \frac{1}{2}d = \frac{1}{2}(3) = 1.5$

$\text{SA} = \pi(1.5)^2 + \pi(1.5)(9)$

$\text{SA} = 2.25\pi + 13.5\pi$

$\text{SA} = 15.75\pi$

$\text{SA} \approx 49.48$

The surface area is 15.75π ft^2.

The surface area is approximately 49.48 ft^2.

87. Because $|b| > |a|$, the denominator will be negative. The numerator will be positive because the product contains an even number of factors. Therefore, the result will be a negative number.

88. a. No; with the irrational number π in the formula, V cannot be a whole number.

b. No; volume is not measured in square units.

Objective 1.4.3 Exercises

89. If there are two terms with a common variable factor, the Distributive Property allows us to combine the two terms into one term. Add the coefficients of the variable factor and write the sum as the coefficient of the common variable factor.

90. The four terms of the variable expression $5x - 6y + 4x - 8$ are $5x$, $-6y$, $4x$, and -8. The terms $5x$ and $4x$ are called like terms. The coefficient of the y-term is -6. The constant term is -8.

91. -5; 25; Commutative; Associative; $4y$

92. $5x + 7x = 12x$

93. $3x + 10x = 13x$

94. $-8ab - 5ab = -13ab$

95. $12\left(\frac{1}{12}\right)x = x$

96. $\frac{1}{3}(3y) = y$

97. $-3(x - 2) = -3x + 6$

98. $-5(x - 9) = -5x + 45$

99. $(x + 2)5 = 5x + 10$

100. $-(x + y) = -x - y$

101. $-(-x - y) = x + y$

102. $5+2(3x-7) = 5 + 6x - 14 = 6x-9$

103. $7-3(4a-5) = 7-12a + 15 = -12a+22$

104. $5v-3(2-4v) = 5v-6+12v = 17v - 6$

105. $-3m -2(4m+3) = -3m -8m-6 = -11m-6$

106. $-3+4(2z-9) = -3 + 8z - 36 = 8z - 39$

107. $-5-6(2y-3) = -5 -12y + 18 = -12y+13$

108. $4x - 3(2y - 5) = 4x - 6y + 15$

109. $-2a - 3(3a - 7) = -2a - 9a + 21 = -11a + 21$

110. $3x - 2(5x - 7) = 3x - 10x + 14 = -7x + 14$

111. $2x - 3(x - 2y) = 2x - 3x + 6y = -x + 6y$

112. $3[a - 5(5 - 3a)] = 3[a - 25 + 15a]$
$= 3[16a - 25]$
$= 48a - 75$

113. $5[-2 - 6(a - 5)] = 5[-2 - 6a + 30]$
$= 5[28 - 6a]$
$= 140 - 30a$

114. $3[x - 2(x + 2y)] = 3[x - 2x - 4y]$
$= 3[-x - 4y]$
$= -3x - 12y$

115. $5[y - 3(y - 2x)] = 5[y - 3y + 6x]$
$= 5[-2y + 6x]$
$= -10y + 30x$

116. $-2(x - 3y) + 2(3y - 5x) = -2x + 6y + 6y - 10x$
$= -12x + 12y$

117. $4(-a - 2b) - 2(3a - 5b) = -4a - 8b - 6a + 10b$
$= -10a + 2b$

118. $5(3a - 2b) - 3(-6a + 5b) = 15a - 10b + 18a - 15b$
$= 33a - 25b$

119. $-7(2a - b) + 2(-3b + a) = -14a + 7b - 6b + 2a$
$= -12a + b$

120. $3x - 2[y - 2(x + 3[2x + 3y])]$
$= 3x - 2[y - 2(x + 6x + 9y)]$
$= 3x - 2[y - 2(7x + 9y)]$
$= 3x - 2[y - 14x - 18y]$
$= 3x - 2[-17y - 14x]$
$= 3x + 34y + 28x$
$= 31x + 34y$

121. $2x - 4[x - 4(y - 2[5y + 3])]$
$= 2x - 4[x - 4(y - 10y - 6)]$
$= 2x - 4[x - 4(-9y - 6)]$
$= 2x - 4[x + 36y + 24]$
$= 2x - 4x - 144y - 96$
$= -2x - 144y - 96$

122. $4 - 2(7x - 2y) - 3(-2x + 3y)$
$= 4 - 14x + 4y + 6x - 9y$
$= 4 - 8x - 5y$

123. $3x + 8(x - 4) - 3(2x - y)$
$= 3x + 8x - 32 - 6x + 3y$
$= 5x - 32 + 3y$

124. $\frac{1}{3}[8x - 2(x - 12) + 3] = \frac{1}{3}[8x - 2x + 24 + 3]$
$= \frac{1}{3}[6x + 27]$
$= 2x + 9$

125. $\frac{1}{4}[14x - 3(x - 8) - 7x] = \frac{1}{4}[14x - 3x + 24 - 7x]$
$= \frac{1}{4}[4x + 24]$
$= x + 6$

126. a. The coefficient of a will be given by $(31 - 88)$, which will be negative.

b. The coefficient of b will be given by $(-102 + 256)$, which will be positive.

c. The constant term will be given by $(73 - 73)$, which will be zero.

127. $3[5 - 2(y - 6)] = 3(5) - 3[2(y - 6)] = 15 - 6(y - 6)$

a. No

b. Yes

Applying Concepts 1.4

128. $-4(5x - y) = -20x + 4y$
The statement is correct; it uses the Distributive Property.

129. $4(3y + 1) = 12y + 4$
The statement is correct; it uses the Distributive Property.

130. $6 - 6x = 0x = 0$
The statement is not correct; it incorrectly uses the Distributive Property. The correct answer is $6 - 6x$.

131. $2 + 3x = (2 + 3)x = 5x$
The statement is not correct; it mistakenly uses the Distributive Property. It is in an irreducible statement. That is, the answer is $2 + 3x$.

132. $3a - 4b = 4b - 3a$
The statement is not correct; it incorrectly uses the Commutative Property of Addition. The correct answer is $3a - 4b = -4b + 3a$.

133. $2(3y) = (2 \cdot 3)(2y) = 12y$
The statement is not correct; it incorrectly uses the Associative Property of Multiplication. The correct answer is $(2 \cdot 3)y = 6y$.

134. $x^4 \cdot \frac{1}{x^4} = 1$
The statement is correct; it uses the Inverse Property of Multiplication.

135. $-x^2 + y^2 = y^2 - x^2$
The statement is correct; it uses the Commutative Property of Addition.

Projects or Group Activities 1.4

136. a. $4 \otimes 5 = 6$

(4x5)÷7 = 20÷7 has a remainder of 6.

b. $6 \otimes 3 = 4$

(6x3) ÷ 7 = 18 ÷ 7 has a remainder of 4

137. Commutative, Yes

138. $2 \otimes (3 \otimes 5) = (2 \otimes 3) \otimes 5$

$2 \otimes 1 = 6 \otimes 5$

$2 = 2$

True

139. $5 \otimes (7 \otimes 8) = (5 \otimes 7) \otimes 8$

$5 \otimes 0 = 0 \otimes 8$

$0 = 0$

Yes, Associative

140. $5 \otimes x = 1$

In order to get =1, you need a value for x so that the remainder is 1.

$5 \otimes 3 = 15 \div 7$ = remainder of 1 so x can be 3.

SECTION 1.5

Concept Check

1. **y+6**

The sum of y and 6 or 6 more than y

2. 5x

The product of 5 and x or 5 times x

3. No, the difference between x and 2 is x-2, where x less than 2 is 2-x

4. No, ten less than m is m-10 but ten less m is 10-m. The "than" reverses the order.

5. 14-x

6. Yes

Objective 1.5.1 Exercises

7. ten more than the product of eight and a number

8. thirteen subtracted from the quotient of negative five and the cube of a number

9. the difference between ten times a number and sixteen times the number

10. The sum of two numbers is 24. To express both numbers in terms of the same variable, let x be one number. Then the other number is $24 - x$.

