INTERMEDIATE ALGEBRA

CONCEPTS AND APPLICATIONS

FIFTH EDITION

STUDENT'S SOLUTIONS MANUAL

JUDITH A. PENNA

Bittinger • Ellenbogen

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Chapter 1

Algebra and Problem Solving

Exercise Set 1.1

1. Seven more than some number

Let n represent the number. Then we have

$n + 7$, or $7 + n$.

2. Let n represent the number; $n - 2$

3. Twelve times a number

Let t represent the number. Then we have

$12t$.

4. Let x represent the number; $2x$

5. Sixty-five percent of some number

Let x represent the number. Then we have

$0.65x$, or $\frac{65}{100}x$.

6. Let x represent the number; $0.39x$, or $\frac{39}{100}x$.

7. Nine less than twice a number

Let y represent the number. Then we have

$2y - 9$.

8. Let y represent the number; $\frac{1}{2}y + 4$, or $\frac{y}{2} + 4$

9. Eight more than ten percent of some number

Let s represent the number. Then we have

$0.1s + 8$

10. Let s represent the number; $0.06s - 5$, or $\frac{6}{100}s - 5$

11. One less than the difference of two numbers

Let m and n represent the numbers. Then we have

$m - n - 1$.

12. Let m and n represent the numbers;

$mn + 2$

13. Ninety miles per every four gallons of gas

We have

$90 \div 4$, or $\frac{90}{4}$.

14. $100 \div 60$, or $\frac{100}{60}$

15. Substitute and carry out the operations indicated.

$$\begin{aligned} 4x - y &= 4 \cdot 3 - 2 \\ &= 12 - 2 \\ &= 10 \end{aligned}$$

16. 19

17. Substitute and carry out the operations indicated.

$$\begin{aligned} 2c \div 3b &= 2 \cdot 6 \div 3 \cdot 4 \\ &= 12 \div 3 \cdot 4 \\ &= 4 \cdot 4 \\ &= 16 \end{aligned}$$

18. 9

19. Substitute and carry out the operations indicated.

$$\begin{aligned} 25 - r^2 + s &= 25 - 3^2 + 7 \\ &= 25 - 9 + 7 \\ &= 16 + 7 \\ &= 23 \end{aligned}$$

20. 11

21. Substitute and carry out the operations indicated.

$$\begin{aligned} 3n^2p + 2p^4 &= 3 \cdot 5^2 \cdot 3 + 2 \cdot 3^4 \\ &= 3 \cdot 25 \cdot 3 + 2 \cdot 81 \\ &= 75 \cdot 3 + 162 \\ &= 225 + 162 \\ &= 387 \end{aligned}$$

22. 280

23. Substitute and carry out the operations indicated.

$$\begin{aligned} 5x \div (2 + x - y) &= 5 \cdot 6 \div (2 + 6 - 2) \\ &= 5 \cdot 6 \div (8 - 2) \\ &= 5 \cdot 6 \div 6 \\ &= 30 \div 6 \\ &= 5 \end{aligned}$$

24. 3

25. Substitute and carry out the operations indicated.

$$\begin{aligned} 29 - (a - b)^2 &= 29 - (7 - 2)^2 \\ &= 29 - 5^2 \\ &= 29 - 25 \\ &= 4 \end{aligned}$$

26. 64

27. Substitute and carry out the operations indicated.

$$\begin{aligned} m + n(5 + n^2) &= 15 + 3(5 + 3^2) \\ &= 15 + 3(5 + 9) \\ &= 15 + 3 \cdot 14 \\ &= 15 + 42 \\ &= 57 \end{aligned}$$

28. 40

29. We substitute 5 for b and 7 for h and multiply:

$A = \frac{1}{2} \cdot b \cdot h = \frac{1}{2} \cdot 5 \cdot 7 = 17.5$ sq ft

30. 3.045 sq m

31. We substitute 4 for b and 3.2 for h and multiply:

$A = \frac{1}{2} \cdot b \cdot h = \frac{1}{2}(4)(3.2) = 6.4$ sq m

32. 9.2 sq ft

33. List the letters in the set: {a,e,i,o,u}, or {a,e,i,o,u,y}

34. {Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday}

35. List the numbers in the set: $\{1, 3, 5, 7, \ldots\}$

36. $\{2, 4, 6, 8, \ldots\}$

37. List the numbers in the set: $\{7, 14, 21, 28, \ldots\}$

38. $\{10, 20, 30, 40, \ldots\}$

39. Specify the conditions under which a number is in the set: $\{x|x$ is an odd number between 10 and 30$\}$

40. $\{x|x$ is a multiple of 4 between 22 and 45$\}$

41. Specify the conditions under which a number is in the set: $\{x|x$ is a whole number less than 5$\}$

42. $\{x|x$ is an integer greater than -4 and less than 3$\}$

43. Specify the conditions under which a number is in the set: $\{n|n$ is a multiple of 5 between 7 and 79$\}$

44. $\{x|x$ is an even number between 9 and 99$\}$

45. Since 7.3 is not a natural number, the statement is false.

46. True

47. Since every member of the set of natural numbers is also a member of the set of whole numbers, the statement is true.

48. True

49. Since $\sqrt{8}$ is not a rational number, the statement is false.

50. False

51. Since every member of the set of irrational numbers is also a member of the set of real numbers, the statement is true.

52. True

53. Since 4.3 is not an integer, the statement is true.

54. True

55. Since every member of the set of rational numbers is also a member of the set of real numbers, the statement is true.

56. False

57. ◈

58. ◈

59. ◈

60. ◈

61. The product of the sum of two numbers and their difference

Let a and b represent the numbers. Then we have

$(a + b)(a - b)$.

62. Let m and n represent the numbers;

$3(m + n)$

63. Half of the difference of two numbers

Let r and s represent the numbers. Then we have

$\frac{1}{2}(r - s)$, or $\frac{r - s}{2}$.

64. Let x and y represent the numbers; $\frac{x - y}{x + y}$

65. The only whole number that is not also a natural number is 0. Using roster notation to name the set, we have $\{0\}$.

