Table of Contents

Chapter 1

Exercise Set 1.1

1 – 9. Answers will vary.

10. Answers will vary. Sample: Most agree that the more absences you have, the lower your grade will be. Every time you miss a class, you miss important information.

11. Answers will vary.

12. It is a good idea to spend at least two hours for studying and doing homework.

13. Do all the homework and preview the new material to be covered in class.

14. It should be read slowly and carefully.

15. **(1)** Carefully write down any formulas or ideas that you need to remember.

(2) Look over the entire exam quickly to get an idea of its length and to make sure that no pages are missing. You will need to pace yourself to make sure that you complete the entire exam. Be prepared to spend more time on problems worth more points.

(3) Read the test directions carefully.

(4) Read each problem carefully. Answer each question completely and make sure that you have answered the specific question asked.

(5) Starting with number 1, work each question in order. If you come across a problem that you are not sure of, do not spend too much time on it. Continue working the questions that you understand. After completing all other questions, go back to finish those questions you were not sure of. Do not spend too much time on any one question.

(6) Attempt each problem. You may be able to earn at least partial credit.

(7) Work carefully and write clearly so that your instructor can read your work. Also, it is easy to make mistakes when your writing is unclear.

(8) Check your work and your answers if you have time.

(9) Do not be concerned if others finish the test before you. Do not be disturbed if you are the last to finish. Use all your extra time to check your work.

16. Answer will vary.

17. The more you put into the course, the more you will get out of it.

18 – 20. Answers will vary.

Exercise Set 1.2

1. A letter used to represent various numbers is a variable.

2. A letter that represents one particular value is a constant.

3. Any combination of numbers, variables, exponents, math symbols, and operations is called an algebraic expression.

4. A collection of objects is a set.

5. The objects in a set are called elements.

6. The set that contains no elements is the empty set.

7. If every element of set A is an element of set B, then set A is a subset of set B.

8. $A \cup B$ represents the union of the two sets A and B.

9. $A \cap B$ represents the intersection of the two sets A and B.

10. A number that can be represented as a quotient of two integers, denominator not 0, is a rational number.

11. A real number that is not a rational number is an irrational number.

12. The symbol ≈ means approximately equal to.

13. $5 > 3$

14. $-1 < 8$

15. $\frac{-4}{2} = 2$

16. $\frac{-9}{3} = -3$

17. $-1 > -1.01$

18. $-3.001 > -3.01$

19. $-5 < -3$

20. $-8 < -1$

21. $-14.98 > -14.99$

22. $-3.4 < -3.2$

23. $1.7 < 1.9$

24. $-1.1 > -21$

25. $-\pi > -4$

26. $\pi < 3.2$

27. $-\frac{7}{8} > -\frac{10}{11}$

28. $-\frac{4}{7} < -\frac{5}{9}$

29. $A = \{0\}$

30. $B = \{1, 3, 5\}$

31. $C = \{18, 20\}$

32. $D = \{-3, -2, -1, 0, 1, 2, ...\}$

33. $E = \{0, 1, 2\}$

34. $F = \{1, 2, 3\}$

35. $H = \{0, 7, 14, 21, 28, ...\}$

36. $L = \{-4, -3, -2, -1, ...\}$

37. $J = \{..., -3, -2, -1, 0, 1, 2, 3\}$

38. $K = \{6, 7, 8, \ldots\}$

39. **a.** 4 is a natural number.

b. 4 and 0 are whole numbers.

c. –2, 4, and 0 are integers.

d. $-2, 4, \frac{1}{2}, \frac{5}{9}, 0, -1.23,$ and $\frac{78}{79}$ are rational numbers.

e. $\sqrt{2}$ and $\sqrt{8}$ are irrational numbers.

f. $-2, 4, \frac{1}{2}, \frac{5}{9}, 0, \sqrt{2}, \sqrt{8}, -1.23,$ and $\frac{78}{79}$ are real numbers.

40. **a.** 2 and 4 are whole numbers.

b. 2 and 4 are natural numbers.

c. $2, 4, -5.33, \frac{11}{2}, -100, -7,$ and 4.7 are rational numbers.

d. 2, 4, –100, and –7 are integers.

e. $\sqrt{5}$ and $\sqrt{2}$ are irrational numbers.

f. $2, 4, -5.33, \frac{11}{2}, \sqrt{5}, \sqrt{2}, -100, -7,$ and 4.7 are real numbers.

41. $A \cup B = \{1, 2, 3, 4, 5, 6\}$
$A \cap B = \{\ \}$ or $\varnothing$

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

43. $A \cup B = \{-4, -3, -2, -1, 0, 1, 3\}$
$A \cap B = \{-3, -1\}$

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

45. $A \cup B = \{2, 4, 6, 8, 10\}$
$A \cap B = \{\ \}$ or $\varnothing$

46. $A \cup B = \{2, 4, 6, 8, ...\}$
$A \cap B = \{2, 4, 6\}$

47. $A \cup B = \{0, 5, 10, 15, 20, 25, 30\}$
$A \cap B = \{\ \}$ or $\varnothing$

48. $A \cup B = \{1, 3, 5, 7, ...\}$
$A \cap B = \{1, 3, 5\}$

49. $A \cup B = \{-1, 0, 1, e, i, \pi\}$
$A \cap B = \{-1, 0, 1\}$

50. $A \cup B = \left\{1, \frac{1}{2}, \frac{1}{4}, \frac{1}{6}, ...\right\}$
$A \cap B = \left\{\frac{1}{4}, \frac{1}{6}, \frac{1}{8}, \frac{1}{10}\right\}$

51. the set of natural numbers

52. the set of whole numbers

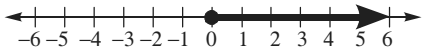
53. the set of whole number multiples of three

54. the set of integer multiples of 4

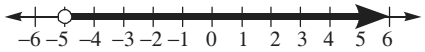
55. the set of odd integers

56. the set of even natural numbers

57. $\{x \mid x \geq 0\}$

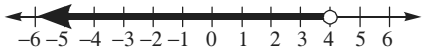


58. $\{w \mid w > -5\}$

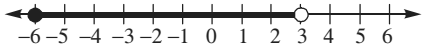


59. $\{z \mid z \leq 2\}$

60. $\{y \mid y < 4\}$

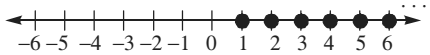


61. $\{p \mid -6 \leq p < 3\}$

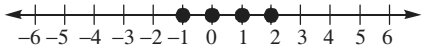


62. $\{x \mid -1.67 \leq x < 5.02\}$

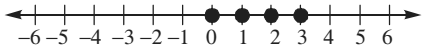
63. $\{q \mid q > -3 \text{ and } q \in N\}$



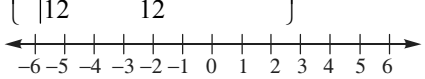
64. $\{x \mid -1.93 \leq x \leq 2 \text{ and } x \in I\}$



65. $\{r \mid r \leq \pi \text{ and } r \in W\}$



66. $\left\{x \middle| \frac{5}{12} < x \leq \frac{7}{12} \text{ and } x \in N\right\}$



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

68. $\{x \mid x \leq 6\}$

69. $\{x \mid x \leq 4 \text{ and } x \in I\}$ or $\{x \mid x < 5 \text{ and } x \in I\}$

70. $\{x \mid x \leq -6 \text{ and } x \in I\}$ or $\{x \mid x < -5 \text{ and } x \in I\}$

71. $\{x \mid -3 < x \leq 5\}$

72. $\{x \mid 4 \leq x < 7.7\}$

73. $\{x \mid -2.5 \leq x < 4.2\}$

74. $\left\{x \middle| -\frac{12}{5} \leq x \leq \frac{4}{11}\right\}$

75. $\{x \mid -3 \leq x \leq 1 \text{ and } x \in I\}$

76. $\{x \mid x \in I\}$

77. Yes; the set of natural numbers is a subset of the set of whole numbers

78. Yes; the set of whole numbers is a subset of the set of rational numbers.

79. No; the set of rational numbers is not a subset of the set of integers.

80. Yes; the set of integers is a subset of the set of rational numbers.

81. Yes; the set of rational numbers is a subset of the set of real numbers.

82. No; the set of rational numbers is not a subset of the set of irrational numbers.

83. No; the set of whole numbers is not a subset of the set of natural numbers.

84. Yes; the set of irrational numbers is a subset of the set of real numbers.

85. Answers may vary.
Possible answer: $\left\{\frac{3}{2}, \frac{4}{3}, \frac{5}{4}, \frac{6}{5}, \frac{7}{6}\right\}$

86. Answers may vary.
Possible answer: {0.1, 0.2, 0.3, 0.4, 05}

87. Answers may vary.
Possible answer: $A = \{2, 4, 5, 8, 9\}$,
$B = \{4, 5, 6, 9\}$
Therefore, $A \cup B = \{2, 4, 5, 6, 8, 9\}$ and
$A \cap B = \{4, 5, 9\}$

88. Answers may vary.
Possible answer: $A = \{3, 5, 7, 8, 9\}$, $B = \{5, 7\}$
Therefore, $A \cup B = \{3, 5, 7, 8, 9\}$ and
$A \cap B = \{5, 7\}$

89. **a.** The set of drivers who had a top 6 finish in the Ford EcoBoost *and* the Coca-Cola 600 is {Busch, Bifle}.

b. Part (a) represents the intersection because it asks for the drivers in both categories.

c. The set of drivers who had a top 6 finish in the Ford Ecoboost *or* the Coca-Cola 600 is {Gordon, Bowyer, Newman, Busch, Bifle, Truex Jr., Kahne, Hamlin, Keselowski, Earnhardt Jr.}.

d. Part (c) represents the union because it asks for the drivers in either category.

90. a. The set of runners who participated in a 3-km *or* a 5-km race is {Adam, Kim, Luan, Ngo, Carmen, Earl, Martha, Betty, Darnell, Frances, George}.

b. Part (a) represents the union because it asks for the runners in either category.

c. The set of runners who participated in a 3-km *and* a 5-km race is {Adam, Luan, Ngo}.

d. Part (c) represents the intersection because it asks for the runners in both categories.

91. a. The set of the five most populous countries in 2010 *or* 2050 is {China, India, United States, Indonesia, Brazil, Nigeria}.

b. The set of the five most populous countries in 1950 *or* 2050 is {China, India, United States, Russia, Japan, Indonesia, Nigeria}.

c. The set of the five most populous countries in 1950 *and* 2010 is {China, India, United States}.

d. The set of the five most populous countries in 2010 *and* 2050 is {China, India, United States, Indonesia}.

e. The set of the five most populous countries in 1950 *and* 2010 *and* 2050 is {China, India, United States}.

92. a. The set of students who participated in the first contest *or* the second contest is {Jill, Sam, Tom, Pat, Shirley, Richard, Bob, Donna, Kate}.

b. The set of students who participated in the second contest *or* the third contest is: {Tom, Shirley, Bob, Donna, Sam, Jill, Kate, Pat, Richard, Arnold}

c. The set of students who participated in the first contest *and* the second contest is {Jill, Sam, Tom, Shirley}.

d. The set of students who participated in the first contest *and* the third contest is {Pat, Richard}.

e. The set of students who participated in the first contest *and* the second contest *and* the third contest is $\{\ \}$ or $\varnothing$.

93. a. A = {Alex, James}
B = {Alex, James, George, Connor}
C = {Alex, Stephen}
D = {Alex, George, Connor}

b. $A \cap B \cap C \cap D = \{\text{Alex}\}$

c. Only Alex met all the requirements to receive the Wolf Badge.

94. a. The categories that have a weight of 15% or greater is {Food and Beverages, Transportation, Housing}.

b. The set of categories that have a weight of less that 10% is {Medical Care, Education and Communication, Recreation, Apparel, Other}.

95. a. $A = \{1, 3, 4, 5, 6, 7\}$

b. $B = \{2, 3, 4, 6, 8, 9\}$

c. $A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$

d. $A \cap B = \{3, 4, 6\}$

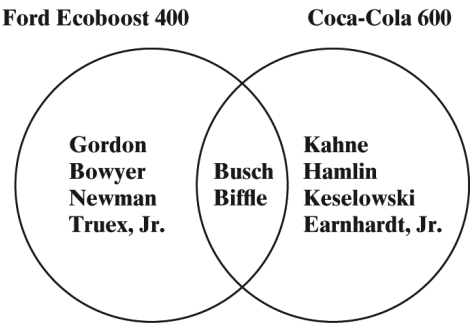
96. a. $A = \{a, b, e, f, g\}$

b. $B = \{b, c, d, f\}$

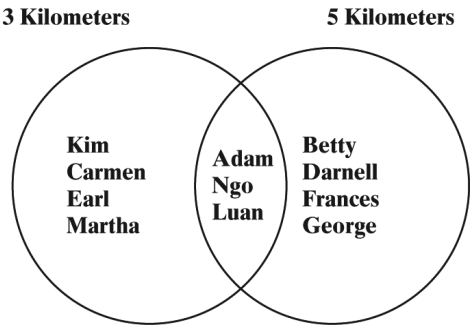
c. $A \cup B = \{a, b, c, d, e, f, g\}$

d. $A \cap B = \{b, f\}$

97.



98.



99. a. Set A is the set of all x such that x is a natural number less than 7.

b. $A = \{1, 2, 3, 4, 5, 6\}$

100. a. Set B is the set of all x such that x is one of the last five capital letters in the English alphabet.

b. $B = \{V, W, X, Y, Z\}$

101. a. The set $\{x | x > 1 \text{ and } x \in N\}$ does not contain fractions and decimal numbers while the set $\{x | x > 1\}$ does contain fractions and decimal number.

b. $\{2, 3, 4, 5, \ldots\}$

c. No, it is not possible to list all real numbers greater than 1 in roster form.

102. a. The set $\{x | 2 < x < 6 \text{ and } x \in N\}$ does not contain fractions and decimal numbers while the set $\{x | 2 < x < 6\}$ does contain fractions and decimal numbers.

b. $\{3, 4, 5\}$

c. No, it is not possible to list all real numbers between 2 and 6 in roster form.

103. $\{4, 5, 6\}$

104. $\{-1, 0, 1, 2, 3\}$

105. The set of natural or counting numbers is an infinite set. One can count, 1, 2, 3, …, infinitely high. Also, there is no largest element.

106. Every integer is also a rational number because it can be written with a denominator of 1.

107. True; the set of whole numbers contains the set of natural numbers.

108. False; 0 is a whole number but is not a natural number.

109. True; $2 = \frac{2}{1}$ is both a rational number and an integer.

110. True; every integer can be written as a fraction with a denominator of 1.

111. False; $\frac{1}{2}$ is a rational number but is not an integer.

112. True; this is how the real numbers are defined.

113. True; this is how the rational and irrational numbers are defined.

114. False; there are infinitely many natural numbers.

115. True; there are no integers between π and 4.

116. True; there are infinitely many rational numbers between 3 and π.

117. a. $\frac{1}{9} = 0.111\ldots$ so $\frac{1}{9} = 0.\overline{1}$

$\frac{2}{9} = 0.222\ldots$ so $\frac{2}{9} = 0.\overline{2}$

$\frac{3}{9} = 0.333\ldots$ so $\frac{3}{9} = 0.\overline{3}$

b. $\frac{4}{9} = 0.444\ldots$ so $\frac{4}{9} = 0.\overline{4}$

$\frac{5}{9} = 0.555\ldots$ so $\frac{5}{9} = 0.\overline{5}$

$\frac{6}{9} = 0.666\ldots$ so $\frac{6}{9}$ or $\frac{2}{3} = 0.\overline{6}$

c. Based on (a) and (b), we deduce that $0.\overline{9} = \frac{9}{9} = 1$.

118. a. The number surveyed who read both the *News* and the *Post* is $4 + 2 = 6$.

b. The number surveyed who read both the *Post* and the *Journal* is $6 + 2 = 8$.

c. The number surveyed who read both the *News* and the *Journal* is $2 + 8 = 10$.

d. Group should share answers.

e. The number surveyed who read all three is 2.

f. The number surveyed who do not read any of the three websites is 7.

Exercise Set 1.3

1. The sum of two positive numbers is a positive number.

2. The sum of two negative numbers is a negative number.

3. For any real number a, its additive inverse is $-a$.

4. For any real number c, $-(-c) = c$.

5. To add two numbers with the same sign, add their absolute values and keep the common sign with the sum.

6. To add two numbers with different signs, subtract the smaller absolute value from the larger absolute value and keep the sign of the number with the larger absolute value.

7. The absolute value of a number is its distance from 0 on the number line.

8. The absolute value of any number is always nonnegative.

9. The property $a(b + c) = ab + ac$ is the distributive property.

10. The property $d + e = e + d$ is the commutative property of addition.

11. $|5| = 5$

12. $|1.9| = 1.9$

13. $|-7| = 7$

14. $|-8| = 8$

15. $|-8.61| = 8.61$

16. $\left|-\frac{7}{8}\right| = \frac{7}{8}$

17. $|0| = 0$

18. $-|1| = -1$

19. $-|-7| = -7$

20. $-|-\pi| = -\pi$

21. $-\left|\frac{5}{9}\right| = -\frac{5}{9}$

22. $-\left|-\frac{7}{19}\right| = -\frac{7}{19}$

23. $|-4| = 4$

24. $\frac{2}{3} = \left|-\frac{2}{3}\right|$

25. $|-8| = 8$ and $-8 = -8$, so $|-8| > -8$.

26. $-7 < |-7|$

27. $|-9| = 9$ and $|9| = 9$, so $|-9| = |9|$.

28. $|\pi| = |-\pi|$

29. $|-2| > -6$

30. $-9 < |-8|$

31. $-(-3) = 3$ and $-|-3| = -3$, so $-(-3) > -|-3|$.

32. $-|-11| < -(-11)$

33. $|19| = 19$ and $|-25| = 25$, so $|19| < |-25|$.

34. $-|-17| < |-13|$

35. $-|5|, -2, -1, |-3|, 4$

36. $-|20|, -|-17|, -12, -|9|, -8$

37. $-32, -|4|, 4, |-7|, 15$

38. $-\pi, -|-3|, -2, |-2|, |-3|, \pi$

39. $-|-6.5|, -6.1, |-6.3|, |6.4|, 6.8$

40. $-|2.9|, -2.4, -2.1, -2, |-2.8|$

41. $-2, \frac{1}{3}, \left|-\frac{1}{2}\right|, \left|\frac{3}{5}\right|, \left|-\frac{3}{4}\right|$

42. $\frac{3}{5}, \left|-\frac{2}{3}\right|, \left|-\frac{5}{3}\right|, \left|-\frac{5}{2}\right|, |-3|$

43. $7 + (-4) = 3$

44. $-2 + 9 = 7$

45. $-12 + (-10) = -22$

46. $-15 + (-18) = -33$

47. $-9 - (-5) = -9 + 5 = -4$

48. $-12 - (-4) = -12 + 4 = -8$

49. $\frac{4}{5}-\frac{6}{7}=\frac{28}{35}-\frac{30}{35}$
$=\frac{28-30}{35}$
$=-\frac{2}{35}$

50. $-\frac{5}{12}-\left(-\frac{7}{8}\right)=-\frac{5}{12}+\frac{7}{8}$
$=-\frac{10}{24}+\frac{21}{24}$
$=\frac{-10+21}{24}$
$=\frac{11}{24}$

51. $-14.21-(-13.22)=-14.21+13.22=-0.99$

52. $79.33-(-16.05)=95.38$

53. $|-5+8|+|3-13|=|3|+|-10|$
$=3+10$
$=13$

54. $|12-5|-|5-12|=|7|-|-7|=7-7=0$

55. $9.9-|8.5|-|17.6|=9.9-8.5-17.6$
$=1.4-17.6$
$=-16.2$

56. $-|7.31|-(-3.28)+5.76=-7.31+3.28+5.76$
$=-4.03+5.76$
$=1.73$

57. $|17-12|-|3|=|5|-|3|=5-3=2$

58. $|11-4|-10=|7|-10=7-10=-3$

59. $-|-3|-|7|+(6+|-2|)=-|-3|-|7|+(6+2)$
$=-|-3|-|7|+8$
$=-3-7+8$
$=-10+8$
$=-2$

60. $|-4|-|-4|-|-4-4|=|-4|-|-4|-|-8|$
$=4-4-8$
$=0-8$
$=-8$

61. $\left(\frac{3}{5}+\frac{3}{4}\right)-\frac{1}{2}=\left(\frac{12}{20}+\frac{15}{20}\right)-\frac{1}{2}$
$=\left(\frac{12+15}{20}\right)-\frac{1}{2}$
$=\frac{27}{20}-\frac{1}{2}$
$=\frac{27}{20}-\frac{10}{20}$
$=\frac{27-10}{20}$
$=\frac{17}{20}$

62. $\frac{4}{5}-\left(\frac{3}{4}-\frac{2}{3}\right)=\frac{4}{5}-\left(\frac{9}{12}-\frac{8}{12}\right)$
$=\frac{4}{5}-\left(\frac{9-8}{12}\right)$
$=\frac{4}{5}-\frac{1}{12}$
$=\frac{48}{60}-\frac{5}{60}$
$=\frac{48-5}{60}$
$=\frac{43}{60}$

63. $-5\cdot 8=-40$

64. $(-9)(-3)=27$

65. $-4\left(-\frac{5}{16}\right)=\left(-\frac{4}{1}\right)\left(-\frac{5}{16}\right)=\frac{(-4)(-5)}{(1)(16)}=\frac{20}{16}=\frac{5}{4}$

66. $-4\left(-\frac{3}{4}\right)\left(-\frac{1}{2}\right)=3\left(-\frac{1}{2}\right)=-\frac{3}{2}$

67. $(-1)(-2)(-1)(2)(-3)=2(-1)(2)(-3)$
$=-2(2)(-3)$
$=-4(-3)$
$=12$

68. $(-3)(-2)(-1)(-2)(-3)=6(-1)(-2)(-3)$
$=-6(-2)(-3)$
$=12(-3)$
$=-36$

69. $(-0.01)(-0.1)(-1)(-10)(-100)$
$= 0.001(-1)(-10)(-100)$
$= -0.001(-10)(-100)$
$= 0.01(-100)$
$= -1$

70. $(-0.02)(-0.2)(-2)(-20)(-200)$
$= 0.004(-2)(-20)(-200)$
$= -0.008(-20)(-200)$
$= 0.16(-200)$
$= -32$

71. $-66 \div (-6) = \dfrac{-66}{-6} = 11$

72. $-16 \div 8 = \dfrac{-16}{8} = -2$

73. $-\dfrac{7}{9} \div \dfrac{-7}{9} = \dfrac{-7}{9} \cdot \dfrac{9}{-7} = \dfrac{-63}{-63} = 1$

74. $-4 \div \left(-\dfrac{1}{4}\right) = -4(-4) = 16$

75. $\left(-\dfrac{3}{4}\right) \div |-16| = -\dfrac{3}{4} \div 16 = -\dfrac{3}{4} \cdot \dfrac{1}{16} = -\dfrac{3 \cdot 1}{4 \cdot 16} = -\dfrac{3}{64}$

76. $\left|\dfrac{3}{8}\right| \div (-4) = \dfrac{3}{8} \cdot \dfrac{1}{-4} = \dfrac{3 \cdot 1}{8(-4)} = \dfrac{3}{-32} = -\dfrac{3}{32}$

77. $\left|-\dfrac{7}{6}\right| \div \left|\dfrac{-1}{2}\right| = \dfrac{7}{6} \div \dfrac{1}{2} = \dfrac{7}{6} \cdot \dfrac{2}{1} = \dfrac{7 \cdot 2}{6 \cdot 1} = \dfrac{14}{6} = \dfrac{7}{3}$

78. $\left|-\dfrac{1}{2}\right| \cdot \left|\dfrac{-3}{4}\right| = \dfrac{1}{2} \cdot \dfrac{3}{4} = \dfrac{1 \cdot 3}{2 \cdot 4} = \dfrac{3}{8}$

79. $10 - 14 = 10 + (-14) = -4$

80. $10(-14) = -140$

81. $-12(-15) = 180$

82. $-12 - 15 = -12 + (-15) = -27$

83. $-\dfrac{1}{4} + \left(-\dfrac{1}{6}\right) = -\dfrac{3}{12} + \left(-\dfrac{2}{12}\right)$
$= -\dfrac{3}{12} - \dfrac{2}{12}$
$= \dfrac{-3-2}{12}$
$= -\dfrac{5}{12}$

84. $-\dfrac{4}{3} + \dfrac{3}{8} = -\dfrac{32}{24} + \dfrac{9}{24} = \dfrac{-32+9}{24} = -\dfrac{23}{24}$

85. $-\dfrac{1}{4}\left(-\dfrac{1}{6}\right) = \dfrac{-1 \cdot -1}{4 \cdot 6} = \dfrac{1}{24}$

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

87. $-14.4 - (-9.6) - 15.8 = -14.4 + 9.6 - 15.8$
$= -4.8 - 15.8$
$= -20.6$

88. $(1.32 - 2.76) - (-3.85 + 4.28)$
$= (-1.44) - (-3.85 + 4.28)$
$= (-1.44) - (0.43)$
$= -1.87$

89. $\left|\dfrac{-9}{4}\right| \div \left|\dfrac{-4}{9}\right| = \dfrac{9}{4} \div \dfrac{4}{9} = \dfrac{9}{4} \cdot \dfrac{9}{4} = \dfrac{9 \cdot 9}{4 \cdot 4} = \dfrac{81}{16}$

90. $-\left|\dfrac{-24}{5}\right| \cdot \left|\dfrac{3}{8}\right| = -\dfrac{24}{5} \cdot \dfrac{3}{8} = -\dfrac{24 \cdot 3}{5 \cdot 8} = -\dfrac{72}{40} = -\dfrac{9}{5}$

91. $\left|(-4)(-3)(-2)\right| + \left|2(-3)(-4)\right|$
$= \left|12(-2)\right| + \left|-6(-4)\right|$
$= |-24| + |24|$
$= 24 + 24$
$= 48$

92. $|-4-3-2| + |2-3-4| = |-7-2| + |-1-4|$
$= |-9| + |-5|$
$= 9 + 5$
$= 14$

93. $5 - |-7| + 3 - |-2| = 5 - 7 + 3 - 2$
$= -2 + 3 - 2$
$= 1 - 2$
$= -1$

94. $\left(|-9| - 8\right) - \left(3 \cdot |-5|\right) = (9 - 8) - (3 \cdot 5)$
$= (1) - (15)$
$= 1 - 15$
$= -14$

95. $\left(-\frac{3}{5}-\frac{4}{9}\right)-\left(-\frac{2}{3}\right)=\left(-\frac{3}{5}-\frac{4}{9}\right)+\frac{2}{3}$
$=\left(-\frac{27}{45}-\frac{20}{45}\right)+\frac{2}{3}$
$=\left(\frac{-27-20}{45}\right)+\frac{2}{3}$
$=-\frac{47}{45}+\frac{2}{3}$
$=-\frac{47}{45}+\frac{30}{45}$
$=\frac{-47+30}{45}$
$=\frac{-17}{45}$ or $-\frac{17}{45}$

96. $\left(\frac{3}{8}-\frac{4}{7}\right)-\left(-\frac{1}{2}\right)=\left(\frac{3}{8}-\frac{4}{7}\right)+\frac{1}{2}$
$=\left(\frac{21}{56}-\frac{32}{56}\right)+\frac{1}{2}$
$=\frac{21-32}{56}+\frac{1}{2}$
$=\frac{-11}{56}+\frac{1}{2}$
$=\frac{-11}{56}+\frac{28}{56}$
$=\frac{-11+28}{56}$
$=\frac{17}{56}$

97. $\left(25-|32|\right)(-7-4)=(25-32)(-7-4)$
$=(-7)(-11)$
$=77$

98. $\left[(-2)\left|-\frac{1}{2}\right|\right]\div\left|-\frac{1}{4}\right|=\left[(-2)\left(\frac{1}{2}\right)\right]\div\left|-\frac{1}{4}\right|$
$=-1\div\left|-\frac{1}{4}\right|$
$=-1\div\frac{1}{4}$
$=-1\cdot\frac{4}{1}$
$=-4$

99. $-10-29=-10+(-29)=-39$

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

101. $7(3)(0)(-19.3)=0$

102. $16(-5)(-10)(0)=0$

103. $r+s=s+r$; commutative property of addition

104. $(5+x)+3x=5+(x+3x)$; associative property of addition

105. $b\cdot 0=0$; multiplicative property of zero

106. $c\cdot d=d\cdot c$; commutative property of multiplication

107. $(x+3)+6=x+(3+6)$; associative property of addition

108. $x+0=x$; identity property of addition

109. $x=1\cdot x$; identity property of multiplication

110. $x(y+z)=xy+xz$; distributive property

111. $2(xy)=(2x)y$; associative property of multiplication

112. $(2x\cdot 3y)\cdot 6y=2x\cdot(3y\cdot 6y)$; associative property of multiplication

113. $4(x+y+2)=4x+4y+8$; distributive property

114. $-(-2)=2$; double negative property

115. $5+0=5$; identity property of addition

116. $4\cdot\frac{1}{4}=1$; inverse property of multiplication

117. $3+(-3)=0$; inverse property of addition

118. $234{,}567\cdot 1=234{,}567$; identity property of multiplication

119. $-(-x)=x$; double negative property

120. $x+(-x)=0$; inverse property of addition

121. $4\cdot(x\cdot 7)\cdot x=4\cdot(7\cdot x)\cdot x$; commutative property of multiplication

122. $y+(7+3y)+8=y+(3y+7)+8$; commutative property of addition

123. $1=\frac{1}{316}\cdot 316$; inverse property of multiplication

124. $1\cdot 2\cdot 3\cdot 4\cdot 6\cdot 6\cdot 7\cdot 8\cdot 9\cdot 0=0$; multiplication property of zero

125. The change in temperature is $45°-(-4°)=45°+4°=49°$ F.

126. The change in temperature is $140° - 40° = 100°$ F.

127. Final depth is $-358.9 + 210.7 = -148.2$ ft or 148.2 ft below the starting point.

128. The new balance is $-\$32.64 + \$99.38 = \$66.74$.

129. $-69.7 - (-79.8) = -69.7 + 79.8 = 10.1$
The difference in the temperatures is 10.1°F.

130. **a.** Joanne will receive a refund because she has paid in more than she owes.

b. $4(3000) = 12{,}000$
$12{,}000 - 10{,}125 = 1875$
Joanne will receive a refund of \$1875.

131. $100 \cdot \$30.30 = \$3030$
$100 \cdot \$42.37 = \$4237$
$\$4237 - \$3030 = \$1207$
Ron had a gain of \$1207.00.

132. First-year income $\approx \$52{,}000$
First-year expenditures $\approx 28{,}000$
$52{,}000 - 28{,}000 = 24{,}000$
The average first year profit will be approximately \$24,000.

133 Since a and $-a$ are the same distance from 0 on a number line, $|a| = |-a|$, is true for all real numbers, $\mathbb{R}$.

134. Since $|a| = \begin{cases} a, & a \ge 0 \\ -a, & a < 0 \end{cases}$, then $|a| = a$ for $a \ge 0$.

135. Since $|6| = 6$ and $|-6| = 6$, the desired values for a are 6 and –6.

136. Since $|a| = \begin{cases} a, & a \ge 0 \\ -a, & a \le 0 \end{cases}$, then $|a| = -a$ only when $a \le 0$.

137. Since $|a| \ge 0$ for all real numbers, there are no values of a for which $|a| = -9$.

138. Since $x - 3 = -(3 - x)$ and $|a| = |-a|$ for all real numbers, $|x - 3| = |3 - x|$ for all real numbers, $\mathbb{R}$.

139 – 142. Answers will vary.

143 $-\dfrac{a}{b}$ or $\dfrac{-a}{b}$

144. In general, $a + (b \cdot c) \ne (a + b) \cdot (a + c)$. To see this, consider $2 + (3 \cdot 4)$ and $(2 + 3) \cdot (2 + 4)$. The left side is $2 + (3 \cdot 4) = 2 + 12 = 14$ and the right side is $(2 + 3) \cdot (2 + 4) = 5 \cdot 6 = 30$.

145. $1 - 2 + 3 - 4 + 5 - 6 + \ldots + 99 - 100$
Group in pairs:
$= (1 - 2) + (3 - 4) + (5 - 6) + \ldots + (99 - 100)$
Simplify all 50 pairs
$= -1 + (-1) + (-1) + \ldots + (-1)$
$= -1(50)$
$= -50$

146. $1 + 2 - 3 + 4 + 5 - 6 + 7 + 8 - 9 + 10 + 11 - 12 + 13 + 14 - 15 + 16 + 17 - 18 + 19 + 20 - 21 + 22 + 23 - 24$
$= (1 + 2 - 3) + (4 + 5 - 6) + (7 + 8 - 9) + (10 + 11 - 12) + (13 + 14 - 15) + (16 + 17 - 18) + (19 + 20 - 21) + (22 + 23 - 24)$
$= 0 + 3 + 6 + 9 + 12 + 15 + 18 + 21$
$= 84$

147. $\dfrac{(1)|-2|(-3)|4|(-5)}{|-1|(-2)|-3|(4)|-5|} = \dfrac{(1) \cdot (2) \cdot (-3) \cdot (4) \cdot (-5)}{(1) \cdot (-2) \cdot (3) \cdot (4) \cdot (5)}$
$= \dfrac{120}{-120}$
$= -1$

148. $\dfrac{(1)(-2)(3)(-4)(5)\ldots(97)(-98)}{(-1)(2)(-3)(4)(-5)\ldots(-97)(98)}$
$= \dfrac{(1)(-2)}{(-1)(2)} \cdot \dfrac{(3)(-4)}{(-3)(4)} \cdot \ldots \cdot \dfrac{(97)(-98)}{(-97)(98)}$
$= \left(\dfrac{-2}{-2}\right)\left(\dfrac{-12}{-12}\right) \cdot \ldots \cdot \left(\dfrac{-9506}{-9506}\right)$
$= 1 \cdot 1 \cdot \ldots \cdot 1$
$= 1$

149. True; the set of real numbers contains the irrational numbers.

150. The set of natural numbers is {1, 2, 3, 4, …}

151. **a.** 3, 4, –2, and 0 are integers.

b. $3,\ 4,\ -2,\ \frac{5}{6},$ and 0 are rational numbers.

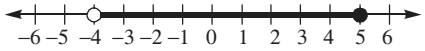
c. $\sqrt{11}$ is an irrational number.

d. $3,\ 4,\ -2,\ \frac{5}{6},\ \sqrt{11},$ and 0 are real numbers.