11. the unknown number: n
the sum of the number and two: $n + 2$
$n - (n + 2) = n - n - 2 = -2$

12. the unknown number: n
the difference between five and the number:
$5 - n$
$n - (5 - n) = n - 5 + n = 2n - 5$

13. the unknown number: n

one-third of the number: $\frac{1}{3}n$

four-fifths of the number: $\frac{4}{5}n$

$\frac{1}{3}n + \frac{4}{5}n = \frac{5}{15}n + \frac{12}{15}n = \frac{17}{15}n$

14. the unknown number: n

three-eighths of the number: $\frac{3}{8}n$

one-sixth of the number: $\frac{1}{6}n$

$\frac{3}{8}n - \frac{1}{6}n = \frac{9}{24}n - \frac{4}{24}n = \frac{5}{24}n$

15. the unknown number: n
the product of eight and the number: $8n$
$5(8n) = 40n$

16. the unknown number: n
two-thirds of the number: $\frac{2}{3}n$
$n + \frac{2}{3}n = \frac{5}{3}n$

17. the unknown number: n
the product of seventeen and the number: $17n$
twice the number: $2n$
$17n - 2n = 15n$

18. the unknown number: n
six times the number: $6n$
the total of six times the number and twenty-two:
$6n + 22$
$\frac{1}{2}(6n + 22) = 3n + 11$

19. the unknown number: n
the square of the number: n^2
the total of twelve and the square of the number:
$12 + n^2$
$n^2 - (12 + n^2) = n^2 - 12 - n^2 = -12$

20. the unknown number: n
the square of the number: n^2
the difference between the number and seventeen:
$n - 17$
$n^2 + 11 + (n - 17) = n^2 + 11 + n - 17 = n^2 + n - 6$

21. the unknown number: n
the sum of five times the number and 12: $5n + 12$
the product of the number and fifteen: $15n$
$15n + (5n + 12) = 15n + 5n + 12 = 20n + 12$

22. the unknown number: n
twice the sum of the number and 11: $2(n + 11)$
$2(n + 11) - 4 = 2n + 22 - 4 = 2n + 18$

23. Let the smaller number be x.
The larger number is $15 - x$.
The sum of twice the smaller number and two more than the larger number:
$2x + (15 - x + 2) = 2x + (17 - x) = x + 17$

24. Let the smaller number be x.
The larger number is $20 - x$.
The difference between five times the larger number and three less than the smaller number:
$5(20 - x) - (x - 3) = 100 - 5x - x + 3 = -6x + 103$

25. Let the larger number be x.
Then the smaller number is $34 - x$.
The difference between two more than the smaller number and twice the larger number:
$[(34 - x) + 2] - 2x = 34 - x + 2 - 2x = 36 - 3x$

26. Let the larger number be x.
Then the smaller number is $33 - x$.
The difference between six more than twice the smaller number and three more than the larger number:
$[2(33 - x) + 6] - (x + 3) = 66 - 2x + 6 - x - 3$
$= 69 - 3x$

27. iii

28. i,ii, iii

Objective 1.5.2 Exercises

29. The length of a rectangle is eight more than its width. To express the length and the width in terms of the same variable, let W be the width. Then the length is $W + 8$.

30. The width of a rectangle is one-third of its length. To express the length and the width in terms of the same variable, let L be the length. Then the width is $\frac{1}{3}L$.

31. Let A = money to be spent on high-speed rails. Then the amount to be spent on the highway is 8A.

32. If population of Houston is P, the population of New York is 4P.

33. Distance from Earth to the moon: d
Distance from Earth to the sun: $390d$

34. Length of the longest road tunnel: L
Length of the longest rail tunnel: $L + 23.36$

35. Amount of the first account: x
Amount of the second account: $10{,}000 - x$

36. Length of the longer piece: L
Length of the shorter piece: $3 - L$

37. Flying time between San Diego and New York: t
Flying time between New York and San Diego: $13 - t$

38. Length of the shorter piece: L
Length of the longer piece: $12 - L$

39. The measure of angle B: x
The measure of angle A is twice that of angle B: $2x$
The measure of angle C is twice that of angle A:
$2(2x) = 4x$

40. The width of the rectangle is W.
The length is three more than twice the width:
$2W + 3$

Applying Concepts 1.5

41. One-half the acceleration due to gravity: $\frac{1}{2}g$
Time squared: t^2
The product: $\frac{1}{2}gt^2$

42. The product of m and a: ma

43. The product of A and v^2: Av^2

44. The quotient of k and m: $\frac{k}{m}$

The square root of the quotient: $\sqrt{\frac{k}{m}}$

Projects or Group Activities 1.5

45. The sum of twice a number and three.

46. Four less than five times a number.

47. Twice the sum of a number and three.

48. The product of five and four less than a number.

CHAPTER 1 REVIEW EXERCISES

1. $\frac{3}{4} : -\frac{3}{4} + \frac{3}{4} = 0$

2. Replace x with the elements in the set and determine whether the inequality is true.
$x > -1$
$-4 > -1$ False
$-2 > -1$ False
$0 > -1$ True
$2 > -1$ True
The inequality is true for 0 and 2.

3. $p \in \{-4, 0, 7\}$
$-|p|$
$-|-4| = -4$
$-|0| = 0$
$-|7| = -7$

4. $\{-2, -1, 0, 1, 2, 3\}$

5. $\{x | x < -3\}$

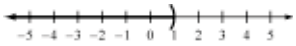
6. $\{x | -2 \le x \le 3\}$

7. $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8\}$

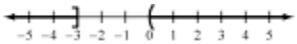
8. $A \cap B = \{2, 3\}$

9. $[-3, \infty)$

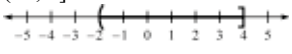
10. $\{x | x < 1\}$



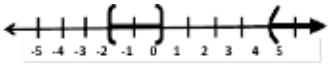
11. $\{x | x \le -3\} \cup \{x | x > 0\}$



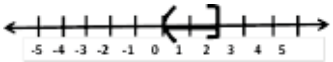
12. $(-2, 4]$



13. $\{x|x>4\} \cup \{x|-2 \le x \le 0\}$



14. $(-\infty, 2] \cap (0, \infty)$



15. **$-10 - (-3) = -10 + 3 = -7$**

16. $-204 \div (-17) = 12$

17.
$$-\frac{3}{8} - \frac{1}{6} = \frac{-9}{24} - \frac{4}{24} = \frac{-13}{24}$$

18.
$$-\frac{3}{8} \div \frac{3}{5} = -\frac{3}{8} \cdot \frac{5}{3}$$
$$= \frac{\overset{1}{\cancel{3}} \cdot 5}{8 \cdot \underset{1}{\cancel{3}}}$$
$$= -\frac{5}{8}$$

19. $-4.07 + 2.3 = -1.77$

20. $-4^2 - (-3)^2 = -16 - 9 = -25$

21. $7-3(5-9)^2 \div 4 \cdot (-2)$
$= 7-3(-4)^2 \div 4 \cdot (-2)$
$= 7-3(16) \div 4 \cdot (-2)$
$= 7-48 \div 4 \cdot (-2)$
$= 7 - 12 \cdot (-2)$
$= 7 + 24 = 31$

22.
$$\frac{2}{3} - \frac{1}{3}\left(\frac{1}{2} - \frac{5}{6}\right)^2 \div \frac{8}{9}$$
$$= \frac{2}{3} - \frac{1}{3}\left(-\frac{2}{6}\right)^2 \div \frac{8}{9}$$
$$= \frac{2}{3} - \frac{1}{3}\left(\frac{4}{36}\right) \div \frac{8}{9}$$
$$= \frac{2}{3} - \frac{4}{108} \div \frac{8}{9} = \frac{2}{3} - \frac{4}{108} \cdot \frac{9}{8}$$
$$= \frac{2}{3} - \frac{36}{864} = \frac{576}{864} - \frac{36}{864}$$
$$= \frac{540}{864} = \frac{5}{8}$$

23.

$$\frac{\frac{6-8(5-3)}{4+2(1-6)}}{\frac{3^2-2^2}{(2-5)^2}} = \frac{\frac{6-8(2)}{4+2(-5)}}{\frac{3^2-2^2}{(-3)^2}} = \frac{\frac{6-8(2)}{4+2(-5)}}{\frac{9-4}{9}}$$

$$= \frac{\frac{6-16}{4+(-10)}}{\frac{9-4}{9}} = \frac{\frac{-10}{-6}}{\frac{5}{9}}$$

$$= \frac{5}{3} \cdot \frac{9}{5} = \frac{45}{15} = 3$$

24. $-3.2 + 1.1(4-3.8)^2 \div (-2.2)$

$= -3.2 + 1.1(0.2)^2 \div (-2.2)$

$= -3.2 + 1.1(0.04) \div (-2.2)$

$= -3.2 + 0.044 \div (-2.2)$

$= -3.2 - 0.02$

$= -3.22$

25. 21y

26. (ab)