66. $\{-1, -2, -3, \ldots\}$

67. List the numbers in the set:

$\{5, 10, 15, 20, \ldots\}$

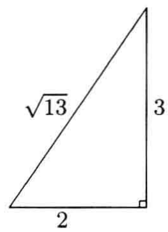
68. $\{3, 6, 9, 12, \ldots\}$

69. List the numbers in the set:

$\{\ldots, -4, -2, 0, 2, 4, \ldots\}$

70. $\{1, 3, 5, 7, \ldots\}$

71. Recall from geometry that when a right triangle has legs of length 2 and 3, the length of the hypotenuse is $\sqrt{2^2+3^2} = \sqrt{4+9} = \sqrt{13}$. We draw such a triangle:



Exercise Set 1.2

1. $|-8| = 8$ $\quad$ -8 is 8 units from 0.

2. 7

3. $|9| = 9$ $\quad$ 9 is 9 units from 0.

4. 12

5. $|-6.2| = 6.2$ $\quad$ -6.2 is 6.2 units from 0.

6. 7.9

7. $|0| = 0$ $\quad$ 0 is 0 units from itself.

8. $3\frac{3}{4}$

9. $\left|1\frac{7}{8}\right| = 1\frac{7}{8}$ $\quad$ $1\frac{7}{8}$ is $1\frac{7}{8}$ units from 0.

10. 0.91

11. $|-4.21| = 4.21$ $\quad$ -4.21 is 4.21 units from 0.

12. 5.309

13. $-8 \le -2$

-8 is less than or equal to -2, a true statement since -8 is left of -2.

14. -1 is less than or equal to -5; false

15. $-7 > 1$

-7 is greater than 1, a false statement since -7 is left of 1.

16. 7 is greater than or equal to -2; true

17. $3 \ge -5$

3 is greater than or equal to -5, a true statement since -5 is left of 3.

18. 9 is less than or equal to 9; true

19. $-9 < -4$

-9 is less than -4, a true statement since -9 is left of -4.

20. 7 is greater than or equal to -8; true

21. $-4 \ge -4$

-4 is greater or equal to -4. Since $-4 = -4$ is true, $-4 \ge -4$ is true.

22. 2 is less than 2; false

23. $-5 < -5$

-5 is less than -5, a false statement since -5 does not lie to the left of itself.

24. -2 is greater than -12; true

25. $5 + 12$

Two positive numbers: Add the numbers, getting 17. The answer is positive, 17.

26. 16

27. $-4 + (-7)$

Two negative numbers: Add the absolute values, getting 11. The answer is negative, -11.

28. -11

29. $-5.9 + 2.7$

A negative and a positive number: The absolute values are 5.9 and 2.7. Subtract 2.7 from 5.9 to get 3.2. The negative number is farther from 0, so the answer is negative, -3.2.

30. 5.4

31. $\frac{2}{7} + \left(-\frac{3}{5}\right) = \frac{10}{35} + \left(-\frac{21}{35}\right)$

A positive and a negative number. The absolute values are $\frac{10}{35}$ and $\frac{21}{35}$. Subtract $\frac{10}{35}$ from $\frac{21}{35}$ to get $\frac{11}{35}$. The negative number is farther from 0, so the answer is negative, $-\frac{11}{35}$.

32. $-\frac{1}{40}$

33. $-4.9 + (-3.6)$

Two negative numbers: Add the absolute values, getting 8.5. The answer is negative, -8.5.

34. -9.6

35. $-\frac{1}{9} + \frac{2}{3} = -\frac{1}{9} + \frac{6}{9}$

A negative and a positive number. The absolute values are $\frac{1}{9}$ and $\frac{6}{9}$. Subtract $\frac{1}{9}$ from $\frac{6}{9}$ to get $\frac{5}{9}$. The positive number is farther from 0, so the answer is positive, $\frac{5}{9}$.

36. $\frac{3}{10}$

37. $0 + (-4.5)$

One number is zero: The sum is the other number, -4.5.

38. -3.19

39. $-7.24 + 7.24$

A negative and a positive number: The numbers have the same absolute value, 7.24, so the answer is 0.

40. 0

41. $15.9 + (-22.3)$

A positive and a negative number: The absolute values are 15.9 and 22.3. Subtract 15.9 from 22.3 to get 6.4. The negative number is farther from 0, so the answer is negative, -6.4.

42. -6.6

43. The opposite of 7.29 is -7.29, because $-7.29+7.29 = 0$.

44. -5.43

45. The opposite of $-4\frac{1}{3}$ is $4\frac{1}{3}$, because $-4\frac{1}{3} + 4\frac{1}{3} = 0$.

46. $-2\frac{3}{5}$

47. The opposite of 0 is 0, because $0 + 0 = 0$.

48. $2\frac{3}{4}$

49. If $x = 7$, then $-x = -7$. (The opposite of 7 is -7.)

50. -3

51. If $x = -2.7$, then $-x = -(-2.7) = 2.7$. (The opposite of -2.7 is 2.7.)

52. 1.9

53. If $x = 1.79$, then $-x = -1.79$. (The opposite of 1.79 is -1.79.)

54. -3.14

55. If $x = 0$, then $-x = 0$. (The opposite of 0 is 0.)

56. 1

57. $9 - 7 = 9 + (-7)$ Change the sign and add.

$= 2$

58. 5

59. $4 - 9 = 4 + (-9)$ Change the sign and add.

$= -5$

60. -7

61. $-6-(-10) = -6+10$ Change the sign and add.

$= 4$

62. 6

63. $-4 - 13 = -4 + (-13) = -17$

64. -15

65. $2.7 - 5.8 = 2.7 + (-5.8) = -3.1$

66. -0.5

67.
$$-\frac{3}{5} - \frac{1}{2} = -\frac{3}{5} + \left(-\frac{1}{2}\right)$$
$$= -\frac{6}{10} + \left(-\frac{5}{10}\right) \quad \text{Finding a common denominator}$$
$$= -\frac{11}{10}$$

68. $-\frac{13}{15}$

69. $-3.9 - (-6.8) = -3.9 + 6.8 = 2.9$

70. -1.1

71. $0 - (-7.9) = 0 + 7.9 = 7.9$

72. -5.3

73. $(-4)7$

Two numbers with unlike signs: Multiply their absolute values, getting 28. The answer is negative, -28.