152. **a.** $A \cup B = \{1, 4, 7, 9, 12, 19\}$

b. $A \cap B = \{4, 7\}$

153. $\{x \mid -4 < x \leq 5\}$



Exercise Set 1.4

1. Numbers or expressions multiplied together are called factors.

2. The quantity 7^2 is called an exponential expression.

3. For 4^3, the 3 is called the exponent.

4. In the expression 4^3, the 4 is called the base.

5. The value of 4^3 is 64.

6. In the expression $\sqrt{81}$, the $\sqrt{\ }$ is called the radical sign.

7. In the expression $\sqrt{81}$, the 81 is called the radicand.

8. The principal or positive square root of 81 is 9.

9. In the expression $\sqrt[4]{81}$, the 4 is called the index.

10. The value of $\sqrt[4]{81}$ is 3.

11. The value of $\sqrt[4]{-81}$ is not a real number.

12. The cube root of a negative number is a negative number.

13. **a.** $3^2 = 3 \cdot 3 = 9$

b. $-3^2 = -(3 \cdot 3) = -9$

c. $(-3)^2 = (-3) \cdot (-3) = 9$

d. $-(-3)^2 = -[(-3) \cdot (-3)] = -9$

14. **a.** $5^2 = 5 \cdot 5 = 25$

b. $-5^2 = -(5 \cdot 5) = -25$

c. $(-5)^2 = (-5) \cdot (-5) = 25$

d. $-(-5)^2 = -[(-5) \cdot (-5)] = -25$

15. **a.** $2^3 = 2 \cdot 2 \cdot 2 = 8$

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

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

d. $-(-2)^3 = -[(-2) \cdot (-2) \cdot (-2)] = -(-8) = 8$

16. **a.** $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

b. $-2^5 = -(2 \cdot 2 \cdot 2 \cdot 2 \cdot 2) = -(32) = -32$

c. $(-2)^5 = (-2) \cdot (-2) \cdot (-2) \cdot (-2) \cdot (-2) = -32$

d. $-(-2)^5 = -[(-2) \cdot (-2) \cdot (-2) \cdot (-2) \cdot (-2)]$
$= -(-32)$
$= 32$

17. $-\left(\frac{3}{5}\right)^4 = -\left(\frac{3}{5}\right)\left(\frac{3}{5}\right)\left(\frac{3}{5}\right)\left(\frac{3}{5}\right) = -\frac{81}{625}$

18. $\left(\frac{1}{2}\right)^3 = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{8}$

19. $(0.2)^3 = (0.2)(0.2)(0.2) = 0.008$

20. $(0.3)^2 = (0.3)(0.3) = 0.09$

21. $\sqrt{49} = 7$ since $7 \cdot 7 = 49$

22. $\sqrt{169} = 13$ since $13 \cdot 13 = 169$

23. $\sqrt[3]{-27} = -3$ since $(-3)(-3)(-3) = -27$

24. $-\sqrt{36} = -6$ since $6 \cdot 6 = 36$.

25. $\sqrt[4]{\frac{1}{16}} = \frac{1}{2}$ since $\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1}{16}$

26. $\sqrt[3]{\frac{-216}{343}} = -\frac{6}{7}$ since $\left(-\frac{6}{7}\right)\left(-\frac{6}{7}\right)\left(-\frac{6}{7}\right) = -\frac{216}{343}$

27. $\sqrt[3]{0.001} = 0.1$ since $(0.1)(0.1)(0.1) = 0.001$

28. $-\sqrt{0.64} = -0.8$ since $(0.8)(0.8) = 0.64$

29. $(0.35)^4 \approx 0.015$

30. $-(1.7)^{3.9} \approx -7.920$

31. $\left(-\frac{13}{12}\right)^{8} \approx 1.897$

32. $\left(\frac{5}{7}\right)^{7} \approx 0.095$

33. $(6.721)^{5.9} \approx 76{,}183.335$

34. $(5.382)^{6.9} \approx 110{,}537.97$

35. $\sqrt[3]{26} \approx 2.962$

36. $-\sqrt[4]{72.8} \approx -2.921$

37. $\sqrt[5]{362.65} \approx 3.250$

38. $-\sqrt{\frac{8}{9}} \approx -0.943$

39. $-\sqrt[3]{\frac{20}{53}} \approx -0.723$

40. $\sqrt[3]{-\frac{15}{19}} \approx -0.924$

41. **a.** x^2 becomes $3^2 = 3 \cdot 3 = 9$

b. $-x^2$ becomes $-3^2 = -3 \cdot 3 = -9$

42. **a.** x^2 becomes $7^2 = 7 \cdot 7 = 49$

b. $-x^2$ becomes $-7^2 = -7 \cdot 7 = -49$

43. **a.** x^2 becomes $(-10)^2 = -10 \cdot -10 = 100$

b. $-x^2$ becomes $-(-10)^2 = -(-10 \cdot -10) = -100$

44. **a.** x^2 becomes $(-2)^2 = (-2)(-2) = 4$

b. $-x^2$ becomes $-(-2)^2 = -(-2)(-2) = -4$

45. **a.** x^2 becomes $\left(\frac{1}{3}\right)^2 = \left(\frac{1}{3}\right)\left(\frac{1}{3}\right) = \frac{1}{9}$

b. $-x^2$ becomes $-\left(\frac{1}{3}\right)^2 = -\left(\frac{1}{3}\right)\left(\frac{1}{3}\right) = -\frac{1}{9}$

46. **a.** x^2 becomes $\left(\frac{3}{4}\right)^2 = \left(\frac{3}{4}\right)\left(\frac{3}{4}\right) = \frac{9}{16}$

b. $-x^2$ becomes $-\left(\frac{3}{4}\right)^2 = -\left(\frac{3}{4}\right)\left(\frac{3}{4}\right) = -\frac{9}{16}$

47. **a.** x^2 becomes $\left(-\frac{1}{2}\right)^2 = \left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right) = \frac{1}{4}$

b. $-x^2$ becomes $-\left(-\frac{1}{2}\right)^2 = -\left(-\frac{1}{2}\right)\left(-\frac{1}{2}\right) = -\frac{1}{4}$

48. **a.** x^2 becomes $\left(-\frac{4}{5}\right)^2 = \left(-\frac{4}{5}\right)\left(-\frac{4}{5}\right) = \frac{16}{25}$

b. $-x^2$ becomes $-\left(-\frac{4}{5}\right)^2 = -\left(-\frac{4}{5}\right)\left(-\frac{4}{5}\right) = -\frac{16}{25}$

49. **a.** x^3 becomes $3^3 = 3 \cdot 3 \cdot 3 = 27$

b. $-x^3$ becomes $-3^3 = -(3 \cdot 3 \cdot 3) = -27$

50. **a.** x^3 becomes $(5)^3 = (5)(5)(5) = 125$

b. $-x^3$ becomes $-(5)^3 = -(5)(5)(5) = -125$

51. **a.** x^3 becomes $(-5)^3 = (-5)(-5)(-5) = -125$

b. $-x^3$ becomes $-(-5)^3 = -(-5)(-5)(-5) = 125$

52. **a.** x^3 becomes $(-3)^3 = (-3)(-3)(-3) = -27$

b. $-x^3$ becomes $-(-3)^3 = -(-3)(-3)(-3) = 27$

53. **a.** x^3 becomes $\left(\frac{2}{5}\right)^3 = \left(\frac{2}{5}\right)\left(\frac{2}{5}\right)\left(\frac{2}{5}\right) = \frac{8}{125}$

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

54. **a.** x^3 becomes $\left(\frac{3}{7}\right)^3 = \left(\frac{3}{7}\right)\left(\frac{3}{7}\right)\left(\frac{3}{7}\right) = \frac{27}{343}$

b. $-x^3$ becomes $-\left(\frac{3}{7}\right)^3 = -\left(\frac{3}{7}\right)\left(\frac{3}{7}\right)\left(\frac{3}{7}\right) = -\frac{27}{343}$

55. **a.** x^3 becomes $\left(-\frac{2}{3}\right)^3 = \left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right) = -\frac{8}{27}$

b. $-x^3$ becomes $-\left(-\frac{2}{3}\right)^3 = -\left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right)\left(-\frac{2}{3}\right) = \frac{8}{27}$

56. a. x^3 becomes

$$\left(-\frac{3}{4}\right)^3=\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)=-\frac{27}{64}$$

b. $-x^3$ becomes

$$-\left(-\frac{3}{4}\right)^3=-\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)\left(-\frac{3}{4}\right)=\frac{27}{64}$$

57. $4^2+2^3-2^2-3^3=16+8-4-27=24-31=-7$

58. $(-1)^2+(-1)^3-1^4+1^5=1-1-1+1=0$

59.
$$\begin{aligned}-2^2-2^3+1^{10}+(-2)^3&=-4-8+1+(-8)\\&=-4-8+1-8\\&=-12+1-8\\&=-11-8\\&=-19\end{aligned}$$

60.
$$\begin{aligned}&(-3)^3-2^2-(-2)^2+(9-9)^2\\&=(-3)^3-2^2-(-2)^2+0^2\\&=-27-4-4+0\\&=-31-4+0\\&=-35+0\\&=-35\end{aligned}$$

61.
$$\begin{aligned}(1.5)^2-(3.9)^2+(-2.1)^3&=2.25-15.21-9.261\\&=-12.96-9.261\\&=-22.221\end{aligned}$$

62.
$$\begin{aligned}(3.7)^2-(0.8)^2+(2.4)^3&=13.69-0.64+13.824\\&=13.05+13.824\\&=26.874\end{aligned}$$

63.
$$\begin{aligned}\left(-\frac{1}{2}\right)^4-\left(\frac{1}{2}\right)^2+\left(-\frac{1}{2}\right)^3&=\frac{1}{16}-\frac{1}{4}-\frac{1}{8}\\&=\frac{2}{32}-\frac{8}{32}-\frac{4}{32}\\&=-\frac{10}{32}\\&=-\frac{5}{16}\end{aligned}$$

64.
$$\begin{aligned}\left(\frac{3}{4}\right)^2-\frac{1}{4}-\left(-\frac{3}{8}\right)^2+\left(\frac{1}{4}\right)^3&=\frac{9}{16}-\frac{1}{4}-\frac{9}{64}+\frac{1}{64}\\&=\frac{36}{64}-\frac{16}{64}-\frac{9}{64}+\frac{1}{64}\\&=\frac{20}{64}-\frac{9}{64}+\frac{1}{64}\\&=\frac{11}{64}+\frac{1}{64}\\&=\frac{12}{64}\\&=\frac{3}{16}\end{aligned}$$

65. $3+5\cdot 8=3+40=43$

66. $(2-6)\div 4+3=(-4)\div 4+3=-1+3=2$

67. $18-7\div 7+8=18-1+8=17+8=25$

68.
$$\begin{aligned}4\cdot 3\div 6-2^3&=4\cdot 3\div 6-8\\&=12\div 6-8\\&=2-8\\&=-6\end{aligned}$$

69.
$$\begin{aligned}16\div 4\cdot 2-4\cdot 3^2&=16\div 4\cdot 2-4\cdot 9\\&=4\cdot 2-4\cdot 9\\&=8-4\cdot 9\\&=8-36\\&=-28\end{aligned}$$

70.
$$\begin{aligned}81\div 9\cdot 3+5\cdot 2^3&=9\cdot 3+5\cdot 2^3\\&=27+5\cdot 2^3\\&=27+5\cdot 8\\&=27+40\\&=67\end{aligned}$$

71. $\frac{2}{3}\div\frac{2}{7}\cdot\frac{1}{2}-\frac{3}{5}\cdot\frac{1}{3}\div\frac{2}{9}=\frac{2}{3}\cdot\frac{7}{2}\cdot\frac{1}{2}-\frac{3}{5}\cdot\frac{1}{3}\div\frac{2}{9}$
$=\frac{7}{3}\cdot\frac{1}{2}-\frac{1}{5}\div\frac{2}{9}$
$=\frac{7}{6}-\frac{1}{5}\div\frac{2}{9}$
$=\frac{7}{6}-\frac{1}{5}\cdot\frac{9}{2}$
$=\frac{7}{6}-\frac{9}{10}$
$=\frac{35}{30}-\frac{27}{30}$
$=\frac{8}{30}$
$=\frac{4}{15}$

72. $\frac{1}{2}\cdot\frac{2}{3}\div\frac{3}{4}-\frac{1}{6}\cdot\left(-\frac{1}{3}\right)=\frac{1}{3}\div\frac{3}{4}-\frac{1}{6}\cdot\left(-\frac{1}{3}\right)$
$=\frac{1}{3}\cdot\frac{4}{3}-\frac{1}{6}\cdot\left(-\frac{1}{3}\right)$
$=\frac{4}{9}-\left(-\frac{1}{18}\right)$
$=\frac{8}{18}+\left(\frac{1}{18}\right)$
$=\frac{9}{18}$
$=\frac{1}{2}$

73. $10\div\left[(3+2^2)-(2^4-8)\right]=10\div\left[(3+4)-(16-8)\right]$
$=10\div[7-8]$
$=10\div(-1)$
$=-10$

74. $\left[(7-3^2)+(7-3)^2\right]\div(35\div5)$
$=\left[(7-9)+(4)^2\right]\div(7)$
$=(-2+16)\div7$
$=14\div7$
$=2$

75. $\left[16\div2\cdot3-\left(4-3^2\right)^2\right]^3=\left[16\div2\cdot3-(4-9)^2\right]^3$
$=\left[16\div2\cdot3-(-5)^2\right]^3$
$=[16\div2\cdot3-25]^3$
$=[8\cdot3-25]^3$
$=[24-25]^3$
$=[-1]^3$
$=-1$

76. $\left[3-(4-2^3)^2\right]^2=\left[3-(4-8)^2\right]^2$
$=\left[3-(-4)^2\right]^2$
$=[3-16]^2$
$=[-13]^2$
$=169$

77. $\{[(12-15)-3]-2\}^2=\{[(-3)-3]-2\}^2$
$=[(-6)-2]^2$
$=(-8)^2$
$=64$

78. $4\{6-[(25\div5)-2]\}^3=4\{6-[5-2]\}^3$
$=4[6-(3)]^3$
$=4[3]^3$
$=4\cdot27$
$=108$

79. $3\left[5(16-6)\div(25\div5)^2\right]^2=3\left[5(10)\div(5)^2\right]^2$
$=3[50\div25]^2$
$=3[2]^2$
$=3\cdot4$
$=12$

80. $\left\{5+\left[4^2-3(2-7)\right]-5\right\}^2=\left\{5+\left[4^2-3(-5)\right]-5\right\}^2$
$=\left\{5+[16-3(-5)]-5\right\}^2$
$=\left\{5+[16+15]-5\right\}^2$
$=\left\{5+31-5\right\}^2$
$=\{31\}^2$
$=961$

81. $\dfrac{4-(2+3)^2-6}{4(3-2)-3^2}=\dfrac{4-(5)^2-6}{4(1)-3^2}$

$=\dfrac{4-25-6}{4(1)-9}$

$=\dfrac{4-25-6}{4-9}$

$=\dfrac{-27}{-5}$

$=\dfrac{27}{5}$

82. $\dfrac{15\div 3+7\cdot 2}{\sqrt{25}\div 5+8\div 2}=\dfrac{15\div 3+7\cdot 2}{5\div 5+8\div 2}=\dfrac{5+14}{1+4}=\dfrac{19}{5}$

83. $\dfrac{8+4\div 2\cdot 3+9}{5^2-3^2\cdot 2-7}=\dfrac{8+4\div 2\cdot 3+9}{25-9\cdot 2-7}$

$=\dfrac{8+2\cdot 3+9}{25-18-7}$

$=\dfrac{8+6+9}{25-18-7}$

$=\dfrac{14+9}{7-7}$

$=\dfrac{23}{0}$ which is undefined

84. $\dfrac{6(-3)+4\cdot 7-4^2}{-6+\sqrt{4}(2^2-1)}=\dfrac{6(-3)+4\cdot 7-16}{-6+\sqrt{4}(4-1)}$

$=\dfrac{-18+28-16}{-6+\sqrt{4}(3)}$

$=\dfrac{10-16}{-6+2(3)}$

$=\dfrac{-6}{-6+6}$

$=\dfrac{-6}{0}$ which is undefined

85. $\dfrac{8-[4-(3-1)^2]}{5-(-3)^2+4\div 2}=\dfrac{8-[4-(2)^2]}{5-(-3)^2+4\div 2}$

$=\dfrac{8-(4-4)}{5-9+4\div 2}$

$=\dfrac{8-0}{5-9+4\div 2}$

$=\dfrac{8}{5-9+2}$

$=\dfrac{8}{-4+2}$

$=\dfrac{8}{-2}$

$=-4$

86. $\dfrac{5-|-15|\div|3|}{2\left(4-|5|\right)+9}=\dfrac{5-15\div 3}{2(4-5)+9}$

$=\dfrac{5-15\div 3}{2(-1)+9}$

$=\dfrac{5-5}{-2+9}=\dfrac{0}{7}=0$

87. $-2|-3|-\sqrt{36}\div|2|+3^2=-2(3)-6\div 2+3^2$

$=-2(3)-6\div 2+9$

$=-6-3+9$

$=-9+9$

$=0$

88. $12-15\div|5|-\left(|4|-2\right)^2=12-15\div|5|-(4-2)^2$

$=12-15\div|5|-(2)^2$

$=12-15\div 5-4$

$=12-3-4$

$=9-4$

$=5$

89. $\dfrac{6-|-4|-4|8-5|}{5-6\cdot 2\div|-6|}=\dfrac{6-|-4|-4|3|}{5-6\cdot 2\div|-6|}$

$=\dfrac{6-4-4\cdot 3}{5-6\cdot 2\div 6}$

$=\dfrac{6-4-12}{5-12\div 6}$

$=\dfrac{2-12}{5-2}$

$=\dfrac{-10}{3}$ or $-\dfrac{10}{3}$

90. $\dfrac{10-|-8|\div|5-9|}{6+8\div1\cdot4-5\cdot2^3}=\dfrac{10-|-8|\div|-4|}{6+8\div1\cdot4-5\cdot2^3}$

$=\dfrac{10-8\div4}{6+8\div1\cdot4-5\cdot2^3}$

$=\dfrac{10-8\div4}{6+8\div1\cdot4-5\cdot8}$

$=\dfrac{10-2}{6+8\cdot4-40}$

$=\dfrac{10-2}{6+32-40}$

$=\dfrac{8}{38-40}$

$=\dfrac{8}{-2}$

$=-4$

91. $\dfrac{2}{5}\left[\sqrt[3]{27}-|-9|+4-3^2\right]^2=\dfrac{2}{5}[3-(9)+4-9]^2$

$=\dfrac{2}{5}(3-9+4-9)^2$

$=\dfrac{2}{5}(-6+4-9)^2$

$=\dfrac{2}{5}(-2-9)^2$

$=\dfrac{2}{5}(-11)^2$

$=\dfrac{2}{5}(121)$

$=\dfrac{242}{5}$

92. $\dfrac{3}{7}\left[\sqrt[5]{32}-(-8)-6^2\div3^2\right]=\dfrac{3}{7}\left[2-(-8)-36\div9\right]$

$=\dfrac{3}{7}[2+8-4]$

$=\dfrac{3}{7}[6]$

$=\dfrac{18}{7}$

93. $\dfrac{24-5-4^2}{|-8|+4-2(3)}+\dfrac{4-(-3)^2+|4|}{3^2-4\cdot3+|-7|}$

$=\dfrac{24-5-16}{8+4-2(3)}+\dfrac{4-(9)+4}{9-4\cdot3+7}$

$=\dfrac{24-5-16}{8+4-6}+\dfrac{4-9+4}{9-12+7}$

$=\dfrac{19-16}{12-6}+\dfrac{-5+4}{-3+7}$

$=\dfrac{3}{6}+\dfrac{-1}{4}$

$=\dfrac{2}{4}+\dfrac{-1}{4}$

$=\dfrac{2-1}{4}$

$=\dfrac{1}{4}$

94. $\dfrac{3(12-9)^2}{-3^2}-\dfrac{2(3^2-4^2)}{4-(-2)}=\dfrac{3(3)^2}{-3^2}-\dfrac{2(3^2-4^2)}{4-(-2)}$

$=\dfrac{3(3)^2}{-3^2}-\dfrac{2(9-16)}{4-(-2)}$

$=\dfrac{3(9)}{-9}-\dfrac{2(-7)}{4-(-2)}$

$=\dfrac{27}{-9}-\dfrac{-14}{4+2}$

$=\dfrac{27}{-9}-\dfrac{-14}{6}$

$=-3+\dfrac{7}{3}$

$=\dfrac{-9}{3}+\dfrac{7}{3}$

$=\dfrac{-9+7}{3}$

$=\dfrac{-2}{3}$ or $-\dfrac{2}{3}$

95. Substitute 2 for x:

$5x^2+7x=5(2)^2+7(2)$

$=5\cdot4+7(2)$

$=20+14$

$=34$

96. Substitute 3 for x:

$$\begin{aligned}5x^2-2x+17 &= 5(3)^2-2(3)+17\\ &= 5(9)-2(3)+17\\ &= 45-6+17\\ &= 39+17\\ &= 56\end{aligned}$$

97. Substitute -1 for x:

$$\begin{aligned}-9x^2+3x-29 &= -9(-1)^2+3(-1)-29\\ &= -9\cdot 1+3(-1)-29\\ &= -9-3-29\\ &= -12-29\\ &= -41\end{aligned}$$

98. Substitute -3 for x:

$$\begin{aligned}-5x^2-x+7 &= -5(-3)^2-(-3)+7\\ &= -5(9)-(-3)+7\\ &= -45+3+7\\ &= -35\end{aligned}$$

99. Substitute 2 for x and 4 for y:

$$\begin{aligned}-7x+3y^2 &= -7(2)+3(4)^2\\ &= -7(2)+3(16)\\ &= -14+48\\ &= 34\end{aligned}$$

100. Substitute 4 for x and -2 for y:

$$\begin{aligned}4x^2-3y-10 &= 4(4)^2-3(-2)-10\\ &= 4(16)-3(-2)-10\\ &= 64+6-10\\ &= 70-10\\ &= 60\end{aligned}$$

101. Substitute 4 for a and -1 for b:

$$\begin{aligned}&3(a+b)^2+4(a+b)-6\\ &= 3[4+(-1)]^2+4[4+(-1)]-6\\ &= 3(3)^2+4(3)-6\\ &= 3(9)+4(3)-6\\ &= 27+12-6\\ &= 39-6\\ &= 33\end{aligned}$$

102. Substitute 3 for p and -3 for q:

$$\begin{aligned}&-2(p-q)^2+8(p-q)-4\\ &= -2\left[3-(-3)\right]^2+8\left[3-(-3)\right]-4\\ &= -2[6]^2+8[6]-4\\ &= -2(36)+8[6]-4\\ &= -72+48-4\\ &= -28\end{aligned}$$

103. Substitute 4 for x:

$$\begin{aligned}&-9-\{x-[2x-(x-3)]\}\\ &= -9-\{4-[2\cdot 4-(4-3)]\}\\ &= -9-\{4-[8-(1)]\}\\ &= -9-\{4-[7]\}\\ &= -9-\{-3\}\\ &= -9+3\\ &= -6\end{aligned}$$

104. Substitute 3 for x:

$$\begin{aligned}&-9-\{2x-[5x-(2x+1)]\}\\ &= -9-\{2\cdot 3-[5\cdot 3-(2\cdot 3+1)]\}\\ &= -9-\{2\cdot 3-[5\cdot 3-(6+1)]\}\\ &= -9-\{2\cdot 3-[5\cdot 3-7]\}\\ &= -9-[2\cdot 3-(15-7)]\\ &= -9-[2\cdot 3-8]\\ &= -9-(6-8)\\ &= -9-(-2)\\ &= -9+2\\ &= -7\end{aligned}$$

105. Substitute -5 for x and 5 for y:

$$\begin{aligned}\frac{(x+3)^2}{25}-\frac{(y-2)^2}{9} &= \frac{(-5+3)^2}{25}-\frac{(5-2)^2}{9}\\ &= \frac{(-2)^2}{25}-\frac{(3)^2}{9}\\ &= \frac{4}{25}-\frac{9}{9}\\ &= \frac{4}{25}-\frac{25}{25}\\ &= -\frac{21}{25}\end{aligned}$$

106. Substitute 4 for x and 3 for y:

$$\begin{aligned}\frac{(x-3)^2}{9}+\frac{(y+5)^2}{16} &= \frac{(4-3)^2}{9}+\frac{(3+5)^2}{16}\\ &= \frac{1^2}{9}+\frac{8^2}{16}\\ &= \frac{1}{9}+\frac{64}{16}\\ &= \frac{1}{9}+4\\ &= \frac{1}{9}+\frac{36}{9}\\ &= \frac{1+36}{9}\\ &= \frac{37}{9}\end{aligned}$$

107. Substitute 6 for a, –11 for b, and 3 for c:

$$\begin{aligned}\frac{-b+\sqrt{b^2-4ac}}{2a} &= \frac{-(-11)+\sqrt{(-11)^2-4(6)(3)}}{2(6)}\\ &= \frac{11+\sqrt{121-72}}{12}\\ &= \frac{11+\sqrt{49}}{12}\\ &= \frac{11+7}{12}\\ &= \frac{18}{12}\\ &= \frac{3}{2}\end{aligned}$$

108. Substitute 2 for a, 1 for b, and –10 for c:

$$\begin{aligned}\frac{-b-\sqrt{b^2-4ac}}{2a} &= \frac{-1-\sqrt{1^2-4(2)(-10)}}{2(2)}\\ &= \frac{-1-\sqrt{1+80}}{2(2)}\\ &= \frac{-1-\sqrt{81}}{2(2)}\\ &= \frac{-1-9}{2(2)}\\ &= \frac{-1-9}{4}\\ &= \frac{-10}{4}\\ &= -\frac{5}{2}\end{aligned}$$

109. The expression is $\frac{7y-14}{2}$.

Now substitute 6 for y:

$$\frac{7y-14}{2}=\frac{7(6)-14}{2}=\frac{42-14}{2}=\frac{28}{2}=14$$

110. The expression is $[5(z-4)]^2$.

Now substitute 10 for z:

$$\begin{aligned}[5(z-4)]^2 &= [5(10-4)]^2\\ &= [5(6)]^2\\ &= [30]^2\\ &= 900\end{aligned}$$

111. The expression is $6(3x+6)-9$.

Now substitute 3 for x:

$$\begin{aligned}6(3x+6)-9 &= 6(3\cdot 3+6)-9\\ &= 6(9+6)-9\\ &= 6(15)-9\\ &= 90-9\\ &= 81\end{aligned}$$

112. The expression is $[2(x+y)-5]^2$.

Now substitute 2 for x and –3 for y:

$$\begin{aligned}[2(x+y)-5]^2 &= \{2[2+(-3)]-5\}^2\\ &= [2(-1)-5]^2\\ &= [-2-5]^2\\ &= (-7)^2\\ &= 49\end{aligned}$$

113. The expression is $\left(\frac{x+3}{2y}\right)^2-3$

Now substitute 5 for x and 2 for y:

$$\begin{aligned}\left(\frac{x+3}{2y}\right)^2-3 &= \left(\frac{5+3}{2\cdot 2}\right)^2-3\\ &= \left(\frac{5+3}{4}\right)^2-3\\ &= \left(\frac{8}{4}\right)^2-3\\ &= 2^2-3\\ &= 4-3\\ &= 1\end{aligned}$$

114. The expression is $\left(\frac{x-4}{10y}\right)^3+19$

Now substitute 5 for x and 2 for y:

$$\left(\frac{x-4}{10y}\right)^3+19=\left(\frac{64-4}{10\cdot 3}\right)^3+19$$
$$=\left(\frac{60}{30}\right)^3+19$$
$$=(2)^3+19$$
$$=8+19$$
$$=27$$

115. a. Substitute 3 for x:

$$\text{distance}=8.2x=8.2(3)=24.6$$

Frank can travel 24.6 miles in 3 hours.

b. Substitute 7 for x:

$$\text{distance}=8.2x=8.2(7)=57.4$$

Frank can travel 57.4 miles in 7 hours.

116. a. 2018 is represented by $x = 4$; substitute 4 for x:

$$\text{salary}=32,550+1,200x$$
$$=32,550+1,200(4)$$
$$=32,550+4,800$$
$$=37,350$$

Mary's salary in 2018 will be \$37,350.

b. 2028 is represented by $x = 14$; substitute 14 for x:

$$\text{salary}=32,550+1,200x$$
$$=32,550+1,200(14)$$
$$=32,550+16,800$$
$$=49,350$$

Mary's salary in 2028 will be \$49,350.

117. a. Substitute 2 for x:

$$\text{height}=-16x^2+72x+22$$
$$=-16(2)^2+72(2)+22$$
$$=-16(4)+72(2)+22$$
$$=-64+144+22$$
$$=80+22$$
$$=102$$

After 2 seconds, the baseball will be 102 feet above the ground.

b. Substitute 4 for x:

$$\text{height}=-16x^2+72x+22$$
$$=-16(4)^2+72(4)+22$$
$$=-16(16)+72(4)+22$$
$$=-256+288+22$$
$$=32+22$$
$$=54$$

After 4 seconds, the baseball will be 54 feet above the ground.

118. a. Substitute 2 for x:

$$\text{velocity}=-32x+72$$
$$=-32(2)+72$$
$$=-64+72$$
$$=8$$

At 2 seconds, the velocity of the baseball is 8 feet per second.

b. Substitute 4 for x:

$$\text{velocity}=-32x+72$$
$$=-32(4)+72$$
$$=-128+72$$
$$=-56$$

At 4 seconds, the velocity of the baseball is -56 feet per second.

119. a. 2025 is represented by $x = 13$; substitute 13 for x:

$$\text{spending}=26.865x+488.725$$
$$=26.865(13)+488.725$$
$$=349.245+488.725$$
$$=837.97$$

The amount each consumer will spend on holiday gifts in 2025 will be \$837.97.

b. 2030 is represented by $x = 18$; substitute 18 for x:

$$\text{spending}=26.865x+488.725$$
$$=26.865(18)+488.725$$
$$=483.57+488.725$$
$$=972.295$$

The amount each consumer will spend on holiday gifts in 2030 will be \$972.30.

120. a. 1970 is represented by $x = 1$; substitute 1 for x:

$$\text{percent}=-6.2x+82.2$$
$$=-6.2(1)+82.2$$
$$=-6.2+82.2$$
$$=76.0$$

In 1970, 76.0% of U.S. adults read a newspaper.

b. 2020 is represented by $x = 6$; substitute 6 for x:

$$\text{percent}=-6.2x+82.2$$
$$=-6.2(6)+82.2$$
$$=-37.2+82.2$$
$$=45$$

In 2020, 45% of U.S. adults will read a newspaper.

121. a. Substitute 20 for x:

$$\begin{aligned}\text{houses sold} &= 30-\frac{1}{4}x\\ &= 30-\frac{1}{4}(20)\\ &= 30-5\\ &= 25\end{aligned}$$

If Mark charges \$20, he sells 25 bluebird houses in one month.

b. Substitute 40 for x:

$$\begin{aligned}\text{houses sold} &= 30-\frac{1}{4}x\\ &= 30-\frac{1}{4}(40)\\ &= 30-10\\ &= 20\end{aligned}$$

If Mark charges \$40, he sells 20 bluebird houses in one month.

122. a. Substitute 90 for x:

$$\begin{aligned}\text{dresses sold} &= 200-\frac{4}{3}x\\ &= 200-\frac{4}{3}(90)\\ &= 200-120\\ &= 80\end{aligned}$$

If Gayle charges \$90, she sells 80 dresses in one month.

b. Substitute 120 for x:

$$\begin{aligned}\text{dresses sold} &= 200-\frac{4}{3}x\\ &= 200-\frac{4}{3}(120)\\ &= 200-160\\ &= 40\end{aligned}$$

If Gayle charges \$120, she sells 40 dresses in one month.

123. a. Substitute 10 for x:

$$\begin{aligned}\text{number of trips} &= -0.03x^2+0.51x+8.05\\ &= -0.03(10)^2+0.51(10)+8.05\\ &= -0.03(100)+5.1+8.05\\ &= -3+13.15\\ &= 10.15\end{aligned}$$

In 2010, there will be about 10.15 billion trips.

b. Substitute 20 for x:

$$\begin{aligned}\text{number of trips} &= -0.03x^2+0.51x+8.05\\ &= -0.03(20)^2+0.51(20)+8.05\\ &= -0.03(400)+10.2+8.05\\ &= -12+18.25\\ &= 6.25\end{aligned}$$

In 2010, there will be about 6.25 billion trips.

124. a. Substitute 200 for x:

$$\begin{aligned}\text{annual profit} &= -x^2+400x-200\\ &= -(200)^2+400(200)-200\\ &= -40,000+80,000-200\\ &= 39,800\end{aligned}$$

If Terri charges \$200, her profit is \$39,800.

b. Substitute 250 for x:

$$\begin{aligned}\text{annual profit} &= -x^2+400x-200\\ &= -(250)^2+400(250)-200\\ &= -62,500+100,000-200\\ &= 37,300\end{aligned}$$

If Terri charges \$250, her profit is \$37,300.

125. a. Substitute 10 for x:

$$\begin{aligned}&\text{percent of children}\\ &= 0.23x^2-1.98x+4.42\\ &= 0.23(10)^2-1.98(10)+4.42\\ &= 0.23(100)-1.98(10)+4.42\\ &= 23-19.8+4.42\\ &= 7.62\end{aligned}$$

The percent of all 10-year-olds who are latchkey kids is 7.62%.

b. Substitute 14 for x.

$$\begin{aligned}&\text{percent of children}\\ &= 0.23x^2-1.98x+4.42\\ &= 0.23(14)^2-1.98(14)+4.42\\ &= 0.23(196)-1.98(14)+4.42\\ &= 45.08-27.72+4.42\\ &= 21.78\end{aligned}$$

The percent of all 14-year-olds who are latchkey kids is 21.78%.

126. a. 2010 is represented by $x = 15$; substitute 15 for x:

number of centenarians

$= 0.30x^2 - 3.69x + 92.04$

$= 0.30(15)^2 - 3.69(15) + 92.04$

$= 0.30(225) - 3.69(15) + 92.04$

$= 67.5 - 55.35 + 92.04$

$= 104.19$

There were approximately 104.19 thousand centenarians living in the United States in 2010.

b. 2050 is represented by $x = 55$; substitute 55 for x:

number of centenarians

$= 0.30x^2 - 3.69x + 92.04$

$= 0.30(55)^2 - 3.69(55) + 92.04$

$= 0.30(3025) - 3.69(55) + 92.04$

$= 907.5 - 202.95 + 92.04$

$= 796.59$

There will be approximately 796.59 thousand centenarians living in the United States in 2050.