27. The Inverse Property of Addition

28. The Associative Property of Multiplication

29. $b^2-4ac = (-3)^2 - 4(2)(-4)$

$= 9 - 4(2)(-4) = 9 + 32 = 41$

30. $-a^2 - b(2a-2)^2 + 2b = -(-3)^2 - 4(2(-3)-2)^2 + 2(4)$

$= -(-3)^2 - 4(-8)^2 + 2(4)$

$= -9 - 4(64) + 2(4)$

$= -9 - 256 + 8$

$= -265 + 8$

$= -257$

31. $6-2(4a-2) = 6-8a+4 = -8a + 10$

32. $-2(x-3) + 4(2-x) = -2x + 6 + 8 - 4x = -6x + 14$

33.

$$\begin{aligned} 4y - 3[x - 2(3-2x) - 4y] &= 4y - 3[x - 6 + 4x - 4y] \\ &= 4y - 3[5x - 6 - 4y] \\ &= 4y - 15x + 18 + 12y \\ &= 16y - 15x + 18 \end{aligned}$$

34. $5+ 2(4x-3y) -3[4-2(x-y)]$

$= 5 + 8x - 6y -3[4-2x+2y]$

$= 5 + 8x - 6y - 12 + 6x - 6y$

$= 14x - 12y - 7$

35. The unknown number: x
The sum of the number and four: $x + 4$
$4(x + 4) = 4x + 16$

36. The unknown number: x
The difference between the number and two: $x - 2$
Twice the difference between the number and two: $2(x - 2)$
$2(x - 2) + 8 = 2x - 4 + 8 = 2x + 4$

37. Let x be the smaller of the numbers. Then the larger number is $40 - x$.
The sum of twice x and five more than $40 - x$:
$2x + (40 - x + 5) = x + 45$

38. Let x be the larger number.
Then the smaller number is $9 - x$.
The difference between three more than twice $(9 - x)$ and one more than x:

$$\begin{aligned} [2(9-x)+3]-(x+1) &= 18-2x+3-x-1 \\ &= -3x+20 \end{aligned}$$

39. The width of the rectangle: W
The length is 3 feet less than $3W$.
The length is $3W - 3$.

40. Let the first integer be x.
The second integer is five more than four times x.
$4x + 5$ is the magnitude of the second integer.

CHAPTER 1 TEST

1. 12

2. Replace x with each element in the set and determine whether the inequality is true.
$-1 > x$
$-1 > -5$ True
$-1 > 3$ False
$-1 > 7$ False
The inequality is true for -5.

3.

$$\begin{aligned} 2-(-12)+3-5 &= 2+12+3+(-5) \\ &= 14+3+(-5) \\ &= 17+(-5) \\ &= 12 \end{aligned}$$

4. $(-2)(-3)(-5) = (6)(-5) = -30$

5. $-180 \div 12 = -15$

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

7. $-5^2 \cdot 4 = -25 \cdot 4 = -100$

8. $(-2)^3(-3)^2 = (-8)(9) = -72$

9. $$\frac{2}{3}-\frac{5}{12}+\frac{4}{9}=\frac{24}{36}-\frac{15}{36}+\frac{16}{36}$$
$$=\frac{24-15+16}{36}$$
$$=\frac{25}{36}$$

10. $$\left(-\frac{2}{3}\right)\left(\frac{9}{15}\right)\left(\frac{10}{27}\right)=-\frac{2\cdot\cancel{3}\cdot\cancel{3}\cdot 2\cdot\cancel{5}}{\cancel{3}\cdot\cancel{3}\cdot\cancel{5}\cdot 3\cdot 3\cdot 3}$$
$$=-\frac{4}{27}$$

11. $4.27 - 6.98 + 1.3 = -2.71 + 1.3 = -1.41$

12. $-15.092 \div 3.08 = -4.9$

13. $$12-4\left(\frac{5^2-1}{3}\right)\div 16=12-4\left(\frac{25-1}{3}\right)\div 16$$
$$=12-4\left(\frac{24}{3}\right)\div 16$$
$$=12-4(8)\div 16$$
$$=12-32\div 16$$
$$=12-2$$
$$=10$$

14. $$8-4(2-3)^2\div 2=8-4(-1)^2\div 2$$
$$=8-4(1)\div 2$$
$$=8-4\div 2$$
$$=8-2$$
$$=6$$

15. $$(a-b)^2\div(2b+1)=(2-(-3))^2\div(2(-3)+1)$$
$$=(5)^2\div(-6+1)$$
$$=(5)^2\div(-5)$$
$$=25\div(-5)$$
$$=-5$$

16. $$\frac{b^2-c^2}{a-2c}=\frac{(3)^2-(-1)^2}{2-2(-1)}$$
$$=\frac{9-1}{2-(-2)}$$
$$=\frac{8}{4}$$
$$=2$$

17. 4

18. The Distributive Property

19. $3x - 2(x - y) - 3(y - 4x)$
$= 3x - 2x + 2y - 3y + 12x$
$= 13x - y$

20. $2x - 4[2 - 3(x + 4y) - 2]$
$= 2x - 4[2 - 3x - 12y - 2]$
$= 2x - 4[-3x - 12y]$
$= 2x + 12x + 48y$
$= 14x + 48y$

21. the unknown number: n
three less than the number: $n - 3$
the product of three less than the number and nine:
$(n - 3)(9)$
$13 - (n - 3)(9) = 13 - 9n + 27 = 40 - 9n$

22. The unknown number: n
The total of twelve times the number and twenty-seven: $12n + 27$
$\frac{1}{3}(12n + 27) = 4n + 9$

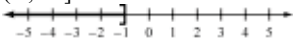
23. $A \cup B = \{1, 2, 3, 4, 5, 7\}$

24. $A \cup B = \{-2, -1, 0, 1, 2, 3\}$

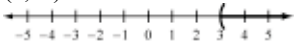
25. $A \cap B = \{5, 7\}$

26. $A \cap B = \{-1, 0, 1\}$

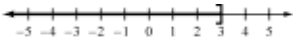
27. $(\infty, -1]$



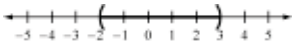
28. $(3, \infty)$



29. $\{x|x \le 3\} \cup \{x|x < -2\}$



30. $\{x|x < 3\} \cap \{x|x > -2\}$



CHAPTER 2 FIRST-DEGREE EQUATIONS AND INEQUALITIES

CHAPTER 2 PREP TEST

1. -4 [1.2.1]

2. -6 [1.2.1]

3. 3 [1.2.1]

4. 1 [1.2.2]

5. $-\frac{1}{2}$ [1.2.2]

6. $10x - 5$ [1.3.3]

7. $6(x-2)+3 = 6x - 12 + 3$ [1.2.1]
$= 6x - 9$

8. $3n + 6$ [1.3.3]

9. $0.08x + 0.05(400 - x)$ [1.3.3]
$= 0.08x + 20 - 0.05x$
$= 0.03x + 20$

10. $20 - n$ [1.4.2]

Section 2.1 Solve Equations using the Addition and Multiplication Properties of Equations

1. An equation contains an equal sign that the values of the two expressions on each side are equal. An expression contains variables and numbers like an equation but does not equal a particular value.

2. The Addition Property of Equations states that the same quantity can be added to each side of an equation without changing the solution of the equation. This property is used to remove a term from one side of an equation by adding the opposite of that term to each side of the equation.

3. The Multiplication Property of Equations states that each side of an equation can be multiplied by the same nonzero number without changing the solution of the equation. This property is used to remove a coefficient from a variable term by multiplying each side of the equation by the reciprocal of the coefficient.