74. -45

75. $(-3)(-8)$

Two numbers with the same sign: Multiply their absolute values, getting 24. The answer is positive, 24.

76. 56

77. $(4.2)(-5)$

Two numbers with unlike signs: Multiply their absolute values, getting 21. The answer is negative, -21.

78. -28

79. $\frac{3}{7}(-1)$

Two numbers with unlike signs: Multiply their absolute values, getting $\frac{3}{7}$. The answer is negative, $-\frac{3}{7}$.

80. $-\frac{2}{5}$

81. $15.2 \times 0 = 0$

82. 0

83. $(-3.2) \times (-1.7)$

Two numbers with the same sign: Multiply their absolute values, getting 5.44. The answer is positive, 5.44.

84. 8.17

85. $\frac{-10}{-2}$

Two numbers with the same sign: Divide their absolute values, getting 5. The answer is positive, 5.

86. 5

87. $\frac{-100}{20}$

Two numbers with unlike signs: Divide their absolute values, getting 5. The answer is negative, -5.

88. -10

89. $\frac{73}{-1}$

Two numbers with unlike signs: Divide their absolute values, getting 73. The answer is negative, -73.

90. -62

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

92. 0

93. The reciprocal of 5 is $\frac{1}{5}$, because $5 \cdot \frac{1}{5} = 1$.

94. $\frac{1}{3}$

95. The reciprocal of -9 is $\frac{1}{-9}$, or $-\frac{1}{9}$, because $-9\left(-\frac{1}{9}\right) = 1$.

96. $-\frac{1}{7}$

97. The reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$, because $\frac{2}{3} \cdot \frac{3}{2} = 1$.

98. $\frac{7}{4}$

99. The reciprocal of $-\frac{3}{11}$ is $-\frac{11}{3}$, because $-\frac{3}{11}\left(-\frac{11}{3}\right) = 1$.

100. $-\frac{3}{7}$

101.
$$\frac{2}{3} \div \frac{4}{5}$$
$$= \frac{2}{3} \cdot \frac{5}{4} \quad \text{Multiplying by the reciprocal of } 4/5$$
$$= \frac{10}{12}, \text{ or } \frac{5}{6}$$

102. $\frac{5}{21}$

103.
$$\left(-\frac{3}{5}\right) \div \frac{1}{2}$$
$$= -\frac{3}{5} \cdot \frac{2}{1} \quad \text{Multiplying by the reciprocal of } 1/2$$
$$= -\frac{6}{5}$$

104. $-\frac{12}{7}$

105.
$$\left(-\frac{2}{9}\right) \div (-8)$$
$$= -\frac{2}{9} \cdot \left(-\frac{1}{8}\right) \quad \text{Multiplying by the reciprocal of } -8$$
$$= \frac{2}{72}, \text{ or } \frac{1}{36}$$

106. $\frac{1}{33}$

107.
$$\frac{12}{7} \div (-1) = \frac{12}{7} \cdot (-1) \quad \text{Multiplying by the reciprocal of } -1$$
$$= -\frac{12}{7}$$

108. $\frac{2}{7}$

109.
$$\begin{aligned} 12-(9-3\cdot 2^3) &= 12-(9-3\cdot 8) && \text{Working within} \\ &= 12-(9-24) && \text{the parentheses} \\ &= 12-(-15) && \text{first} \\ &= 12+15 \\ &= 27 \end{aligned}$$

110. -3

111. $\frac{5\cdot 2-4^2}{27-2^4} = \frac{5\cdot 2-16}{27-16} = \frac{10-16}{11} = \frac{-6}{11}$, or $-\frac{6}{11}$

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

113. $\frac{3^4-(5-3)^4}{1-2^3} = \frac{3^4-2^4}{1-8} = \frac{81-16}{-7} = \frac{65}{-7}$, or $-\frac{65}{7}$

114. $\frac{55}{2}$

115. $5^3-[2(4^2-3^2-6)]^3 = 5^3-[2(16-9-6)]^3 =$
$5^3-[2\cdot 1]^3 = 5^3-2^3 = 125-8 = 117$

116. 13

117. $|2^2-7|^3+1 = |4-7|^3+1 = |-3|^3+1 =$
$3^3+1 = 27+1 = 28$

118. 79

119. $30 - (-5)^2 + 15 \div (-3) \cdot 2$

$= 30 - 25 + 15 \div (-3) \cdot 2$ Evaluating the exponential expression

$= 30 - 25 - 5 \cdot 2$ Dividing

$= 30 - 25 - 10$ Multiplying

$= -5$ Subtracting

120. 0

121. $12 - \sqrt{7-3} + 4 \div 3 \cdot 2^3$

$= 12 - \sqrt{4} + 4 \div 3 \cdot 2^3$

$= 12 - 2 + 4 \div 3 \cdot 8$

$= 12 - 2 + \frac{4}{3} \cdot 8$

$= 12 - 2 + \frac{32}{3}$

$= 10 + \frac{32}{3}$

$= \frac{62}{3}$

122. $13\frac{1}{2}$, or $\frac{27}{2}$

123. Using the commutative law of addition, we have

$3x + 8y = 8y + 3x$.

Using the commutative law of multiplication, we have

$3x + 8y = x3 + 8y$

or $3x + 8y = 3x + y8$

or $3x + 8y = x3 + y8$.

124. $9 + ab$; $ba + 9$

125. Using the commutative law of multiplication, we have

$(7x)y = y(7x)$

or $(7x)y = (x7)y$.