127. a. Substitute 10 for x:

$\text{sales} = 0.07x^2 + 1.46x + 5.67$

$= 0.07(10)^2 + 1.46(10) + 5.67$

$= 0.07(100) + 14.6 + 5.67$

$= 7 + 20.27$

$= 27.27$

In 2010, sales of organically grown food will be about \$27.27 billion.

b. Substitute 20 for x:

$\text{sales} = 0.07x^2 + 1.46x + 5.67$

$= 0.07(20)^2 + 1.46(20) + 5.67$

$= 0.07(400) + 29.2 + 5.67$

$= 28 + 34.87$

$= 62.87$

In 2020, sales of organically grown food will be about \$62.87 billion.

128. a. Substitute 10 for x:

$\text{cell phone users} = 0.04x^2 + 19.96x + 94.84$

$= 0.04(10)^2 + 19.96(10) + 94.84$

$= 0.04(100) + 199.6 + 94.84$

$= 4 + 294.44$

$= 298.44$

In 2010, number of cell phone users will be about 298.44 million.

b. Substitute 20 for x:

$\text{cell phone users} = 0.04x^2 + 19.96x + 94.84$

$= 0.04(20)^2 + 19.96(20) + 94.84$

$= 0.04(400) + 399.2 + 94.84$

$= 16 + 494.04$

$= 510.04$

In 2020, number of cell phone users will be about 510.04 million.

129. a^n means n factors of a.

130. $\sqrt[n]{a} = b$ means n factors of b equals a.

131. The principal square root of a positive number radicand is the positive number whose square equals the radicand.

132. $\sqrt{-4}$ cannot be a real number because the square of a real number cannot be negative.

133. An odd root of a negative number will be negative because a negative number raised to an odd power is a negative number.

134. An odd root of a positive number will be positive because a positive number raised to an odd power is a positive number.

135. Parentheses, exponents and roots, multiplication and division from left to right, addition and subtraction from left to right.

136. a. Answers will vary.

b. $\dfrac{5-18\div 3^2}{4-3\cdot 2} = \dfrac{5-18\div 9}{4-3\cdot 2} = \dfrac{5-2}{4-6} = \dfrac{3}{-2} = -\dfrac{3}{2}$

137. a. Answers will vary.

b. $16\div 2^2 + 6\cdot 4 - 24\div 6 = 16\div 4 + 6\cdot 4 - 24\div 6$

$= 4 + 24 - 4$

$= 28 - 4$

$= 24$

138. a. Answers will vary.

b. $\{5-[4-(3-8)]\}^2 = \{5-[4-(-5)]\}^2$

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

$= [5-9]^2$

$= (-4)^2$

$= 16$

139. **a.** $A \cap B = \{b, c, f\}$

b. $A \cup B = \{a, b, c, d, f, g, h\}$

140. $|a| = |-a|$ for all real numbers or $\mathbb{R}$.

141. Since $|a| = \begin{cases} a & \geq 0 \\ -a & a < 0 \end{cases}$ then $|a| = a$ for $a \geq 0$.

142. $|a| = 8$ for $a = 8$ or $a = -8$ since $|8| = 8$ and $|-8| = 8$.

143. $-|6|, -4, -|-2|, 0, |-5|$

144. associative property of addition

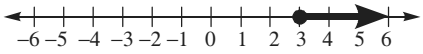
Mid-Chapter Test: 1.1 – 1.4

1. Answers will vary.

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

3. $D = \{0, 5, 10, 15, ...\}$ is the set of whole number multiples of 5.

4. $\{x \mid x \geq 3\}$



5. $\frac{3}{5} > \frac{4}{9}$

6. $\{x \mid -5 \leq x < 2\}$

7. No, W is not a subset of N because $0 \in W$, but $0 \notin N$..

8. $-15, |-6|, 7, |-17|$

9. $7 - 2.3 - (-4.5) = 7 - 2.3 + 4.5$
$= 4.7 + 4.5$
$= 9.2$

10. $\left(\frac{2}{5} + \frac{1}{3}\right) - \frac{1}{2} = \left(\frac{6}{15} + \frac{5}{15}\right) - \frac{1}{2}$
$= \frac{11}{15} - \frac{1}{2}$
$= \frac{22}{30} - \frac{15}{30}$
$= \frac{7}{30}$

11. $(5)(-2)(3.2)(-8) = -10(3.2)(-8)$
$= -32(-8)$
$= 256$

12. $\left|-\frac{8}{13}\right| \div (-2) = \frac{8}{13} \div (-2)$
$= \frac{8}{13} \cdot \left(\frac{1}{-2}\right)$
$= \frac{8(1)}{13(-2)}$
$= \frac{8}{-26}$
$= -\frac{4}{13}$

13. $(7 - |-2|) - (-8 + |16|) = (7 - 2) - (-8 + 16)$
$= 5 - 8$
$= 5 + (-8)$
$= -3$

14. $5(x + y) = 5x + 5y$ illustrates the distributive property.

15. $\sqrt{0.81} = 0.9$ because $(0.9)(0.9) = 0.81$.

16. **a.** $-11^2 = -121$

b. $(-11)^2 = 121$

17. **a.** Grouping symbols, exponents and radicals multiplication and division from left to right, addition and subtraction from left to right.

b. $4 - 2 \cdot 3^2 = 4 - 2 \cdot 9 = 4 - 18 = -14$

18. $5 \cdot 4 \div 10 + 2^5 - 11 = 5 \cdot 4 \div 10 + 32 - 11$
$= 20 \div 10 + 32 - 11$
$= 2 + 32 - 11$
$= 34 - 11$
$= 23$

19. $\frac{1}{4}\left\{\left[(12 \div 4)^2 - 7\right]^3 \div 2\right\}^2 = \frac{1}{4}\left\{\left[(3)^2 - 7\right]^3 \div 2\right\}^2$
$= \frac{1}{4}\left\{\left[9 - 7\right]^3 \div 2\right\}^2$
$= \frac{1}{4}\left\{\left[2\right]^3 \div 2\right\}^2$
$= \frac{1}{4}\{8 \div 2\}^2$
$= \frac{1}{4}\{4\}^2$
$= \frac{1}{4} \cdot 16$
$= 4$

20. $\dfrac{\sqrt{16}+\left(\sqrt{49}-6\right)^4}{\sqrt[3]{-27}-(4-3^2)}=\dfrac{\sqrt{16}+(7-6)^4}{\sqrt[3]{-27}-(4-9)}$

$=\dfrac{\sqrt{16}+(1)^4}{\sqrt[3]{-27}-(-5)}$

$=\dfrac{4+1}{-3-(-5)}$

$=\dfrac{4+1}{-3+5}$

$=\dfrac{5}{2}$

Exercise Set 1.5

1. The rule $a^m \cdot a^n = a^{m+n}$ is called the product rule for exponents.

2. For $a \neq 0$, the rule $\dfrac{a^m}{a^n} = a^{m-n}$ is called the quotient rule for exponents.

3. For $a \neq 0$, the rule $a^{-m} = \dfrac{1}{a^m}$ is called the negative exponent rule.

4. For $a \neq 0$, the rule $a^0 = 1$ is called the zero exponent rule.

5. The expression 0^0 is undefined.

6. The rule $\left(a^m\right)^n = a^{m \cdot n}$ is called the raising a power to a power rule.

7. The raising a power to a power rule states that $(ab)^m = a^m b^m$.

8. The raising a quotient to a power rule states that $\left(\dfrac{a}{b}\right)^m = \dfrac{a^m}{b^m}$.

9. $2^3 \cdot 2^2 = 2^{3+2} = 2^5 = 32$

10. $3^2 \cdot 3^3 = 3^{2+3} = 3^5 = 243$

11. $\dfrac{3^7}{3^5} = 3^{7-5} = 3^2 = 9$

12. $\dfrac{8^7}{8^6} = 8^{7-6} = 8^1 = 8$

13. $\dfrac{2^5}{2^8} = 2^{5-8} = 2^{-3} = \dfrac{1}{2^3} = \dfrac{1}{8}$

14. $\dfrac{3^4}{3^6} = 3^{4-6} = 3^{-2} = \dfrac{1}{3^2} = \dfrac{1}{9}$

15. $9^{-2} = \dfrac{1}{9^2} = \dfrac{1}{81}$

16. $7^{-2} = \dfrac{1}{7^2} = \dfrac{1}{49}$

17. $\dfrac{1}{5^{-3}} = 5^3 = 125$

18. $\dfrac{1}{3^{-2}} = 3^2 = 9$

19. $15^0 = 1$

20. $24^0 = 1$

21. $\left(2^3\right)^2 = 2^{3 \cdot 2} = 2^6 = 64$

22. $\left(3^2\right)^2 = 3^{2 \cdot 2} = 3^4 = 81$

23. $(2 \cdot 4)^2 = 2^2 \cdot 4^2 = 4 \cdot 16 = 64$

24. $(6 \cdot 5)^2 = 6^2 \cdot 5^2 = 36 \cdot 25 = 900$

25. $\left(\dfrac{4}{7}\right)^2 = \dfrac{4^2}{7^2} = \dfrac{16}{49}$

26. $\left(\dfrac{3}{5}\right)^4 = \dfrac{3^4}{5^4} = \dfrac{81}{625}$

27. $\left(\dfrac{2}{3}\right)^{-4} = \left(\dfrac{3}{2}\right)^4 = \dfrac{3^4}{2^4} = \dfrac{81}{16}$

28. $\left(\dfrac{5}{6}\right)^{-2} = \left(\dfrac{6}{5}\right)^2 = \dfrac{6^2}{5^2} = \dfrac{36}{25}$

29. **a.** $5x^0 = 5 \cdot 1 = 5$

b. $-5x^0 = -5 \cdot 1 = -5$

c. $(-5x)^0 = 1$

d. $-\left(-5x^0\right) = -(1) = -1$

30. a. $7y^0 = 7 \cdot 1 = 7$

b. $(7y)^0 = 1$

c. $-7y^0 = -7 \cdot 1 = -7$

d. $(-7y)^0 = 1$

31. a. $3xyz^0 = 3xy \cdot 1 = 3xy$

b. $(3xyz)^0 = 1$

c. $3x(yz)^0 = 3x \cdot 1 = 3x$

d. $3(xyz)^0 = 3 \cdot 1 = 3$

32. a. $x^0 + y^0 = 1 + 1 = 2$

b. $(x+y)^0 = 1$

c. $x + y^0 = x + 1$

d. $x^0 + y = 1 + y$

33. a. $3^{-2} = \dfrac{1}{3^2} = \dfrac{1}{9}$

b. $(-3)^{-2} = \dfrac{1}{(-3)^2} = \dfrac{1}{9}$

c. $-3^{-2} = -\dfrac{1}{3^2} = -\dfrac{1}{9}$

d. $-(-3)^{-2} = -\dfrac{1}{(-3)^2} = -\dfrac{1}{9}$

34. a. $4^{-3} = \dfrac{1}{4^3} = \dfrac{1}{64}$

b. $(-4)^{-3} = \dfrac{1}{(-4)^3} = \dfrac{1}{-64} = -\dfrac{1}{64}$

c. $-4^{-3} = -\dfrac{1}{4^3} = -\dfrac{1}{64}$

d. $-(-4)^{-3} = -\dfrac{1}{(-4)^3} = -\dfrac{1}{-64} = \dfrac{1}{64}$

35. a. $\left(\dfrac{1}{2}\right)^{-1} = \left(\dfrac{2}{1}\right)^1 = 2$

b. $\left(-\dfrac{1}{2}\right)^{-1} = \left(-\dfrac{2}{1}\right)^1 = -2$

c. $-\left(\dfrac{1}{2}\right)^{-1} = -\left(\dfrac{2}{1}\right)^1 = -2$

d. $-\left(-\dfrac{1}{2}\right)^{-1} = -\left(-\dfrac{2}{1}\right)^1 = -(-2) = 2$

36. a. $\left(\dfrac{3}{5}\right)^{-2} = \left(\dfrac{5}{3}\right)^2 = \dfrac{5^2}{3^2} = \dfrac{25}{9}$

b. $\left(-\dfrac{3}{5}\right)^{-2} = \left(-\dfrac{5}{3}\right)^2 = \left(\dfrac{-5}{3}\right)^2 = \dfrac{(-5)^2}{3^2} = \dfrac{25}{9}$

c. $-\left(\dfrac{3}{5}\right)^{-2} = -\left(\dfrac{5}{3}\right)^2 = -\dfrac{5^2}{3^2} = -\dfrac{25}{9}$

d. $-\left(-\dfrac{3}{5}\right)^{-2} = -\left(-\dfrac{5}{3}\right)^2 = -\left(\dfrac{-5}{3}\right)^2 = -\dfrac{(-5)^2}{3^2} = -\dfrac{25}{9}$

37. $7y^{-3} = 7 \cdot \dfrac{1}{y^3} = \dfrac{7}{y^3}$

38. $4k^{-5} = 4\left(\dfrac{1}{k^5}\right) = \dfrac{4}{k^5}$

39. $\dfrac{9}{x^{-4}} = 9x^4$

40. $\dfrac{8}{5x^{-2}} = \dfrac{8x^2}{5}$

41. $\dfrac{3a}{b^{-3}} = 3ab^3$

42. $\dfrac{10x^4}{y^{-1}} = 10x^4y^1 = 10x^4y$

43. $\dfrac{17m^{-2}n^{-3}}{2} = \dfrac{17}{2m^2n^3}$

44. $\dfrac{13x^{-3}}{z^4} = \dfrac{13}{x^3z^4}$

45. $\dfrac{5x^{-2}y^{-3}}{z^{-4}} = \dfrac{5z^4}{x^2y^3}$

46. $\dfrac{8^{-1}z}{x^{-1}y^{-1}} = \dfrac{xyz}{8}$

47. $\dfrac{4x^{-3}}{x^2} = \dfrac{4}{x^2 \cdot x^3} = \dfrac{4}{x^{2+3}} = \dfrac{4}{x^5}$

48. $\dfrac{p^4}{3p^{-2}} = \dfrac{1}{3}\left(p^{4-(-2)}\right) = \dfrac{1}{3}\left(p^6\right) = \dfrac{p^6}{3}$

49. a. $x^7 \cdot x^3 = x^{7+3} = x^{10}$

b. $\left(x^7\right)^3 = x^{7\cdot 3} = x^{21}$

c. $\dfrac{x^7}{x^3} = x^{7-3} = x^4$

d. $\dfrac{x^3}{x^7} = x^{3-7} = x^{-4} = \dfrac{1}{x^4}$

50. a. $j^8 j^5 = j^{8+5} = j^{13}$

b. $\left(j^8\right)^5 = j^{8\cdot 5} = j^{40}$

c. $\dfrac{j^8}{j^5} = j^{8-5} = j^3$

d. $\dfrac{j^5}{j^8} = j^{5-8} = j^{-3} = \dfrac{1}{j^3}$

51. a. $x^4 x^6 = x^{4+6} = x^{10}$

b. $x^{-4} x^6 = x^{-4+6} = x^2$

c. $x^4 x^{-6} = x^{4+(-6)} = x^{-2} = \dfrac{1}{x^2}$

d. $x^{-4} x^{-6} = x^{-4+(-6)} = x^{-10} = \dfrac{1}{x^{10}}$

52. a. $k^3 k^9 = k^{3+9} = k^{12}$

b. $k^{-3} k^9 = k^{-3+9} = k^6$

c. $k^3 k^{-9} = k^{3+(-9)} = k^{-6} = \dfrac{1}{k^6}$

d. $k^{-3} k^{-9} = k^{-3+(-9)} = k^{-12} = \dfrac{1}{k^{12}}$

53. a. $\dfrac{x^2}{x^{-5}} = x^{2-(-5)} = x^7$

b. $\dfrac{x^{-2}}{x^5} = x^{-2-5} = x^{-7} = \dfrac{1}{x^7}$

c. $\dfrac{x^{-2}}{x^{-5}} = x^{-2-(-5)} = x^3$

d. $\dfrac{x^{-5}}{x^{-2}} = x^{-5-(-2)} = x^{-3} = \dfrac{1}{x^3}$

54. a. $\dfrac{m^4}{m^{-7}} = m^{4-(-7)} = m^{11}$

b. $\dfrac{m^{-4}}{m^7} = m^{-4-7} = m^{-11} = \dfrac{1}{m^{11}}$

c. $\dfrac{m^{-4}}{m^{-7}} = m^{-4-(-7)} = m^3$

d. $\dfrac{m^{-7}}{m^{-4}} = m^{-7-(-4)} = m^{-3} = \dfrac{1}{m^3}$

55. a. $\left(\dfrac{x}{y}\right)^3 = \dfrac{x^3}{y^3}$

b. $\left(\dfrac{x}{y}\right)^{-3} = \left(\dfrac{y}{x}\right)^3 = \dfrac{y^3}{x^3}$

c. $(xy)^3 = x^3 y^3$

d. $(xy)^{-3} = \dfrac{1}{(xy)^3} = \dfrac{1}{x^3 y^3}$

56. a. $\left(\dfrac{c}{d}\right)^5 = \dfrac{c^5}{d^5}$

b. $\left(\dfrac{c}{d}\right)^{-5} = \left(\dfrac{d}{c}\right)^5 = \dfrac{d^5}{c^5}$

c. $(cd)^5 = c^5 d^5$

d. $(cd)^{-5} = \dfrac{1}{(cd)^5} = \dfrac{1}{c^5 d^5}$

57. $\dfrac{r^{-5}}{r^0} = r^{-5-0} = r^{-5} = \dfrac{1}{r^5}$

58. $\dfrac{p^0}{p^{-3}} = p^{0-(-3)} = p^{0+3} = p^3$

59. $\dfrac{5w^{-2}}{w^{-7}} = 5w^{-2-(-7)} = 5w^{-2+7} = 5w^5$

60. $\dfrac{3w^{-5}}{w^{-2}} = 3w^{-5-(-2)} = 3w^{-3} = \dfrac{3}{w^3}$

61. $\begin{aligned} 3a^{-2} \cdot 4a^{-6} &= 3 \cdot 4 \cdot a^{-2} \cdot a^{-6} \\ &= 12a^{-2+(-6)} \\ &= 12a^{-8} \\ &= \dfrac{12}{a^8} \end{aligned}$

62. $\left(-8v^4\right)\left(-3v^{-5}\right) = -8\cdot(-3)\cdot v^4\cdot v^{-5}$
$= 24v^{4+(-5)}$
$= 24v^{-1}$
$= \dfrac{24}{v}$

63. $\left(-3p^{-2}\right)\left(-p^3\right) = (-3)(-1)p^{-2}\cdot p^3$
$= 3p^{-2+3}$
$= 3p^1$
$= 3p$

64. $\left(2x^{-3}y^{-4}\right)\left(6x^{-4}y^7\right) = 2\cdot 6\cdot x^{-3}\cdot x^{-4}\cdot y^{-4}\cdot y^7$
$= 12x^{-3+(-4)}y^{-4+7}$
$= 12x^{-7}y^3$
$= \dfrac{12y^3}{x^7}$

65. $\left(5r^2s^{-2}\right)\left(-2r^5s^2\right) = 5(-2)r^2\cdot r^5\cdot s^{-2}\cdot s^2$
$= -10r^{2+5}\cdot s^{-2+2}$
$= -10r^7s^0$
$= -10r^7$

66. $\left(-6p^{-4}q^6\right)\left(2p^3q\right) = -6\cdot 2\cdot p^{-4}\cdot p^3\cdot q^6\cdot q^1$
$= -12\cdot p^{-4+3}\cdot q^{6+1}$
$= -12p^{-1}q^7$
$= -\dfrac{12q^7}{p}$

67. $\left(2x^4y^7\right)\left(4x^3y^{-5}\right) = 2\cdot 4\cdot x^4\cdot x^3\cdot y^7\cdot y^{-5}$
$= 8x^{4+3}y^{7+(-5)}$
$= 8x^7y^2$

68. $\left(3g^{-3}h^4\right)\left(5g^8h^{-4}\right) = 3\cdot 5\cdot g^{-3}\cdot g^8\cdot h^4\cdot h^{-4}$
$= 15g^{-3+8}h^{4+(-4)}$
$= 15g^5h^0$
$= 15g^5$

69. $\dfrac{33x^5y^{-4}}{11x^3y^2} = \left(\dfrac{33}{11}\right)\dfrac{x^{5-3}}{y^{2-(-4)}} = \dfrac{3x^2}{y^6}$

70. $\dfrac{\left(x^{-2}\right)\left(4x^2\right)}{x^3} = \dfrac{4x^{-2+2}}{x^3} = \dfrac{4x^0}{x^3} = \dfrac{4\cdot 1}{x^3} = \dfrac{4}{x^3}$

71. $\dfrac{9xy^{-4}z^3}{-3x^{-2}yz} = \left(\dfrac{9}{-3}\right)\dfrac{x^{1-(-2)}z^{3-1}}{y^{1-(-4)}} = -\dfrac{3x^3z^2}{y^5}$

72. $\dfrac{16x^{-2}y^3z^{-2}}{-2x^4y} = \left(\dfrac{16}{-2}\right)\dfrac{y^{3-1}}{x^{4-(-2)}z^2} = -\dfrac{8y^2}{x^6z^2}$

73. **a.** $4(a+b)^0 = 4\cdot 1 = 4$

b. $4a^0 + 4b^0 = 4\cdot a^0 + 4\cdot b^0$
$= 4\cdot 1 + 4\cdot 1$
$= 4 + 4$
$= 8$

c. $(4a+4b)^0 = 1$

d. $-4a^0 + 4b^0 = -4\cdot a^0 + 4\cdot b^0$
$= -4\cdot 1 + 4\cdot 1$
$= -4 + 4$
$= 0$

74. **a.** $-3^0 + (-3)^0 = -1\cdot 3^0 + (-3)^0$
$= -1\cdot 1 + 1$
$= -1 + 1$
$= 0$

b. $-3^0 - (-3)^0 = -1\cdot 3^0 - (-3)^0$
$= -1\cdot 1 - 1$
$= -1 - 1$
$= -2$

c. $-3^0 + 3^0 = -1\cdot 3^0 + 3^0$
$= -1\cdot 1 + 1$
$= -1 + 1$
$= 0$

d. $-3^0 - 3^0 = -1\cdot 3^0 - 3^0$
$= -1\cdot 1 - 1$
$= -1 - 1$
$= -2$

75. **a.** $4^{-1} - 3^{-1} = \dfrac{1}{4} - \dfrac{1}{3} = \dfrac{3}{12} - \dfrac{4}{12} = -\dfrac{1}{12}$

b. $4^{-1} + 3^{-1} = \dfrac{1}{4} + \dfrac{1}{3} = \dfrac{3}{12} + \dfrac{4}{12} = \dfrac{7}{12}$

c. $2\cdot 4^{-1}+3\cdot 5^{-1}=2\cdot\frac{1}{4}+3\cdot\frac{1}{5}$
$=\frac{2}{4}+\frac{3}{5}$
$=\frac{10}{20}+\frac{12}{20}$
$=\frac{22}{20}$
$=\frac{11}{10}$ or $1\frac{1}{10}$

d. $(2\cdot 4)^{-1}+(3\cdot 5)^{-1}=8^{-1}+15^{-1}$
$=\frac{1}{8}+\frac{1}{15}$
$=\frac{15}{120}+\frac{8}{120}$
$=\frac{23}{120}$

76. a. $5^{-2}+4^{-1}=\frac{1}{5^2}+\frac{1}{4}$
$=\frac{1}{25}+\frac{1}{4}$
$=\frac{4}{100}+\frac{25}{100}$
$=\frac{29}{100}$

b. $5^{-2}+4^{-1}=\frac{1}{5^2}-\frac{1}{4}$
$=\frac{1}{25}-\frac{1}{4}$
$=\frac{4}{100}-\frac{25}{100}$
$=-\frac{21}{100}$

c. $3\cdot 5^{-2}+2\cdot 4^{-1}=\frac{3}{5^2}+\frac{2}{4}$
$=\frac{3}{25}+\frac{2}{4}$
$=\frac{12}{100}+\frac{50}{100}$
$=\frac{62}{100}$
$=\frac{31}{50}$

d. $(3\cdot 5)^{-2}-(2\cdot 4)^{-1}=15^{-2}-8^{-1}$
$=\frac{1}{15^2}-\frac{1}{8}$
$=\frac{1}{225}-\frac{1}{8}$
$=\frac{8}{1800}-\frac{225}{1800}$
$=-\frac{217}{1800}$

77. $\left(3^{-2}\right)^2=3^{-2\cdot 2}=3^{-4}=\frac{1}{3^4}=\frac{1}{81}$

78. $\left(2^2\right)^{-3}=2^{2\cdot(-3)}=2^{-6}=\frac{1}{2^6}=\frac{1}{64}$

79. $\left(b^{-3}\right)^{-2}=b^{(-3)(-2)}=b^6$

80. $\left(z^{-5}\right)^{-3}=z^{-5(-3)}=z^{15}$

81. $(-c)^3=(-1\cdot c)^3=(-1)^3\cdot c^3=-1\cdot c^3=-c^3$

82. $(-c)^4=(-1\cdot c)^4=(-1)^4\cdot c^4=1\cdot c^4=c^4$

83. $(-x)^{-4}=\frac{1}{(-x)^4}=\frac{1}{x^4}$

84. $(-x)^{-3}=\frac{1}{(-x)^3}=-\frac{1}{x^3}$

85. $\left(-5x^{-3}\right)^2=(-5)^2\cdot\left(x^{-3}\right)^2=25\cdot x^{-6}=\frac{25}{x^6}$

86. $-11\left(x^{-3}\right)^2=-11\cdot x^{(-3)\cdot 2}=-11\cdot x^{-6}=-\frac{11}{x^6}$

87. $4^{-2}+8^{-1}=\frac{1}{16}+\frac{1}{8}=\frac{1}{16}+\frac{2}{16}=\frac{3}{16}$

88. $5^{-1}+2^{-1}=\frac{1}{5}+\frac{1}{2}=\frac{2}{10}+\frac{5}{10}=\frac{7}{10}$

89. $3\cdot 4^{-2}+9\cdot 8^{-1}=3\cdot\frac{1}{4^2}+9\cdot\frac{1}{8^1}$
$=3\cdot\frac{1}{16}+9\cdot\frac{1}{8}$
$=\frac{3}{16}+\frac{9}{8}$
$=\frac{3}{16}+\frac{18}{16}$
$=\frac{21}{16}$ or $1\frac{5}{16}$

90. $5\cdot 2^{-3}+7\cdot 4^{-2}=5\cdot\frac{1}{2^3}+7\cdot\frac{1}{4^2}$
$=5\cdot\frac{1}{8}+7\cdot\frac{1}{16}$
$=\frac{5}{8}+\frac{7}{16}$
$=\frac{10}{16}+\frac{7}{16}$
$=\frac{17}{16}$ or $1\frac{1}{16}$

91. $\left(\frac{4b}{3}\right)^{-2}=\left(\frac{3}{4b}\right)^{2}=\frac{3^2}{(4b)^2}=\frac{9}{16b^2}$

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

93. $\left(4x^2y^{-2}\right)^2=(4)^2\left(x^2\right)^2\left(y^{-2}\right)^2$
$=(4)^2x^{2\cdot 2}y^{(-2)\cdot 2}$
$=16x^4y^{-4}$
$=\frac{16x^4}{y^4}$

94. $\left(8s^{-3}t^{-4}\right)^2=8^2s^{(-3)\cdot 2}t^{(-4)\cdot 2}=8^2s^{-6}t^{-8}=\frac{64}{s^6t^8}$

95. $\left(5p^2q^{-4}\right)^{-3}=5^{-3}p^{2(-3)}q^{(-4)(-3)}$
$=5^{-3}p^{-6}q^{12}$
$=\frac{q^{12}}{5^3p^6}$
$=\frac{q^{12}}{125p^6}$

96. $\left(4x^2y^3\right)^{-3}=\frac{1}{\left(4x^2y^3\right)^3}=\frac{1}{4^3x^{2\cdot 3}y^{3\cdot 3}}=\frac{1}{64x^6y^9}$

97. $\left(-3g^{-4}h^3\right)^{-3}=(-3)^{-3}g^{(-4)(-3)}h^{3\cdot(-3)}$
$=(-3)^{-3}g^{12}h^{-9}$
$=\frac{g^{12}}{(-3)^3h^9}$
$=\frac{g^{12}}{-27h^9}$
$=-\frac{g^{12}}{27h^9}$

98. $8\left(x^2y^{-1}\right)^{-4}=8\cdot x^{2\cdot(-4)}y^{(-1)(-4)}=8x^{-8}y^4=\frac{8y^4}{x^8}$

99. $\left(\frac{5j}{4k^2}\right)^2=\frac{(5j)^2}{\left(4k^2\right)^2}=\frac{5^2j^2}{4^2k^{2\cdot 2}}=\frac{25j^2}{16k^4}$

100. $\left(\frac{3x^2y^4}{z}\right)^3=\frac{3^3x^{2\cdot 3}y^{4\cdot 3}}{z^3}=\frac{3^3x^6y^{12}}{z^3}=\frac{27x^6y^{12}}{z^3}$

101. $\left(\frac{2r^4s^5}{r^2}\right)^3=\left(2r^4r^{-2}s^5\right)^3$
$=\left(2r^2s^5\right)^3$
$=2^3r^{2\cdot 3}s^{5\cdot 3}$
$=8r^6s^{15}$

102. $\left(\frac{5m^5n^6}{10m^4n^7}\right)^3=\left(\frac{5m^5m^{-4}}{10n^7n^{-6}}\right)^3=\left(\frac{m^1}{2n^1}\right)^3=\frac{m^3}{2^3n^3}=\frac{m^3}{8n^3}$

103. $\left(\frac{4xy}{y^3}\right)^{-3}=\left(\frac{y^3}{4xy}\right)^3$
$=\left(\frac{y^3y^{-1}}{4x}\right)^3$
$=\frac{\left(y^2\right)^3}{(4x)^3}$
$=\frac{y^{2\cdot 3}}{4^3x^3}$
$=\frac{y^6}{64x^3}$

104. $\left(\frac{14x^2y}{7xz}\right)^{-3} = \left(\frac{7xz}{14x^2y}\right)^3$

$= \left(\frac{z}{2x^2x^{-1}y}\right)^3$

$= \left(\frac{z}{2xy}\right)^3$

$= \frac{z^3}{2^3x^3y^3}$

$= \frac{z^3}{8x^3y^3}$

105. $\left(\frac{9x^{-2}}{xy}\right)^{-2} = \left(\frac{xy}{9x^{-2}}\right)^2$

$= \left(\frac{x \cdot x^2y}{9}\right)^2$

$= \left(\frac{x^3y}{9}\right)^2$

$= \frac{x^{3\cdot2}y^2}{9^2}$

$= \frac{x^6y^2}{81}$

106. $\left(\frac{4x^2y}{x^{-5}}\right)^{-3} = \left(\frac{x^{-5}}{4x^2y}\right)^3$

$= \left(\frac{1}{4x^2x^5y}\right)^3$

$= \left(\frac{1}{4x^7y}\right)^3$

$= \frac{1^3}{4^3x^{7\cdot3}y^3}$

$= \frac{1}{64x^{21}y^3}$

107. $\left(\frac{5x^{-2}y}{x^{-5}}\right)^3 = \left(5x^{-2}x^5y\right)^3$

$= \left(5x^3y\right)^3$

$= 5^3x^{3\cdot3}y^3$

$= 125x^9y^3$

108. $\left(\frac{3xy}{z^{-2}}\right)^3 = \left(3xyz^2\right)^3$

$= 3^3x^3y^3\left(z^2\right)^3$

$= 27x^3y^3z^{2\cdot3}$

$= 27x^3y^3z^6$

109. $\left(\frac{a^0b^2c^{-3}}{a^{-5}b^6c^{-7}}\right)^{-1} = \frac{a^{-5}b^6c^{-7}}{a^0b^2c^{-3}} = \frac{a^{-5-0}b^{6-2}}{c^{-3-(-7)}} = \frac{b^4}{a^5c^4}$

110. $\left(\frac{x^2y^{-3}z^6}{x^{-1}y^2z^4}\right)^{-1} = \left(\frac{x^{2-(-1)}z^{6-4}}{y^{2-(-3)}}\right)^{-1} = \left(\frac{x^3z^2}{y^5}\right)^{-1} = \frac{y^5}{x^3z^2}$

111. $\left(\frac{4x^{-1}y^{-2}z^3}{2xy^2z^{-3}}\right)^{-2} = \left(\frac{2z^{3-(-3)}}{x^{1-(-1)}y^{2-(-2)}}\right)^{-2}$

$= \left(\frac{2z^6}{x^2y^4}\right)^{-2}$

$= \left(\frac{x^2y^4}{2z^6}\right)^2$

$= \frac{\left(x^2\right)^2\left(y^4\right)^2}{2^2\left(z^6\right)^2}$

$= \frac{x^4y^8}{4z^{12}}$

112. $\left(\frac{9x^4y^{-6}z^4}{3xy^{-6}z^{-2}}\right)^{-2} = \left(\frac{3xy^{-6}z^{-2}}{9x^4y^{-6}z^4}\right)^2$

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

$= \left(\frac{y^0}{3x^3z^6}\right)^2$

$= \frac{y^{0\cdot2}}{3^2x^{3\cdot2}z^{6\cdot2}}$

$= \frac{y^0}{3^2x^6z^{12}}$

$= \frac{1}{9x^6z^{12}}$

113. $\dfrac{\left(2x^{-1}y^{-2}\right)^{-3}}{\left(5x^{-1}y^{3}\right)^{2}} = \dfrac{2^{-3}\left(x^{-1}\right)^{-3}\left(y^{-2}\right)^{-3}}{5^{2}\left(x^{-1}\right)^{2}\left(y^{3}\right)^{2}}$

$= \dfrac{2^{-3}x^{3}y^{6}}{5^{2}x^{-2}y^{6}}$

$= \dfrac{x^{3-(-2)}y^{6-6}}{2^{3}\cdot 5^{2}}$

$= \dfrac{x^{5}y^{0}}{8\cdot 25}$

$= \dfrac{x^{5}}{200}$

114. $\dfrac{\left(2xy^{2}z^{-3}\right)^{2}}{\left(9x^{-1}yz^{2}\right)^{-1}} = \dfrac{2^{2}x^{2}y^{2\cdot 2}z^{-3\cdot 2}}{9^{-1}x^{-1\cdot(-1)}y^{-1}z^{2(-1)}}$

$= \dfrac{4x^{2}y^{4}z^{-6}}{9^{-1}x^{1}y^{-1}z^{-2}}$

$= \dfrac{4\cdot 9x^{2-1}y^{4-(-1)}}{z^{-2-(-6)}}$

$= \dfrac{36xy^{5}}{z^{4}}$

115. $\dfrac{\left(2x^{4}y^{0}z^{-5}\right)^{-3}}{\left(3x^{2}y^{5}z^{3}\right)^{-2}} = \dfrac{2^{-3}x^{4(-3)}y^{0(-3)}z^{-5(-3)}}{3^{-3}x^{2(-2)}y^{5(-2)}z^{3(-2)}}$

$= \dfrac{2^{-3}x^{-12}y^{0}z^{15}}{3^{-2}x^{-4}y^{-10}z^{-6}}$

$= \dfrac{3^{2}y^{0-(-10)}z^{15-(-6)}}{2^{3}x^{-4-(-12)}}$

$= \dfrac{9y^{10}z^{21}}{8x^{8}}$

116. $\dfrac{\left(4a^{-3}b^{5}c^{-3}\right)^{-4}}{\left(5a^{0}b^{-9}c^{4}\right)^{-2}} = \dfrac{4^{-4}a^{-3(-4)}b^{5(-4)}c^{-3(-4)}}{5^{-2}a^{0(-2)}b^{-9(-2)}c^{4(-2)}}$

$= \dfrac{4^{-4}a^{12}b^{-20}c^{12}}{5^{-2}a^{0}b^{18}c^{-8}}$

$= \dfrac{5^{2}a^{12-0}c^{12-(-8)}}{4^{4}b^{-18-20}}$

$= \dfrac{25a^{12}c^{20}}{256b^{38}}$

117. $x^{2a}\cdot x^{5a+3} = x^{2a+5a+3} = x^{7a+3}$

118. $y^{2m+3}\cdot y^{5m-7} = y^{2m+3+5m-7} = y^{7m-4}$

119. $w^{2a-5}\cdot w^{3a-2} = w^{2a-5+3a-2} = w^{5a-7}$

120. $d^{-4x+7}\cdot d^{5x-6} = d^{-4x+7+5x-6} = d^{x+1}$

121. $\dfrac{x^{2w+3}}{x^{w-4}} = x^{2w+3-(w-4)} = x^{2w+3-w+4} = x^{w+7}$

122. $\dfrac{y^{5m-1}}{y^{7m-1}} = y^{(5m-1)-(7m-1)}$

$= y^{5m-1-7m+1}$

$= y^{-2m+0}$

$= y^{-2m}$

$= \dfrac{1}{y^{2m}}$

123. $\left(x^{3p+5}\right)\left(x^{2p-3}\right) = x^{3p+5+2p-3} = x^{5p+2}$

124. $\left(s^{2t-3}\right)\left(s^{-t+5}\right) = s^{(2t-3)+(-t+5)} = s^{t+2}$

125. $x^{-m}\left(x^{3m+2}\right) = x^{-m}x^{3m+2} = x^{-m+3m+2} = x^{2m+2}$

126. $y^{3b+2}\cdot y^{2b+4} = y^{3b+2+2b+4} = y^{5b+6}$

127. $\dfrac{30m^{a+b}n^{b-a}}{6m^{a-b}n^{a+b}} = \left(\dfrac{30}{6}\right)\dfrac{m^{a+b-(a-b)}}{n^{a+b-(b-a)}}$

$= \dfrac{5m^{a+b-a+b}}{n^{a+b-b+a}}$

$= \dfrac{5m^{2b}}{n^{2a}}$

128. $\dfrac{24x^{c+3}y^{d+4}}{8x^{c-4}y^{d+6}} = \left(\dfrac{24}{8}\right)\dfrac{x^{c+3-(c-4)}}{y^{d+6-(d+4)}}$

$= \dfrac{3x^{c+3-c+4}}{y^{d+6-d-4}}$

$= \dfrac{3x^{7}}{y^{2}}$

129. **a.** $x^{4} > x^{3}$ when $x < 0$ or $x > 1$

b. $x^{4} < x^{3}$ when $0 < x < 1$

c. $x^{4} = x^{3}$ when $x = 0$ or $x = 1$

d. x^{4} is not greater than x^{3} when $0 \le x \le 1$

130. $3^{-8} = \dfrac{1}{3^{8}}$

$2^{-8} = \dfrac{1}{2^{8}}$

Since $\dfrac{1}{3^{8}} < \dfrac{1}{2^{8}}$, then $3^{-8} < 2^{-8}$.