4. Yes

5. No, does not contain an equal sign so it is an expression.

6. No, the variable of x is squared.

7. Yes

8. No, does not contain an equal sign so it is an expression.

9. No, does not contain a variable.

10. No, some equations have many solutions and some have none at all.

11. $7 - 3m = 4$
$7 - 3(1) = 4$
$4 = 4$
Yes

12. $4y - 5 = 3y$
$4(5) - 5 = 3(5)$
$20 - 5 = 15$
$15 = 15$
Yes

13. $6x - 1 = 7x + 1$
$6(-2) - 1 = 7(-2) + 1$
$-12 - 1 = -14 + 1$
$-13 = -13$
Yes

14. $x^2 = 4x - 5$
$(3)^2 = 4(3) - 5$
$9 = 12 - 5$
$9 \neq 7$
No

15. To solve the equation $a - 42 = 13$, use the Addition Property of Equations to add 42 to each side of the equation. The solution is 55.

16. To solve the equation $12 + x = 5$, subtract 12 from each side of the equation. The solution is -7.

17. To solve the equation $-\frac{2}{5}n = 8$, use the Multiplication Property of Equations to multiply each side of the equation by $-\frac{5}{2}$. The solution is -20.

18. To solve the equation $9 = 18b$, divide each side of the equation by 18. The solution is $\frac{1}{2}$.

19. $x - 2 = 7$
$x - 2 + 2 = 7 + 2$
$x = 9$
The solution is 9.

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

21. $a + 3 = -7$
$a + 3 - 3 = -7 - 3$
$a = -10$
The solution is -10.

22. $-12 = x - 3$

$-12 + 3 = x - 3 + 3$

$-9 = x$

The solution is –9.

23. $3x = 12$

$\frac{3x}{3} = \frac{12}{3}$

$x = 4$

The solution is 4.

24. $8x = 4$

$\frac{8x}{8} = \frac{4}{8}$

$x = \frac{1}{2}$

The solution is $\frac{1}{2}$.

25. –y = 7

$\frac{-1y}{-1} = \frac{7}{-1}$

y= -7

26. – x = 0

$\frac{-1x}{-1} = \frac{0}{-1}$

x = 0

27. $\frac{2}{7} + x = \frac{17}{21}$

$\frac{2}{7} - \frac{2}{7} + x = \frac{17}{21} - \frac{2}{7}$

$x = \frac{17}{21} - \frac{6}{21}$

$x = \frac{11}{21}$

The solution is $\frac{11}{21}$.

28. $x + \frac{2}{3} = \frac{5}{6}$

$x + \frac{2}{3} - \frac{2}{3} = \frac{5}{6} - \frac{2}{3}$

$x = \frac{5}{6} - \frac{4}{6}$

$x = \frac{1}{6}$

The solution is $\frac{1}{6}$.

29. $\frac{3a}{7} = -21$

$\frac{7}{3}\left(\frac{3}{7}a\right) = \frac{7}{3}(-21)$

$a = -49$

The solution is –49.

30. $\frac{3t}{8} = -15$

$\frac{8}{3}\left(\frac{3}{8}t\right) = \frac{8}{3}(-15)$

$t = -40$

The solution is –40.

31. $-\frac{5}{12}y = \frac{7}{16}$

$-\frac{12}{5}\left(-\frac{5}{12}y\right) = -\frac{12}{5}\left(\frac{7}{16}\right)$

$y = -\frac{21}{20}$

The solution is $-\frac{21}{20}$.

32. $-\frac{3}{4}x = -\frac{4}{7}$

$-\frac{4}{3}\left(-\frac{3}{4}x\right) = -\frac{4}{3}\left(-\frac{4}{7}\right)$

$x = \frac{16}{21}$

The solution is $\frac{16}{21}$.

33. $b - 14.72 = -18.45$

$b - 14.72 + 14.72 = -18.45 + 14.72$

$b = -3.73$

The solution is –3.73.

34. $b + 3.87 = -2.19$

$b + 3.87 - 3.87 = -2.19 - 3.87$

$b = -6.06$

The solution is –6.06.

35. $3x + 5x = 12$

$8x = 12$

$\frac{8x}{8} = \frac{12}{8}$

$x = \frac{3}{2}$

The solution is $\frac{3}{2}$.

36. $2x - 7x = 15$

$-5x = 15$

$\frac{-5x}{-5} = \frac{15}{-5}$

$x = -3$

The solution is –3.

37. $2x - 4 = 12$

$2x - 4 + 4 = 12 + 4$

$2x = 16$

$\frac{2x}{2} = \frac{16}{2}$

$x = 8$

The solution is 8.

38. $5 - 7a = 19$

$5 - 7a - 5 = 19 - 5$

$-7a = 14$

$\frac{-7a}{-7} = \frac{14}{-7}$

$a = -2$

The solution is -2.

39. $16 = 1-6x$

$16 - 1 = 1 - 6x - 1$

$15 = -6x$

$\frac{15}{-6} = \frac{-6x}{-6}$

$\frac{-5}{2} = x$

The solution is $\frac{-5}{2}$

40. $7 = 7 - 5x$

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

$0 = -5x$

$\frac{0}{-5} = \frac{-5x}{-5}$

$0 = x$

The solution is 0.

41. $-9 = 4x + 3$

$-9 - 3 = 4x + 3 - 3$

$-12 = 4x$

$\frac{-12}{4} = \frac{4x}{4}$

$-3 = x$

The solution is -3.

42. $7x - 9 = 3 - 4x$

$7x + 4x - 9 = 3 - 4x + 4x$

$11x - 9 = 3$

$11x - 9 + 9 = 3 + 9$

$11x = 12$

$\frac{11x}{11} = \frac{12}{11}$

$x = \frac{12}{11}$

The solution is $\frac{12}{11}$.

43. $2 - 3t = 3t - 4$

$2 - 3t - 3t = 3t - 3t - 4$

$2 - 6t = -4$

$2 - 2 - 6t = -4 - 2$

$-6t = -6$

$\frac{-6t}{-6} = \frac{-6}{-6}$

$t = 1$

The solution is 1.

44. $3x - 2x + 7 = 12 - 4x$

$x + 7 = 12 - 4x$

$x + 4x + 7 = 12 - 4x + 4x$

$5x + 7 = 12$

$5x + 7 - 7 = 12 - 7$

$5x = 5$

$\frac{5x}{5} = \frac{5}{5}$

$x = 1$

The solution is 1.

45. $2x - 9x + 3 = 6 - 5x$

$-7x + 3 = 6 - 5x$

$-7x + 5x + 3 = 6 - 5x + 5x$

$-2x + 3 = 6$

$-2x + 3 - 3 = 6 - 3$

$-2x = 3$

$\frac{-2x}{-2} = \frac{3}{-2}$

$x = -\frac{3}{2}$

The solution is $-\frac{3}{2}$.

46. $2x-5+7x=11-3x+4x$
$9x-5=11+x$
$9x-x-5=11+x-x$
$8x-5=11$
$8x-5+5=11+5$
$8x=16$
$\frac{8x}{8}=\frac{16}{8}$
$x=2$
The solution is 2.

47. $9+4x-12=-3x+5x+8$
$4x-3=2x+8$
$4x-2x-3=2x-2x+8$
$2x-3=8$
$2x-3+3=8+3$
$2x=11$
$\frac{2x}{2}=\frac{11}{2}$
$x=\frac{11}{2}$
The solution is $\frac{11}{2}$.

48. Negative. Because $\frac{10}{9}>1$ and $0<r<1$, the value of x must be negative.

49. Greater than 1. The solution is $b=\frac{a}{-5}$. Because $a<-5$, the numerator and denominator are both negative, giving a positive number. The actual value is greater than 1 because $|a|>|-5|$.

50. $9x-3(5-x)=3(8x+7)$
$9x-\underline{15}+\underline{3x}=\underline{24x}+\underline{21}$

51. 42

52. $2x+2(x+1)=10$
$2x+2x+2=10$
$4x+2=10$
$4x=8$
$\frac{4x}{4}=\frac{8}{4}$
$x=2$
The solution is 2.

53. $2x+3(x-5)=15$
$2x+3x-15=15$
$5x-15=15$
$5x=30$
$\frac{5x}{5}=\frac{30}{5}$
$x=6$
The solution is 6.

54. $2(a-3)=2(4-2a)$
$2a-6=8-4a$
$6a-6=8$
$6a=14$
$\frac{6a}{6}=\frac{14}{6}$
$a=\frac{7}{3}$
The solution is $\frac{7}{3}$.

55. $5(2-b)=-3(b-3)$
$10-5b=-3b+9$
$10=2b+9$
$1=2b$
$\frac{1}{2}=\frac{2b}{2}$
$\frac{1}{2}=b$
The solution is $\frac{1}{2}$.