126. $(ab)(-9)$; $-9(ba)$

127. $(3x)y$

$= 3(xy)$ Associative law of multiplication

128. $(-7a)b$

129. $x + (2y + 5)$

$= (x + 2y) + 5$ Associative law of addition

130. $3y + (4 + 10)$

131. $3(a + 1)$

$= 3 \cdot a + 3 \cdot 1$ Using the distributive law

$= 3a + 3$

132. $8x + 8$

133. $4(x - y)$

$= 4 \cdot x - 4 \cdot y$ Using the distributive law

$= 4x - 4y$

134. $9a - 9b$

135. $-5(2a + 3b)$

$= -5 \cdot 2a + (-5) \cdot 3b$

$= -10a - 15b$

136. $-6c - 10d$

137. $2a(b - c + d)$

$= 2a \cdot b - 2a \cdot c + 2a \cdot d$

$= 2ab - 2ac + 2ad$

138. $5xy - 5xz + 5xw$

139. $5x + 5y = 5 \cdot x + 5 \cdot y = 5(x + y)$

140. $7(a + b)$

141. $3p - 9 = 3 \cdot p - 3 \cdot 3 = 3(p - 3)$

142. $3(4x - 1)$

143. $7x - 21y = 7 \cdot x - 7 \cdot 3y = 7(x - 3y)$

144. $3(2y - 3)$

145. $2x - 2y + 2z = 2 \cdot x - 2 \cdot y + 2 \cdot z = 2(x - y + z)$

146. $3(x + y - z)$

147. Five less than seventy percent of a number

Let x represent the number. Then we have $0.7x - 5$, or $\frac{70}{100}x - 5$.

148. Let x represent the number; $\frac{1}{2}x + 2$

149.

150.

151.

152.

153. $(3 - 8)^2 + 9 = 34$

154. $2 \cdot (7 + 3^2 \cdot 5) = 104$

155. $5 \cdot 2^3 \div (3 - 4)^4 = 40$

156. $(2 - 7) \cdot 2^2 + 9 = -11$

157. Any value of a such that $a \leq -6.2$ satisfies the given conditions. The largest of these values is -6.2.

158. $5(a+bc)$

$= (a+bc)5$ Commutative law of multiplication

$= a5+(bc)5$ Distributive law

$= a5+(cb)5$ Commutative law of multiplication

$= a5+c(b5)$ Associative law of multiplication

$= c(b5)+a5$ Commutative law of addition

Exercise Set 1.3

1. $3x = 15$ and $2x = 10$

The equation $3x = 15$ is true only when $x = 5$. Similarly, $2x = 10$ is true only when $x = 5$. Since both equations have the same solution, they are equivalent.

2. Equivalent

3. $x + 5 = 11$ and $3x = 18$

Each equation has only one solution, the number 6. Thus the equations are equivalent.

4. Not equivalent

5. $13 - x = 4$ and $2x = 20$

When x is replaced by 9, the first equation is true, but the second equation is false. Thus the equations are not equivalent.

6. Equivalent

7. $5x = 2x$ and $\frac{4}{x} = 3$

When x is replaced by 0, the first equation is true, but the second equation is not defined. Thus the equations are not equivalent.

8. Not equivalent

9.
$$x - 5.2 = 9.4$$
$$x - 5.2 + 5.2 = 9.4 + 5.2 \quad \text{Addition principle; adding 5.2}$$
$$x + 0 = 9.4 + 5.2 \quad \text{Law of opposites}$$
$$x = 14.6$$

Check:

$x - 5.2 = 9.4$		
$14.6 - 5.2$?	9.4	
9.4	9.4	TRUE

The solution is 14.6.

10. 6.9

11.
$$9y = 72$$
$$\frac{1}{9} \cdot 9y = \frac{1}{9} \cdot 72 \quad \text{Multiplication principle; multiplying by } \frac{1}{9}\text{, the reciprocal of 9}$$
$$1y = 8$$
$$y = 8$$

Check:

$9y = 72$		
$9 \cdot 8$?	72	
72	72	TRUE

The solution is 8.

12. 9

13.
$$4x - 12 = 60$$
$$4x - 12 + 12 = 60 + 12$$
$$4x = 72$$
$$\frac{1}{4} \cdot 4x = \frac{1}{4} \cdot 72$$
$$1x = \frac{72}{4}$$
$$x = 18$$

Check:

$4x - 12 = 60$		
$4 \cdot 18 - 12$?	60	
$72 - 12$		
60	60	TRUE

The solution is 18.

14. 19

15.
$$5y + 3 = 28$$
$$5y + 3 + (-3) = 28 + (-3)$$
$$5y = 25$$
$$\frac{1}{5} \cdot 5y = \frac{1}{5} \cdot 25$$
$$1y = \frac{25}{5}$$
$$y = 5$$

Check:

$5y + 3 = 28$		
$5 \cdot 5 + 3$?	28	
$25 + 3$		
28	28	TRUE

The solution is 5.

16. 9

17.
$$2y - 11 = 37$$
$$2y - 11 + 11 = 37 + 11$$
$$2y = 48$$
$$\frac{1}{2} \cdot 2y = \frac{1}{2} \cdot 48$$
$$1y = \frac{48}{2}$$
$$y = 24$$

Check:

$2y - 11 = 37$		
$2 \cdot 24 - 11$?	37	
$48 - 11$		
37	37	TRUE

The solution is 24.

18. 14

19. $4a + 5a = (4+5)a = 9a$

20. $12x$

21. $7rt - 9rt = (7-9)rt = -2rt$

22. $10ab$

23. $8x^2 + x^2 = (8+1)x^2 = 9x^2$

24. $8a^2$

25. $12a - a = (12-1)a = 11a$

26. $14x$

27. $t - 9t = (1-9)t = -8t$

28. $-5x$

29. $5x - 3x + 8x = (5-3+8)x = 10x$

30. $-6x$

31.
$$\begin{aligned} &5x - 2x^2 + 3x \\ &= 5x + 3x - 2x^2 \quad \text{Commutative law of addition} \\ &= (5+3)x - 2x^2 \\ &= 8x - 2x^2 \end{aligned}$$

32. $13a - 5a^2$

33.
$$\begin{aligned} &3a + 5a^2 - a + 4a^2 \\ &= 3a - a + 5a^2 + 4a^2 \quad \text{Commutative law of addition} \\ &= (3-1)a + (5+4)a^2 \\ &= 2a + 9a^2 \end{aligned}$$