131. a. $(-1)^n = 1$ for any even number n because an even number of negative factors is positive.

b. $(-1)^n = -1$ for any odd number n because an odd number of negative factors is negative.

132. a. $(-12)^{-8} = \dfrac{1}{(-12)^8}$ which is positive.

b. $(-12)^{-7} = \dfrac{1}{(-12)^7}$ which is negative.

133. a. Yes, $\left(-\dfrac{2}{3}\right)^{-2} = \left(\dfrac{2}{3}\right)^{-2}$. By the negative exponent rule, $\left(-\dfrac{2}{3}\right)^{-2} = \left(-\dfrac{3}{2}\right)^{2} = \dfrac{9}{4}$ and $\left(\dfrac{2}{3}\right)^{-2} = \left(\dfrac{3}{2}\right)^{2} = \dfrac{9}{4}$.

b. Yes. $x^{-2} = \dfrac{1}{x^2}$, $x \neq 0$, and $(-x)^{-2} = \dfrac{1}{(-x)^2} = \dfrac{1}{x^2}$, $x \neq 0$.

134. a. No, $\left(-\dfrac{2}{3}\right)^{-3}$ and $\left(\dfrac{2}{3}\right)^{-3}$ are not equal:

$$\left(-\frac{2}{3}\right)^{-3} = \left(-\frac{3}{2}\right)^{3} = \left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{3}{2}\right) = -\frac{27}{8}$$

while $\left(\dfrac{2}{3}\right)^{-3} = \left(\dfrac{3}{2}\right)^{3} = \left(\dfrac{3}{2}\right)\left(\dfrac{3}{2}\right)\left(\dfrac{3}{2}\right) = \dfrac{27}{8}$

b. No. $x^{-3} = \dfrac{1}{x^3}$ while $(-x)^{-3} = \dfrac{1}{(-x)^3} = -\dfrac{1}{x^3}$.

c. $(-x)^{-3} = \dfrac{1}{(-x)^3} = -\dfrac{1}{x^3} = -x^{-3}$. They are opposites.

135. Let a represent the unknown exponent,

$$\left(\frac{x^2y^{-2}}{x^{-3}y^a}\right)^2 = x^{10}y^2$$
$$\left(x^{2-(-3)}y^{-2-a}\right)^2 = x^{10}y^2$$
$$\left(x^5y^{-2-a}\right)^2 = x^{10}y^2$$
$$x^{10}y^{2(-2-a)} = x^{10}y^2$$
$$x^{10}y^{-4-2a} = x^{10}y^2$$

Thus, $-4-2a = 2$

$$2a = -4-2$$
$$2a = -6$$
$$a = -3$$

136. Let a represent the unknown exponent.

$$\left(\frac{x^{-2}y^3z}{x^4y^az^{-3}}\right)^3 = \frac{z^{12}}{x^{18}y^6}$$
$$\left(\frac{z^{1-(-3)}}{x^{4-(-2)}y^{a-3}}\right)^3 = \frac{z^{12}}{x^{18}y^6}$$
$$\left(\frac{z^4}{x^6y^{a-3}}\right)^3 = \frac{z^{12}}{x^{18}y^6}$$
$$\frac{z^{4\cdot3}}{x^{6\cdot3}y^{3(a-3)}} = \frac{z^{12}}{x^{18}y^6}$$
$$\frac{z^{12}}{x^{18}y^{3a-9}} = \frac{z^{12}}{x^{18}y^6}$$

Thus, $3a-9 = 6$

$$3a = 15$$
$$a = 5$$

137. Let a and b represent the unknown exponents.

$$\left(\frac{x^ay^5z^{-2}}{x^4y^bz}\right)^{-1} = \frac{x^5z^3}{y^2}$$
$$\left(\frac{y^{5-b}}{x^{4-a}z^{1-(-2)}}\right)^{-1} = \frac{x^5z^3}{y^2}$$
$$\frac{x^{4-a}z^3}{y^{5-b}} = \frac{x^5z^3}{y^2}$$

Thus, $4-a = 5$

$$a = -1$$

and $5-b = 2$

$$b = 3$$

138. $\left(\dfrac{x^{1/2}}{x^{-1}}\right)^{3/2} = \left(x^{1/2-(-1)}\right)^{3/2}$

$= \left(x^{3/2}\right)^{3/2}$

$= x^{(3/2)\cdot(3/2)}$

$= x^{9/4}$

139. $\left(\dfrac{x^{5/8}}{x^{1/4}}\right)^{3} = \left(x^{5/8-1/4}\right)^{3} = \left(x^{3/8}\right)^{3} = x^{(3/8)\cdot 3} = x^{9/8}$

140. $\left(\dfrac{x^{4}}{x^{-1/2}}\right)^{-1} = \left(x^{4-(-1/2)}\right)^{-1}$

$= \left(x^{9/2}\right)^{-1}$

$= x^{(9/2)\cdot(-1)}$

$= x^{-9/2}$

$= \dfrac{1}{x^{9/2}}$

141. $\dfrac{x^{1/2}y^{-3/2}}{x^{5}y^{5/3}} = \dfrac{1}{x^{5-1/2}y^{5/3-(-3/2)}} = \dfrac{1}{x^{9/2}y^{19/6}}$

142. $\left(\dfrac{x^{1/2}y^{4}}{x^{-3}y^{5/2}}\right)^{2} = \left(x^{1/2-(-3)}y^{4-5/2}\right)^{2}$

$= \left(x^{7/2}y^{3/2}\right)^{2}$

$= x^{(7/2)\cdot 2}y^{(3/2)\cdot 2}$

$= x^{7}y^{3}$

143. **a.** 1, 2, 4, 8, 16, and 32 cents.

b. $2^0, 2^1, 2^2, 2^3, 2^4, 2^5$

c. 2^{10}

d. 2^{n-1}

e. 2^{29}

f. $2^{29} \approx 536{,}870{,}912$ cents

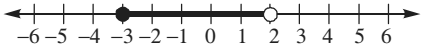
g. $\dfrac{536{,}870{,}912 \text{ cents}}{100 \text{ cents/\$}} = \$5{,}368{,}709.12$

h. $\dfrac{2^{n-1}}{100}$

144. **a.** $A \cup B = \{1, 2, 3, 4, 5, 6, 9\}$

b. $A \cap B = \{\ \}$ or $\varnothing$

145. $\{x \mid -3 \le x < 2\}$



146. $8 + |12| \div |-3| - 4 \cdot 2^2 = 8 + 12 \div 3 - 4 \cdot 2^2$

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

$= 8 + 4 - 16$

$= 12 - 16$

$= -4$

147. $\sqrt[3]{-125} = -5$ because $(-5)(-5)(-5) = -125$

Exercise Set 1.6

1. Assume that $a \times 10^b$ represents a number written in scientific notation. Then a must be a number greater than or equal to one and less than 10.

2. Assume that $a \times 10^b$ represents a number written in scientific notation. Then b must be an integer.

3. Assume that $a \times 10^b$ represents a number written in scientific notation that is less than one. Then b must be a negative integer.

4. Assume that $a \times 10^b$ represents a number written in scientific notation that is greater than or equal to one. Then b must be a nonnegative integer.

5. $3700 = 3.7 \times 10^3$

6. $860 = 8.6 \times 10^2$

7. $0.043 = 4.3 \times 10^{-2}$

8. $0.000000918 = 9.18 \times 10^{-7}$

9. $760{,}000 = 7.6 \times 10^5$

10. $9{,}260{,}000{,}000 = 9.26 \times 10^9$

11. $0.00000186 = 1.86 \times 10^{-6}$

12. $0.00000914 = 9.14 \times 10^{-6}$

13. $5{,}780{,}000 = 5.78 \times 10^6$

14. $952{,}000{,}000 = 9.52 \times 10^8$

15. $0.000106 = 1.06 \times 10^{-4}$

16. $0.0000723 = 7.23 \times 10^{-5}$

17. $3.1 \times 10^4 = 31{,}000$

18. $5 \times 10^8 = 500{,}000{,}000$

19. $2.13 \times 10^{-5} = 0.0000213$

20. $6.78\times10^{-5}=0.0000678$

21. $9.17\times10^{-1}=0.917$

22. $4.56\times10^{-1}=0.456$

23. $9.3\times10^{1}=93$

24. $5.4\times10^{1}=54$

25. $3.0\times10^{6}=3,000,000$

26. $7.6\times10^{4}=76,000$

27. $1\times10^{6}=1,000,000$

28. $1\times10^{-8}=0.00000001$

29. $\left(4\times10^{5}\right)\left(6\times10^{2}\right)=(4\times6)\left(10^{5}\times10^{2}\right)$
$=24\times10^{7}$
$=240,000,000$

30. $\left(8\times10^{4}\right)\left(6\times10^{3}\right)=(8\times6)\left(10^{4}\times10^{3}\right)$
$=48\times10^{7}$
$=480,000,000$

31. $\left(8.2\times10^{5}\right)\left(1.4\times10^{-2}\right)=(8.2\times1.4)\left(10^{5}\times10^{-2}\right)$
$=11.48\times10^{3}$
$=11,480$

32. $\left(6.3\times10^{4}\right)\left(3.7\times10^{-8}\right)=(6.3\times3.7)\left(10^{4}\times10^{-8}\right)$
$=23.31\times10^{-4}$
$=0.002331$

33. $\left(9.1\times10^{-4}\right)\left(7.4\times10^{-4}\right)=(9.1\times7.4)\left(10^{-4}\times10^{-4}\right)$
$=67.34\times10^{-8}$
$=0.0000006734$

34. $\left(7.6\times10^{-3}\right)\left(1.2\times10^{-1}\right)=(7.6\times1.2)\left(10^{-3}\times10^{-1}\right)$
$=9.12\times10^{-4}$
$=0.000912$

35. $\dfrac{1.68\times10^{4}}{5.6\times10^{7}}=\left(\dfrac{1.68}{5.6}\right)\times10^{4-7}=0.3\times10^{-3}=0.0003$

36. $\dfrac{9.3\times10^{13}}{6.2\times10^{8}}=\left(\dfrac{9.3}{6.2}\right)\times10^{13-8}=1.5\times10^{5}=150,000$

37. $\dfrac{9.45\times10^{-3}}{3.5\times10^{2}}=\left(\dfrac{9.45}{3.5}\right)\times10^{-3-2}$
$=2.7\times10^{-5}$
$=0.000027$

38. $\dfrac{8.5\times10^{3}}{1.7\times10^{-2}}=\left(\dfrac{8.5}{1.7}\right)\times10^{3-(-2)}=5\times10^{5}=500,000$

39. $\dfrac{8.4\times10^{-6}}{4\times10^{-4}}=\left(\dfrac{8.4}{4}\right)\times10^{-6-(-4)}=2.1\times10^{-2}=0.021$

40. $\dfrac{7.2\times10^{-2}}{3.6\times10^{-6}}=\left(\dfrac{7.2}{3.6}\right)\times10^{-2-(-6)}=2\times10^{4}=20,000$

41. $(0.03)(0.0005)=\left(3\times10^{-2}\right)\left(5\times10^{-4}\right)$
$=(3\times5)\left(10^{-2}\times10^{-4}\right)$
$=15\times10^{-6}$
$=1.5\times10^{-5}$

42. $(2500)(7000)=\left(2.5\times10^{3}\right)\left(7\times10^{3}\right)$
$=(2.5\times7)\left(10^{3}\times10^{3}\right)$
$=17.5\times10^{6}$
$=1.75\times10^{7}$

43. $\dfrac{35,000,000}{7000}=\dfrac{3.5\times10^{7}}{7.0\times10^{3}}$
$=\left(\dfrac{3.5}{7}\right)\times10^{7-3}$
$=0.5\times10^{4}$
$=5.0\times10^{3}$

44. $\dfrac{560,000}{0.0008}=\dfrac{5.6\times10^{5}}{8.0\times10^{-4}}$
$=\left(\dfrac{5.6}{8.0}\right)\times10^{5-(-4)}$
$=0.7\times10^{9}$
$=7\times10^{8}$

45. $\dfrac{0.00069}{23,000}=\dfrac{6.9\times10^{-4}}{2.3\times10^{4}}=\left(\dfrac{6.9}{2.3}\right)\times10^{-4-4}=3.0\times10^{-8}$

46. $\dfrac{0.000018}{0.000009}=\dfrac{1.8\times10^{-5}}{9.0\times10^{-6}}$

$=\left(\dfrac{1.8}{9.0}\right)\times10^{-5-(-6)}$

$=0.2\times10^{1}$

$=2.0\times10^{0}$

47. $(47{,}000)(35{,}000{,}000)=\left(4.7\times10^{4}\right)\left(3.5\times10^{7}\right)$

$=(4.7\times3.5)\left(10^{4}\times10^{7}\right)$

$=16.45\times10^{11}$

$=1.645\times10^{12}$

48. $(0.0015)(0.00038)=\left(1.5\times10^{-3}\right)\left(3.8\times10^{-4}\right)$

$=(1.5\times3.8)\left(10^{-3}\times10^{-4}\right)$

$=5.7\times10^{-7}$

49. $\dfrac{2016}{0.0021}=\dfrac{2.016\times10^{3}}{2.1\times10^{-3}}$

$=\left(\dfrac{2.016}{2.1}\right)\times10^{3-(-3)}$

$=0.96\times10^{6}$

$=9.6\times10^{5}$

50. $\dfrac{0.018}{160}=\dfrac{1.8\times10^{-2}}{1.6\times10^{2}}$

$=\left(\dfrac{1.8}{1.6}\right)\times10^{-2-2}$

$=1.125\times10^{-4}$

51. $\dfrac{0.00153}{0.00051}=\dfrac{1.53\times10^{-3}}{5.1\times10^{-4}}$

$=\left(\dfrac{1.53}{5.1}\right)\times10^{-3+4}$

$=0.3\times10^{1}$

$=3.0\times10^{0}$

52. $\dfrac{0.0000286}{0.00143}=\dfrac{2.82\times10^{-5}}{1.41\times10^{-3}}$

$=\left(\dfrac{2.82}{1.41}\right)\times10^{-5-(-3)}$

$=2.0\times10^{-2}$

53. $\left(4.78\times10^{9}\right)\left(1.96\times10^{5}\right)=(4.78\times1.96)\left(10^{9}\times10^{5}\right)$

$=9.3688\times10^{14}$

$\approx9.369\times10^{14}$

54. $\left(4.9\times10^{5}\right)\left(1.347\times10^{31}\right)$

$=(4.9\times1.347)\left(10^{5}\times10^{31}\right)$

$=6.6003\times10^{36}$

$\approx6.600\times10^{36}$

55. $\left(7.23\times10^{-3}\right)\left(1.46\times10^{5}\right)$

$=(7.23\times1.46)\left(10^{-3}\times10^{5}\right)$

$=10.5558\times10^{2}$

$=1.05558\times10^{3}$

$\approx1.056\times10^{3}$

56. $\left(4.16\times10^{3}\right)\left(9.14\times10^{-31}\right)$

$=\left(4.16\times9.14\right)\left(10^{3}\times10^{-31}\right)$

$=38.0224\times10^{-28}$

$=3.80224\times10^{-27}$

$\approx3.802\times10^{-27}$

57. $\left(2.14\times10^{-3}\right)\left(3.79\times10^{-15}\right)$

$=\left(2.14\times3.79\right)\left(10^{-3}\times10^{-15}\right)$

$=8.1106\times10^{-18}$

$\approx8.111\times10^{-18}$

58. $\left(4.36\times10^{-6}\right)\left(1.07\times10^{-6}\right)$

$=(4.36\times1.07)\left(10^{-6}\times10^{-6}\right)$

$=4.6652\times10^{-12}$

$\approx4.665\times10^{-12}$

59. $\dfrac{5.55\times10^{3}}{1.11\times10^{1}}=\left(\dfrac{5.55}{1.11}\right)\times10^{3-1}=5.0\times10^{2}$

60. $\dfrac{9.675\times10^{25}}{3.225\times10^{15}}=\left(\dfrac{9.675}{3.225}\right)\times10^{25-15}=3.0\times10^{10}$

61. $\dfrac{1.5\times10^{35}}{4.5\times10^{-26}}=\left(\dfrac{1.5}{4.5}\right)\times10^{35-(-26)}$

$=0.\overline{3}\times10^{61}$

$=3.333\times10^{60}$

62. $\dfrac{3.71\times10^{11}}{4.72\times10^{-9}}=\left(\dfrac{3.71}{4.72}\right)\times10^{11-(-9)}$

$\approx0.78602\times10^{20}$

$\approx7.860\times10^{19}$

63. $\dfrac{4.36\times10^{-4}}{8.17\times10^{-7}}=\left(\dfrac{4.36}{8.17}\right)\times10^{-4-(-7)}$
$=0.5337\times10^{3}$
$=5.337\times10^{2}$

64. $\dfrac{2.47\times10^{-16}}{1.59\times10^{-3}}=\left(\dfrac{2.47}{1.59}\right)\times10^{-16-(-3)}$
$\approx1.55345\times10^{-13}$
$\approx1.553\times10^{-13}$

65. 2.5 billion $=2,500,000,000=2.5\times10^{9}$

66. 93 million $=93,000,000=9.3\times10^{7}$

67. 510.1 million $=510,100,000=5.101\times10^{8}$

68. 9.3 billion $=9,300,000,000=9.3\times10^{9}$

69. 69 billion $=69,000,000,000=6.9\times10^{10}$

70. 61 billion $=61,000,000,000=6.1\times10^{10}$

71. 16.54 trillion $=16,540,000,000,000=1.654\times10^{13}$

72. 15.62 trillion $=15,620,000,000,000=1.562\times10^{13}$

73. $0.0000254=2.54\times10^{-5}$

74. $0.000000000106=1.06\times10^{-10}$

75. $0.0000158=1.58\times10^{-5}$

76. $0.00003125=3.125\times10^{-5}$

77. $0.000000001=1\times10^{-9}$

78. $0.000000000000000037=3.7\times10^{-17}$

79. a. $\dfrac{1.42\times10^{6}}{27.5}=\dfrac{1.42\times10^{6}}{2.75\times10}$
$=\left(\dfrac{1.42}{2.75}\right)\times10^{6-1}$
$\approx0.516364\times10^{5}$
$\approx51,636.4$
It travels about 51,636.4 miles per day.

b. $\dfrac{1.42\times10^{6}}{(27.5\times24)}=\dfrac{1.42\times10^{6}}{660}$
$=\dfrac{1.42\times10^{6}}{6.60\times10^{2}}$
$=\left(\dfrac{1.42}{6.60}\right)\times10^{6-2}$
$\approx0.21515\times10^{4}$
≈2151.5
It travels about 2151.5 miles per hour.

80. a. $\dfrac{5.85\times10^{8}}{365.3}=\dfrac{5.85\times10^{8}}{3.653\times10^{2}}$
$=\left(\dfrac{5.85}{3.653}\right)\times10^{8-2}$
$\approx1.6014235\times10^{6}$
$\approx1,601,423.5$
It travels about 1,601,423.5 miles per day.

b. $\dfrac{5.85\times10^{8}}{(365.3\times24)}=\dfrac{5.85\times10^{8}}{8767.2}$
$=\dfrac{5.85\times10^{8}}{8.7672\times10^{3}}$
$=\left(\dfrac{5.85}{8.7672}\right)\times10^{8-3}$
$\approx0.66726\times10^{6}$
$\approx66,726.0$
It travels about 66,726.0 miles per hour.

81. a. $\dfrac{9.3\times10^{7}}{3.6\times10^{4}}=\left(\dfrac{9.3}{3.6}\right)\times10^{7-4}$
$\approx2.5833\times10^{3}$
≈2583.3
It would take about 2583.3 hours.

b. $\dfrac{2.5833\times10^{3}}{24}=\dfrac{2.5833\times10^{3}}{2.4\times10}$
$=\left(\dfrac{2.5833}{2.4}\right)\times10^{3-1}$
$\approx1.076\times10^{3}$
≈107.6
It would take about 107.6 days.

82. a. $\dfrac{2.5\times10^{13}}{3.6\times10^{4}}=\left(\dfrac{2.5}{3.6}\right)\times10^{13-4}$
$\approx0.6944444444\times10^{9}$
$\approx694,444,444.4$
It would take about 694,444,444.4 hours.

b. $\dfrac{694,444,444.4}{24} = \dfrac{6.944444444\times10^8}{2.4\times10}$

$= \left(\dfrac{6.944444444}{2.4}\right)\times10^{8-1}$

$\approx 2.89351852\times10^7$

$\approx 28,935,185.2$

It would take about 28,925,185.2 days.

c. $\dfrac{2.89351852\times10^7}{365} = \dfrac{2.89351852\times10^7}{3.65\times10^2}$

$= \left(\dfrac{2.89351852}{3.65}\right)\times10^{7-2}$

$\approx 0.792745\times10^5$

$\approx 79,274.5$

It would take about 79,274.5 years.

83. a. $7.059\times10^9 - 3.154\times10^8$

$= 7.059\times10^9 - 0.3154\times10^1\times10^8$

$= 7.059\times10^9 - 0.3154\times10^9$

$= 6.7436\times10^9$

$\approx 6.744\times10^9$

About 6.744×10^9 people lived outside of the United States in 2013.

b. $\dfrac{3.154\times10^8}{7.059\times10^9} = \left(\dfrac{3.154}{7.059}\right)\times10^{8-9}$

$\approx 0.4468\times10^{-1}$

≈ 0.04468

$\approx 4.47\%$

About 4.47% of the world's population lived in the United States in 2013.

84. a. $7.059\times10^9 - 1.347\times10^9 = 5.712\times10^9$

About 5.712×10^9 people lived outside of the United States in 2013.

b. $\dfrac{1.347\times10^9}{7.059\times10^9} = \left(\dfrac{1.347}{7.059}\right)\times10^{9-9}$

$\approx 0.1908\times10^0$

≈ 0.1908

$\approx 19.08\%$

About 19.08% of the world's population lived in China in 2013.

85. a. $15,094,000,000,000 = 1.5094\times10^{13}$

$315,100,000 = 3.151\times10^8$

b. $\dfrac{1.5094\times10^{13}}{3.151\times10^8} = \left(\dfrac{1.5094}{3.151}\right)\times10^{13-8}$

$\approx 0.4790225\times10^5$

$\approx 47,902,25$

The GDP per capita is about $47,902.25.

86. a. $7,298,100,000,000 = 7.2981\times10^{12}$

$1,354,000,000 = 1.354\times10^9$

b. $\dfrac{7.2981\times10^{12}}{1.354\times10^9} = \left(\dfrac{7.2981}{1.354}\right)\times10^{12-9}$

$\approx 5.39003\times10^3$

$\approx 5390.03\times10^3$

The GDP per capita is about $5390.03.

87. a. $1.789\times10^9 - 1.714\times10^9 = 0.075\times10^9$

$= 75,000,000$

The difference is 75,000,000 lbs.

b. $\dfrac{75,000,000}{1.789\times10^9} = \dfrac{7.5\times10^7}{1.789\times10^9}$

$= \left(\dfrac{7.5}{1.789}\right)\times10^{7-9}$

$\approx 4.19\times10^{-2}$

≈ 0.0419

$\approx 41.9\%$

The weight of the bridge decreased by 0.0419 or 4.19%.

88. a. $\dfrac{8.80\times10^7}{1.84\times10^5} = \left(\dfrac{8.80}{1.84}\right)\times10^{7-5}$

$\approx 4.7826\times10^2$

≈ 478.26

The total weight of the New River Gorge Bridge is about 478.26 times greater than the weight of its heaviest piece.

b. $8.80\times10^7 - 1.84\times10^5$

$= 8.80\times10^7 - 0.0184\times10^2\times10^5$

$= 8.80\times10^7 - 0.0184\times10^7$

$= 8.7816\times10^7$

$= 87,816,000$

The difference in weight between the total weight of the bridge and the weight of the heaviest single piece is about 8.7816×10^7 or 87,816,000 pounds.

89. $\left(1\times10^{22}\right)\left(2.3\times10^{-4}\right)=\left(1\times2.3\right)\left(10^{22}\times10^{-4}\right)$
$=2.3\times10^{18}$
There are about 2.3×10^{18} silicon dioxide molecules in a grain of sand.

90. $\left(9.5\times10^{21}\right)\left(0.73\right)=\left(9.5\times10^{21}\right)\left(7.3\times10^{-1}\right)$
$=\left(9.5\times7.3\right)\left(10^{21}\times10^{-1}\right)$
$=69.35\times10^{20}$
$\approx6.94\times10^{21}$
There are about 6.94×10^{21} copper atoms in one inch of 12-gague copper wire.

91. a. Indonesia: $238,000,000=2.38\times10^{8}$
United States: $316,000,000=3.16\times10^{8}$
India: $1,210,000,000=1.210\times10^{9}$
China: $1,354,000,000=1.354\times10^{9}$

b. $1.210\times10^{9}+1.354\times10^{9}=2.564\times10^{9}$

c. $2.38\times10^{8}+3.16\times10^{8}=5.54\times10^{8}$

d. $\dfrac{2.564\times10^{9}}{5.54\times10^{8}}=\left(\dfrac{2.564}{5.54}\right)\times10^{9}$
$\approx0.463\times10$
≈4.63
The combined populations of China and India are about 4.6 times greater than the combined populations of the United States and India.

92. a. Indonesia: $699,500=6.995\times10^{5}$
United States: $3,536,000=3.536\times10^{6}$
India: $1,148,000=1.148\times10^{6}$
China: $3,695,000=3.695\times10^{6}$

b. $\dfrac{2.38\times10^{8}}{6.995\times10^{5}}=\left(\dfrac{2.38}{6.995}\right)\times10^{3}$
$\approx0.340\times10^{3}$
≈340
Indonesia's population density is around 340 people/mi^2.

c. $\dfrac{3.16\times10^{8}}{3.536\times10^{6}}=\left(\dfrac{3.16}{3.536}\right)\times10^{2}$
$\approx0.89\times10^{2}$
≈89
The United States' population density is around 89 people/mi^2.

d. $\dfrac{1.210\times10^{9}}{1.148\times10^{6}}=\left(\dfrac{1.210}{1.148}\right)\times10^{3}$
$\approx1.054\times10^{3}$
≈1054
India's population density is around 1054 people/mi^2.

e. $\dfrac{1.354\times10^{9}}{3.695\times10^{6}}=\left(\dfrac{1.354}{3.695}\right)\times10^{3}$
$\approx0.366\times10^{3}$
≈366
China's population density is around 366 people/mi^2.

93. a. $0.37\left(2.303\times10^{12}\right)=\left(3.7\times10^{-1}\right)\left(2.303\times10^{12}\right)$
$=\left(3.7\times2.303\right)\times10^{-1+12}$
$=8.5211\times10^{11}$
$\$8.5211\times10^{11}$ was spent on Social Security, Medicare, and other Retirement in 2011.

b. $0.24\left(2.303\times10^{12}\right)=\left(2.4\times10^{-1}\right)\left(2.303\times10^{12}\right)$
$=\left(2.4\times2.303\right)\times10^{-1+12}$
$=5.5272\times10^{11}$
$\$5.5272\times10^{11}$ was spent on National Defense, Veterans, and Foreign Affairs in 2011.

c. $0.06\left(2.303\times10^{12}\right)=\left(6.0\times10^{-2}\right)\left(2.303\times10^{12}\right)$
$=\left(6.0\times2.303\right)\times10^{-2+12}$
$=13.818\times10^{10}$
$=1.3818\times10^{11}$
$\$1.3818\times10^{11}$ was spent on Net Interest on the Debt in 2011.

94. a. $0.36\left(3.603\times10^{12}\right)=\left(3.6\times10^{-1}\right)\left(3.603\times10^{12}\right)$
$=\left(3.6\times2.303\right)\times10^{-1+12}$
$=12.9708\times10^{11}$
$=1.29708\times10^{12}$
$\$1.29708\times10^{12}$ was borrowed to cover the deficit in 2011.

b. $0.30\left(3.603\times10^{12}\right)=\left(3.0\times10^{-1}\right)\left(3.603\times10^{12}\right)$
$=\left(3.0\times3.603\right)\times10^{-1+12}$
$=10.809\times10^{11}$
$=1.0809\times10^{12}$
$\$1.0809\times10^{12}$ was received from personal income taxes in 2011.

c. $0.05\left(3.603\times10^{12}\right)=\left(5.0\times10^{-2}\right)\left(3.603\times10^{12}\right)$
$=\left(5.0\times3.603\right)\times10^{-2+12}$
$=18.015\times10^{10}$
$=1.8015\times10^{11}$
$\$1.8015\times10^{11}$ was received from corporate income taxes in 2011.

d. $\dfrac{1.0809\times10^{12}}{1.8015\times10^{11}}=\left(\dfrac{1.0809}{1.8015}\right)\times10^{12-11}$
$=0.6\times10$
$=6$
The income from personal income taxes is 6 times greater than the income from corporate income taxes.

95. Answers will vary.

96. a. $\dfrac{1}{10}=10^{-1}$; subtract 1 from the exponent.

b. $\dfrac{1}{100}=10^{-2}$; subtract 2 from the exponent.

c. $\dfrac{1}{1\text{ million}}=\dfrac{1}{1,000,000}=10^{-6}$; subtract 6 from the exponent.

d. $\dfrac{6.58\times10^{-4}}{1\text{ million}}=6.58\times10^{-4}\times10^{-6}=6.58\times10^{-10}$

97. a. $10=10^{1}$; add 1 to the exponent.

b. $100=10^{2}$; add 2 to the exponent.

c. $1\text{ million}=1,000,000=10^{6}$; add 6 to the exponent.

d. $7.59\times10^{7}\times1\text{ million}=7.59\times10^{7}\times10^{6}$
$=7.59\times10^{13}$

98. a. $5.25\times10^{4}-4.25\times10^{4}=1\times10^{4}$
It is off by 1×10^{4} or 10,000.

b. $5.25\times10^{5}-5.25\times10^{4}=52.5\times10^{4}-5.25\times10^{4}$
$=47.25\times10^{4}$
$=4.725\times10^{5}$
It is off by 4.725×10^{5} or 472,500.

c. The error in part b is more serious because 472,500 is greater than 10,000.