56. $3-2(y-3)=4y-7$
$3-2y+6=4y-7$
$-2y+9=4y-7$
$-6y+9=-7$
$-6y=-16$
$\frac{-6y}{-6}=\frac{-16}{-6}$
$y=\frac{8}{3}$
The solution is $\frac{8}{3}$.

57. $3(y-5)-5y=2y+9$
$3y-15-5y=2y+9$
$-2y-15=2y+9$
$-4y-15=9$
$-4y=24$
$\frac{-4y}{-4}=\frac{24}{-4}$
$y=-6$
The solution is -6.

58. $4(x-2)+2=4x-2(2-x)$
$4x-8+2=4x-4+2x$
$4x-6=6x-4$
$-2x-6=-4$
$-2x=2$
$\frac{-2x}{-2}=\frac{2}{-2}$
$x=-1$
The solution is -1.

59. $2x-3(x-4)=2(3-2x)+2$
$2x-3x+12=6-4x+2$
$-x+12=8-4x$
$3x+12=8$
$3x=-4$
$\frac{3x}{3}=\frac{-4}{3}$
$x=-\frac{4}{3}$
The solution is $-\frac{4}{3}$.

60. $2(2d+1)-3d=5(3d-2)+4d$
$4d+2-3d=15d-10+4d$
$2+d=19d-10$
$2=18d-10$
$12=18d$
$\frac{12}{18}=\frac{18d}{18}$
$\frac{2}{3}=d$
The solution is $\frac{2}{3}$.

61. $-4(7y-1)+5y=-2(3y+4)-3y$
$-28y+4+5y=-6y-8-3y$
$-23y+4=-9y-8$
$-14y+4=-8$
$-14y=-12$
$\frac{-14y}{-14}=\frac{-12}{-14}$
$y=\frac{6}{7}$
The solution is $\frac{6}{7}$.

62. $4[3+5(3-x)+2x]=6-2x$
$4[3+15-5x+2x]=6-2x$
$4[18-3x]=6-2x$
$72-12x=6-2x$
$72-10x=6$
$-10x=-66$
$\frac{-10x}{-10}=\frac{-66}{-10}$
$x=\frac{33}{5}$
The solution is $\frac{33}{5}$.

63. $2[4+2(5-x)-2x]=4x-7$
$2[4+10-2x-2x]=4x-7$
$2[14-4x]=4x-7$
$28-8x=4x-7$
$28-12x=-7$
$-12x=-35$
$\frac{-12x}{-12}=\frac{-35}{-12}$
$x=\frac{35}{12}$
The solution is $\frac{35}{12}$.

64. $2[b-(4b-5)]=3b+4$
$2(b-4b+5)=3b+4$
$2b-8b+10=3b+4$
$-6b+10=3b+4$
$-9b+10=4$
$-9b=-6$
$\frac{-9b}{-9}=\frac{-6}{-9}$
$b=\frac{2}{3}$
The solution is $\frac{2}{3}$.

65. $-3[x+4(x+1)]=x+4$
$-3(x+4x+4)=x+4$
$-3(5x+4)=x+4$
$-15x-12=x+4$
$-16x-12=4$
$-16x=16$
$\frac{-16x}{-16}=\frac{16}{-16}$
$x=-1$
The solution is -1.

66. $4[a-(3a-5)]=a-7$

$4(a-3a+5)=a-7$

$4(-2a+5)=a-7$

$-8a+20=a-7$

$-9a+20=-7$

$-9a=-27$

$\frac{-9a}{-9}=\frac{-27}{-9}$

$a=3$

The solution is 3.

67. $5-6[2t-2(t+3)]=8-t$

$5-6(2t-2t-6)=8-t$

$5-12t+12t+36=8-t$

$41=8-t$

$33=-t$

$-33=t$

The solution is –33.

68. $-3(x-2)=2[x-4(x-2)+x]$

$-3x+6=2(x-4x+8+x)$

$-3x+6=2(-2x+8)$

$-3x+6=-4x+16$

$x+6=16$

$x=10$

The solution is 10.

69. $3[x-(2-x)-2x]=3(4-x)$

$3[x-2+x-2x]=12-3x$

$3(-2)=12-3x$

$-6=12-3x$

$-18=-3x$

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

$6=x$

The solution is 6.

70. $\frac{2}{9}t-\frac{5}{6}=\frac{1}{12}t$

$36\left(\frac{2}{9}t-\frac{5}{6}\right)=36\left(\frac{1}{12}t\right)$

$\frac{36\cdot 2t}{9}-\frac{36\cdot 5}{6}=\frac{36\cdot t}{12}$

$8t-30=3t$

$-30=-5t$

$\frac{-30}{-5}=\frac{-5t}{-5}$

$6=t$

The solution is 6.

71. $\frac{3}{4}t-\frac{7}{12}=\frac{1}{6}$

$12\left(\frac{3}{4}t-\frac{7}{12}\right)=12\cdot\frac{1}{6}$

$\frac{12\cdot 3t}{4}-\frac{12\cdot 7}{12}=2$

$9t-7=2$

$9t=9$

$\frac{9t}{9}=\frac{9}{9}$

$t=1$

The solution is 1.

72. $\frac{2}{3}x-\frac{5}{6}x-3=\frac{1}{2}x-5$

$6\left(\frac{2}{3}x-\frac{5}{6}x-3\right)=6\left(\frac{1}{2}x-5\right)$

$\frac{6\cdot 2x}{3}-\frac{6\cdot 5x}{6}-6\cdot 3=\frac{6\cdot x}{2}-6\cdot 5$

$4x-5x-18=3x-30$

$-x-18=3x-30$

$-4x-18=-30$

$-4x=-12$

$\frac{-4x}{-4}=\frac{-12}{-4}$

$x=3$

The solution is 3.

73. $\frac{1}{2}x-\frac{3}{4}x+\frac{5}{8}=\frac{3}{2}x-\frac{5}{2}$

$8\left(\frac{1}{2}x-\frac{3}{4}x+\frac{5}{8}\right)=8\left(\frac{3}{2}x-\frac{5}{2}\right)$

$\frac{8\cdot x}{2}-\frac{8\cdot 3x}{4}+\frac{8\cdot 5}{8}=\frac{8\cdot 3x}{2}-\frac{8\cdot 5}{2}$

$4x-6x+5=12x-20$

$-2x+5=12x-20$

$-14x+5=-20$

$-14x=-25$

$\frac{-14x}{-14}=\frac{-25}{-14}$

$x=\frac{25}{14}$

The solution is $\frac{25}{14}$.

74.

$$\frac{3x-2}{4}-3x=12$$
$$4\left(\frac{3x-2}{4}-3x\right)=4(12)$$
$$\frac{4(3x-2)}{4}-4\cdot 3x=48$$
$$3x-2-12x=48$$
$$-9x-2=48$$
$$-9x=50$$
$$\frac{-9x}{-9}=\frac{50}{-9}$$
$$x=-\frac{50}{9}$$

The solution is $-\frac{50}{9}$.

75.

$$\frac{2a-9}{5}+3=2a$$
$$5\left(\frac{2a-9}{5}+3\right)=5\cdot 2a$$
$$\frac{5(2a-9)}{5}+5\cdot 3=10a$$
$$2a-9+15=10a$$
$$2a+6=10a$$
$$6=8a$$
$$\frac{6}{8}=\frac{8a}{8}$$
$$\frac{3}{4}=a$$

The solution is $\frac{3}{4}$.

76.

$$\frac{x-2}{4}-\frac{x+5}{6}=\frac{5x-2}{9}$$
$$36\left(\frac{x-2}{4}-\frac{x+5}{6}\right)=36\left(\frac{5x-2}{9}\right)$$
$$\frac{36(x-2)}{4}-\frac{36(x+5)}{6}=\frac{36(5x-2)}{9}$$
$$9(x-2)-6(x+5)=4(5x-2)$$
$$9x-18-6x-30=20x-8$$
$$3x-48=20x-8$$
$$-17x-48=-8$$
$$-17x=40$$
$$\frac{-17x}{-17}=\frac{40}{-17}$$
$$x=-\frac{40}{17}$$

The solution is $-\frac{40}{17}$.