34. $14x + 2x^3 - 6x^2$

35.
$$\begin{aligned} &4x - 7 + 18x + 25 \\ &= 4x + 18x - 7 + 25 \\ &= (4+18)x + (-7+25) \\ &= 22x + 18 \end{aligned}$$

36. $9p + 12$

37.
$$\begin{aligned} &-7t^2 + 3t + 5t^3 - t^3 + 2t^2 - t \\ &= (-7+2)t^2 + (3-1)t + (5-1)t^3 \\ &= -5t^2 + 2t + 4t^3 \end{aligned}$$

38. $-12n + 6n^2 + 5n^3$

39.
$$\begin{aligned} &a - (2a+5) \\ &= a - 2a - 5 \\ &= -a - 5 \end{aligned}$$

40. $-4x - 9$

41.
$$\begin{aligned} &4m - (3m-1) \\ &= 4m - 3m + 1 \\ &= m + 1 \end{aligned}$$

42. $a + 3$

43.
$$\begin{aligned} &3d - 7 - (5 - 2d) \\ &= 3d - 7 - 5 + 2d \\ &= 5d - 12 \end{aligned}$$

44. $13x - 16$

45.
$$\begin{aligned} &-2(x+3) - 5(x-4) \\ &= -2x - 6 - 5x + 20 \\ &= -7x + 14 \end{aligned}$$

46. $-15y - 45$

47.
$$\begin{aligned} &5x - 7(2x-3) \\ &= 5x - 14x + 21 \\ &= -9x + 21 \end{aligned}$$

48. $-12y + 24$

49.
$$\begin{aligned} &9a - [7 - 5(7a-3)] \\ &= 9a - [7 - 35a + 15] \\ &= 9a - [22 - 35a] \\ &= 9a - 22 + 35a \\ &= 44a - 22 \end{aligned}$$

50. $47b - 51$

51.
$$\begin{aligned} &5\{-2a + 3[4 - 2(3a+5)]\} \\ &= 5\{-2a + 3[4 - 6a - 10]\} \\ &= 5\{-2a + 3[-6 - 6a]\} \\ &= 5\{-2a - 18 - 18a\} \\ &= 5\{-20a - 18\} \\ &= -100a - 90 \end{aligned}$$

52. $-721x - 728$

53.
$$\begin{aligned} &2y + \{7[3(2y-5) - (8y+7)] + 9\} \\ &= 2y + \{7[6y - 15 - 8y - 7] + 9\} \\ &= 2y + \{7[-2y - 22] + 9\} \\ &= 2y + \{-14y - 154 + 9\} \\ &= 2y + \{-14y - 145\} \\ &= 2y - 14y - 145 \\ &= -12y - 145 \end{aligned}$$

54. $-11b + 217$

55.
$$\begin{aligned} 5x + 2x &= 56 \\ 7x &= 56 \\ \frac{1}{7} \cdot 7x &= \frac{1}{7} \cdot 56 \\ x &= 8 \end{aligned}$$

Check:

$$\begin{array}{r|l} 5x+2x & = 56 \\ \hline 5\cdot 8+2\cdot 8 \;?\; & 56 \\ 40+16 & \\ 56 & 56 \quad \text{TRUE} \end{array}$$

The solution is 8.

56. 12

57.
$$\begin{aligned} 9y-7y &= 42 \\ 2y &= 42 \\ \frac{1}{2}\cdot 2y &= \frac{1}{2}\cdot 42 \\ y &= 21 \end{aligned}$$

Check:

$$\begin{array}{r|l} 9y-7y & = 42 \\ \hline 9\cdot 21-7\cdot 21 \;?\; & 42 \\ 189-147 & \\ 42 & 42 \quad \text{TRUE} \end{array}$$

The solution is 21.

58. 13

59.
$$\begin{aligned} -6y-10y &= -32 \\ -16y &= -32 \\ -\frac{1}{16}\cdot(-16y) &= -\frac{1}{16}\cdot(-32) \\ y &= 2 \end{aligned}$$

Check:

$$\begin{array}{r|l} -6y-10y & = -32 \\ \hline -6\cdot 2-10\cdot 2 \;?\; & -32 \\ -12-20 & \\ -32 & -32 \quad \text{TRUE} \end{array}$$

The solution is 2.

60. −2

61.
$$\begin{aligned} 2(x+6) &= 8x \\ 2x+12 &= 8x \\ 2x+12-2x &= 8x-2x \\ 12 &= 6x \\ \frac{1}{6}\cdot 12 &= \frac{1}{6}\cdot 6x \\ 2 &= x \end{aligned}$$

Check:

$$\begin{array}{r|l} 2(x+6) & = 8x \\ \hline 2(2+6) \;?\; & 8\cdot 2 \\ 2\cdot 8 & 16 \\ 16 & 16 \quad \text{TRUE} \end{array}$$

The solution is 2.

62. 3

63.
$$\begin{aligned} 80 &= 10(3t+2) \\ 80 &= 30t+20 \\ 80-20 &= 30t+20-20 \\ 60 &= 30t \\ \frac{1}{30}\cdot 60 &= \frac{1}{30}\cdot 30t \\ 2 &= t \end{aligned}$$

Check:

$$\begin{array}{r|l} 80 & = 10(3t+2) \\ \hline 80 \;?\; & 10(3\cdot 2+2) \\ & 10(6+2) \\ & 10\cdot 8 \\ 80 & 80 \quad \text{TRUE} \end{array}$$

The solution is 2.

64. 1

65.
$$\begin{aligned} 180(n-2) &= 900 \\ 180n-360 &= 900 \\ 180n-360+360 &= 900+360 \\ 180n &= 1260 \\ \frac{1}{180}\cdot 180n &= \frac{1}{180}\cdot 1260 \\ n &= 7 \end{aligned}$$

Check:

$$\begin{array}{r|l} 180(n-2) & = 900 \\ \hline 180(7-2) \;?\; & 900 \\ 180\cdot 5 & \\ 900 & 900 \quad \text{TRUE} \end{array}$$

The solution is 7.