99. a $\dfrac{1.86\times10^{5}\text{ mi}}{1\text{ sec}}\cdot\dfrac{60\text{ sec}}{1\text{ min}}\cdot\dfrac{60\text{ min}}{1\text{ hr}}\cdot\dfrac{24\text{ hr}}{1\text{ day}}\cdot\dfrac{365\text{ days}}{1\text{ yr}}$
$=1.86\times10^{5}\times6.0\times10^{1}\times6.0\times10^{1}\times2.4\times10^{1}\times3.65\times10^{2}$
$=(1.86\times6\times6\times2.4\times3.65)\left(10^{5+1+1+1+2}\right)$
$\approx587\times10^{10}$
$\approx5.87\times10^{12}$ miles

b. $\dfrac{93,000,000}{1.86\times10^{5}}=\dfrac{9.3\times10^{7}}{1.86\times10^{5}}$
$=\left(\dfrac{9.3}{1.86}\right)\times10^{7-5}$
$=5\times10^{2}$
$=500$ seconds or $8\dfrac{1}{3}$ minutes

c. $\dfrac{6.25\times10^{16}}{0.5\times1.86\times10^{5}}\approx6.72\times10^{11}$ seconds or 21,309 years

Chapter 1 Review Exercises

1. {4, 5, 6, 7, 8, 9}

2. {0, 3, 6, 9,…}

3. Yes, the set of rational numbers is a subset of the set of real numbers.

4. Yes, the set of natural numbers is a subset of the set of whole numbers.

5. No, the set of rational numbers is not a subset of the set of irrational numbers.

6. Yes, the set of irrational numbers is a subset of the set of real numbers.

7. 4 and 6 are natural numbers.

8. 4, 6, and 0 are whole numbers.

9. –2, 4, 6, and 0 are integers.

10. $-2,\ 4,\ 6,\ \dfrac{1}{2},\ 0,\ \dfrac{15}{27},\ -\dfrac{1}{5},$ and 1.47 are rational numbers.

11. $\sqrt{7}$ and $\sqrt{3}$ are irrational numbers.

12. $-2,\ 4,\ 6,\ \dfrac{1}{2},\ \sqrt{7},\ \sqrt{3},\ 0,\ \dfrac{15}{27},\ -\dfrac{1}{5},$ and 1.47 are real numbers.

13. False. $\dfrac{0}{1}=0$ *is* a real number.

14. True. Division by 0 is undefined.

15. True. 0, $\frac{3}{5}$, -2, and 4 can all be written as a quotient of two integers with the denominator not 0.

16. True. The set of real numbers contains both the rational and irrational numbers.

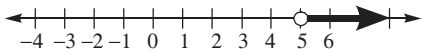
17. $A \cup B = \{1, 2, 3, 4, 5, 6, 8, 10\}$
$A \cap B = \{2, 4, 6\}$

18. $A \cup B = \{2, 3, 4, 5, 6, 7, 8, 9\}$
$A \cap B = \{\ \}$ or $\varnothing$

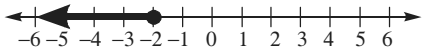
19. $A \cup B = \{1, 2, 3, 4, ...\}$
$A \cap B = \{\ \}$ or $\varnothing$

20. $A \cup B = \{3, 4, 5, 6, 9, 10, 11, 12\}$
$A \cap B = \{9, 10\}$

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

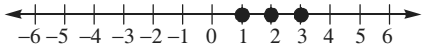


22. $\{x \mid x \le -2\}$



23. $\{x \mid -1.3 < x \le 2.4\}$

24. $\left\{x \middle| \frac{2}{3} \le x < 4 \text{ and } x \in N\right\}$



25. $-3 < 0$

26. $-4 < -3.9$

27. $1.06 < 1.6$

28. $|-8| = 8$

29. $|-4| = 4$ and $|-10| = 10$, so $|-4| < |-10|$.

30. $|-9| = 9$, so $13 > |-9|$.

31. $\left|-\frac{2}{3}\right| = \frac{2}{3} = \frac{10}{15}$ and $\frac{3}{5} = \frac{9}{15}$, so $\left|-\frac{2}{3}\right| > \frac{3}{5}$.

32. $-|-2| = -2$, so $-|-2| > -6$.

33. $-\pi, -3, 3, \pi$

34. $0, \frac{3}{5}, 2.7, |-3|$

35. $-2, 3, |-5|, |-10|$

36. $-7, -3, |-3|, |-7|$

37. $-4, -|-3|, 5, 6$

38. $-2, 0, |1.6|, |-2.3|$

39. distributive property

40. commutative property of multiplication

41. associative property of addition

42. identity property of addition

43. associative property of multiplication

44. double negative property

45. multiplicative property of zero

46. inverse property of addition

47. inverse property of multiplication

48. identity property of multiplication

49. $5 + 3^2 - \sqrt{36} \div 2 = 5 + 9 - 6 \div 2$
$= 5 + 9 - 3$
$= 14 - 3$
$= 11$

50. $-4 \div (-2) + 16 - \sqrt{81} = -4 \div (-2) + 16 - 9$
$= 2 + 16 - 9$
$= 18 - 9$
$= 9$

51. $(7 - 9) - (-3 + 5) + 16 = (-2) - 2 + 16$
$= -2 + (-2) + 16$
$= -4 + 16$
$= 12$

52. $2|-7| - 4|-6| + 7 = 2(7) - 4(6) + 7$
$= 14 - 24 + 7$
$= -10 + 7$
$= -3$

53. $(6 - 9) \div (9 - 6) + 3 = -3 \div 3 + 3$
$= -1 + 3$
$= 2$

54. $|6-3|\div 3+4\cdot 8-12=|3|\div 3+4\cdot 8-12$
$=3\div 3+4\cdot 8-12$
$=1+32-12$
$=33-12$
$=21$

55. $\sqrt{9}+\sqrt[3]{64}+\sqrt[5]{32}=3+4+2=9$

56. $3^2-6\cdot 9+4\div 2^2-15=9-6\cdot 9+4\div 4-15$
$=9-54+1-15$
$=-45+1-15$
$=-44-15$
$=-59$

57. $4-(2-9)^0+3^2\div 1+3=4-(-7)^0+3^2\div 1+3$
$=4-1+9\div 1+3$
$=4-1+9+3$
$=3+9+3$
$=12+3$
$=15$

58. $5^2+(-2+2^2)^3+9=5^2+(-2+4)^3+9$
$=5^2+(2)^3+9$
$=25+8+9$
$=33+9$
$=42$

59. $-3^2+14\div 2\cdot 3-8=-9+14\div 2\cdot 3-8$
$=-9+7\cdot 3-8$
$=-9+21-8$
$=12-8$
$=4$

60. $\left\{\left[(12\div 4)^2-1\right]^2\div 16\right\}^3=\left\{\left[(3)^2-1\right]^2\div 16\right\}^3$
$=\left[(9-1)^2\div 16\right]^3$
$=\left[8^2\div 16\right]^3$
$=(64\div 16)^3$
$=4^3$
$=64$

61. $\dfrac{9+7\div(3^2-2)+6\cdot 8}{\sqrt{81}+\sqrt{1}-10}=\dfrac{9+7\div(9-2)+6\cdot 8}{\sqrt{81}+\sqrt{1}-10}$
$=\dfrac{9+7\div 7+6\cdot 8}{9+1-10}$
$=\dfrac{9+1+48}{10-10}$
$=\dfrac{58}{0}$ which is undefined

62. $\dfrac{-(5-7)^2-3(-2)+|-6|}{18-9\div 3\cdot 5}=\dfrac{-(-2)^2-3(-2)+|-6|}{18-9\div 3\cdot 5}$
$=\dfrac{-4-3(-2)+|-6|}{18-9\div 3\cdot 5}$
$=\dfrac{-4-3(-2)+6}{18-9\div 3\cdot 5}$
$=\dfrac{-4+6+6}{18-3\cdot 5}$
$=\dfrac{-4+6+6}{18-15}$
$=\dfrac{8}{3}$

63. Substitute 2 for x:
$2x^2+3x+8=2(2)^2+3(2)+8$
$=2(4)+3(2)+8$
$=8+6+8$
$=14+8$
$=22$

64. Substitute –3 for a and –4 for b:
$5a^2-7b^2=5(-3)^2-7(-4)^2$
$=5(9)-7(16)$
$=45-112$
$=-67$

65. a. 1976 is represented by $x = 7$, so substitute 7 for x:
dollars spent $=50.86x^2-316.75x+541.48$
$=50.86(7)^2-316.75(7)+541.48$
$=50.86(49)-316.75(7)+541.48$
$=2492.14-2217.25+541.48$
$=816.37$
In 1976, the amount spent was approximately \$816.37 million.

b. 2016 is represented by $x = 17$, so substitute 17 for x:

$$\begin{aligned}\text{dollars spent} &= 50.86x^2 - 316.75x + 541.48\\ &= 50.86(17)^2 - 316.75(17) + 541.48\\ &= 50.86(289) - 316.75(17) + 541.48\\ &= 14,698.54 - 5384.75 + 541.48\\ &= 9855.27\end{aligned}$$

In 2016, the amount spent will be approximately \$9855.27 million.

66. a. 1980 is represented by $x = 4$, so substitute 4 for x:

$$\begin{aligned}\text{freight hauled} &= 14.04x^2 + 1.96x + 712.05\\ &= 14.04(4)^2 + 1.96(4) + 712.05\\ &= 14.04(16) + 1.96(4) + 712.05\\ &= 224.64 + 7.84 + 712.05\\ &= 944.53\end{aligned}$$

In 1980, the amount of freight hauled by trains was approximately 944.53 ton-miles.

b. 2015 is represented by $x = 11$, so substitute 11 for x:

$$\begin{aligned}\text{freight hauled} &= 14.04x^2 + 1.96x + 712.05\\ &= 14.04(11)^2 + 1.96(11) + 712.05\\ &= 14.04(121) + 1.96(11) + 712.05\\ &= 1698.84 + 21.56 + 712.05\\ &= 2432.45\end{aligned}$$

In 2015, the amount of freight hauled by trains will be approximately 2432.45 ton-miles.

67. $2^3 \cdot 2^2 = 2^{3+2} = 2^5 = 32$

68. $x^2 \cdot x^3 = x^{2+3} = x^5$

69. $\dfrac{a^{12}}{a^4} = a^{12-4} = a^8$

70. $\dfrac{y^{12}}{y^5} = y^{12-5} = y^7$

71. $\dfrac{b^7}{b^{-2}} = b^{7-(-2)} = b^{7+2} = b^9$

72. $c^3 \cdot c^{-6} = c^{3+(-6)} = c^{-3} = \dfrac{1}{c^3}$

73. $5^{-2} \cdot 5^{-1} = 5^{-2+(-1)} = 5^{-3} = \dfrac{1}{5^3} = \dfrac{1}{125}$

74. $8x^0 = 8(1) = 8$

75. $\left(-9m^3\right)^2 = (-9)^2\left(m^3\right)^2 = 81m^{3\cdot 2} = 81m^6$

76. $\left(\dfrac{5}{7}\right)^{-1} = \left(\dfrac{7}{5}\right)^1 = \dfrac{7}{5}$

77. $\left(\dfrac{2}{3}\right)^{-3} = \left(\dfrac{3}{2}\right)^3 = \dfrac{3^3}{2^3} = \dfrac{27}{8}$

78. $\left(\dfrac{x}{y^2}\right)^{-1} = \left(\dfrac{y^2}{x}\right)^1 = \dfrac{y^2}{x}$

79. $\left(5xy^3\right)\left(-3x^2y\right) = (5\cdot(-3))\cdot x^{1+2}\cdot y^{3+1}$
$= -15x^3y^4$

80. $\left(2v^3w^{-4}\right)\left(7v^{-6}w\right) = (2\cdot 7)\cdot v^{3+(-6)}\cdot w^{-4+1}$
$= 14v^{-3}w^{-3}$
$= \dfrac{14}{v^3w^3}$

81. $\dfrac{6x^{-3}y^5}{2x^2y^{-2}} = \left(\dfrac{6}{2}\right)\dfrac{y^{5-(-2)}}{x^{2-(-3)}} = \dfrac{3y^7}{x^5} = \dfrac{3y^7}{x^5}$

82. $\dfrac{12x^{-3}y^{-4}}{4x^{-2}y^5} = \left(\dfrac{12}{4}\right)\dfrac{1}{x^{-2-(-3)}y^{5-(-4)}} = \dfrac{3}{xy^9}$

83. $\dfrac{g^3h^{-6}j^{-9}}{g^{-2}h^{-1}j^5} = \dfrac{g^{3-(-2)}}{h^{-1-(-6)}j^{5-(-9)}} = \dfrac{g^5}{h^5j^{14}}$

84. $\dfrac{21m^{-3}n^{-2}}{7m^{-4}n^2} = \left(\dfrac{21}{7}\right)\dfrac{m^{-3-(-4)}}{n^{2-(-2)}} = \dfrac{3m}{n^4}$

85. $\left(\dfrac{4a^2b}{a}\right)^3 = (4a^{2-1}b)^3 = (4ab)^3 = 4^3a^3b^3 = 64a^3b^3$

86. $\left(\dfrac{x^5y}{-3y^2}\right)^2 = \left(\dfrac{x^5}{-3y^{2-1}}\right)^2$
$= \left(\dfrac{x^5}{-3y}\right)^2$
$= \dfrac{(x^5)^2}{(-3)^2y^2}$
$= \dfrac{x^{5\cdot 2}}{9y^2}$
$= \dfrac{x^{10}}{9y^2}$

87. $\left(\dfrac{p^3q^{-1}}{p^{-4}q^5}\right)^2 = \left(\dfrac{p^{3-(-4)}}{q^{5-(-1)}}\right)^2 = \left(\dfrac{p^7}{q^6}\right)^2 = \dfrac{p^{7\cdot 2}}{q^{6\cdot 2}} = \dfrac{p^{14}}{q^{12}}$

88. $\left(\dfrac{-2ab^{-3}}{c^2}\right)^3 = \left(\dfrac{-2a}{b^3c^2}\right)^3$

$= \dfrac{(-2a)^3}{(b^3c^2)^3}$

$= \dfrac{(-2)^3 \cdot a^3}{b^{3\cdot 3} \cdot c^{2\cdot 3}}$

$= -\dfrac{8a^3}{b^9c^6}$

89. $\left(\dfrac{5xy^3}{z^2}\right)^{-2} = \left(\dfrac{z^2}{5xy^3}\right)^2$

$= \dfrac{(z^2)^2}{5^2x^2(y^3)^2}$

$= \dfrac{z^{2\cdot 2}}{25x^2y^{3\cdot 2}}$

$= \dfrac{z^4}{25x^2y^6}$

90. $\left(\dfrac{9m^{-2}n}{3mn}\right)^{-3} = \left(\dfrac{3mn}{9m^{-2}n}\right)^3$

$= \left[\left(\dfrac{3}{9}\right)m^{1-(-2)}n^{1-1}\right]^3$

$= \left(\dfrac{m^3n^0}{3}\right)^3$

$= \left(\dfrac{m^3 \cdot 1}{3}\right)^3$

$= \dfrac{(m^3)^3}{3^3}$

$= \dfrac{m^9}{27}$

91. $\left(-2m^2n^{-3}\right)^{-2} = (-2)^{-2}\left(m^2\right)^{-2}\left(n^{-3}\right)^{-2}$

$= (-2)^{-2}m^{2\cdot(-2)}n^{-3\cdot(-2)}$

$= (-2)^{-2}m^{-4}n^6$

$= \dfrac{n^6}{(-2)^2m^4}$

$= \dfrac{n^6}{4m^4}$

92. $\left(\dfrac{15x^5y^{-3}z^{-2}}{-3x^4y^{-4}z^3}\right)^4 = \left[\left(\dfrac{15}{-3}\right)\dfrac{x^{5-4}y^{-3-(-4)}}{z^{3-(-2)}}\right]^4$

$= \left[\dfrac{-5xy}{z^5}\right]^4$

$= \dfrac{(-5)^4x^4y^4}{z^{5\cdot 4}}$

$= \dfrac{625x^4y^4}{z^{20}}$

93. $\left(\dfrac{2x^{-1}y^5z^4}{3x^4y^{-2}z^{-2}}\right)^{-2} = \left(\dfrac{2y^{5-(-2)}z^{4-(-2)}}{3x^{4-(-1)}}\right)^{-2}$

$= \left(\dfrac{2y^7z^6}{3x^5}\right)^{-2}$

$= \left(\dfrac{3x^5}{2y^7z^6}\right)^2$

$= \dfrac{3^2x^{5\cdot 2}}{2^2y^{7\cdot 2}z^{6\cdot 2}}$

$= \dfrac{9x^{10}}{4y^{14}z^{12}}$

94. $\left(\dfrac{10x^{-2}y^{-2}z}{-x^4y^{-4}z^3}\right)^{-1} = \left(\dfrac{10y^{-2-(-4)}}{-x^{4-(-2)}z^{3-1}}\right)^{-1}$

$= \left(\dfrac{10y^2}{-x^6z^2}\right)^{-1}$

$= \left(\dfrac{-x^6z^2}{10y^2}\right)^1$

$= -\dfrac{x^6z^2}{10y^2}$

95. $0.0000742 = 7.42\times10^{-5}$

96. $460{,}000 = 4.6\times10^5$

97. $183{,}000 = 1.83\times10^5$

98. $0.000002 = 2.0\times10^{-6}$

99. $\left(25\times10^{-3}\right)\left(1.2\times10^6\right) = (25\times1.2)\times10^{-3+6}$

$= 30\times10^3$

$= 3\times10^4$

$= 30{,}000$

100. $\dfrac{21\times10^3}{7\times10^5}=\left(\dfrac{21}{7}\right)\times10^{3-5}=3\times10^{-2}=0.03$

101. $\dfrac{6{,}000{,}000}{0.02}=\dfrac{6\times10^6}{2\times10^{-2}}$

$=\left(\dfrac{6}{2}\right)\times10^{6-(-2)}$

$=3\times10^8$

$=300{,}000{,}000$

102. $(0.004)(500{,}000)=\left(4\times10^{-3}\right)\left(5\times10^5\right)$

$=(4\times5)\times10^{-3+5}$

$=20\times10^2$

$=2\times10^3$

$=2000$

103. a. $6.60\times10^6-3.86\times10^6$

$=(6.60-3.86)\times10^6$

$=2.74\times10^6$

The land area of Russia is 2.74×10^6 mi^2 larger than the land area of Canada.

b. $3.75\times10^6-3.72\times10^6$

$=(3.75-3.72)\times10^6$

$=0.03\times10^6$

$=3.00\times10^4$

The land area of China is 3.00×10^4 mi^2 larger than the land area of the United States.

c. $\dfrac{6.60\times10^6}{3.86\times10^6}=\left(\dfrac{6.60}{3.86}\right)\times10^{6-6}$

$\approx1.71\times10^0$

≈1.71

The land area of Russia is about 1.71 times larger than the land area of Canada.

d. $\dfrac{3.75\times10^6}{3.72\times10^6}=\left(\dfrac{3.75}{3.72}\right)\times10^{6-6}$

$\approx1.01\times10^0$

≈1.01

The land area of China is about 1.01 times larger than the land area of the United States.

104. a. $1.4\times10^{10}=14{,}000{,}000{,}000$

b. $1.4\times10^{10}=14\times10^9=14$ billion

Voyager 1 has traveled 14 billion kilometers.

c. $\dfrac{1.4\times10^{10}}{28}=\dfrac{1.4\times10^{10}}{2.8\times10^1}$

$=\left(\dfrac{1.4}{2.8}\right)\times10^{10-1}$

$=0.5\times10^9$

$=5.0\times10^8$

Voyager 1 has averaged 5.0×10^8 or 500,000,000 kilometers per year.

d. $(1.4\times10^{10})\cdot(0.6)=(1.4\times10^{10})\cdot(6\times10^{-1})$

$=(1.4\times6)\times10^{10-1}$

$=8.4\times10^9$

Voyager 1 has traveled about 8.4×10^9 miles or 8,400,000,000 miles.

Chapter 1 Practice Test

1. $A=\{6, 7, 8, 9,\ldots\}$

2. False. For example, π is a real number but it is not a rational number.

3. True. This is how the set of real numbers is defined.

4. $-\dfrac{3}{5}, 2, -4, 0, \dfrac{19}{12}, 2.57,$ and -1.92 are rational numbers.

5. $-\dfrac{3}{5}, 2, -4, 0, \dfrac{19}{12}, 2.57, \sqrt{8}, \sqrt{2},$ and -1.92 are real numbers.

6. $A\cup B=\{5, 7, 8, 9, 10, 11, 14\}$

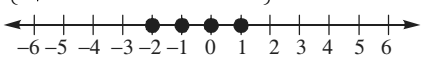
$A\cap B=\{8, 10\}$

7. $A\cup B=\{1, 3, 5, 7,\ldots\}$

$A\cap B=\{3, 5, 7, 9, 11\}$

8. $\{x\mid -2.3\le x<5.2\}$

9. $\left\{x\left|-\dfrac{5}{2}<x<\dfrac{6}{5}\text{ and }x\in I\right.\right\}$



10. $-|4|, -2, |3|, 9$

11. associative property of addition

12. commutative property of addition

13. $\{6-[7-3^2 \div (3^2-2\cdot 3)]\}$
$= \{6-[7-3^2 \div (9-2\cdot 3)]\}$
$= \{6-[7-3^2 \div (9-6)]\}$
$= \{6-[7-3^2 \div 3]\}$
$= \{6-[7-9 \div 3]\}$
$= \{6-[7-3]\}$
$= \{6-4\}$
$= 2$

14. $2^4+4^2 \div 2^3 \cdot \sqrt{25}+7 = 16+16 \div 8 \cdot \sqrt{25}+7$
$= 16+16 \div 8 \cdot 5+7$
$= 16+2 \cdot 5+7$
$= 16+10+7$
$= 33$

15. $\dfrac{-3|4-8| \div 2+6}{-\sqrt{36}+18 \div 3^2+4} = \dfrac{-3|-4| \div 2+6}{-\sqrt{36}+18 \div 3^2+6}$
$= \dfrac{-3(4) \div 2+6}{-\sqrt{36}+18 \div 3^2+4}$
$= \dfrac{-3(4) \div 2+6}{-6+18 \div 9+4}$
$= \dfrac{-12 \div 2+6}{-6+2+4}$
$= \dfrac{-6+6}{-6+2+4}$
$= \dfrac{0}{0}$ which is undefined

16. $\dfrac{-6^2+3(4-|6|) \div 6}{4-(-3)+12 \div 4 \cdot 5} = \dfrac{-6^2+3(4-6) \div 6}{4-(-3)+12 \div 4 \cdot 5}$
$= \dfrac{-6^2+3(-2) \div 6}{4-(-3)+12 \div 4 \cdot 5}$
$= \dfrac{-36+3(-2) \div 6}{4-(-3)+12 \div 4 \cdot 5}$
$= \dfrac{-36+(-6) \div 6}{4+3+3 \cdot 5}$
$= \dfrac{-36+(-1)}{4+3+15}$
$= \dfrac{-37}{7+15}$
$= \dfrac{-37}{22}$
$= -\dfrac{37}{22}$

17. Substitute 2 for x and 3 for y:
$-x^2+2xy+y^2 = -(2)^2+2(2)(3)+(3)^2$
$= -4+2(2)(3)+9$
$= -4+12+9$
$= 8+9$
$= 17$

18. a. Substitute 1 for t:
$h = -16t^2+120t+200$
$= -16(1)^2+120(1)+200$
$= -16(1)+120(1)+200$
$= -16+120+200$
$= 304$
After 1 second, the cannonball is 304 feet above sea level.

b. Substitute 5 for t:
$h = -16t^2+120t+200$
$= -16(5)^2+120(5)+200$
$= -16(25)+120(5)+200$
$= -400+600+200$
$= 400$
After 5 seconds, the cannonball is 400 feet above sea level.

19. $3^{-2} = \frac{1}{3^2} = \frac{1}{9}$

20. $\left(\frac{4m^{-3}}{n^2}\right)^2 = \left(\frac{4}{m^3 n^2}\right)^2 = \frac{4^2}{m^{3\cdot 2} n^{2\cdot 2}} = \frac{16}{m^6 n^4}$

21. $\frac{24a^2b^{-3}c^0}{30a^3b^2c^{-2}} = \left(\frac{24}{30}\right)\frac{c^{0-(-2)}}{a^{3-2}b^{2-(-3)}} = \frac{4c^2}{5ab^5}$

22. $\left(\frac{-3x^3y^{-2}}{x^{-1}y^5}\right)^{-3} = \left(\frac{-3x^{3-(-1)}}{y^{5-(-2)}}\right)^{-3}$

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

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

$= \frac{y^{7\cdot 3}}{(-3)^3 x^{4\cdot 3}}$

$= -\frac{y^{21}}{27x^{12}}$

23. $389,000,000 = 3.89\times 10^8$

24. $\frac{3.12\times 10^6}{1.2\times 10^{-2}} = \left(\frac{3.12}{1.2}\right)\times 10^{6-(-2)}$

$= 2.6\times 10^8$

$= 260,000,000$

25. **a.** 9.2 billion $= 9,000,000,000 = 9.2\times 10^9$

b. Ages 0 – 14:

$0.195\cdot(9.2\times 10^9) = (1.95\times 10^{-1})(9.2\times 10^9)$

$= (1.95\times 9.2)\times 10^{-1+9}$

$= 17.94\times 10^8$

$= 1.794\times 10^9$

Ages 15 – 64:

$0.631\cdot(9.2\times 10^9) = (6.31\times 10^{-1})(9.2\times 10^9)$

$= (6.31\times 9.2)\times 10^{-1+9}$

$= 58.052\times 10^8$

$= 5.8052\times 10^9$

Ages 65 and older:

$0.174\cdot(9.2\times 10^9) = (1.74\times 10^{-1})(9.2\times 10^9)$

$= (1.74\times 9.2)\times 10^{-1+9}$

$= 16.008\times 10^8$

$= 1.6008\times 10^9$

Chapter 2

Exercise Set 2.1

1. The parts that are added in an algebraic expression are called the terms of the expression.

2. Terms that have identical variable parts are called like terms.

3. The goal in solving equations is to isolate the variable on one side of the equation.

4. We can eliminate fractions from an equation by multiplying both sides of the equation by the least common denominator.

5. An equation that is always true is known as a(n) identity.

6. An equation that true for only specific values of the variable is known as a(n) conditional equation.

7. An equation that is never true is known as a(n) contradiction.

8. The degree of a term is the sum of the exponents on the variables in the term.

9. The symbol Ø is used to indicate the solution set of a contradiction.

10. The symbol $\mathbb{R}$ is used to indicate the solution set of an identity.

11. symmetric property

12. symmetric property

13. transitive property

14. transitive property

15. reflexive property

16. reflexive property

17. addition property

18. multiplication property

19. multiplication property

20. addition property

21. multiplication property

22. addition property

23. addition property

24. multiplication property

25. $5y$ is degree one since the exponent is 1.

26. $-2x$ is degree one since the exponent is 1.

27. $5c^3$ is degree three since the exponent is 3.

28. $-6y^2$ is degree two since the exponent is 2.

29. $3ab$ is degree two since $3ab$ can be written as $3a^1b^1$ and the sum of the exponents is 1 + 1 = 2.

30. $\frac{1}{2}x^4y$ is degree five since $\frac{1}{2}x^4y$ can be written as $\frac{1}{2}x^4y^1$ and the sum of the exponents is 4 + 1 = 5.

31. The degree of 6 is zero since 6 can be written as $6x^0$.

32. The degree of –3 is zero since –3 can be written as $-3x^0$.

33. $-5r$ is degree one since $-5r$ can be written as $-5r^1$.

34. $18p^2q^3$ is degree five since the sum of the exponents is 2 + 3 = 5.

35. $5a^2b^4c$ is degree seven since $5a^2b^4c$ can be written as $5a^2b^4c^1$ and the sum of the exponents is 2 + 4 + 1 = 7.

36. m^4n^6 is degree ten since the sum of the exponents is 4 + 6 = 10.

37. $3x^5y^6z$ is degree 12 since $3x^5y^6z$ can be written as $3x^5y^6z^1$ and the sum of the exponents is 5 + 6 + 1 = 12.

38. $-2x^4y^7z^8$ is degree nineteen since the sum of the exponents is 4 + 7 + 8 = 19.

39. $7r+3b-11x+12y$ cannot be simplified since all the terms are "unlike".

40. $3x^2+4x+5$ cannot be simplified since all the terms are "unlike".

41. $-2x^2-5x+7x-3$
$=-2x^2+2x-3$

42. $2a^2 - 4ab + 5ab - 10b^2$
$= 2a^2 + ab - 10b^2$

43. $10.6c^2 - 2.3c + 5.9c - 1.9c^2$
$= 10.6c^2 - 1.9c^2 - 2.3c + 5.9c$
$= 8.7c^2 + 3.6c$

44. $4.3 - 3.2x - 2(x - 2)$
$= 4.3 - 3.2x - 2x + 4$
$= -3.2x - 2x + 4.3 + 4$
$= -5.2x + 8.3$

45. $w^3 + w^2 - w + 1$ cannot be further simplified since all of the terms are "unlike".

46. $7x^3y^2 + 11y^3x^2$ cannot be simplified since all of the terms are "unlike".

47. $8pq - 9pq + p + q$
$= -pq + p + q$

48. $b + b^2 - 4b + b^2 + 3b$
$= b^2 + b^2 + b - 4b + 3b$
$= 2b^2 + 0b$
$= 2b^2$

49. $12\left(\frac{1}{6} + \frac{d}{4}\right) + 5d$
$= 12 \cdot \frac{1}{6} + 12 \cdot \frac{d}{4} + 5d$
$= \frac{12}{6} + \frac{12d}{4} + 5d$
$= 2 + 3d + 5d$
$= 2 + 8d = 8d + 2$

50. $60\left(\frac{7}{15}x - \frac{3}{4}\right) - 2x = 60 \cdot \frac{7}{15}x - 60 \cdot \frac{3}{4} - 2x$
$= \frac{420}{15}x - \frac{180}{4} - 2x$
$= 28x - 45 - 2x$
$= 28x - 2x - 45$
$= 26x - 45$

51. $8\left(\frac{7}{8}x + 3\right) + 5x - 7 = 8 \cdot \frac{7}{8}x + 8 \cdot 3 + 5x - 7$
$= \frac{56}{8}x + 24 + 5x - 7$
$= 7x + 24 + 5x - 7$
$= 7x + 5x + 24 - 7$
$= 12x + 17$

52. $-4\left(\frac{3}{4}x - 5\right) + 7x - 1 = (-4)\frac{3}{4}x - (-4)5 + 7x - 1$
$= \frac{-12}{4}x + 20 + 7x - 1$
$= -3x + 20 + 7x - 1$
$= -3x + 7x + 20 - 1$
$= 4x + 19$

53. $4 - [6(3x + 2) - x] + 4$
$= 4 - [18x + 12 - x] + 4$
$= 4 - [17x - 12] + 4$
$= 4 - 17x - 12 + 4$
$= 4 - 12 + 4 - 17x$
$= -4 - 17x$
$= -17x - 4$

54. $-9 + 3\left[4(2x - 3) - 5x\right] + 2x$
$= -9 + 3[8x - 12 - 5x] + 2x$
$= -9 + 3[3x - 12] + 2x$
$= -9 + 9x - 36 + 2x$
$= 9x + 2x - 36 - 9$
$= 11x - 45$

55. $9x - \left[3x - (5x - 4y)\right] - 2y$
$= 9x - [3x - 5x + 4y] - 2y$
$= 9x - [-2x + 4y] - 2y$
$= 9x + 2x - 4y - 2y$
$= 11x - 6y$

56. $-2[3x - (2y - 1) - 5x] + y$
$= -2[3x - 2y + 1 - 5x] + y$
$= -2[3x - 5x - 2y + 1] + y$
$= -2[-2x - 2y + 1] + y$
$= 4x + 4y - 2 + y$
$= 4x + 4y + y - 2$
$= 4x + 5y - 2$

57. $5b - \{7[2(3b-2)-(4b+9)]-2\}$
$= 5b - \{7[6b-4-4b-9]-2\}$
$= 5b - \{7[6b-4b-4-9]-2\}$
$= 5b - [7(2b-13)-2]$
$= 5b - [14b-91-2]$
$= 5b - (14b-93)$
$= 5b - 14b + 93$
$= -9b + 93$

58. $2\{[3a-(2b-5a)]-3(2a-b)\}$
$= 2\{[3a-2b+5a]-6a+3b\}$
$= 2\{8a-2b-6a+3b\}$
$= 2\{2a+b\}$
$= 4a+2b$

59. $-\{[2rs-3(r+2s)]-2(2r^2-s)\}$
$= -\{[2rs-3r-6s]-4r^2+2s\}$
$= -\{2rs-3r-6s-4r^2+2s\}$
$= -\{2rs-3r-4s-4r^2\}$
$= -2rs+3r+4s+4r^2$
$= 4r^2-2rs+3r+4s$

60. $p^2q+4pq-[-(pq+4p^2q)+pq]$
$= p^2q+4pq-[-pq-4p^2q+pq]$
$= p^2q+4pq-[-pq+pq-4p^2q]$
$= p^2q+4pq-[-4p^2q]$
$= p^2q+4pq+4p^2q$
$= p^2q+4p^2q+4pq$
$= 5p^2q+4pq$

61. $5a-1=14$
$5a-1+1=14+1$
$5a=15$
$\frac{5a}{5}=\frac{15}{5}$
$a=3$

62. $-7x+3=17$
$-7x+3-3=17-3$
$-7x=14$
$\frac{-7x}{-7}=\frac{14}{-7}$
$x=-2$

63. $-8x+7+3x=-3$
$-8x+3x+7=-3$
$-5x+7=-3$
$-5x+7-7=-3-7$
$-5x=-10$
$\frac{-5x}{-5}=\frac{-10}{-5}$
$x=2$

64. $7x-6-5x=-8$
$2x-6=-8$
$2x-6+6=-8+6$
$2x=-2$
$\frac{2x}{2}=\frac{-2}{2}$
$x=-1$

65. $5s-3=2s+6$
$5s-3-2s=2s+6-2s$
$3s-3=6$
$3s-3+3=6+3$
$3s=9$
$\frac{3s}{3}=\frac{9}{3}$
$s=3$

66. $8w+7=-3w-15$
$8w+7+3w=-3w-15+3w$
$11w+7=-15$
$11w+7-7=-15-7$
$11w=-22$
$\frac{11w}{11}=\frac{-22}{11}$
$w=-2$