77.

$$\frac{2x-1}{4}+\frac{3x+4}{8}=\frac{1-4x}{12}$$
$$24\left(\frac{2x-1}{4}+\frac{3x+4}{8}\right)=24\left(\frac{1-4x}{12}\right)$$
$$\frac{24(2x-1)}{4}+\frac{24(3x+4)}{8}=\frac{24(1-4x)}{12}$$
$$6(2x-1)+3(3x+4)=2(1-4x)$$
$$12x-6+9x+12=2-8x$$
$$21x+6=2-8x$$
$$29x+6=2$$
$$29x=-4$$
$$\frac{29x}{29}=\frac{-4}{29}$$
$$x=-\frac{4}{29}$$

The solution is $-\frac{4}{29}$.

78.

$$\frac{2}{3}(15-6a)=\frac{5}{6}(12a+18)$$
$$6\left[\frac{2}{3}(15-6a)\right]=6\left[\frac{5}{6}(12a+18)\right]$$
$$4(15-6a)=5(12a+18)$$
$$60-24a=60a+90$$
$$60=84a+90$$
$$-30=84a$$
$$\frac{-30}{84}=\frac{84a}{84}$$
$$-\frac{5}{14}=a$$

The solution is $-\frac{5}{14}$.

79.

$$\frac{1}{5}(20x+30)=\frac{1}{3}(6x+36)$$
$$15\left[\frac{1}{5}(20x+30)\right]=15\left[\frac{1}{3}(6x+36)\right]$$
$$3(20x+30)=5(6x+36)$$
$$60x+90=30x+180$$
$$30x+90=180$$
$$30x=90$$
$$\frac{30x}{30}=\frac{90}{30}$$
$$x=3$$

The solution is 3.

80.

$$\frac{1}{3}(x-7)+5=6x+4$$
$$\frac{x}{3}-\frac{7}{3}+5=6x+4$$
$$3\left(\frac{x}{3}-\frac{7}{3}+5\right)=3(6x+4)$$
$$\frac{3x}{3}-\frac{21}{3}+15=18x+12$$
$$x-7+15=18x+12$$
$$x+8=18x+12$$
$$8=17x+12$$
$$-4=17x$$
$$\frac{-4}{17}=\frac{17x}{17}$$
$$-\frac{4}{17}=x$$

The solution is $-\frac{4}{17}$.

81.

$$2(y-4)+8=\frac{1}{2}(6y+20)$$
$$2y-8+8=\frac{6y}{2}+\frac{20}{2}$$
$$2y=3y+10$$
$$-y=10$$
$$(-1)(-y)=(-1)(10)$$
$$y=-10$$

The solution is –10.

82.

$$\frac{7}{8}x-\frac{1}{4}=\frac{3}{4}x-\frac{1}{2}$$
$$8\cdot\left(\frac{7}{8}x-\frac{1}{4}\right)=8\cdot\left(\frac{3}{4}x-\frac{1}{2}\right)$$
$$\frac{56}{8}x-\frac{8}{4}=\frac{24}{4}x-\frac{8}{2}$$
$$7x-2=6x-4$$
$$x-2=-4$$
$$x=-2$$

The solution is –2.

83.

$$\frac{1}{2}x-\frac{3}{5}=\frac{2}{5}x+\frac{1}{2}$$
$$10\cdot\left(\frac{1}{2}x-\frac{3}{5}\right)=10\cdot\left(\frac{2}{5}x+\frac{1}{2}\right)$$
$$\frac{10}{2}x-\frac{30}{5}=\frac{20}{5}x+\frac{10}{2}$$
$$5x-6=4x+5$$
$$x-6=5$$
$$x=11$$

The solution is 11.

84.

$$-4.2(p+3.4)=11.13$$
$$-4.2p-14.28=11.13$$
$$-4.2p=25.41$$
$$\frac{-4.2p}{-4.2}=\frac{25.41}{-4.2}$$
$$p=-6.05$$

The solution is –6.05.

85.

$$-1.6(b-2.35)=-11.28$$
$$-1.6b+3.76=-11.28$$
$$-1.6b=-15.04$$
$$\frac{-1.6b}{-1.6}=\frac{-15.04}{-1.6}$$
$$b=9.4$$

The solution is 9.4.

86.

$$0.11x+0.04(700-x)=0.06(700)$$
$$100[0.11x+0.04(700-x)]=100[0.06(700)]$$
$$11x+4(700-x)=6(700)$$
$$11x+2800-4x=4200$$
$$7x+2800=4200$$
$$7x=1400$$
$$\frac{7x}{7}=\frac{1400}{7}$$
$$x=200$$

The solution is 200.

87.

$$x+0.06(60)=0.20(x+20)$$
$$100\cdot[x+0.06(60)]=100\cdot[0.20(x+20)]$$
$$100x+6(60)=20(x+20)$$
$$100x+360=20x+400$$
$$80x+360=400$$
$$80x=40$$
$$\frac{80x}{80}=\frac{40}{80}$$
$$x=0.5$$

The solution is 0.5.

88. Three

89. i

$$-3[5-4(x-2)]=5(x-5)$$
$$-15+12(x-2)=5x-25$$

90. When translating a sentence into an equation, the word "is" translates to the equals sign.

91. A group of ten friends goes to a restaurant. Some people in the group order the all-you-can-eat-buffet, while the rest of the group orders the soup-and-sandwich combo. If 2 people order the buffet, then the number of people who order the soup-and-sandwich combo is 8.
If 7 people order the buffet, then the number of people who order the soup-and-sandwich combo is 3.
If n people order the buffet, then an expression that represents the number of people who order the soup-and-sandwich combo is $10 - n$.

92. Strategy
To find the Celsius temperature, write and solve an equation using C to represent the Celsius temperature.

Solution
The Fahrenheit temperature (59°) is 32° more than $\frac{9}{5}$ the Celsius temperature (C).

$$59 = 32 + \frac{9}{5}C$$
$$5(59) = 5\left(32 + \frac{9}{5}C\right)$$
$$295 = 160 + 5\left(\frac{9}{5}C\right)$$
$$295 = 160 + 9C$$
$$135 = 9C$$
$$\frac{135}{9} = \frac{9C}{9}$$
$$15 = C$$

The temperature is 15°C.

93. Strategy
To find the Fahrenheit temperature, write and solve an equation using F to represent the Fahrenheit temperature. $C = \frac{5}{9}(F - 32)$

Solution
$$5 = \frac{5}{9}(F - 32)$$
$$9(5) = 9\left[\frac{5}{9}(F - 32)\right]$$
$$45 = 5(F - 32)$$

45 = 5F – 160

45 + 160 = 5F – 160 + 160

205 = 5F

205 = 5F

5 5

41 = F

The temperature is 41°F.

94. Strategy
To find the charge per hour for labor, write and solve an equation using L to represent the charge per hour for labor.

Solution
The total charge for labor was 4L dollars.

428.55 = 4L + 148.55

280 = 4L

L =70

Labor costs $70 per hour.

95. Strategy
To find the number of bags purchased, write and solve an equation using b to represent the number of bags purchased.

Solution
The first bag purchased cost $10.90. That means that $b - 1$ bags cost $10.50($b$ – 1).
$$84.40 = 10.90 + 10.50(b - 1)$$
$$84.40 = 10.90 + 10.50b - 10.50$$
$$84.40 = 0.40 + 10.50b$$
$$84 = 10.50b$$
$$8 = b$$

The customer purchased 8 bags of feed.

96. Strategy
To find the number of adult and children's tickets, write and solve an equation using a to represent the number of adult tickets and $6 - a$ to represent the number of children's tickets.

Solution
The cost for the family of six was $34.50.
$$34.50 = 7.75a + 4.75(6 - a)$$
$$34.50 = 7.75a + 28.50 - 4.75a$$
$$34.50 = 3a + 28.50$$
$$6 = 3a$$
$$2 = a$$

The family purchased 2 adult tickets and 4 children's tickets.

97. Strategy

To find the amount per hour the teachers will be paid for the extra hours they will work, write and solve an equation using a to represent the amount each teacher will be paid per hour for the extra hours.

Total earned = original salary + 190 hours (pay per hour)

Solution

The total earned after increase is $83,500

83500 = 79400 + 190x

83500-79400 = 79400 + 190x – 79400

4100 = 190x

21.5789 = x

The teacher would earn $21.58 per hour for each extra hour worked.