66. 7

67.
$$\begin{aligned} 5y-(2y-10) &= 25 \\ 5y-2y+10 &= 25 \\ 3y+10 &= 25 \\ 3y+10-10 &= 25-10 \\ 3y &= 15 \\ \frac{1}{3}\cdot 3y &= \frac{1}{3}\cdot 15 \\ y &= 5 \end{aligned}$$

Check:

$$\begin{array}{r|l} 5y-(2y-10) & = 25 \\ \hline 5\cdot 5-(2\cdot 5-10) \;?\; & 25 \\ 25-(10-10) & \\ 25-0 & \\ 25 & 25 \quad \text{TRUE} \end{array}$$

The solution is 5.

68. 7

69.
$$\begin{aligned} 7y - 1 &= 23 - 5y \\ 7y - 1 + 5y &= 23 - 5y + 5y \\ 12y - 1 &= 23 \\ 12y - 1 + 1 &= 23 + 1 \\ 12y &= 24 \\ \frac{1}{12} \cdot 12y &= \frac{1}{12} \cdot 24 \\ y &= 2 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{7y - 1 = 23 - 5y} \\ \hline 7 \cdot 2 - 1 \ ? & 23 - 5 \cdot 2 \\ 14 - 1 & 23 - 10 \\ 13 & 13 \qquad \text{TRUE} \end{array}$$

The solution is 2.

70. -6

71.
$$\begin{aligned} \frac{1}{5} + \frac{3}{10}x &= \frac{4}{5} \\ \frac{1}{5} + \frac{3}{10}x - \frac{1}{5} &= \frac{4}{5} - \frac{1}{5} \\ \frac{3}{10}x &= \frac{3}{5} \\ \frac{10}{3} \cdot \frac{3}{10}x &= \frac{10}{3} \cdot \frac{3}{5} \\ x &= 2 \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{\frac{1}{5} + \frac{3}{10}x = \frac{4}{5}} \\ \hline \frac{1}{5} + \frac{3}{10} \cdot 2 \ ? & \frac{4}{5} \\ \frac{1}{5} + \frac{3}{5} & \\ \frac{4}{5} & \frac{4}{5} \quad \text{TRUE} \end{array}$$

The solution is 2.

72. $\frac{37}{5}$

73.
$$\begin{aligned} 0.9y - 0.7 &= 4.2 \\ 0.9y - 0.7 + 0.7 &= 4.2 + 0.7 \\ 0.9y &= 4.9 \\ \frac{1}{0.9}(0.9y) &= \frac{1}{0.9}(4.9) \\ y &= \frac{4.9}{0.9} \\ y &= \frac{49}{9} \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{0.9y - 0.7 = 4.2} \\ \hline 0.9\left(\frac{49}{9}\right) - 0.7 \ ? & 4.2 \\ 4.9 - 0.7 & \\ 4.2 & 4.2 \quad \text{TRUE} \end{array}$$

The solution is $\frac{49}{9}$.

74. 13

75.
$$\begin{aligned} 5r - 2 + 3r &= 2r + 6 - 4r \\ 8r - 2 &= 6 - 2r \\ 8r - 2 + 2r &= 6 - 2r + 2r \\ 10r - 2 &= 6 \\ 10r - 2 + 2 &= 6 + 2 \\ 10r &= 8 \\ \frac{1}{10} \cdot 10r &= \frac{1}{10} \cdot 8 \\ r &= \frac{8}{10} \\ r &= \frac{4}{5} \end{aligned}$$

Check:
$$\begin{array}{r|l} \multicolumn{2}{c}{5r - 2 + 3r = 2r + 6 - 4r} \\ \hline 5 \cdot \frac{4}{5} - 2 + 3 \cdot \frac{4}{5} \ ? & 2 \cdot \frac{4}{5} + 6 - 4 \cdot \frac{4}{5} \\ \frac{20}{5} - \frac{10}{5} + \frac{12}{5} & \frac{8}{5} + \frac{30}{5} - \frac{16}{5} \\ \frac{22}{5} & \frac{22}{5} \qquad \text{TRUE} \end{array}$$

The solution is $\frac{4}{5}$.

76. -8

77.
$$\begin{aligned} \frac{1}{8}(16y + 8) - 17 &= -\frac{1}{4}(8y - 16) \\ 2y + 1 - 17 &= -2y + 4 \\ 2y - 16 &= -2y + 4 \\ 2y - 16 + 2y &= -2y + 4 + 2y \\ 4y - 16 &= 4 \\ 4y - 16 + 16 &= 4 + 16 \\ 4y &= 20 \\ \frac{1}{4} \cdot 4y &= \frac{1}{4} \cdot 20 \\ y &= 5 \end{aligned}$$

Check:

$$\begin{array}{r|l}
\multicolumn{2}{c}{\frac{1}{8}(16y+8)-17 = -\frac{1}{4}(8y-16)} \\ \hline
\frac{1}{8}(16\cdot 5+8)-17 \ ? & -\frac{1}{4}(8\cdot 5-16) \\
\frac{1}{8}(80+8)-17 & -\frac{1}{4}(40-16) \\
\frac{1}{8}\cdot 88-17 & -\frac{1}{4}\cdot 24 \\
11-17 & -6 \\
-6 & -6 \qquad \text{TRUE}
\end{array}$$

The solution is 5.