67. $4x-5=2(x+5)$
$4x-5=2x+10$
$4x-5+5=2x+10+5$
$4x=2x+15$
$4x-2x=2x+15-2x$
$2x=15$
$\frac{2x}{2}=\frac{15}{2}$
$x=\frac{15}{2}$

68. $4x-8=-4(2x-3)+4$
$4x-8=-8x+12+4$
$4x-8=-8x+16$
$4x-8+8x=-8x+16+8x$
$12x-8=16$
$12x-8+8=16+8$
$12x=24$
$\frac{12x}{12}=\frac{24}{12}$
$x=2$

69. $-3(t-5)=2(t-5)$
$-3t+15=2t-10$
$-3t+15-2t=2t-10-2t$
$-5t+15=-10$
$-5t+15-15=-10-15$
$-5t=-25$
$\frac{-5t}{-5}=\frac{-25}{-5}$
$t=5$

70. $4(2x-4)=-2(x+3)$
$8x-16=-2x-6$
$8x-16+2x=-2x-6+2x$
$10x-16=-6$
$10x-16+16=-6+16$
$10x=10$
$\frac{10x}{10}=\frac{10}{10}$
$x=1$

71. $3x+4(2-x)=4x+5$
$3x+8-4x=4x+5$
$-x+8=4x+5$
$-x+8-4x=4x+5-4x$
$-5x+8=5$
$-5x+8-8=5-8$
$-5x=-3$
$\frac{-5x}{-5}=\frac{-3}{-5}$
$x=\frac{3}{5}$

72. $4x-2(3x-7)=2x-6$
$4x-6x+14=2x-6$
$-2x+14=2x-6$
$-2x+14-2x=2x-6-2x$
$-4x+14=-6$
$-4x+14-14=-6-14$
$-4x=-20$
$\frac{-4x}{-4}=\frac{-20}{-4}$
$x=5$

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

74. $3k+7=4-(9-k)$
$3k+7=4-9+k$
$3k+7=-5+k$
$3k-k+7=-5+k-k$
$2k+7=-5$
$2k+7-7=-5-7$
$2k=-12$
$\frac{2k}{2}=\frac{-12}{2}$
$k=-6$

75. $p-(p+4)=4(p-1)+2p$
$p-p-4=4p-4+2p$
$-4=6p-4$
$-4+4=6p-4+4$
$0=6p$
$\frac{0}{6}=\frac{6p}{6}$
$0=p$

76. $q-(-3q+4)=-2(q-3)+14$
$q+3q-4=-2q+6+14$
$4q-4=-2q+20$
$4q+2q-4=-2q+2q+20$
$6q-4=20$
$6q-4+4=20+4$
$6q=24$
$\frac{6q}{6}=\frac{24}{6}$
$q=4$

77. $-3(y-1)+2y=4(y-3)$
$-3y+3+2y=4y-12$
$-y+3=4y-12$
$-y+3+y=4y-12+y$
$3=5y-12$
$3+12=5y-12+12$
$15=5y$
$\frac{15}{5}=\frac{5y}{5}$
$3=y$

78. $5r-13-6r=3(r+5)-16$
$5r-13-6r=3r+15-16$
$-r-13=3r-1$
$-r-13+r=3r-1+r$
$-13=4r-1$
$-13+1=4r-1+1$
$-12=4r$
$\frac{-12}{4}=\frac{4r}{4}$
$-3=r$

79. $6-(n+3)=3n+5-2n$
$6-n-3=3n+5-2n$
$3-n=n+5$
$3-n+n=n+5+n$
$3=2n+5$
$3-5=2n+5-5$
$-2=2n$
$\frac{-2}{2}=\frac{2n}{2}$
$-1=n$
$n=-1$

80. $8-3(2a-4)=5+3a-4a$
$8-6a+12=5+3a-4a$
$-6a+20=5-a$
$-6a+20+a=5-a+a$
$-5a+20=5$
$-5a+20-20=5-20$
$-5a=-15$
$\frac{-5a}{-5}=\frac{-15}{-5}$
$a=3$

81. $4(2x-2)-3(x+7)=-4$
$8x-8-3x-21=-4$
$5x-29=-4$
$5x-29+29=-4+29$
$5x=25$
$\frac{5x}{5}=\frac{25}{5}$
$x=5$

82. $-2(3w+6)-(4w-3)=21$
$-6w-12-4w+3=21$
$-10w-9=21$
$-10w-9+9=21+9$
$-10w=30$
$\frac{-10w}{-10}=\frac{30}{-10}$
$w=-3$

83. $-4(3-4x)-2(x-1)=12x$
$-12+16x-2x+2=12x$
$14x-10=12x$
$14x-10-14x=12x-14x$
$-10=-2x$
$\frac{-10}{-2}=\frac{-2x}{-2}$
$5=x$
$x=5$

84. $-4(2z-6) = -3(z-4) + z$
$-8z + 24 = -3z + 12 + z$
$-8z + 24 = -2z + 12$
$-8z + 24 + 8z = -2z + 12 + 8z$
$24 = 12 + 6z$
$24 - 12 = 12 + 6z - 12$
$12 = 6z$
$\frac{12}{6} = \frac{6z}{6}$
$2 = z$
$z = 2$

85. $5(a+3) - a = -(4a-6) + 1$
$5a + 15 - a = -4a + 6 + 1$
$4a + 15 = -4a + 7$
$4a + 15 + 4a = -4a + 7 + 4a$
$8a + 15 = 7$
$8a + 15 - 15 = 7 - 15$
$8a = -8$
$\frac{8a}{8} = \frac{-8}{8}$
$a = -1$

86. $3(2x-4) + 3(x+1) = 9$
$6x - 12 + 3x + 3 = 9$
$9x - 9 = 9$
$9x - 9 + 9 = 9 + 9$
$9x = 18$
$\frac{9x}{9} = \frac{18}{9}$
$x = 2$

87. $-2\left[8 - (4 - w)\right] - 8 = 4(w+5)$
$-2[8 - 4 + w] - 8 = 4w + 20$
$-2[4 + w] - 8 = 4w + 20$
$-8 + 2w - 8 = 4w + 20$
$-16 - 2w = 4w + 20$
$-16 + 16 - 2w = 4w + 20 + 16$
$-2w = 4w + 36$
$-2w - 4w = 4w - 4w + 36$
$-6w = 36$
$\frac{-6w}{-6} = \frac{36}{-6}$
$w = -6$

88. $3\left[6 - (h+2)\right] - 6 = 4(-h+7)$
$3[6 - h - 2] - 6 = -4h + 28$
$3[4 - h] - 6 = -4h + 28$
$12 - 3h - 6 = -4h + 28$
$-3h + 6 = -4h + 28$
$-3h + 6 + 4h = -4h + 28 + 4h$
$h + 6 = 28$
$h + 6 - 6 = 28 - 6$
$h = 22$

89. $2[3x - (4x-6)] = 5(x-6)$
$2(3x - 4x + 6) = 5x - 30$
$6x - 8x + 12 = 5x - 30$
$-2x + 12 = 5x - 30$
$-2x + 12 + 2x = 5x - 30 + 2x$
$12 = 7x - 30$
$12 + 30 = 7x - 30 + 30$
$42 = 7x$
$\frac{42}{7} = \frac{7x}{7}$
$6 = x$
$x = 6$

90. $-z - 6z + 3 = 4 - [6 - z - (3 - 2z)]$
$-7z + 3 = 4 - (6 - z - 3 + 2z)$
$-7z + 3 = 4 - (3 + z)$
$-7z + 3 = 4 - 3 - z$
$-7z + 3 = 1 - z$
$-7z + 3 + 7z = 1 - z + 7z$
$3 = 1 + 6z$
$3 - 1 = 1 + 6z - 1$
$2 = 6z$
$\frac{2}{6} = \frac{6z}{6}$
$\frac{1}{3} = z$
$z = \frac{1}{3}$

91. $4\{2-[3(c+1)-2(c+1)]\}=-2c$

$4\{2-[3c+3-2c-2]\}=-2c$

$4\{2-[c+1]\}=-2c$

$4\{2-c-1\}=-2c$

$4\{1-c\}=-2c$

$4-4c=-2c$

$4-4c+2c=-2c+2c$

$-2c+4=0$

$-2c+4-4=0-4$

$-2c=-4$

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

$c=2$

92. $3\{[(x-2)+4x]-(x-3)\}=4-(x-12)$

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

$3(5x-2-x+3)=16-x$

$3(4x+1)=16-x$

$12x+3=16-x$

$12+3+x=16-x+x$

$13x+3=16$

$13x+3-3=16-3$

$13x=13$

$\frac{13x}{3}=\frac{13}{3}$

$x=1$

93. $-\{4(d+3)-5[3d-2(2d+7)]-8\}=-10d-6$

$-\{4(d+3)-5[3d-4d-14]-8\}=-10d-6$

$-\{4(d+3)-5[-d-14]-8\}=-10d-6$

$-\{4d+12+5d+70-8\}=-10d-6$

$-\{9d+74\}=-10d-6$

$-9d-74=-10d-6$

$-9d-74+10d=-10d-6+10d$

$d-74=-6$

$d-74+74=-6+74$

$d=68$

94. $-3(6-4x)=4-\{5x-[6x-(4x-(3x+2))]\}$

$-18+12x=4-\{5x-[6x-(4x-3x-2)]\}$

$-18+12x=4-\{5x-[6x-(x-2)]\}$

$-18+12x=4-\{5x-[6x-x+2)]\}$

$-18+12x=4-[5x-(5x+2)]$

$-18+12x=4-[5x-5x-2]$

$-18+12x=4-(-2)$

$-18+12x=6$

$-18+18+12x=6+18$

$12x=24$

$\frac{12x}{12}=\frac{24}{12}$

$x=2$

95. $\frac{d}{5}=-7$

$5\left(\frac{d}{5}\right)=5(-7)$

$d=-35$

96. $-\frac{q}{8}=5$

$-8\left(-\frac{q}{8}\right)=-8(5)$

$q=-40$

97. $\frac{4x-2}{3}=-6$

$3\left(\frac{4x-2}{3}\right)=3(-6)$

$4x-2=-18$

$4x-2+2=-18+2$

$4x=-16$

$\frac{4x}{4}=\frac{-16}{4}$

$x=-4$

98. $\dfrac{7m+9}{6}=5$

$6\left(\dfrac{7m+9}{6}\right)=6(5)$

$7m+9=30$

$7m+9-9=30-9$

$7m=21$

$\dfrac{7m}{7}=\dfrac{21}{7}$

$m=3$

99. $4-\dfrac{3}{4}a=7$

$4-\dfrac{3}{4}a-4=7-4$

$-\dfrac{3}{4}a=3$

$-4\left(-\dfrac{3}{4}a\right)=-4(3)$

$3a=-12$

$\dfrac{3a}{3}=\dfrac{-12}{3}$

$a=-4$

100. $-2=-\dfrac{1}{3}x+4$

$-2-4=-\dfrac{1}{3}x+4-4$

$-6=-\dfrac{1}{3}x$

$-3(-6)=-3\left(-\dfrac{1}{3}x\right)$

$18=x$

101. $\dfrac{3}{4}t+\dfrac{7}{8}t=39$

$8\left(\dfrac{3}{4}t+\dfrac{7}{8}t\right)=8(39)$

$6t+7t=312$

$13t=312$

$\dfrac{13t}{13}=\dfrac{312}{13}$

$t=24$

102. $\dfrac{1}{3}x+\dfrac{5}{6}=2x$

$6\left[\dfrac{1}{3}x+\dfrac{5}{6}\right]=6(2x)$

$2x+5=12x$

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

$5=10x$

$\dfrac{5}{10}=\dfrac{10x}{10}$

$\dfrac{1}{2}=x \quad \text{or} \quad x=\dfrac{1}{2}$

103. $\dfrac{2}{3}z-5=\dfrac{z}{6}+1$

$\dfrac{2}{3}z-5+5=\dfrac{z}{6}+1+5$

$\dfrac{2}{3}z=\dfrac{z}{6}+6$

$\dfrac{2}{3}z-\dfrac{z}{6}=\dfrac{z}{6}+6-\dfrac{z}{6}$

$\dfrac{2}{3}z-\dfrac{z}{6}=6$

$6\left(\dfrac{2}{3}z-\dfrac{z}{6}\right)=6(6)$

$4z-z=36$

$3z=36$

$\dfrac{3z}{3}=\dfrac{36}{3}$

$z=12$

104. $\dfrac{1}{2}x+2=\dfrac{1}{8}x-1$

$8\left[\dfrac{1}{2}x+2\right]=8\left[\dfrac{1}{8}x-1\right]$

$4x+16=x-8$

$4x+16-x=x-8-x$

$3x+16=-8$

$3x+16-16=-8-16$

$3x=-24$

$\dfrac{3x}{3}=\dfrac{-24}{3}$

$x=-8$

105.
$$\frac{1}{2}=\frac{4}{5}x-\frac{1}{4}$$
$$20\left(\frac{1}{2}\right)=20\left(\frac{4}{5}x-\frac{1}{4}\right)$$
$$10=16x-5$$
$$10+5=16x-5+5$$
$$15=16x$$
$$\frac{15}{16}=\frac{16x}{16}$$
$$\frac{15}{16}=x$$

106.
$$\frac{5}{6}m-\frac{5}{12}=\frac{7}{8}m+\frac{2}{3}$$
$$24\left(\frac{5}{6}m-\frac{5}{12}\right)=24\left(\frac{7}{8}m+\frac{2}{3}\right)$$
$$20m-10=21m+16$$
$$20m-10-20m=21m+16-20m$$
$$-10=m+16$$
$$-10-16=m+16-16$$
$$-26=m \quad \text{or} \quad m=-26$$

107.
$$x+6=-\frac{2}{3}(x+1)$$
$$x+6=-\frac{2}{3}x-\frac{2}{3}$$
$$3(x+6)=3\left(-\frac{2}{3}x-\frac{2}{3}\right)$$
$$3x+18=-2x-2$$
$$3x+18-18=-2x-2-18$$
$$3x=-2x-20$$
$$3x+2x=-2x-20+2x$$
$$5x=-20$$
$$\frac{5x}{5}=\frac{-20}{5}$$
$$x=-4$$

108.
$$x-2=\frac{3}{4}(x+4)$$
$$4(x-2)=4\left[\frac{3}{4}(x+4)\right]$$
$$4(x-2)=3(x+4)$$
$$4x-8=3x+12$$
$$4x-8-3x=3x+12-3x$$
$$x-8=12$$
$$x-8+8=12+8$$
$$x=20$$

109.
$$\frac{1}{2}(x-2)=\frac{1}{3}(x+2)$$
$$6\left[\frac{1}{2}(x-2)\right]=6\left[\frac{1}{3}(x+2)\right]$$
$$3(x-2)=2(x+2)$$
$$3x-6=2x+4$$
$$3x-6-2x=2x+4-2x$$
$$x-6=4$$
$$x-6+6=4+6$$
$$x=10$$

110.
$$\frac{1}{4}(x+3)=\frac{1}{3}(x-2)+1$$
$$12\left[\frac{1}{4}(x+3)\right]=12\left[\frac{1}{3}(x-2)+1\right]$$
$$3(x+3)=4(x-2)+12$$
$$3x+9=4x-8+12$$
$$3x+9=4x+4$$
$$3x+9-4x=4x+4-4x$$
$$-x+9=4$$
$$-x+9-9=4-9$$
$$-x=-5$$
$$x=5$$

111.
$$0.4n+4.7=5.1n$$
$$0.4n+4.7-0.4n=5.1n-0.4n$$
$$4.7=4.7n$$
$$\frac{4.7}{4.7}=\frac{4.7n}{4.7}$$
$$1.00=n \quad \text{or} \quad n=1.00$$

112.
$$0.8x-4=2.1x+3.2$$
$$0.8x-4+4=2.1x+3.2+4$$
$$0.8x=2.1x+7.2$$
$$0.8x-2.1x=2.1x+7.2-2.1x$$
$$-1.3x=7.2$$
$$\frac{-1.3x}{-1.3}=\frac{7.2}{-1.3}$$
$$x\approx -5.54$$

113.
$$1.69x-3.1=0.05-5.9x$$
$$1.69x-3.1+3.1=0.05-5.9x+3.1$$
$$1.69x=3.15-5.9x$$
$$1.69x+5.9x=3.15-5.9x+5.9x$$
$$7.59x=3.15$$
$$\frac{7.59x}{7.59}=\frac{3.15}{7.59}$$
$$x\approx 0.42$$

114.
$$4.2x+9.7=-3.95x-6.8$$
$$4.2x+9.7-9.7=-3.95x-6.8-9.7$$
$$4.2x=-3.95x-16.5$$
$$4.2x+3.95x=-3.95x-16.5+3.95x$$
$$8.15x=-16.5$$
$$\frac{8.15x}{8.15}=\frac{-16.5}{8.15}$$
$$x\approx -2.02$$

115.
$$4.7x-3.6(x-1)=4.9$$
$$4.7x-3.6x+3.6=4.9$$
$$1.1x+3.6=4.9$$
$$1.1x+3.6-3.6=4.9-3.6$$
$$1.1x=1.3$$
$$\frac{1.1x}{1.1}=\frac{1.3}{1.1}$$
$$x\approx 1.18$$

116.
$$6.1p-4.5(3-2p)=15.7$$
$$6.1p-13.5+9p=15.7$$
$$15.1p-13.5=15.7$$
$$15.1p-13.5+13.5=15.7+13.5$$
$$15.1p=29.2$$
$$\frac{15.1p}{15.1}=\frac{29.2}{15.1}$$
$$p\approx 1.93$$

117.
$$0.6(500-2.4x)=3.6(2x-4000)$$
$$300-1.44x=7.2x-14,400$$
$$300-1.44x+1.44x=7.2x-14,400+1.44x$$
$$300=8.64x-14,400$$
$$300+14,400=8.64x-14,400+14,400$$
$$14,700=8.64x$$
$$\frac{14,700}{8.64}=\frac{8.64x}{8.64}$$
$$1701.39\approx x$$
$$x\approx 1701.39$$

118.
$$0.6(14x-8000)=-0.4(20x+12,000)+20.6x$$
$$8.4x-4800=-8x-4800+20.6x$$
$$8.4x-4800=12.6x-4800$$
$$8.4x-4800-8.4x=12.6x-4800-8.4x$$
$$-4800=4.2x-4800$$
$$-4800+4800=4.2x-4800+4800$$
$$0=4.2x$$
$$\frac{0}{4.2}=\frac{4.2x}{4.2}$$
$$x=0.00$$

119.
$$3(y+3)-4(2y-7)=-5y+2$$
$$3y+9-8y+28=-5y+2$$
$$-5y+37=-5y+2$$
$$-5y+37+5y=-5y+2+5y$$
$$37=2$$
The solution set is $\varnothing$.
The equation is a contradiction.

120.
$$7x+5-5(x-3)=5(x+4)-3x$$
$$7x+5-5x+15=5x+20-3x$$
$$2x+20=2x+20$$
$$2x+20-2x=2x+20-2x$$
$$20=20$$
The solution set is $\mathbb{R}$.
The equation is an identity.

121. $7+3(x-2)+8x=6(x+1)+2x-9$

$7+3x-6+8x=6x+6+2x-9$

$11x+1=8x-3$

$11x+1-1=8x-3-1$

$11x=8x-4$

$11x-8x=8x-4-8x$

$3x=-4$

$x=-\frac{4}{3}$

The solution set is $\left\{-\frac{4}{3}\right\}$.

The equation is conditional.

122. $-5(c+3)+4(c-2)=2(c+2)$

$-5c-15+4c-8=2c+4$

$-c-23=2c+4$

$-c-23+c=2c+4+c$

$-23=3c+4$

$-23-4=3c+4-4$

$-27=3c$

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

$-9=c$

The solution set is $\{-9\}$.

The equation is conditional.

123. $6(x-1)=-3(2-x)+3x$

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

$6x-6=-6+6x$

$6x-6-6x=-6+6x-6x$

$-6=-6$

The solution set is $\mathbb{R}$.

The equation is an identity.

124. $4(2-3x)=-[6x-(8-6x)]$

$8-12x=-(6x-8+6x)$

$8-12x=-(12x-8)$

$8-12x=-12x+8$

$8-12x+12x=-12x+8+12x$

$8=8$

The solution set is $\mathbb{R}$.

The equation is an identity.

125. $4-\left(\frac{2}{3}x+2\right)=2\left(-\frac{1}{3}x+1\right)$

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

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

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

$2=2$

The solution set is $\mathbb{R}$.

The equation is an identity.

126. $7-\left(\frac{1}{2}x+4\right)=3\left(-\frac{1}{6}x+2\right)$

$7-\frac{1}{2}x-4=-\frac{1}{2}x+6$

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

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

$3=6$

The solution set is $\varnothing$.

The equation is a contradiction.

127. $0.8z-0.3(z+10)=0.5(z+1)$

$0.8z-0.3z-3.0=0.5z+0.5$

$0.5z-3.0=0.5z+0.5$

$0.5z-3.0-0.5z=0.5z+0.5-0.5z$

$-3.0=0.5$

The solution set is $\varnothing$.

The equation is a contradiction.

128. $0.6(z+5)-0.5(z+2)=0.1(z-23)$

$0.6z+3.0-0.5z-1.0=0.1z-2.3$

$0.1z+3.0=0.1z-2.3$

$0.1z+3.0-0.1z=0.1z-2.3-0.1z$

$3.0=-2.3$

The solution set is $\varnothing$.

The equation is contradiction.

129. a. For 2008, substitute 8 for t.

$P=0.82t+78.5$

$P=0.82(8)+78.5$

$P=6.56+78.5$

$P=85.06$

$P\approx 85$

In 2008, the population density will be about 85 people per square mile.

b. Substitute 100 for P and solve for t.

$$P = 0.82t + 78.5$$
$$100 = 0.82t + 78.5$$
$$100 - 78.5 = 0.82t + 78.5 - 78.5$$
$$21.5 = 0.82t$$
$$\frac{21.5}{0.82} = \frac{0.82t}{0.82}$$
$$26.22 \approx t$$

The population density should reach 100 people per square mile during the year 2026.

130. a. For first night, substitute 1 for n.

$$W = 5n + 5$$
$$W = 5(1) + 5$$
$$W = 10$$

Wait 10 minutes the first night.

b. For fourth night, substitute 4 for n.

$$W = 5n + 5$$
$$W = 5(4) + 5$$
$$W = 25$$

Wait 25 minutes the fourth night.

c. Substitute 30 for W and solve for n.

$$W = 5n + 5$$
$$30 = 5n + 5$$
$$30 - 5 = 5n + 5 - 5$$
$$25 = 5n$$
$$\frac{25}{5} = \frac{5n}{5}$$
$$5 = n$$

Wait 30 minutes the fifth night.

d. Substitute 40 for W and solve for n.

$$W = 5n + 5$$
$$40 = 5n + 5$$
$$40 - 5 = 5n + 5 - 5$$
$$35 = 5n$$
$$\frac{35}{5} = \frac{5n}{5}$$
$$7 = n$$

Wait 40 minutes the seventh night.

131. a. For 2014, substitute 14 for x.

$$P = 0.06x + 12.4$$
$$= 0.06(14) + 12.4$$
$$= 0.84 + 12.4$$
$$= 13.24$$

In 2014, the percentage of Americans older than 65 will be 13.24%.

b. Substitute 15 for P and solve for x.

$$P = 0.06x + 12.4$$
$$15 = 0.06x + 12.4$$
$$15 - 12.4 = 0.06x + 12.4 - 12.4$$
$$2.6 = 0.06x$$
$$\frac{2.6}{0.06} = \frac{0.06x}{0.06}$$
$$43.3 \approx x$$
$$43 + 2000 = 2043$$

The percentage of Americans older than 65 will reach 15% in 2043.

132. a. Substitute 50 for x.

$$P = 3.75x - 33.75$$
$$= 3.75(50) - 33.75$$
$$= 187.5 - 33.75$$
$$= 153.75$$

If she sells 50 pies, Janet's weekly profit is \$153.75.

b. Substitute 0 for P.

$$P = 3.75x - 33.75$$
$$0 = 3.75x - 33.75$$
$$0 + 33.75 = 3.75x - 33.75 + 33.75$$
$$33.75 = 3.75x$$
$$\frac{33.75}{3.75} = \frac{3.75x}{3.75}$$
$$9 = x$$

Janet would have to sell 9 pies in one week in order to break even.

c. Substitute 300 for P.

$$P = 3.75x - 33.75$$
$$300 = 3.75x - 33.75$$
$$300 + 33.75 = 3.75x - 33.75 + 33.75$$
$$333.75 = 3.75x$$
$$\frac{333.75}{3.75} = \frac{3.75x}{3.75}$$
$$89 = x$$

Janet would have to sell 89 pies in one week in order to have a profit of \$300.

133. $* \Delta - \square = \odot$ for Δ

$$* \Delta - \square + \square = \odot + \square$$
$$* \Delta = \odot + \square$$
$$\frac{* \Delta}{*} = \frac{\odot + \square}{*}$$
$$\Delta = \frac{\odot + \square}{*}$$

134. $\Delta(\odot + \square) = \otimes$ for Δ

$$\frac{\Delta(\odot + \square)}{\odot + \square} = \frac{\otimes}{\odot + \square}$$
$$\Delta = \frac{\otimes}{\odot + \square}$$

135. $\odot \square + \Delta = \otimes$ for $\odot$

$$\odot \square + \Delta - \Delta = \otimes - \Delta$$
$$\odot \square = \otimes - \Delta$$
$$\frac{\odot \square}{\square} = \frac{\otimes - \Delta}{\square}$$
$$\odot = \frac{\otimes - \Delta}{\square}$$

136. $\Delta(\odot + \square) = \otimes$ for $\square$

$$\Delta \odot + \Delta \square = \otimes$$
$$\Delta \odot + \Delta \square - \Delta \odot = \otimes - \Delta \odot$$
$$\Delta \square = \otimes - \Delta \odot$$
$$\frac{\Delta \square}{\Delta} = \frac{\otimes - \Delta \odot}{\Delta}$$
$$\square = \frac{\otimes - \Delta \odot}{\Delta}$$

137. Answers may vary. Possible answer:
$2x + 3 = 8$
$14x = 35$
$x = \frac{5}{2}$
All three equations can be written in the form $2x = 5$.

138. Answers may vary. Possible answer:
$2x = 8$
$x + 3 = 7$
$x - 2 = 2$
All three equations, when simplified are equivalent to $x = 4$.

139. Answers may vary. One possible answer is $x + 5 = x + 3$. Make sure that the variable terms "cancel" and leave a false statement.

140. Answers may vary. One possible answer is $x + 5 = x + 5$. Make sure that the expressions on either side of the equal sign are equivalent.

141. Answers may vary. One possible answer is $\frac{5}{2}p + 7 = 6 + 2p + 4$.

142. Answers may vary. One possible answer is $4 + 4m + 1 = 2m + 9$.

143. $2(a + 5) + n = 4a - 8$
Substitute -2 for a and solve for n.

$$2(-2 + 5) + n = 4(-2) - 8$$
$$2(3) + n = -8 - 8$$
$$6 + n = -16$$
$$6 + n - 6 = -16 - 6$$
$$n = -22$$

144. $-3(x + 2) + 5x + 12 = n$
Substitute 6 for x and solve for n.

$$-3(6 + 2) + 5(6) + 12 = n$$
$$-3(8) + 30 + 12 = n$$
$$-24 + 30 + 12 = n$$
$$18 = n$$

145. **a.** Answers will vary.

b. The definition of absolute value is

$$|a| = \begin{cases} a \text{ if } a \geq 0 \\ -a \text{ if } a < 0 \end{cases}$$

146. **a.** $-3^2 = -(3 \cdot 3) = -9$

b. $(-3)^2 = (-3)(-3) = 9$

147. $\sqrt[3]{-125} = -5$ since $(-5)^3 = -125$

148. $\left(-\frac{2}{7}\right)^2 = \left(-\frac{2}{7}\right)\left(-\frac{2}{7}\right) = \frac{4}{49}$

Exercise Set 2.2

1. To express a problem using mathematical symbols is to create a mathematical model.

2. A number or variable placed below and to the right of a variable is a subscript.

3. To express a problem algebraically is to translate the problem into mathematical language.

4. The first step in our problem-solving procedure is to understand the problem.

5. To check an answer we first ask, "Does the answer make sense?"

6. A formula is an equation that is a mathematical model of a real-life situation.

7. $W = Fd$
$= 20(15)$
$= 300$

8. $A = lw$
$= 7(6)$
$= 42$

9. $A = P + Prt$
$= 160 + 160(0.05)(2)$
$= 160 + 16$
$= 176$

10. $S = 2lw + 2wh + 2lh$
$= 2(7)(4) + 2(4)(3) + 2(7)(3)$
$= 56 + 24 + 42$
$= 122$

11. $A = \pi r^2$
$= \pi(8)^2$
$= \pi(64)$
≈ 201.06

12. $V = \pi r^2 h$
$= \pi(3)^2(5)$
$= \pi \cdot 9 \cdot 5$
≈ 141.37

13. $A = \frac{1}{2}bh$
$= \frac{1}{2}(7)(6)$
$= \frac{1}{2}(42)$
$= 21$

14. $A = \frac{1}{2}h(b_1 + b_2)$
$= \frac{1}{2}(15)(20 + 28)$
$= \frac{1}{2}(15)(48)$
$= 24(15)$
$= 360$

15. $Z = \frac{x - \bar{x}}{s}$
$= \frac{130 - 100}{15}$
$= \frac{30}{15}$
$= 2$

16. $E = a_1 p_1 + a_2 p_2$
$= 10(0.2) + 100(0.3)$
$= 2 + 30$
$= 32$

17. $m = \frac{y_2 - y_1}{x_2 - x_1}$
$= \frac{4 - (-3)}{-2 - (-6)}$
$= \frac{4 + 3}{-2 + 6}$
$= \frac{7}{4}$

18. $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
$= \sqrt{(5 - (-3))^2 + (-6 - 3)^2}$
$= \sqrt{(5 + 3)^2 + (-6 - 3)^2}$
$= \sqrt{8^2 + (-9)^2}$
$= \sqrt{64 + 81}$
$= \sqrt{145} \approx 12.04$

19. $R_T = \frac{R_1 R_2}{R_1 + R_2}$
$= \frac{100 \cdot 200}{100 + 200}$
$= \frac{20{,}000}{300}$
≈ 66.67

20. $F = G\frac{m_1 m_2}{r^2}$
$F = 0.5\left(\frac{100 \cdot 200}{4^2}\right)$
$= 0.5\left(\frac{20{,}000}{16}\right)$
$= 0.5(1250)$
$= 625$

21. $x = \dfrac{-b+\sqrt{b^2-4ac}}{2a}$

$= \dfrac{-(-5)+\sqrt{(-5)^2-4(2)(-12)}}{2(2)}$

$= \dfrac{5+\sqrt{25+96}}{4}$

$= \dfrac{5+\sqrt{121}}{4}$

$= \dfrac{5+11}{4}$

$= \dfrac{16}{4}$

$= 4$

22. $x = \dfrac{-b-\sqrt{b^2-4ac}}{2a}$

$= \dfrac{-(-5)-\sqrt{(-5)^2-4(2)(-12)}}{2(2)}$

$= \dfrac{5-\sqrt{25+96}}{4}$

$= \dfrac{5-\sqrt{121}}{4}$

$= \dfrac{5-11}{4}$

$= \dfrac{-6}{4}$

$= -\dfrac{3}{2}$

23. $A = p\left(1+\dfrac{r}{n}\right)^{nt}$

$= 100\left(1+\dfrac{0.06}{1}\right)^{1\cdot 3}$

$= 100(1.06)^3$

$= 100(1.191016)$

≈ 119.10

24. $s_n = \dfrac{n(a_1+a_n)}{2}$

$= \dfrac{50(-4+339)}{2}$

$= \dfrac{50(335)}{2}$

$= \dfrac{16,750}{2}$

$= 8375$

25. $3x+y=5$

$3x+y-3x=5-3x$

$y=5-3x$

or

$y=-3x+5$

26. $6x-2y=16$

$6x-2y-6x=-6x+16$

$-2y=-6x+16$

$\dfrac{-2y}{-2}=\dfrac{-6x+16}{-2}$

$y=3x-8$

27. $3x+2y=6$

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

$2y=-3x+6$

$\dfrac{2y}{2}=\dfrac{-3x+6}{2}$

$y=-\dfrac{3}{2}x+3$

28. $-6x+5y=25$

$-6x+5y+6x=6x+25$

$5y=6x+25$

$\dfrac{5y}{5}=\dfrac{6x+25}{5}$

$y=\dfrac{6}{5}x+5$

29.
$$\begin{aligned} 7x &= 3y - 2 \\ 7x - 3y &= 3y - 2 - 3y \\ 7x - 3y &= -2 \\ 7x - 3y - 7x &= -2 - 7x \\ -3y &= -7x - 2 \\ \frac{-3y}{-3} &= \frac{-7x-2}{-3} \\ y &= \frac{7}{3}x + \frac{2}{3} \end{aligned}$$

30.
$$\begin{aligned} 9x &= 7y + 23 \\ 9x - 23 &= 7y + 23 - 23 \\ 9x - 23 &= 7y \\ \frac{9x-23}{7} &= \frac{7y}{7} \\ \frac{9}{7}x - \frac{23}{7} &= y \\ y &= \frac{9}{7}x - \frac{23}{7} \end{aligned}$$

31.
$$\begin{aligned} \frac{x}{5} + \frac{y}{2} &= 1 \\ \frac{x}{5} + \frac{y}{2} - \frac{x}{5} &= 1 - \frac{x}{5} \\ \frac{y}{2} &= 1 - \frac{x}{5} \\ 2\left(\frac{y}{2}\right) &= 2\left(-\frac{x}{5} + 1\right) \\ y &= -\frac{2}{5}x + 2 \end{aligned}$$

32.
$$\begin{aligned} \frac{x}{4} - \frac{y}{6} &= 2 \\ 12\left(\frac{x}{4} - \frac{y}{6}\right) &= 12 \cdot 2 \\ 3x - 2y &= 24 \\ 3x - 2y - 3x &= -3x + 24 \\ -2y &= -3x + 24 \\ \frac{-2y}{-2} &= \frac{-3x+24}{-2} \\ y &= \frac{3}{2}x - 12 \end{aligned}$$