98. Strategy

To find the number of people in the family, write and solve an equation using x to represent the number of people in the family.

Solution

The cost for the first person is $7.50 and the cost for the rest of the family is $4.25($x$ – 1).

$28.75 = 7.50 + 4.25(x - 1)$

$28.75 = 7.50 + 4.25x - 4.25$

$28.75 = 3.25 + 4.25x$

$25.50 = 4.25x$

$6 = x$

There are 6 people in the family.

99. Strategy

To find Charlotte's annual income, write and solve an equation using I to represent her annual income.

Tax = 4681.25 + 25% of income over $34,000

Solution

8181.25 = 4681.25 + .25(I – 34000)

8181.25 = 4681.25 + .25I – 8500

8181.25 = .25I – 3818.75

8181.25 + 3818.75 = .25I – 3818.75 + 3818.75

12000 = .25I

48000 = I

Charlotte's Annual Income is $48,000.

100. Strategy

To find the couple's annual income, write and solve an equation using I to represent their annual income.

Tax =9362.50 + 25% of income over $68,000

Solution

10612.50 = 9362.50 + .25(I – 68000)

10612.50 = 9362.50 + .25I - 17000

10612.50 = .25I -7637.50

18250 = .25I

73000 = I

The couple's annual income is $73,000.

Applying Concepts 2.1

101. $\frac{1}{\frac{1}{y}} = -9$

$y = -9$

The solution is –9.

102. $8 \div \frac{1}{x} = -3$

$8x = -3$

$\frac{8x}{8} = \frac{-3}{8}$

$x = -\frac{3}{8}$

The solution is $-\frac{3}{8}$.

103.

$\frac{10}{\frac{3}{x}} - 5 = 4x$

$10\left(\frac{x}{3}\right) - 5 = 4x$

$\frac{10}{3}x - 5 = 4x$

$\frac{10}{3}x - \frac{10}{3}x - 5 = 4x - \frac{10}{3}x$

$-5 = \frac{2}{3}x$

$\frac{3}{2}(-5) = \frac{3}{2}\left(\frac{2}{3}x\right)$

$-\frac{15}{2} = x$

The solution is $-\frac{15}{2}$.

104. $\frac{6}{\frac{7}{a}} = -18$

$6\left(\frac{a}{7}\right) = -18$

$\frac{6}{7}a = -18$

$\frac{7}{6}\left(\frac{6}{7}a\right) = (-18)\frac{7}{6}$

$a = -21$

The solution is –21.

105. $2[3(x+4) - 2(x+1)] = 5x + 3(1-x)$

$2[3x + 12 - 2x - 2] = 5x + 3 - 3x$

$2(x + 10) = 2x + 3$

$2x + 20 = 2x + 3$

$2x - 2x + 20 = 2x - 2x + 3$

$20 = 3$

There is no solution.

106. $3[4(y+2) - (y+5)] = 3(3y+1)$

$3[4y + 8 - y - 5] = 9y + 3$

$3(3y + 3) = 9y + 3$

$9y + 9 = 9y + 3$

$9y - 9y + 9 = 9y - 9y + 3$

$9 = 3$

There is no solution.

107.

$$\frac{4[(x-3)+2(1-x)]}{5}=x+1$$
$$\frac{4(x-3+2-2x)}{5}=x+1$$
$$\frac{4(-x-1)}{5}=x+1$$
$$\frac{-4x-4}{5}=x+1$$
$$5\left(\frac{-4x-4}{5}\right)=5(x+1)$$
$$-4x-4=5x+5$$
$$-4x+4x-4=5x+4x+5$$
$$-4=9x+5$$
$$-4-5=9x+5-5$$
$$-9=9x$$
$$\frac{-9}{9}=\frac{9x}{9}$$
$$-1=x$$

The solution is –1.

108. $\frac{4(x-5)-(x+1)}{3}=x-7$

$$\frac{4x-20-x-1}{3}=x-7$$
$$\frac{3x-21}{3}=x-7$$
$$x-7=x-7$$
$$-7=-7$$

The solution is all real numbers.

109. $3(2x+2)-4(x-3)=2(x+9)$

$$6x+6-4x+12=2x+18$$
$$2x+18=2x+18$$
$$2x-2x+18=2x-2x+18$$
$$18=18$$
$$0=0$$

The solution is all real numbers.

110.

$$2584\div x=54\frac{46}{x}$$
$$\frac{2584}{x}=\frac{54x+46}{x}$$
$$x\left(\frac{2584}{x}\right)=x\left(\frac{54x+46}{x}\right)$$
$$2584=54x+46$$
$$2584-46=54x+46-46$$
$$2538=54x$$
$$\frac{2538}{54}=\frac{54x}{54}$$
$$47=x$$

The solution is 47.

111. n + n + 1 + n + 2 = 33

3n + 3 = 33

3n = 30

n = 10

The three numbers are 10, 11, and 12.

112. n + n+2 + n+4 = 105

3n + 6 = 105

3n + 99

n = 33

The three numbers are 33, 35, and 37.

113. n + n+2 + n+4 + n+6 = 92

4n + 12 = 92

4n = 80

n=20

The four numbers are 20, 22, 24, and 26.

Section 2.2 Value Mixture and Motion Problems

1. ii, $3.75 is less than the cost of each ingredient.

iii, $9.50 is more than the cost of either ingredient

2. i, The mix prices has to be between the price of using all Michigan Premium at $1.60 per pound and the price of using all Fescue at $2.00 per pound. The closer the price is to one end or the other is influenced by a greater amount of that seed being used. Since $1.75 is closer to the $1.60, the greater amount must be Michigan Premium.

3. i

4. Lois walks faster than Damien.

a. Lois will walk a greater distance than Damien.

b. The time for Lois will be the same as the time walked by Damien because they started at the same time and walked until they met.

c. Total distance is 2 miles.

5. If Margot walks 2 mph in 1 hour, she would have walked 2 miles. Juanita would do 3 miles. So if they are going in opposite directions, they would be 5 miles apart which is less than 6 miles.

6. Emma bikes faster than Morgan. Morgan begins 5 minutes before Emma but arrives at the store at the same time.

a. The distance biked by each girl is equal as their starting and ending points are the same.

b. The time Emma spent is 5 minutes less than Morgan spent.

7. **a.** The total value of a 20-pound bag of bird seed that costs \$0.42 per pound is \$8.40.

b. The cost per ounce of a 24-ounce box of chocolates that has a total value of \$16.80 is \$0.70.

8. **a.**

	Amount, *A*	•	**Cost, *C***	=	**Value, *V***
Dried cranberries	x	•	7.20	=	$7.20x$
Dried apricots	$15 - x$	•	4.50	=	$4.50(15 - x)$
Mixture	15	•	5.40	=	81

b. Use the expressions in the last column of the table in part (a) to write an equation that can be solved to find the number of pounds of dried cranberries in the mixture:
$7.20x + 4.50(15 - x) = 81$.

9. The mixture will cost between \$7 and \$10 per pounds. d and f

10. More popcorn. We know that the cost of the mixture will be between the \$3/pound and \$2.20/pound costs of the ingredients. Because the cost of the mixture is \$2.50, which is closer to \$2.20 than to \$3, the mixture contains more of the lower cost ingredient, caramel popcorn.

11. Strategy
Cost of mixture: x

	Amount	**Cost**	**Value**
Snow peas	20	1.99	39.80
Petite onions	14	39.80	16.66
Mixture	34	x	$34x$

The sum of the values before mixing equals the value after mixing.
$39.80 + 16.66 = 34x$

Solution
$56.46 = 34x$
$1.66 = x$
The cost of the mixture is \$1.66 per pound.

12. Strategy
Pounds of \$5.50 coffee: x
Pounds of \$3.00 coffee: $40 - x$

	Amount	**Cost**	**Value**
\$5.50 coffee	x	5.50	$5.50x$
\$3.00 coffee	$40 - x$	3.00	$3(40 - x)$
Mixture	40	4.00	$4(40)$

The sum of the values before mixing equals the value after mixing.
$5.50x + 3(40 - x) = 4(40)$

Solution
$5.50x + 3(40 - x) = 4(40)$
$5.50x + 120 - 3x = 160$
$2.50x + 120 = 160$
$2.50x = 40$
$x = 16$
$40 - x = 40 - 16 = 24$
The blend must contain 24 lb of the \$3.00 grade of coffee and 16 lb of the \$5.50 grade.