78. 6

79. $$\begin{aligned}
5+2(x-3) &= 2[5-4(x+2)] \\
5+2x-6 &= 2[5-4x-8] \\
2x-1 &= 2[-4x-3] \\
2x-1 &= -8x-6 \\
2x-1+1 &= -8x-6+1 \\
2x &= -8x-5 \\
2x+8x &= -8x-5+8x \\
10x &= -5 \\
\frac{1}{10}\cdot 10x &= \frac{1}{10}(-5) \\
x &= -\frac{1}{2}
\end{aligned}$$

Check:

$$\begin{array}{r|l}
\multicolumn{2}{c}{5+2(x-3) = 2[5-4(x+2)]} \\ \hline
5+2\left(-\frac{1}{2}-3\right) \ ? & 2\left[5-4\left(-\frac{1}{2}+2\right)\right] \\
5+2\left(-\frac{7}{2}\right) & 2\left[5-4\left(\frac{3}{2}\right)\right] \\
5-7 & 2[5-6] \\
-2 & 2[-1] \\
-2 & -2 \qquad \text{TRUE}
\end{array}$$

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

80. $\frac{23}{8}$

81. $$\begin{aligned}
4x-2x-2 &= 2x \\
2x-2 &= 2x \\
-2x+2x-2 &= -2x+2x \\
-2 &= 0
\end{aligned}$$

Since the original equation is equivalent to the false equation $-2=0$, there is no solution. The solution set is $\emptyset$. The equation is a contradiction.

82. All real numbers; identity

83. $$\begin{aligned}
2+9x &= 3(3x+1)-1 \\
2+9x &= 9x+3-1 \\
2+9x &= 9x+2 \\
2+9x-9x &= 9x+2-9x \\
2 &= 2
\end{aligned}$$

The original equation is equivalent to the equation $2=2$ which is true for all real numbers. Thus the solution set is the set of all real numbers. The equation is an identity.

84. $\emptyset$; contradiction

85. $$\begin{aligned}
-8x+5 &= 5-10x \\
-8x+5-5 &= 5-10x-5 \\
-8x &= -10x \\
-8x+10x &= -10x+10x \\
2x &= 0 \\
\frac{1}{2}\cdot 2x &= \frac{1}{2}\cdot 0 \\
x &= 0
\end{aligned}$$

There is one solution, 0. The equation is conditional.

86. All real numbers; identity

87. $$\begin{aligned}
2\{9-3[-2x-4]\} &= 12x+42 \\
2\{9+6x+12\} &= 12x+42 \\
2\{21+6x\} &= 12x+42 \\
42+12x &= 12x+42 \\
42+12x-12x &= 12x+42-12x \\
42 &= 42
\end{aligned}$$

The original equation is equivalent to the equation $42=42$, which is true for all real numbers. Thus the solution set is the set of all real numbers. The equation is an identity.

88. 0; conditional

89. Roster notation: List the numbers in the set.

$\{1,2,3,4,5,6,7,8,9\}$

Set-builder notation: Specify the conditions under which a number is in the set.

$\{x|x$ is a positive integer less than $10\}$

90. $\{-8,-7,-6,-5,-4,-3,-2,-1\}$;

$\{x|x$ is a negative integer greater than $-9\}$

91.

92.

93.

94.

95.
$$\begin{aligned} 4.23x - 17.898 &= -1.65x - 42.454 \\ 5.88x - 17.898 &= -42.454 \\ 5.88x &= -24.556 \\ x &= -\frac{24.556}{5.88} \\ x &\approx -4.176190476 \end{aligned}$$

The check is left to the student. The solution is approximately -4.176190476.

96. 0.2140224

97.
$$\begin{aligned} x - \{3x - [2x - (5x - (7x - 1))]\} &= x + 7 \\ x - \{3x - [2x - (5x - 7x + 1)]\} &= x + 7 \\ x - \{3x - [2x - (-2x + 1)]\} &= x + 7 \\ x - \{3x - [2x + 2x - 1]\} &= x + 7 \\ x - \{3x - [4x - 1]\} &= x + 7 \\ x - \{3x - 4x + 1\} &= x + 7 \\ x - \{-x + 1\} &= x + 7 \\ x + x - 1 &= x + 7 \\ 2x - 1 &= x + 7 \\ x - 1 &= 7 \\ x &= 8 \end{aligned}$$

The check is left to the student. The solution is 8.

98. 4

99.
$$\begin{aligned} 17 - 3\{5 + 2[x - 2]\} + 4\{x - 3(x + 7)\} &= \\ &9\{x + 3[2 + 3(4 - x)]\} \\ 17 - 3\{5 + 2x - 4\} + 4\{x - 3x - 21\} &= \\ &9\{x + 3[2 + 12 - 3x]\} \\ 17 - 3\{1 + 2x\} + 4\{-2x - 21\} &= 9\{x + 3[14 - 3x]\} \\ 17 - 3 - 6x - 8x - 84 &= 9\{x + 42 - 9x\} \\ -14x - 70 &= 9\{-8 + 42\} \\ -14x - 70 &= -72x + 378 \\ 58x - 70 &= 378 \\ 58x &= 448 \\ x &= \frac{448}{58}, \text{ or } \frac{224}{29} \end{aligned}$$

The check is left to the student. The solution is $\frac{224}{29}$.

100. $\frac{19}{46}$

Exercise Set 1.4

1. ***Familiarize.*** There are two numbers involved, and we want to find both of them. We can let x represent the first number and note that the second number is 7 more than the first. Also, the sum of the numbers is 65.

Translate. The second number can be named $x+7$. We translate to an equation:

$$\begin{array}{ccccccc} \underbrace{\text{First number}} & \text{plus} & \underbrace{\text{second number}} & \text{is} & 65. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & (x+7) & = & 65 \end{array}$$

2. Let x and $x + 11$ represent the numbers;
$x + (x + 11) = 83$

3. ***Familiarize.*** Since the sidewalk's speed is 5 ft/sec and Alida's walking speed is 4 ft/sec, Alida will move at a speed of 5+4, or 9 ft/sec on the sidewalk. Let t = the time, in seconds, it takes her to walk the length of the moving sidewalk, 300 ft.

Translate. We will use the formula Distance = Speed $\times$ Time.

$$\begin{array}{ccccc} \underbrace{\text{Distance}} & = & \underbrace{\text{Speed}} & \times & \underbrace{\text{Time}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 300 & = & 9 & \times & t \end{array}$$

4. Let t = the time, in hours, it will take Fran to swim 1.8 km upriver; $(5 - 2.3)t = 1.8$, or $2.7t = 1.8$

5. ***Familiarize.*** The plane's speed, traveling into the wind, is the difference between its speed in still air and the speed of the head wind: 390 − 65, or 325 km/h. Let t = the time, in hours, it will take the plane to travel 725 km into the wind.