33.
$$\begin{aligned} 3(x-2) + 3y &= 6x \\ 3x - 6 + 3y &= 6x \\ 3x - 6 + 3y - 3x &= 6x - 3x \\ -6 + 3y &= 3x \\ -6 + 3y + 6 &= 3x + 6 \\ 3y &= 3x + 6 \\ \frac{3y}{3} &= \frac{3x+6}{3} \\ y &= x + 2 \end{aligned}$$

34.
$$\begin{aligned} -2(x-5) - 7y &= 5x + 24 \\ -2x + 10 - 7y &= 5x + 24 \\ -2x + 10 - 7y + 2x &= 5x + 24 + 2x \\ 10 - 7y &= 7x + 24 \\ 10 - 7y - 10 &= 7x + 24 - 10 \\ -7y &= 7x + 14 \\ \frac{-7y}{-7} &= \frac{7x+14}{-7} \\ y &= -x - 2 \end{aligned}$$

35.
$$\begin{aligned} y + 1 &= -\frac{4}{3}(x-9) \\ 3[y+1] &= 3\left[-\frac{4}{3}(x-9)\right] \\ 3y + 3 &= -4(x-9) \\ 3y + 3 &= -4x + 36 \\ 3y + 3 - 3 &= -4x + 36 - 3 \\ 3y &= \\ \frac{3y}{3} &= \frac{-4x+33}{3} \\ y &= -\frac{4}{3} + 11 \end{aligned}$$

36.
$$\begin{aligned} y - 4 &= \frac{2}{3}(x+6) \\ 3[y-4] &= 3\left[\frac{2}{3}(x+6)\right] \\ 3y - 12 &= 2(x+6) \\ 3y - 12 &= 2x + 12 \\ 3y - 12 + 12 &= 2x + 12 + 12 \\ 3y &= 2x + 24 \\ \frac{3y}{3} &= \frac{2x+24}{3} \\ y &= \frac{2}{3}x + 8 \end{aligned}$$

37. $E = IR$

$$\frac{E}{R} = \frac{IR}{R}$$

$$\frac{E}{R} = I \text{ or } I = \frac{E}{R}$$

38. $C = 2\pi r$

$$\frac{C}{2\pi} = \frac{2\pi r}{2\pi}$$

$$\frac{C}{2\pi} = r \text{ or } r = \frac{C}{2\pi}$$

39. $C = \pi d$

$$\frac{C}{\pi} = \frac{\pi d}{\pi}$$

$$\frac{C}{\pi} = d \text{ or } d = \frac{C}{\pi}$$

40. $A = lw$

$$\frac{A}{w} = \frac{lw}{w}$$

$$\frac{A}{w} = l \text{ or } l = \frac{A}{w}$$

41. $P = 2l + 2w$

$$P - 2w = 2l + 2w - 2w$$

$$P - 2w = 2l$$

$$\frac{P-2w}{2} = \frac{2l}{2}$$

$$\frac{P-2w}{2} = l \text{ or } l = \frac{P-2w}{2}$$

42. $ax + b = y$

$$ax + b - b = y - b$$

$$ax = y - b$$

$$\frac{ax}{x} = \frac{y-b}{x}$$

$$a = \frac{y-b}{x}$$

43. $V = lwh$

$$\frac{V}{lw} = \frac{lwh}{lw}$$

$$\frac{V}{lw} = h \text{ or } h = \frac{V}{lw}$$

44. $V = \pi r^2 h$

$$\frac{V}{\pi r^2} = \frac{\pi r^2 h}{\pi r^2}$$

$$\frac{V}{\pi r^2} = h \text{ or } h = \frac{V}{\pi r^2}$$

45. $A = P + Prt$

$$A - P = P + Prt - P$$

$$A - P = Prt$$

$$\frac{A-P}{Pt} = \frac{Prt}{Pt}$$

$$\frac{A-P}{Pt} = r \text{ or } r = \frac{A-P}{Pt}$$

46. $Ax + By = C$

$$Ax + By - Ax = C - Ax$$

$$By = C - Ax$$

$$\frac{By}{B} = \frac{C-Ax}{B}$$

$$y = \frac{C-Ax}{B}$$

47. $V = \frac{1}{3}lwh$

$$3V = 3\left(\frac{1}{3}lwh\right)$$

$$3V = lwh$$

$$\frac{3V}{wh} = \frac{lwh}{wh}$$

$$\frac{3V}{wh} = l \text{ or } l = \frac{3V}{wh}$$

48. $A = \frac{1}{2}bh$

$$2A = 2 \cdot \frac{1}{2}bh$$

$$2A = bh$$

$$\frac{2A}{h} = \frac{bh}{h}$$

$$\frac{2A}{h} = b \text{ or } b = \frac{2A}{h}$$

49.
$$y = mx + b$$
$$y - b = mx + b - b$$
$$y - b = mx$$
$$\frac{y-b}{x} = \frac{mx}{x}$$
$$\frac{y-b}{x} = m \text{ or } m = \frac{y-b}{x}$$

50.
$$IR + Ir = E$$
$$IR + Ir - Ir = E - Ir$$
$$IR = E - Ir$$
$$\frac{IR}{I} = \frac{E-Ir}{I}$$
$$R = \frac{E-Ir}{I}$$

51.
$$y - y_1 = m(x - x_1)$$
$$\frac{y-y_1}{x-x_1} = \frac{m(x-x_1)}{x-x_1}$$
$$\frac{y-y_1}{x-x_1} = m \text{ or } m = \frac{y-y_1}{x-x_1}$$

52.
$$a_n = a_1 + (n-1)d$$
$$a_n - a_1 = a_1 + (n-1)d - a_1$$
$$a_n - a_1 = (n-1)d$$
$$\frac{a_n - a_1}{n-1} = \frac{(n-1)d}{n-1}$$
$$d = \frac{a_n - a_1}{n-1}$$

53.
$$z = \frac{x-\mu}{\sigma}$$
$$\sigma z = \sigma\left(\frac{x-\mu}{\sigma}\right)$$
$$\sigma z = x - \mu$$
$$\sigma z - x = x - \mu - x$$
$$\sigma z - x = -\mu$$
$$x - \sigma z = \mu$$

54.
$$z = \frac{x-\mu}{\sigma}$$
$$\sigma z = \sigma\left(\frac{x-\mu}{\sigma}\right)$$
$$\sigma z = x - \mu$$
$$\frac{\sigma z}{z} = \frac{x-\mu}{\sigma}$$
$$\sigma = \frac{x-\mu}{z}$$

55.
$$P_1 = \frac{T_1 P_2}{T_2}$$
$$T_2 P_1 = T_2\left(\frac{T_1 P_2}{T_2}\right)$$
$$T_2 P_1 = T_1 P_2$$
$$\frac{T_2 P_1}{P_1} = \frac{T_1 P_2}{P_1}$$
$$T_2 = \frac{T_1 P_2}{P_1}$$

56.
$$y = \frac{kx}{z}$$
$$zy = z\left(\frac{kx}{z}\right)$$
$$zy = kx$$
$$\frac{zy}{y} = \frac{kx}{y}$$
$$z = \frac{kx}{y}$$

57.
$$A = \frac{1}{2}h(b_1 + b_2)$$
$$2A = 2\left[\frac{1}{2}h(b_1 + b_2)\right]$$
$$2A = h(b_1 + b_2)$$
$$\frac{2A}{b_1 + b_2} = \frac{h(b_1 + b_2)}{b_1 + b_2}$$
$$\frac{2A}{b_1 + b_2} = h \text{ or } h = \frac{2A}{b_1 + b_2}$$

58. $S = 2\pi r^2 + 2\pi rh$

$S - 2\pi r^2 = 2\pi r^2 + 2\pi rh - 2\pi r^2$

$S - 2\pi r^2 = 2\pi rh$

$\dfrac{S - 2\pi r^2}{2\pi r} = \dfrac{2\pi rh}{2\pi r}$

$h = \dfrac{S - 2\pi r^2}{2\pi r}$

59. $S = \dfrac{n}{2}(f + l)$

$2S = 2\left[\dfrac{n}{2}(f + l)\right]$

$2S = n(f + l)$

$\dfrac{2S}{f + l} = \dfrac{n(f + l)}{f + l}$

$\dfrac{2S}{f + l} = n$ or $n = \dfrac{2S}{f + l}$

60. $S = \dfrac{n}{2}(f + l)$

$2S = 2\left[\dfrac{n}{2}(f + l)\right]$

$2S = n(f + l)$

$2S = nf + nl$

$2S - nf = nf + nl - nf$

$2S - nf = nl$

$\dfrac{25 - nf}{n} = \dfrac{nl}{n}$

$\dfrac{2S - nf}{n} = l$ or $l = \dfrac{2S - nf}{n}$

61. $C = \dfrac{5}{9}(F - 32)$

$\dfrac{9}{5}C = \dfrac{9}{5} \cdot \dfrac{5}{9}(F - 32)$

$\dfrac{9}{5}C = F - 32$

$\dfrac{9}{5}C + 32 = F - 32 + 32$

$\dfrac{9}{5}C + 32 = F$ or $F = \dfrac{9}{5}C + 32$

62. $F = \dfrac{9}{5}C + 32$

$F - 32 = \dfrac{9}{5}C + 32 - 32$

$F - 32 = \dfrac{9}{5}C$

$\dfrac{5}{9}(F - 32) = \dfrac{5}{9} \cdot \dfrac{9}{5}C$

$\dfrac{5}{9}(F - 32) = C$ or $C = \dfrac{5}{9}(F - 32)$

63. $F = \dfrac{km_1m_2}{d^2}$

$Fd^2 = d^2\left(\dfrac{km_1m_2}{d^2}\right)$

$Fd^2 = km_1m_2$

$\dfrac{Fd^2}{km_2} = \dfrac{km_1m_2}{km_2}$

$\dfrac{Fd^2}{km_2} = m_1$ or $m_1 = \dfrac{Fd^2}{km_2}$

64. $F = \dfrac{km_1m_2}{d^2}$

$Fd^2 = d^2\left(\dfrac{km_1m_2}{d^2}\right)$

$Fd^2 = km_1m_2$

$\dfrac{Fd^2}{km_1} = \dfrac{km_1m_2}{km_1}$

$\dfrac{Fd^2}{km_1} = m_2$ or $m_2 = \dfrac{Fd^2}{km_1}$

65. a. Let d = U.S. dollars and p = Mexican pesos. Then $p = 12.78d$.

b. Solve $p = 12.78d$ for d.

$p = 12.78d$

$\dfrac{p}{12.78} = \dfrac{12.78d}{12.78}$

$\dfrac{p}{12.78} = d$ or $d = \dfrac{p}{12.78} \approx 0.08p$

66. a. Let d = U.S. dollars and c = Canadian dollars. Then $c = 1.02d$.

b. Solve $c = 1.02d$ for d.

$$c = 1.02d$$
$$\frac{c}{1.02} = \frac{1.02d}{1.02}$$
$$\frac{c}{1.02} = d \quad \text{or} \quad d = \frac{c}{1.02} \approx 0.98c$$

67. a. $i = prt$
$= 6000(0.03)(4)$
$= 720$
Bhagirathi must pay \$720 in simple interest.

b. $6000 + 720 = 6720$
Bhagirathi must pay a total of \$6720.

68. a. $i = prt$
$= 4500(0.0175)(2)$
$= 157.5$
Peter must pay \$157.50 in simple interest.

b. $4500 + 157.50 = 4657.50$
Peter must pay a total of \$4657.50.

69. $i = prt$
$4875 = (20{,}000)(.0375)t$
$4875 = 750t$
$\frac{4875}{750} = \frac{750t}{750}$
$6.5 = t$
The length of the loan was 6.5 years.

70. $i = prt$
$52.90 = (500) \cdot r \cdot (2)$
$52.90 = 1000r$
$\frac{52.90}{1000} = \frac{1000r}{1000}$
$0.0529 = r$
The interest rate was 5.29%.

71. $i = prt$
$5262.5 - 5000 = (5000) \cdot r \cdot (3)$
$262.5 = 15{,}000r$
$\frac{262.5}{15{,}000} = \frac{15{,}000r}{15{,}000}$
$0.0175 = r$
The interest rate was 1.75%.

72. $i = prt$
$2166 - 2000 = (2000) \cdot r \cdot (2)$
$166 = 4000r$
$\frac{166}{4000} = \frac{4000r}{4000}$
$0.0415 = r$
The interest rate was 4.15%.

73. a. $A = \pi r^2$
$= \pi(1)^2$
≈ 3.14 square inches

b. $A = \pi r^2$
$= \pi(5)^2$
$= 25\pi$
≈ 78.54 square inches.

74. First we note that the radius of the larger circle is $r_1 = 25$ feet and the radius of the smaller circle is $r_2 = 15$ feet.
Area of blue
=Area of big circle–Area of small circle
$= \pi r_1^2 - \pi r_2^2$
$= \pi(25)^2 - \pi(15)^2$
$= 625\pi - 225\pi$
$= 400\pi$
≈ 1256.64 square feet

75. a. 6 inches is 0.5 feet.
$V = lwh$
$= 15(10)(0.5)$
$= 75$ cubic feet

b. $\frac{75}{27} \approx 2.78$ cubic yards

c. To get 2.78 cubic yards of concrete, 3 cubic yards must be purchased.
$3(\$35) = \$105$

76. a. 4 inches $= \frac{1}{3}$ ft
$V = lwh$
$= (108)(56)\left(\frac{1}{3}\right)$
$= 2016$ ft^3

b. $\left(2016 \text{ ft}^3\right)\left(\frac{1 \text{ yd}^3}{27 \text{ ft}^3}\right) \approx 74.67 \text{ yd}^3$

c. $\left(75 \text{ yd}^3\right)\left(\frac{\$40}{\text{yd}^3}\right) = \$3000$

77. a. The volume of a cylinder is given by $V = \pi r^2 h$. Note that the radius is half the diameter so the radius is 2.5 inches.

$$V = \pi r^2 h$$
$$= \pi (2.5)^2 (6.25)$$
$$\approx 122.72 \text{ cubic inches}$$

b. For the volume of the box:

$$V = lwh$$
$$= (7)(5)(3.5)$$
$$= 122.5 \text{ cubic inches}$$

c. The cylinder has greater volume by about $122.72 - 122.5 = 0.22$ cubic inches.

78. a. $V = \pi r^2 h$

$$= \pi (4.5)^2 (10.5)$$
$$\approx 667.98 \text{ cubic inches}$$

b. $\frac{667.98}{231} \approx 2.89$ gallons

c. 2.89 gallons requires 2.89 ounces

79. $A = p\left(1 + \frac{r}{n}\right)^{nt}$

$$= 10,000\left(1 + \frac{0.06}{4}\right)^{4 \cdot 2}$$
$$= 10,000(1.015)^8$$
$$= 11,264.93$$

Beth will have \$11,264.93 in her account.

80. $A = p\left(1 + \frac{r}{n}\right)^{nt}$

$$= 8500\left(1 + \frac{0.032}{12}\right)^{12 \cdot 4}$$
$$\approx 8500\left(1.0026666667\right)^{48}$$
$$\approx 9659.05$$

Vigay will have \$9659.05 in his account.

81. a. Note that 36 months is 3 years so $t = 3$.

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 4390\left(1 + \frac{0.041}{2}\right)^{(2)(3)}$$
$$= 4390\left(1 + 0.0205\right)^6$$
$$= 4390\left(1.0205\right)^6$$
$$\approx 4958.41$$

The certificate will be worth \$4958.41 after 36 months.

b. $4958.41 - 4390 = 568.41$

Heather earned \$568.41 in interest.

82. a. 30 months = 2.5 years

$$A = p\left(1 + \frac{r}{n}\right)^{nt}$$
$$= 12,000\left(1 + \frac{0.015}{12}\right)^{(12)(2.5)}$$
$$= 12,000\left(1.00125\right)^{30}$$
$$\approx 12,458.25$$

The certificate will be worth \$12,458.25 after 30 months.

b. $12,458.25 - 12,000 = 458.25$

Linda will earn \$458.25 in interest.

83. a. $A = p\left(1 + \frac{r}{n}\right)^{nt}$

$$= 50,000\left(1 + \frac{0.021}{12}\right)^{(12)(10)}$$
$$= 50,000\left(1.00175\right)^{120}$$
$$\approx 61,672.58$$

The certificate will be worth \$61,672.58 in 10 years.

b. $61,672.58 - 50,000 = 11,672.58$

Jon will earn \$11,672.58 in interest.

84. The credit union with simple interest:
$i = prt$
$i = (1500)(0.045)(1)$
$i = 67.50$
The bank account with compound interest:
$A = p\left(1 + \frac{r}{n}\right)^{nt}$
$A = 1500\left(1 + \frac{0.04}{4}\right)^{(4)(1)}$
$A = 1500(1.01)^4$
$A \approx 1560.91$
The bank account will earn
$\$1560.91 - \$1500 = \$60.91$. The credit union account pays \$6.59 more.

85. $h = -16t^2 + v_0 t + h_0$

a. $h = -16(1)^2 + 55(1) + 4$
$= 43$
The height of the baseball after 1 second is 43 feet.

b. $h = -16(2)^2 + 55(2) + 4$
$= 50$
The height of the baseball after 2 seconds is 50 feet.

c. $h = -16(3.5)^2 + 55(3.5) + 4$
$= 0.5$
The height of the baseball after 3.5 seconds is 0.5 feet.

86. $h = -16t^2 + v_0 t + h_0$

a. $h = -16(1)^2 + 147(1)$
$= 131$
The height of the rocket after 1 second is 131 feet.

b. $h = -16(4)^2 + 147(4)$
$= 332$
The height of the rocket after 4 seconds is 332 feet.

c. $h = -16(9)^2 + 147(9)$
$= 131$
The height of the rocket after 4 seconds is 27 feet.

87. $w = 0.02c$

a. $c = 2600 - 2400 = 200$
$w = 0.02(200)$
$= 4$
Her weekly weight loss is 4 pounds per week.

b. $2 = 0.02c$
$\frac{2}{0.02} = c$
$c = 100$
2400 + 100 = 2500
She would have to burn 2500 calories per day to lose 2 pounds in a week.

88. $m = –0.875x + 190$

a. $m = –0.875(50) + 190$
$= –43.75 + 190$
$= 146.25$
The maximum rate is 146.25 beats per minute.

b. $160 = –0.875x + 190$
$160 - 190 = –0.875x + 190 - 190$
$–30 = –0.875x$
$34.29 \approx x$
This person is about 34.29 years old.

89. a. $S = 100 – a$

b. $S = 100 – 60 = 40$
A 60-year-old should keep 40% in stocks.

90. a. $\text{BMI} = \frac{w}{h^2}$

b. $\text{BMI} = \frac{705w}{h^2}$

c. Answers will vary.

91. $r = \dfrac{\frac{s}{t}}{\frac{t}{u}} = \dfrac{s}{t} \div \dfrac{t}{u} = \dfrac{s}{t} \cdot \dfrac{u}{t} = \dfrac{su}{t^2}$

In simplified form, it is $r = \dfrac{su}{t^2}$.

a. $r = \dfrac{su}{t^2}$

$rt^2 = t^2\left(\dfrac{su}{t^2}\right)$

$rt^2 = su$

$\dfrac{rt^2}{u} = \dfrac{su}{u}$

$\dfrac{rt^2}{u} = s$ or $s = \dfrac{rt^2}{u}$

b. $r = \dfrac{su}{t^2}$

$rt^2 = t^2\left(\dfrac{su}{t^2}\right)$

$rt^2 = su$

$\dfrac{rt^2}{s} = \dfrac{su}{s}$

$\dfrac{rt^2}{s} = u$ or $u = \dfrac{rt^2}{s}$

92. $-\sqrt{3^2+4^2} + |3-4| - 6^2 = -\sqrt{9+16} + |-1| - 36$

$= -\sqrt{25} + 1 - 36$

$= -5 + 1 - 36$

$= -40$

93. $\dfrac{7+9\div\left(2^3+4\div 4\right)}{|3-7|+\sqrt{5^2-3^2}} = \dfrac{7+9\div(8+4\div 4)}{|3-7|+\sqrt{25-9}}$

$= \dfrac{7+9\div(8+1)}{|-4|+\sqrt{16}} = \dfrac{7+9\div 9}{4+4}$

$= \dfrac{7+1}{4+4} = \dfrac{8}{8}$

$= 1$

94. $a^3 - 3a^2b + 3ab^2 - b^3$ with $a = -2$ and $b = 3$

$(-2)^3 - 3(-2)^2(3) + 3(-2)(3)^2 - (3)^3$

$-8 - 3(4)(3) + 3(-2)(9) - 27$

$-8 - (12)(3) + (-6)(9) - 27$

$-8 - 36 + -54 - 27$

-125

95. $\dfrac{1}{4}t + \dfrac{1}{2} = 1 - \dfrac{1}{8}t$

$8\left(\dfrac{1}{4}t + \dfrac{1}{2}\right) = 8\left(1 - \dfrac{1}{8}t\right)$

$2t + 4 = 8 - t$

$2t + 4 + t = 8 - t + t$

$3t + 4 = 8$

$3t + 4 - 4 = 8 - 4$

$3t = 4$

$\dfrac{3t}{3} = \dfrac{4}{3}$

$t = \dfrac{4}{3}$

Exercise Set 2.3

1. The phrase "a number increased by 3" can be represented by the algebraic expression $\underline{x + 3}$.

2. The phrase "a number decreased by 3" can be represented by the algebraic expression $\underline{x - 3}$.

3. A seven foot rope is cut into two pieces. If we let x = the length of the first piece, then $\underline{7 - x}$ equals the length of the second piece.

4. The word "$\underline{\text{is}}$" in a word problem often means "is equal to."

5. The phrase "6 $\underline{\text{less}}$ than a number" can be represented by the algebraic expression $x - 6$.

6. The phrase "5 $\underline{\text{greater}}$ than a number" can be represented by the algebraic expression $x + 5$.

7. $19.95y$

8. $11n - 7.5$

9. $4m - 17$

10. $7p + 8$

11. Let x = the length of the first piece in feet. Then the second piece has length $12 - x$ feet.
$x;\ 12 - x$

12. Let y = the number of hours Robin spends on the task. Then the number of hours Tom spends is $17 - y$.

$y;\ 17 - y$

13. Let w = the width of the rectangle in meters. Then the length is $w + 29$ meters.

$w;\ w + 29$

14. Let a = the measure of the smaller angle in degrees. Then the larger angle measures $a + 7$ degrees.

$a;\ a + 7$

15. Let t = the time Mitzi's best student took to complete the test. Then Mitzi's time is $\frac{1}{4}t$.

$t;\ \frac{1}{4}t$

16. Let x = the time it takes George to paint the house. Then $2x$ is the time it takes Jason to paint the house.

$x;\ 2x$

17. Let z = the speed at which Betty can jog. Then Nora's speed is $z + 1.3$.

$z;\ z + 1.3$

18. Let s = the speed limit on the local road. Then the speed limit on the express way is $s + 30$.

$s;\ s + 30$

19. Let e = the original cost of the electricity. The increase is $0.22e$, so the new cost is the original cost plus the increase, $e + 0.22e$ or $1.22e$.

$e;\ e + 0.22e$

20. Let p = the original price of the refrigerator. The reduction in price is $0.06p$, so the new price is the original price minus the reduction, $p - 0.06p$ or $0.94p$.

$p;\ p - 0.06p$

21.
$$B = 4A$$
$$A + B = 180$$
$$A + 4A = 180$$
$$5A = 180$$
$$A = 36$$
$$B = 4A = 4(36) = 144$$

The measure of angle A is 36° and B is 144°.

22. Let x = measure of angle B

$4x$ = measure of angle A

measure of angle A + measure of angle B = 90°

$4x + x = 90$

$5x = 90$

$x = 18$

Angle B is 18° and angle A is $4 \times 18^\circ = 72^\circ$.

23. Let x = measure of angle C

$2x - 15$ = measure of angle D

measure of angle C + measure of angle D = 90°

$x + 2x - 15 = 90$

$3x - 15 = 90$

$3x - 15 + 15 = 90 + 15$

$3x = 105$

$x = 35$

Angle C is 35° and angle D is $2 \times 35^\circ - 15^\circ = 55^\circ$.

24.
$$A = B + 30$$
$$A + B = 180$$
$$B + 30 + B = 180$$
$$2B + 30 = 180$$
$$2B = 150$$
$$B = 75$$
$$A = B + 30 = 75 + 30 = 105$$

The measure of angle A is 105° and B is 75°.

25. Let x=smallest angle, then

x+20=second angle

$2x$=third angle

$$x + x + 20 + 2x = 180$$
$$4x + 20 = 180$$
$$4x = 160$$
$$x = 40$$
$$x + 20 = 40 + 20 = 60$$
$$2x = 2(40) = 80$$

The measures of the angles are 40°, 60°, and 80°.

26. Let x=smallest angle, then
$2x$=second angle
x+60=third angle
$x+2x+x+60=180$
$4x+60=180$
$4x=120$
$x=30$
$2x=2(30)=60$
$x+60=30+60=90$
The measures of the angles are 30°, 60°, and 90°.

27. Let x = the cost of the regular subscription.
$x-0.25x=24$
$0.75x=24$
$\frac{0.75x}{0.75}=\frac{24}{0.75}$
$x=32$
The original cost of the subscription was $32.

28. Let p = regular price of suit, then
$0.25p$ = amount of reduction
$p\ \ 0.25p=187.50$
$0.75p=187.50$
$p=250$
The regular price of the suit is $250.

29. Let x = number of rides.
$1.80x=45$
$\frac{1.80x}{1.80}=\frac{45}{1.80}$
$x=25$ rides
Kate would need to ride the bus 25 times per month.

30. Let x = number of weeks.
$12.50x=940$
$\frac{12.50x}{12.50}=\frac{940}{12.50}$
$x=75.2$
It will take 75.2 weeks for the two costs to be the same.

31. Let n = number of miles.
$0.20n+35=80$
$0.20n=45$
$\frac{0.20n}{0.20}=\frac{45}{0.20}$
$n=225$ miles
Tanya can drive 225 miles in one day.

32. Let x = total cost of food and beverages.
$4.50(4)+0.15x=258$
$18+0.15x=258$
$0.15x=240$
$x=1600$
The total cost of food and beverages served is $1600.

33. Let x = the number of golfing trips.
The cost of a social membership:
$50x+25x+1775=75x+1775$
The cost of a golf membership:
$25x+2425$
Set these two expressions equal to each other and solve for x.
$75x+1775=25x+2425$
$75x+1775-25x=25x+2425-25x$
$50x+1775=2425$
$50x+1775-1775=2425-1775$
$50x=650$
$x=13$
He must go golfing 13 times per year for the two options to cost the same amount.

34. Let h = number of hours, then
$361+13h$ = cost for h hours using the Premier membership
$281+18h$ = cost for h hours using the Select membership
$361+13h=281+18h$
$361=281+5h$
$80=5h$
$\frac{80}{5}=\frac{5h}{5}$
$16=h$
The total cost for the two memberships will be the same at 16 hours.

35. Let t = number of trips, then
$2.50t$ = cost for one trip without pass
$0.50t+20=2.50t$
$20=2.00t$
$10=t$
The Morgans would have to go more than 10 times for the cost of the monthly pass to be worthwhile.

36. Let t = number of trips, then
$25 + t =$ cost for t trips using the Sun Pass
$1.25t =$ cost for t trips using cash
$25 + t = 1.25t$
$25 = 0.25t$
$\frac{25}{0.25} = \frac{0.25t}{0.25}$
$100 = t$
The total amount spent with Sun Pass will be equal to amount using cash when 100 trips are made.

37. Let r = the monthly rent in 2010. Then $r + 0.075r = 1.075r$ is the monthly rent in 2009.
$r + 0.075r = 1720$
$1.075r = 1720$
$\frac{1.075r}{1.075} = \frac{1720}{1.075}$
$r = 1600$
The monthly rent in 2009 was \$1600.

38. Let x = maximum price
$x + 0.047x = 838$
$1.047x = 838$
$x \approx 800$
The maximum price they can spend is \$800.

39. Let s = sales from the northwest district (in millions of dollars), then $s + 0.31$ is the sales from the southeast district (in millions of dollars).
$s + s + 0.31 = 4.6$
$2s + 0.31 = 4.6$
$2s = 4.29$
$s = 2.145$
$2.145 + 0.31 = 2.455$
The sales from the northwest district were \$2.145 million and the sales from the southeast district were \$2.455 million.

40. Let x = the number of Brown Swiss cows. Then $x + 29 =$ the number of Holstein cows.
$x + (x + 29) = 137$
$2x + 29 = 137$
$2x = 108$
$\frac{2x}{2} = \frac{108}{2}$
$x = 54$
$54 + 29 = 83$
There are 54 Brown Swiss cows and 83 Holstein cows.

41. Let f = fiber in a medium-sized apple. Then $1.1f$ = amount of fiber in one serving of canned blackberries.
$1.1f = 4.4$
$\frac{1.1f}{1.1} = \frac{4.4}{1.1}$
$f = 4$
A medium-sized apple has 4 grams of fiber.

42. Let l = amount of lycopene in a tablespoon of ketchup. Then $1.5l$ = the amount of lycopene in one pink grapefruit.
$1.5l = 3$
$\frac{1.5l}{1.5} = \frac{3}{1.4}$
$l = 2$
One tablespoon of ketchup contains 2 mg of lycopene.

43. Let p = the original price. Then the discounted price is $p - 0.2p$.
$p - 0.2p = 59.96$
$0.8p = 59.96$
$\frac{0.8p}{0.8} = \frac{59.96}{0.8}$
$p = 74.95$
The original price of the software was \$74.95.

44. Let w = the minimum wage in 2008. Then $w + 0.1069w = 1.1069w$ is the minimum wage in 2009.
$1.1069w = 7.25$
$\frac{1.1069w}{1.1069} = \frac{7.25}{1.1069}$
$w \approx 6.55$
The minimum wage in 2008 was \$6.55 per hour.

45. Let x = number of grasses. Then $2x - 5$ = number of weeds and $2x + 2$ is the number of trees.
$x + (2x - 5) + (2x + 2) = 57$
$x + (2x - 5) + (2x + 2) = 57$
$5x - 3 = 57$
$5x = 60$
$\frac{5x}{5} = \frac{60}{5}$
$x = 12$
There are 12 grasses,
$2(12) - 5 = 24 - 5 = 19$ weeds, and
$2(12) + 2 = 24 + 2 = 26$ trees.

46. Let x = number of cups of raisins. Then $3x$ = number of cups of peanuts and $x + 2.5$ is the number of cups of almonds.

$$x + (3x) + (x + 2.5) = 10$$
$$5x + 2.5 = 10$$
$$5x = 7.5$$
$$\frac{5x}{5} = \frac{7.5}{5}$$
$$x = 1.5$$

There are 1.5 cups of raisins, $3(1.5) = 4.5$ cups of peanuts, and $1.5 + 2.5 = 4$ cups of almonds.

47. Let r = tax rate.

$$85 + 85r + 9.25 = 106.66$$
$$85r + 94.25 = 106.66$$
$$85r + 94.25 - 94.25 = 106.66 - 94.25$$
$$85r = 12.41$$
$$\frac{85r}{85} = \frac{12.41}{85}$$
$$r = 0.146$$

The tax rate is 14.6%.

48. Let r = the sales tax rate.

$$8.25 + 8.25r + 7.95 = 16.86$$
$$8.25r + 16.2 = 16.86$$
$$8.25r = 0.66$$
$$\frac{8.25r}{8.25} = \frac{0.66}{8.25}$$
$$r = 0.08$$

The sales tax rate was 0.08, or 8%.

49. Let x = number of hours.

$$300 + 5x = 17.5x$$
$$300 = 12.5x$$
$$\frac{300}{12.5} = \frac{12.5x}{12.5}$$
$$24 = x$$

It takes 24 or more hours per month for a membership to become advantageous.

50. Let x = number of hours.

$$25 + 10x = 18.50x$$
$$25 = 8.50x$$
$$\frac{25}{8.50} = \frac{8.50x}{8.50}$$
$$2.9 \approx x$$

It takes 3 or more hours per month for Plan 1 to become advantageous.

51. a. Let x = number of months (or monthly payments) necessary for the accumulated payments under the original mortgage plan to equal the accumulated payments and closing cost under the other plan.

$$875x = 755x + 2520$$
$$120x = 2520$$
$$\frac{120x}{120} = \frac{2520}{120}$$
$$x = 21$$

In 21 months Dung will have paid the same amount on his new mortgage plus closing costs as he would on his original mortgage.

b. Let s = the amount Dung would have spent on his original mortgage minus the amount he would spend on his new mortgage plus closing costs.

$$s = 875x - (755x + 2520)$$
$$s = 875(60) - [755(60) + 2520]$$
$$s = 52{,}500 - [45{,}300 + 2520]$$
$$s = 52{,}500 - [47{,}820]$$
$$s = 4680$$

Dung would save $4680.

52. a. Let x = number of months (or monthly payments) necessary for the accumulated payments under the original loan to equal the accumulated payments and closing fee under the new loan.

$$1545x = 1275x + 5130$$
$$270x = 5130$$
$$\frac{270x}{270} = \frac{5130}{270}$$
$$x = 19$$

In 19 months after refinancing Elizabeth will have spent the same amount on her new loan plus the refinancing fee as she would have on her original loan.

b. Let s = the amount Elizabeth would have spent on her original loan minus the amount she will spend on her new loan plus the refinancing fee.

$$s = 1545x - (1275x + 5130)$$
$$s = 1545(48) - [1275(48) + 5130]$$
$$s = 74{,}160 - [61{,}200 + 5130]$$
$$s = 74{,}160 - [66{,}330]$$
$$s = 7830$$

Elizabeth will save $7830.

53. Let n = the number of medals won by Franklin. Then $n + 1$ = the number won by Phelps, n = the number won by Schmitt, and $2n - 5$ = the number won by Lochte.

$$n+(n+1)+(n)+(2n-5)=21$$
$$5n-4=21$$
$$5n=25$$
$$n=5$$

Franklin won 5 medals, Phelps won 5 + 1 = 6 medals, Coughlin won 5 medals, and Lochte won 2(5) – 5 = 5 medals.

54. Let x = the number of D's. Then $2x$ = the number of C's, $x+2$ = the number of B's, and $2x+2$ = the number of A's.

$$x+(x+2)+2x+(2x+2)=34$$
$$6x+4=34$$
$$6x=30$$
$$x=5$$

There were 5 D's, $2(5)=10$ C's, $5+2=7$ B's, and $2(5)+2=12$ A's on the test.