13. Strategy
Number of adult tickets: x
Number of child tickets: $460 - x$

	Amount	**Cost**	**Value**
Adult tickets	x	5.00	$5x$
Child tickets	$460 - x$	2.00	$2(460 - x)$

The sum of the values of each type of ticket sold equals the total value of all the tickets sold (1880 dollars).
$5x + 2(460 - x) = 1880$

Solution
$5x + 2(460 - x) = 1880$
$5x + 920 - 2x = 1880$
$3x + 920 = 1880$
$3x = 960$
$x = 320$
320 adult tickets were sold.

14. Strategy
Number of adult tickets sold: x
Number of other tickets sold: $505 - x$

	Amount	**Cost**	**Value**
Adults	x	6	$6x$
Children and Senior	$505 - x$	3	$3(505 - x)$

The sum of the values of each kind of ticket equals the value of all the tickets (1997 dollars).
$6x + 3(505 - x) = 1977$

Solution
$6x + 1515 - 3x = 1977$
$3x + 1515 = 1977$
$3x = 462$
$x = 154$
154 adult tickets were sold.

15. Strategy
Liters of imitation maple syrup: x

	Amount	Cost	Value
Imitation Syrup	x	4.00	$4x$
Maple Syrup	50	9.50	9.50(50)
Mixture	$50 + x$	5.00	$5(50 + x)$

The sum of the values before mixing equals the value after mixing.
$4x + 9.50(50) = 5(50 + x)$

Solution
$$4x + 9.50(50) = 5(50 + x)$$
$$4x + 475 = 250 + 5x$$
$$-x + 475 = 250$$
$$-x = -225$$
$$x = 225$$
The mixture must contain 225 L of imitation maple syrup.

16. Strategy
Bushels of soybeans: x
Bushels of wheat: $800 - x$

	Amount	Cost	Value
Soybeans	x	8.50	$8.50x$
Wheat	$800 - x$	4.50	$4.50(800 - x)$
Mixture	800	5.50	5.50(800)

The sum of the values before mixing equals the value after mixing.
$8.50x + 4.50(800 - x) = 5.50(800)$

Solution
$$8.50x + 4.50(800 - x) = 5.50(800)$$
$$8.50x + 3600 - 4.50x = 4400$$
$$4x + 3600 = 4400$$
$$4x = 800$$
$$x = 200$$
$800 - x = 800 - 200 = 600$
200 bushels of soybeans and 600 bushels of wheat were used.

17. Strategy
Number of pounds of nuts used: x
Number of pounds of pretzels used: $20 - x$

	Amount	Cost	Value
Nuts	x	3.99	$3.99x$
Pretzels	$20 - x$	1.29	$1.29(20 - x)$
Mixture	20	2.37	47.40

The sum of the values before mixing equals the value after mixing.
$$3.99x + 1.29(20 - x) = 47.40$$
$$3.99x + 25.80 - 1.29x = 47.40$$
$$2.70x + 25.80 = 47.40$$
$$2.70x = 21.60$$
$$x = 8$$
The mixture must contain 8 pounds of nuts.

18. Strategy
Ounces of pure silver: x

	Amount	Cost	Value
Pure silver	x	5.20	$5.20x$
Silver alloy	50	2.80	280(50)
Mixture	$50 + x$	4.40	$4.40(50 + x)$

The sum of the values before mixing equals the value after mixing.
$5.20x + 2.80(50) = 4.40(50 + x)$

Solution
$$5.20x + 2.80(50) = 4.40(50 + x)$$
$$5.20x + 140 = 220 + 4.40x$$
$$0.80x = 80$$
$$x = 100$$
100 oz of pure silver must be used.

19. Strategy
Cost per pound of mixture: x

	Amount	Cost	Value
\$6.00 tea	30	6.00	6.00(30)
\$3.20 tea	70	3.20	3.20(70)
Mixture	100	x	$100x$

The sum of the values before mixing equals the value after mixing.
$6.00(30) + 3.20(70) = 100x$

Solution
$$6.00(30) + 3.20(70) = 100x$$
$$180 + 224 = 100x$$
$$404 = 100x$$
$$4.04 = x$$
The cost of the mixture is \$4.04 per pound.

20. Strategy
Cost per ounce of salad dressing: x

	Amount	Cost	Value
Olive oil	64		8.29
Vinegar	20		1.99
Salad dressing	84	x	$84x$

The sum of the values before mixing equals the value after mixing.
$8.29 + 1.99 = 84x$

Solution
$$10.28 = 84x$$
$$.12 = x \text{ or } x = .12$$
The cost of salad dressing is \$.12 per ounce.

21. Strategy
Gallons of cranberry juice: x

	Amount	Cost	Value
Cranberry	x	4.20	$4.20x$
Apple	50	2.10	50(2.10)
Mixture	$50 + x$	3.00	$3(50 + x)$

The sum of the values before mixing equals the value after mixing.
$4.20x + 50(2.10) = 3(50 + x)$

Solution
$$4.20x + 50(2.10) = 3(50 + x)$$
$$4.20x + 105 = 150 + 3x$$
$$1.20x + 105 = 150$$
$$1.20x = 45$$
$$x = 37.5$$
The mixture must contain 37.5 gal of cranberry juice.

22. Strategy
Kilograms of walnuts: x
Kilograms of cashews: $50 - x$

	Amount	Cost	Value
Walnuts	x	4.05	$4.05x$
Cashews	$50 - x$	7.25	$7.25(50 - x)$
Mixture	50	6.25	$6.25(50)$

The sum of the values before mixing equals the value after mixing.
$4.05x + 7.25(50 - x) = 6.25(50)$

Solution
$$4.05x + 7.25(50 - x) = 6.25(50)$$
$$4.05x + 362.50 - 7.25x = 312.50$$
$$-3.20x + 362.50 = 312.50$$
$$-3.20x = -50$$
$$x = 15.625$$
$50 - x = 50 - 15.625 = 34.375$
The mixture must contain 15.6 kg of walnuts and 34.4 kg of cashews.

23. a. Marv and Nancy start biking at the same time.Marvin bikes at 12 mph and Nancy bikes at 15 mph. After t hours, Marvin has biked $12t$ miles and Nancy has biked $15t$ miles.

b In calm air a plane flies at a rate of 380 mph. The wind is blowing at 20 mph. Flying with the wind, the plane flies at 400 mph. Flying against the wind, the plane flies at 360 mph.

24. a.

	Rate, r	•	Time, t	=	Distance, d
Sam	$4r$	•	0.25	=	$0.25(4r)$
Jose	r	•	0.25	=	$0.25r$

b. Use the expressions in the last column of the table in part (a) to write an equation that can be solved to find Jose's rate:
$0.25(4r) + 0.25r = 3.75$.

25. a. Less than

b. Equal to

c. 3 mi

26. a. Equal to

b. Greater than

27. Strategy
To find the rate of speed solve the equation $d = rt$ for r using $d = 20$ mi, and $t = 30$ min $= 0.5$ h.

Solution
$$d = rt$$
$$20 = r0.5$$
$$40 = r$$
The student drives at 40 mph.

28. Strategy
To find the distance, solve the equation $d = rt$ for d using $r = 16$ mph and $t = 45$ min $= 0.75$ h.

Solution
$$d = rt$$
$$d = 16 \cdot 0.75$$
$$d = 12$$
The cyclist rides 12 mi.

29. Strategy
To find the time for the Boeing 737-800, first solve the equation $d = rt$ for r using $d = 1680$ mi and $t = 3$ h. Then, since the Boeing 747-400 is 30 mph faster, subtract 30 mph from the value of r. Finally, solve the equation $d = rt$ for t using $d = 1680$ mi and r.

Solution
$$d = rt$$
$$1680 = r3$$
$$560 = r$$
$560 - 30 = 530$ mph
$$d = rt$$
$$1680 = 530t$$
$$3.2 \approx t$$
It would take the Boeing 737-800 3.2 h.

30. Strategy
To find the time solve the equation $d = rt$ for t using $d = 195$ ft and $r = 5 + 7 = 12$ ft/s.

Solution
$$d = rt$$
$$195 = 12t$$
$$16.25 = t$$
It takes the guess 16.25 s.