Translate. We will use the formula Distance = Speed $\times$ Time.

$$\begin{array}{ccccc} \underbrace{\text{Distance}} & = & \underbrace{\text{Speed}} & \times & \underbrace{\text{Time}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 725 & = & 325 & \times & t \end{array}$$

6. Let t = the boat's time, in hours; $(14 + 7)t = 56$, or $21t = 56$

7. ***Familiarize.*** There are three angle measures involved, and we want to find all three. We can let x represent the smallest angle measure and note that the second is one more than x and the third is one more than the second, or two more than x. We also note that the sum of the three angle measures must be 180°.

Translate. The three angle measures are x, $x + 1$, and $x + 2$. We translate to an equation:

$$\begin{array}{ccccccc} \underbrace{\text{First}} & \text{plus} & \underbrace{\text{second}} & \text{plus} & \underbrace{\text{third}} & \text{is} & 180^\circ. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & (x+1) & + & (x+2) & = & 180 \end{array}$$

8. Let w = the wholesale price; $1.5w + 0.25 = 1.99$

9. ***Familiarize.*** Let t represent the time required. Note that the plane must climb 29,000 − 8000, or 21,000 ft.

Translate.

$$\begin{array}{ccccc} \underbrace{\text{Speed}} & \times & \underbrace{\text{Time}} & = & \underbrace{\text{Distance}} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 3500 & \times & t & = & 21,000 \end{array}$$

10. Let x represent the longer length; $x + \frac{2}{3}x = 10$

11. ***Familiarize***. Let x represent the measure of the second angle. Then the first angle is three times x, and the third is $12°$ less than twice x. The sum of the three angle measures is $180°$.

Translate. The first angle is $3x$, the second is x, and the third is $2x - 12$. Translate to an equation:

$$\begin{array}{ccccccc} \underbrace{\text{First}} & \text{plus} & \underbrace{\text{second}} & \text{plus} & \underbrace{\text{third}} & \text{is} & 180°. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 3x & + & x & + & (2x-12) & = & 180 \end{array}$$

12. Let x represent the measure of the second angle;
$4x + x + (2x + 5) = 180$

13. ***Familiarize***. Note that each odd integer is two more than the one preceding it. If we let n represent the first odd integer, then the second is 2 more than the first and the third is 2 more than the second, or 4 more than the first. We are told that the sum of the first, twice the second, and three times the third is 70.

Translate. The three odd integers are n, $n+2$, and $n+4$. Translate to an equation.

$$\begin{array}{ccccccc} \underbrace{\text{First}} & \text{plus} & \underbrace{\text{two times second}} & \text{plus} & \underbrace{\text{three times third}} & \text{is} & 70. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ n & + & 2(n+2) & + & 3(n+4) & = & 70 \end{array}$$

14. Let x represent the first number; $2x + 3(x + 2) = 76$

15. ***Familiarize***. Recall that the perimeter of a square is 4 times the length of a side. Let s = the length of a side of the smaller square. Then $2s$ = the length of a side of the larger square. The sum of the two perimeters is 100 cm.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{Perimeter of smaller square}} & \text{plus} & \underbrace{\text{perimeter of larger square}} & \text{is} & 100\text{ cm.} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ 4s & + & 4 \cdot 2s & = & 100 \end{array}$$

16. Let x represent the length of one piece;
$$\left(\frac{x}{4}\right)^2 = \left(\frac{100 - x}{4}\right)^2 + 144$$

17. ***Familiarize***. If we let x represent the first number, then the second is six less than 3 times x and the third is two more than $\frac{2}{3}$ of the second. The sum of the three numbers is 172.

Translate.

$$\begin{array}{ccccccc} \underbrace{\text{First}} & \text{plus} & \underbrace{\text{second}} & \text{plus} & \underbrace{\text{third}} & \text{is} & 172. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ x & + & 3x-6 & + & \frac{2}{3}\left(3x-6\right)+2 & = & 172 \end{array}$$

18. Let x represent the price of the least expensive set;
$(x + 20) + (x + 6 \cdot 20) = x + 12 \cdot 20$

19. ***Familiarize***. After the next test there will be six test scores. The average of the six scores is their sum divided by 6. We let x represent the next test score.

Translate.

$$\begin{array}{ccc} \underbrace{\text{The average of the six scores}} & \text{is} & 88. \\ \downarrow & \downarrow & \downarrow \\ \dfrac{93+89+72+80+96+x}{6} & = & 88 \end{array}$$

20. Let p = the population at the start of the three-year period; $1.12(1.12)(1.12)p = 50,577$

21. ***Familiarize***. Let x = the unknown factor. Then the product of the two numbers, 125, is represented by $50x$.

Translate.

$$\begin{array}{ccc} \underbrace{\text{The product}} & \text{is} & 125. \\ \downarrow & \downarrow & \downarrow \\ 50x & = & 125 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} 50x &= 125 \\ x &= \frac{1}{50} \cdot 125 \\ x &= \frac{5}{2},\text{ or } 2.5 \end{aligned}$$

Check. If the other number is $\frac{5}{2}$, the product is $50 \cdot \frac{5}{2}$, or 125. Our answer checks.

State. The other number is $\frac{5}{2}$, or 2.5.

22. 50.3

23. ***Familiarize***. Let n = the number.

Translate. We reword the problem.

$$\begin{array}{ccccc} \underbrace{\text{A number}} & \text{plus} & 16.8 & \text{is} & 173.5. \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \\ n & + & 16.8 & = & 173.5 \end{array}$$

Carry out. We solve the equation.

$$\begin{aligned} n + 16.8 &= 173.5 \\ n &= 173.5 - 16.8 \\ n &= 156.7 \end{aligned}$$

Check. Since $156.7 + 16.8 = 173.5$, our answer checks.

State. The number is 156.7.

24. 320

25. ***Familiarize***. Let y = the number.