55. Let x = number of animals. Then x + 100,000 = number of plants,
x + 290,000 = number of non-beetle insects, and
$2x$ – 140,000 = number of beetles.

$$x+(x+100,000)+(x+290,000)+(2x-140,000)$$
$$=5x+250,000$$
$$5x+250,000=1,500,000$$
$$5x=1,250,000$$
$$\frac{5x}{5}=\frac{1,250,000}{5}$$
$$x=250,000$$

There are 250,000 animal species. 250,000 + 100,000 = 350,000 plant species,
250,000 + 290,000 = 540,000 non-beetle insect species, and
2(250,000) – 140,000 = 360,000 beetle species.

56. Let l = the length of the shortest side of the triangle. Then $2l+3$ = the length of the first side of the triangle and $2l+2$ = the length of the second side of the triangle.

$$l+(2l+3)+(2l+2)=30$$
$$5l+5=30$$
$$5l+5-5=30-5$$
$$5l=25$$
$$\frac{5l}{5}=\frac{25}{5}$$
$$l=5$$

The length of the shortest side of the triangle is 5 inches, the length of the first side of the triangle is 2(5) + 3 = 13 inches, and the length of the second side of the triangle is 2(5) + 2 = 12 inches.

57. Let s = the length of the smaller side. The lengths of the other two sides are (s + 3) and $(2s-3)$. The perimeter is the sum of the sides.

$$s+(s+3)+(2s-3)=36$$
$$4s=36$$
$$s=9$$

The length of the smaller side is 9 in. The lengths of the other two sides are $(9+3)=12$ in. and $(2(9)-3)=18-3=15$ in.

58. Let s = the length of the smaller side. The lengths of the other two sides are (2s + 4) and $(3s-4)$. The perimeter is the sum of the sides.

$$s+(2s+4)+(3s-4)=60$$
$$6s=60$$
$$s=10$$

The length of the smaller side is 10 ft. The lengths of the other two sides are $2(10)+4=24$ ft. and $3(10)-4=26$ ft.

59. Let x = the measure of the smallest angle in degrees. The other two angle measurements are $(x+12)$ and $(3x-27)$. The sum of the measures of the interior angles is 180º, so

$$x+(x+12)+(3x-27)=180$$
$$5x-15=180$$
$$5x=195$$
$$x=39$$

The smallest angle is 39º. The other angles are $39^\circ+12^\circ=51^\circ$ and $3(39^\circ)-27^\circ=90^\circ$.

60. Let x = the measure of the smallest angle in degrees. The other two angle measurements are $(2x-20)$ and $(2x+25)$. The sum of the measures of the interior angles is 180º, so

$$x+(2x-20)+(2x+25)=180$$
$$5x+5=180$$
$$5x=175$$
$$x=35$$

The smallest angle is 35º. The other angles are $2(35°)-20°=50°$ and $2(35°)+25°=95°$.

61. Let x = length of one side of the square.
Since there are 7 sides, the total perimeter is $7x$.

$$7x=91$$
$$\frac{7x}{7}=\frac{91}{7}$$
$$x=13$$

The dimensions of each square will be 13 meters by 13 meters.

62. Let x = the width. Then, $x + 3$ = length and since the perimeter is 22 feet, the equation is

$$P=2l+2w$$
$$22=2(x+3)+2x$$
$$22=2x+6+2x$$
$$22=4x+6$$
$$16=4x$$
$$\frac{16}{4}=\frac{4x}{4}$$
$$4=x$$

The width is 4 feet and the length is $4 + 3 = 7$ feet.

63. Let h = height of each bookshelf. Then $h + 3$ is the width.

$$2h+4(h+3)=30$$
$$2h+4h+12=30$$
$$6h=18$$
$$h=3$$
$$h+3=6$$

The width is 6 feet and the height is 3 feet.

64. Let w = the width of each rectangle.
Then $w + 1$ is the length. The fencing runs along 6 widths and 4 lengths.

$$6w+4(w+1)=114$$
$$6w+4w+4=114$$
$$10w=110$$
$$w=11$$
$$w+1=12$$

Each rectangle has width 11 meters and length 12 meters.

65. Let p = the original price of the calculator.

$$p-0.10p-5=49$$
$$0.90p-5=49$$
$$0.90p=54$$
$$\frac{0.90p}{0.90}=\frac{54}{0.90}$$
$$p=60$$

The original price of the calculator was \$60.

66. Let x = the original price of the printer.

$$x-0.2x-10=210$$
$$0.8x-10=210$$
$$0.8x=220$$
$$\frac{0.8x}{0.8}=\frac{220}{0.8}$$
$$x=275$$

The original price was \$275.

67. a. Let x = the retail price.

Bass Pro Shops sale price $\rightarrow x-0.3x$

Gander Mountain sale price $\rightarrow x-75$

These are equal, so:

$$x-0.3x=x-75$$
$$-0.3x=-75$$
$$\frac{-0.3x}{-0.3}=\frac{-75}{-0.3}$$
$$x=250$$

The retail price is \$250.

b. The sale price is \$250 – \$75 = \$175.

68. a. Let x = the original price of the bike.

Toys "R" Us sale price $\rightarrow x-0.37x$

Wal-Mart sale price $\rightarrow x-50$

These are equal, so:

$$x-0.37x=x-50$$
$$-0.37x=-50$$
$$\frac{-0.37x}{-0.37}=\frac{-50}{-0.37}$$
$$x\approx 135.14$$

The original price of the bike was \$135.14.

b. The sale price was \$135.14 – \$50 = \$85.14.

69. Let a = the amount of land that Dale owns. Then

$\frac{1}{4}a$ = the amount of land that Lee owns and,

$\frac{1}{2}a-60=$ the amount of land that Marie owns.

$$a+\left(\frac{1}{4}a\right)+\left(\frac{1}{2}a-60\right)=640$$
$$a+\frac{1}{4}a+\frac{1}{2}a-60=640$$
$$a+\frac{1}{4}a+\frac{1}{2}a=700$$
$$4\left(a+\frac{1}{4}a+\frac{1}{2}a\right)=4(700)$$
$$4a+a+2a=2800$$
$$7a=2800$$
$$\frac{7a}{7}=\frac{2800}{7}$$
$$a=400$$

Dale owns 400 acres, Lee owns $\frac{1}{4}(400)=100$ acres, and Marie owns $\frac{1}{2}(400)-60=200-60=140$ acres.

70. Let x = bill before tax. Then

$\frac{5}{8}x$ = amount paid by the Newton family and

$\frac{3}{8}x+0.15x$ is the amount paid by the Lee family.

The equation is

$$\frac{5}{8}x+\frac{3}{8}x+0.15x=184.60$$
$$1.15x=184.60$$
$$\frac{1.15x}{1.15}=\frac{184.60}{1.15}$$
$$x\approx 160.52$$

The amount paid by the Newton family is $\frac{5}{8}(160.52)=\$100.33$ and the amount paid by the Lee family is \$184.60 – \$100.33 = \$84.27.

71. a. Let x = the fifth score.

$$\frac{88+92+97+96+x}{5}=90$$

b. Answers may vary

c.
$$\frac{373+x}{5}=90$$
$$5\left(\frac{373+x}{5}\right)=5(90)$$
$$373+x=450$$
$$x=77$$

Paula needs a score of 77 on the fifth test.

72. a. Let x be the score for the final exam.

$$\frac{70+83+97+84+74+x+x}{7}=80$$
$$\frac{408+2x}{7}=80$$
$$7\left(\frac{408+2x}{7}\right)=7(80)$$
$$408+2x=560$$
$$2x=152$$
$$\frac{2x}{x}=\frac{152}{2}$$
$$x=76$$

Francis needs to score 76 points on the final exam to have an average score of 80 points.

b. Again, let x be the score for the final exam.

$$\frac{70+83+97+84+74+2x}{7}=90$$
$$\frac{408+2x}{7}=90$$
$$7\left(\frac{408+2x}{7}\right)=7(90)$$
$$408+2x=630$$
$$2x=222$$
$$\frac{2x}{x}=\frac{222}{2}$$
$$x=111$$

No, in order to have a final average of 90, Francis will need a score of 111 on the final exam. Since this is impossible, he must settle for a final grade lower than 90.

73. a. and b. Answers will vary.

74. a. and b. Answers will vary.

75. Let x = number of miles driven.

$3(28)+0.15x+0.04\left[3(28)+0.15x\right]=121.68$

Original Charge 4% Sales Tax

$84+0.15x+0.04(84+0.15x)=121.68$

$84+0.15x+3.36+0.006x=121.68$

$87.36+0.156x=121.68$

$0.156x=34.32$

$\frac{0.156x}{0.156}=\frac{34.32}{0.156}$

$x=220$

Martina drove a total of 220 miles during the three days.

76. Let x = original value (price) of the stock.
The value of the stock on Tuesday is $x+5\%$ of x or $x+0.05x=1.05x$.
The value on Wednesday is $1.05x-0.05(1.05x)$.

$1.05x-0.05(1.05x)=59.85$

$1.05x-0.0525x=59.85$

$0.9975x=59.85$

$\frac{0.9975x}{0.9975}=\frac{59.85}{0.9975}$

$x=60$

The original value of the stock was \$60.

77. a., b., and c. Answers will vary.

78. $7-\left|-\frac{3}{5}\right|=7-\frac{3}{5}=\frac{35}{5}-\frac{3}{5}=\frac{32}{5}$

79. $-6.4-(-3.7)=-6.4+3.7=-2.7$

80. $\left|-\frac{5}{8}\right|\div\left|-4\right|=\frac{5}{8}\div 4=\frac{5}{8}\cdot\frac{1}{4}=\frac{5}{32}$

81. $5-\left|-3\right|-\left|12\right|=5-3-12=2-12=-10$

82. $\left(2x^4y^{-6}\right)^{-3}=2^{-3}\left(x^4\right)^{-3}\left(y^{-6}\right)^{-3}$

$=\frac{1}{8}x^{-12}y^{18}$

$=\frac{y^{18}}{8x^{12}}$

Mid-Chapter Test: 2.1 – 2.3

1. The degree of $6x^5y^7$ is 12 because the sum of the exponents is $5+7=12$.

2. $3x^2+7x-9x+2x^2-11$

$=3x^2+2x^2+7x-9x-11$

$=5x^2-2x-11$

3. $2(a-1.3)+4(1.1a-6)+17$

$=2a-2.6+4.4a-24+17$

$=2a+4.4a-2.6-24+17$

$=6.4a-9.6$

4. $7x-9=5x-21$

$7x-9-5x=5x-21-5x$

$2x-9=-21$

$2x-9+9=-21+9$

$2x=-12$

$\frac{2x}{2}=\frac{-12}{2}$

$x=-6$

5. $\frac{3}{4}y+\frac{1}{2}=\frac{7}{8}y-\frac{5}{4}$

$\frac{3}{4}y+\frac{1}{2}-\frac{7}{8}y=\frac{7}{8}y-\frac{5}{4}-\frac{7}{8}y$

$\frac{6}{8}y+\frac{1}{2}-\frac{7}{8}y=-\frac{5}{4}$

$-\frac{1}{8}y+\frac{1}{2}=-\frac{5}{4}$

$-\frac{1}{8}y+\frac{1}{2}-\frac{1}{2}=-\frac{5}{4}-\frac{1}{2}$

$-\frac{1}{8}y=-\frac{5}{4}-\frac{2}{4}$

$-\frac{1}{8}y=-\frac{7}{4}$

$-8\left(-\frac{1}{8}y\right)=-8\left(-\frac{7}{4}\right)$

$y=14$

6. $3p-2(p+6)=4(p+1)-5$

$3p-2p-12=4p+4-5$

$p-12=4p-1$

$p-12-p=4p-1-p$

$-12=3p-1$

$-12+1=3p-1+1$

$-11=3p$

$\frac{-11}{3}=\frac{3p}{3}$

$-\frac{11}{3}=p$

7. $0.6(a-3)-3(0.4a+2)=-0.2(5a+9)-4$

$0.6a-1.8-1.2a-6=-a-1.8-4$

$-0.6a-7.8=-a-5.8$

$-0.6a-7.8+a=-a-5.8+a$

$0.4a-7.8=-5.8$

$0.4a-7.8+7.8=-5.8+7.8$

$0.4a=2$

$\frac{0.4a}{0.4}=\frac{2}{0.4}$

$a=5$

8. $4x+15-9x=-7(x-2)+2x+1$

$4x+15-9x=-7x+14+2x+1$

$-5x+15=-5x+15$

$-5x+15+5x=-5x+15+5x$

$15=15$

The equation is an identity. The solution set is $\mathbb{R}$, the set of all real numbers.

9. $-3(3x+1)=-\left[4x+(6x-5)\right]+x+7$

$-9x-3=-\left[4x+6x-5\right]+x+7$

$-9x-3=-\left[10x-5\right]+x+7$

$-9x-3=-10x+5+x+7$

$-9x-3=-9x+12$

$-9x-3+9x=-9x+12+9x$

$-3=12$

The equation is a contradiction. The solution set is $\varnothing$, the empty set.

10. $A=\frac{1}{2}hb$

$A=\frac{1}{2}(10)(16)$

$=5(16)$

$=80$

11. $R_T=\frac{R_1R_2}{R_1+R_2}$

$R_T=\frac{(100)(50)}{100+50}$

$=\frac{5000}{150}$

$=\frac{100}{3}$

12. $y=7x+13$

$y-13=7x+13-13$

$y-13=7x$

$\frac{y-13}{7}=\frac{7x}{7}$

$\frac{y-13}{7}=x$ or $x=\frac{y-13}{7}$

13. $A=\frac{2x_1+x_2+x_3}{n}$

$nA=n\left(\frac{2x_1+x_2+x_3}{n}\right)$

$nA=2x_1+x_2+x_3$

$nA-2x_1-x_2=2x_1+x_2+x_3-2x_1-x$

$nA-2x_1-x_2=x_3$

or

$x_3=nA-2x_1-x_2$

14. $A=P\left(1+\frac{r}{n}\right)^{nt}$

$=700\left(1+\frac{0.06}{4}\right)^{4\cdot5}$

$=700(1.015)^{20}$

$=942.80$

The certificate of deposit will be worth \$942.80 after 5 years.

15. $A = 2B + 6$

$$A + B = 90$$
$$2B + 6 + B = 90$$
$$3B + 6 = 90$$
$$3B = 84$$
$$B = 28$$

Angle A measures $2(28) + 6 = 62°$ and angle B measures $28°$.

16. Let d = the number of days.

$$15 + 1.75d = 32.50$$
$$15 + 1.75d - 15 = 32.50 - 15$$
$$1.75d = 17.5$$
$$\frac{1.75d}{1.75} = \frac{17.5}{1.75}$$
$$d = 10$$

Tom rented the ladder for 10 days.

17. Let x = the length of the shortest side. Then the length of the longest side is $2x$ and the length of the last side is $x + 20$.

$$x + 2x + x + 20 = 100$$
$$4x + 20 = 100$$
$$4x = 80$$
$$x = 20$$

The sides of the triangle have lengths of 20 feet, $20 + 20 = 40$ feet, and $2(20) = 40$ feet.

18. Let r = the tax rate (as a decimal). Then the total tax is given by $36r$.

$$36 + 36r = 37.62$$
$$36r = 1.62$$
$$r = \frac{1.62}{36} = 0.45$$

The sales tax rate was 4.5%.

19. Let n = the number of months, then $52n$ is the total increase in population.

$$3613 + 52n = 5693$$
$$52n = 2080$$
$$n = \frac{2080}{52} = 40$$

40 months ago the population was 3613.

20. Mary is incorrect. To obtain an equivalent equation, both sides of the equation must be multiplied by the *same* non-zero constant. She should multiply both sides of the equation by the least common multiple of the denominators, 12.

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

Exercise Set 2.4

1. Let t = time in hours.

Balloon	Rate	Time	Distance
1	14	t	$14t$
2	11	t	$11t$

distance apart = balloon 1 dist.–balloon 2 dist.

$$12 = 14t - 11t$$
$$12 = 3t$$
$$4 = t$$

It will take 4 hours for the balloons to be 12 miles apart.

2. Let t = time in hours.

Car	Rate	Time	Distance
1	76	t	$76t$
2	68	t	$68t$

distance apart = car 1 dist. – car 2 dist.

$$20 = 76t - 68t$$
$$12 = 8t$$
$$2.5 = t$$

It will take 2.5 hours for the cars to be 20 miles apart.

3. Let t = the time each are gleaning.

	Rate	Time	Distance
Rodney	0.15	t	$0.15t$
Dennis	0.10	t	$0.10t$

$$0.15t + 0.10t = 1.5$$
$$0.25t = 1.5$$
$$t = 6$$

Rodney and Dennis will meet after 6 hours.

4. Let t = time required for them to meet.

	Rate	Time	Distance
Ena	60	t	$60t$
Jana	50	t	$50t$

Since the distances traveled total to 385 miles,

$$60t + 50t = 385$$
$$110t = 385$$
$$t = 3.5 \text{ hours}$$

It will them 3.5 hours to meet somewhere in between their houses.

5. Let t = time in hours.

Rider	Rate	Time	Distance
James	13	t	$13t$
Kathy	15	t	$15t$

distance apart = bicycle 1 dist. + bicycle 2 dist.

$$21 = 13t + 15t$$
$$21 = 28t$$
$$0.75 = t$$

It will take 0.75 hours or 45 minutes for the bicycles to be 20 miles apart.

6. Let t = time needed for them to be out of range.

	Rate	Time	Distance
Alice	3.8	t	$3.8t$
Mary	4.2	t	$4.2t$

Since the distances traveled total to 2 miles,

$$3.8t + 4.2t = 2$$
$$8t = 2$$
$$t = 0.25 \text{ hours or 15 minutes}$$

It will them 0.25 hours or 15 minutes for them to be out of range.

7. a. Let r = Wayne's speed.

	Rate	Time	Distance
Mary	$2r$	3	$(2r)(3)$
Wayne	r	3	$3r$

After 3 hours, Mary is 18 miles ahead of Wayne:

$$(2r)(3) = 3r + 18$$
$$6r = 3r + 18$$
$$3r = 18$$
$$r = 6$$

Wayne's speed is 6 miles per hour.

b. Mary's speed is $(2)(6) = 12$ miles per hour.

8. Let r = David's speed

	Rate	Time	Distance
David	r	0.5	$0.5r$
Abdollah	$\frac{2}{3}r$	0.5	$\frac{1}{2}\left(\frac{2}{3}r\right)$

After 0.5 hours, David is 1 mile ahead:

$$\frac{1}{2}r = \frac{1}{2}\left(\frac{2}{3}r\right) + 1 = \frac{1}{3}r + 1$$
$$6\left(\frac{1}{2}r\right) = 6\left(\frac{1}{3}r + 1\right)$$
$$3r = 2r + 6$$
$$r = 6$$

David's speed is 6 miles per hour, and Abdollah's speed is $\frac{2}{3}r = \frac{2}{3}(6) = 4$ miles per hour.

9. a. Let t = time needed for Kristen to catch up with Luis.

	Rate	Time	Distance
Luis	4	$t+0.75$	$4(t+0.75)$
Kristen	24	t	$24t$

$24t = 4(t+0.75)$ It

$24t = 4t + 3$

$20t = 3$

$t = 0.15$

$0.15 \text{ hours } = (0.15)(60) = 9 \text{ minutes}$

will take Kristen 9 minutes to catch up with Luis.

b. When Kristen catches up with Luis (after 0.15 hours), Kristen will have traveled a distance of $(24)(0.15) = 3.6$ miles. She will be 3.6 miles from their house.

10. a. Let t = time needed for Rhiannon to catch up with Max.

	Rate	Time	Distance
Max	3	$t+0.5$	$3(t+0.5)$
Rhiannon	4	t	$4t$

$4t = 3(t+0.5)$ It

$4t = 3t + 1.5$

$t = 1.5$

$1.5 \text{ hours} = (1.5)(60) = 90 \text{ minutes}$

will take Rhiannon 90 minutes, or 1.5 hours, to catch up with Max.

b. When Rhiannon catches up with Max (after 1.5 hours), Rhiannon will have traveled a distance of $(4)(1.5) = 6$ miles. She will be 6 miles from their beach condo.

11. Let t = time for Lightning to finish the race.

	Rate	Time	Amount
Zippy	5	$t-0.25$	$5(t-0.25)$
Lightning	4	t	$4.5t$

a. Both go the same distance, so

$5(t-0.25) = 4.5t$

$5t - 1.25 = 4.5t$

$0.5t = 1.25$

$t = 2.5$

Lightning finishes the race in 2.5 hours

b. Zippy takes $2.5 - 0.25 = 2.25$ hours to finish the race.

c. The distance covered is $5(2.25) = 11.25$ inches.

12. a. Let t = time to reach bottom of canyon.

	Rate	Time	Distance
Trip down	3.5	t	$3.5t$
Trip up	2.1	$16-t$	$2.1(1.6-t)$

distance down = distance up

$3.5t = 2.1(16-t)$

$3.5t = 33.6 - 2.1t$

$5.6t = 33.6$

$t = 6$

It took her 6 hours to reach the bottom of the canyon.

b. total distance $= 2(\text{distance down})$

$= 2(3.5 \cdot 6)$

$= 2(21)$

$= 42$

The total distance traveled is 42 miles.

13. Let t = time of operation for smaller machine.

	Rate	Time	Amount
Smaller machine	400	t	$400t$
Larger machine	600	$t+2$	$600(t-2)$

$$400t + 600(t+2) = 15,000$$
$$400t + 600t + 1200 = 15,000$$
$$1000t = 13,800$$
$$t = 13.8$$

The smaller machine operated for 13.8 hours.

14. Let t = time the slower copier takes to finish the job.

Copier	Rate	Time	Fliers
1	55	10	550
2	45	$10+t$	$45(10+t)$

Since the total number of fliers is 1900,

$$550 + 45(10+t) = 1900$$
$$550 + 450 + 45t = 1900$$
$$1000 + 45t = 1900$$
$$45t = 900$$
$$t = 20$$

It will take the slower copier 20 minutes to finish the job.

15. Let x = ounces of 12% solution.

Solution	Strength	Ounces	Acid
Mail	12%	x	$0.12x$
Store	5%	40	$0.05(40)$
Mixture	8%	$x+40$	$0.08(x+40)$

$$0.12x + 0.05(40) = 0.08(x+40)$$
$$0.12x + 2 = 0.08x + 3.2$$
$$0.04x = 1.2$$
$$x = 30$$

She should mix 30 ounces of the 12% vinegar.

16. Let x = number of cups of table vinegar.

Vinegar	% Acetic Acid	No. of Cups	Amount
Table	0.05	x	$0.05x$
Pickling	0.15	2	$0.15(2)$
Mixture	0.13	$2+x$	$0.13(2+x)$

$$0.05x+0.15(2)=0.13(2+x)$$
$$0.05x+0.3=0.26+0.13x$$
$$0.05x+0.3-0.05x=0.26+0.13x-0.05x$$
$$0.3=0.26+0.08x$$
$$0.3-0.26=0.26+0.08x-0.26$$
$$0.04=0.08x$$
$$0.08x=0.04$$
$$x=\frac{0.04}{0.08}=0.5$$

Alex will need 0.5 cup of table vinegar.

17. Let x = ounces of distilled water added.

Solution	Strength	Ounces	Acid
Pure hydrogen peroxide	60%	**2500**	$0.60(2500)$
Distilled water	0%	x	0
Mixture	25%	$x+2500$	$0.25(x+2500)$

Since no acid is being added to the mixture, the amount of acid in the final mixture will be the same as the amount of acid in the original 2500 gallons.

$$0.25(x+2500)=0.60(2500)$$
$$0.25x+625=1500$$
$$0.25x=875$$
$$x=3500$$

David needs to add 3500 gallons of distilled water.

18. Let x = number of ounces of water.

Solution	Strength	Ounces	Acid
Sulfuric acid	25%	8	$0.25(8)$
Water	0	x	$0(x)$
Mixture	5%	$8+x$	$0.05(8+x)$

$$0.25(8)+0(x)=0.05(8+x)$$
$$2=0.4+0.05x$$
$$1.6=0.05x$$
$$\frac{1.6}{0.05}=\frac{0.05x}{0.05}$$
$$32=x$$

He should add 32 ounces of water.

19. Let x = number of teaspoons of 30% sauce.

Sauce	Strength	Teaspoons	Acid
#1	30%	x	$0.30x$
#2	80%	$4-x$	$0.80(4-x)$
Mixture	45%	4	$0.45(4)$

$$0.30x+0.80(4-x)=0.45(4)$$
$$0.30x+3.2-0.80x=1.8$$
$$-0.50x=-1.4$$
$$x=2.8$$

She should use 2.8 teaspoons of the 30% sauce and $4-2.8=1.2$ teaspoons of the 80% sauce.

20. Let x = number of ounces of 1% solution.

Solution	Strength	Ounces	Rosemary Oil
1	1%	x	$0.01x$
2	5%	$3-x$	$0.05(3-x)$
Mixture	2%	3	$0.02(3)$

$$0.01x+0.05(3-x)=0.02(3)$$
$$0.01x+0.15-0.05x=0.06$$
$$0.01x+0.15-0.05x=0.06$$
$$-0.04x+0.15=0.06$$
$$-0.04x=-0.09$$
$$x=2.25$$

She should use 2.25 ounces of 1% solution and $3-2.25=0.75$ ounces of 5% solution.

21. Let x = pounds of Kona coffee.

Item	Cost	Pounds	Total
Kona	6.20	x	$6.20x$
Amaretto	5.80	18	$5.80(18)$
Mixture	6.10	$18+x$	$6.10(18+x)$

$$6.20x+5.80(18)=6.10(18+x)$$
$$6.2x+104.4=109.8+6.1x$$
$$0.1x=5.4$$
$$x=54$$

She should mix 54 pounds of Kona coffee with the amaretto coffee.

22. Let x = gallons of 93-octane needed to add.

Gasoline	Octane%	Gallons	Amount of Octane
87-octane	87%	850	$0.87(850)$
93-octane	93%	x	$0.93x$
Mixture	89%	$850+x$	$0.89(850+x)$

$$0.87(850)+0.93x=0.89(850+x)$$
$$739.5+0.93x=756.5+0.89x$$
$$0.04x=17$$
$$x=425$$

Blake should add 425 gallons of 93-octane gasoline.

23. Let x = number of pounds of the orange slices.

Type	Cost	No. of Pounds	Amount
Orange Slices	\$1.29	x	$1.29x$
Strawberry Leaves	\$1.79	$12-x$	$(12-x)$
Mixture	$\frac{17.48}{12}=\$1.46$	12	17.48

$$1.29x+1.79(12-x)=17.48$$
$$1.29x+21.48-1.79x=17.48$$
$$-0.50x+21.48=17.48$$
$$-0.50x=-4$$
$$x=\frac{-4}{-0.50}=8$$

8 pounds of the orange slices should be mixed with $12-8=4$ pounds of the strawberry leaves to produce the desired mixture.

24. Let x = pounds of almonds.

Item	Cost	Pounds	Total
Almonds	6.00	x	$6x$
Walnuts	5.20	$30-x$	$5.2(30-x)$

$$6x+5.2(30-x)=165$$
$$6x+156-5.2x=165$$
$$0.8x=9$$
$$x=11.25$$
$$30-x=18.75$$

The mixture should contain 11.25 pounds of almonds and 18.75 pounds of walnuts.

25. Let x = amount invested at 3% over a one-year period.

Account	Principal	Rate	Time	Interest
3%	x	0.03	1	$0.03x$
4.1%	$30000-x$	0.041	1	$0.041(30000-x)$

The total interest is \$1091.73.

$$0.03x+0.041(30000-x)=1091.73$$
$$0.03x+1230-0.041x=1091.73$$
$$-0.011x+1230=1091.73$$
$$-.011x=-138.27$$
$$x=12570$$

Thus, \$12,570 was invested at 3% and the remaining amount of \$30,000 – \$12,570 = \$17,430 was invested at 4.1%.

26. Let x = amount invested at 3.5%.

Account	Principal	Rate	Time	Interest
3.5%	x	0.035	2	$(0.035)(2)x=0.07x$
2.5%	$3000-x$	0.025	2	$(0.025)(2)(3000-x)=0.05(3000-x)$

The total interest is \$190.

$$0.07x+0.05(3000-x)=190$$
$$0.07x+150-0.05x=190$$
$$0.02x+150=190$$
$$0.02x=40$$
$$x=\frac{40}{0.02}=2000$$

Thus, \$2000 was invested at 3.5% and the remaining amount of \$3000 – \$2000 = \$1000 was invested at 2.5%.

27. Let x = amount invested in the breakfast café.

Business	Interest Rate	Amount Invested	Interest Received
Breakfast café	0.02	x	$2(0.02x)$
Comic book store	0.01	$10,000 - x$	$2\left[0.01(10,000 - x)\right]$

$$2(0.02x) + 2\left[0.01(10,000 - x)\right] = 330$$
$$0.04x + 2\left[100 - 0.01x\right] = 330$$
$$0.04x + 200 - 0.02 = 330$$
$$0.02x + 200 = 330$$
$$0.02x = 130$$
$$x = 6500$$

Kelly invested \$6500 in the breakfast café and $10,000 - 6500 = \$3500$ in the comic book store.

28. Let x = amount lent to Judy.

Friend	Interest Rate	Amount Lent	Interest Received
Judy	0.025	x	$3(0.025x)$
Maryanne	0.03	$15,000 - x$	$3\left[0.03(15,000 - x)\right]$

$$3(0.025x) + 3\left[0.03(15,000 - x)\right] = 1305$$
$$0.075x + 3\left[450 - 0.03x\right] = 1305$$
$$0.075x + 1350 - 0.09x = 1305$$
$$-0.015x + 1350 = 1305$$
$$-0.015x = -45$$
$$x = 3000$$

Kelly lent \$3000 to Judy and $15,000 - 3000 = \$12,000$ to Maryanne.

29. Let t = time (in hours) before they meet.

	Rate	Time	Distance
Julie	52	t	$52t$
Kamilia	50	t	$50t$

Their combined distances are 2448 miles.

$$52t + 50t = 2448$$
$$102t = 2448$$
$$t = 24$$

They will meet after 24 hours.

30. a. Let x = their speed in miles per hour. Note that 1 hr. 45min. = 1.75 hours and that 1 hr. 15 min. = 1.25 hours.

	Rate	Time	Distance
Mike	x	1.5	$1.5x$
Scott	x	1.25	$1.25x$

The total distance traveled is 110 miles.

$$1.5x + 1.25x = 110$$
$$2.75x = 110$$
$$x = 40$$

They are each traveling at a speed of 40 mph.

b. The restaurant is $(1.25 \text{ hr})(40 \text{ mph}) = 50$ miles away from Scott's house.

31. Let x = time needed for both pumps to empty the pool.

Pump	Rate	Time	Amount Pumped
1	10	t	$10t$
2	20	t	$20t$

The total amount of water pumped is 15,000 gallons.

$$10t + 20t = 15{,}000$$
$$30t = 15{,}000$$
$$t = \frac{15{,}000}{30} = 500 \text{ minutes}$$

It will take the pumps 500 minutes or $\frac{500}{60} = 8\frac{1}{3}$ hours to empty the pool.

32. Let x = time it takes the two machines to bottle 2750 bottles of ketchup.

Machine	Rate	Time	Bottles
Older	25	x	$25x$
Newer	30	x	$30x$

$$25x + 30x = 2750$$
$$55x = 2750$$
$$x = 50$$

It will take 50 minutes.

33. Let x = amount of 32% solution that Marcia should add.

Type	Strength of Solution	No. of Ounces	Amount
32%	0.32	x	$0.32x$
17%	0.17	32	$0.17(32)$
Mixture	0.20	$x + 32$	$0.20(x+32)$

$$0.32x + 0.17(32) = 0.20(x+32)$$
$$0.32x + 5.44 = 0.20x + 6.4$$
$$0.12x + 5.44 = 6.4$$
$$0.12x = 0.96$$
$$x = 8$$

Marcia should add 8 ounces.

34. Let x = amount of 1.5% butterfat milk needed.

Type	Strength	Quarts	Amount of Butterfat
6%	0.06	200	$0.06(200)$
1.5%	0.015	x	$0.015x$
2.4%	0.024	$200 + x$	$0.024(200+x)$

$$0.06(200) + 0.015x = 0.024(200+x)$$
$$12 + 0.015x = 4.8 + 0.024x$$
$$12 = 4.8 + 0.009x$$
$$7.2 = 0.009x$$
$$800 = x$$

Sundance Dairy should combine 800 quarts of 1.5% butterfat milk with 200 quarts of 6% butterfat milk to produce 1000 quarts of 2.4% butterfat milk.

35. a. Let t = time before the jets meet.

	Rate	Time	Distance
Jet	780	t	$780t$
Refueling Plane	520	$t + 2$	$520(t+2)$

The distances traveled are equal.

$$780t = 520(t+2)$$
$$780t = 520t + 1040$$
$$260t = 1040$$
$$t = 4$$

The two planes will meet in 4 hours.

b. $780t = 780(4) = 3120$

The refueling will take place 3120 miles from the base.

36. a. Let t = time before Kimberly catches up.

	Rate	Time	Distance
Shannon	3	$\frac{1}{3}+t$	$3\left(\frac{1}{3}+t\right)$
Kimberly	15	t	$15t$

The distances traveled are equal.

$$15t = 3\left(\frac{1}{3}+t\right)$$
$$15t = 1+3t$$
$$12t = 1$$
$$t = \frac{1}{12} \text{ hour or 5 minutes}$$

It will take $\frac{1}{12}$ hour or 5 minutes.

b. $15t = 15\left(\frac{1}{12}\right) = 1.25$

The meeting will take place 1.25 miles from the dock.

37. Let x = number of small paintings sold.

Item	Cost	Number	Amount
Small	60	x	$60x$
Large	180	$12-x$	$180(12-x)$

$$60x+180(12-x) = 1200$$
$$60x+2160-180x = 1200$$
$$-120x = -960$$
$$x = 8$$

Joseph DeGuizman sold 8 small paintings and $12-8=4$ large paintings.

38. Let t = amount of time Hal worked at the job paying \$7.00 per hour.

	Rate	Time	Distance
Job 1	7.50	t	$7.50t$
Job 2	8.25	$24-t$	$8.25(24-t)$

The total earned was \$190.50.

$$7.50t+8.25(24-t) = 190.50$$
$$7.50t+198-8.25t = 190.50$$
$$-0.75t = -7.50$$
$$t = 10$$

Hal worked 10 hours at \$7.50 per hour and $24-10=14$ hours at \$8.25 per hour.

39. Let x = amount of 80% solution needed.

Solution	Strength of Solution	No. of Ounces	Amount of Alcohol
80%	0.80	x	$0.80x$
Water	0	$128-x$	$0(128-x)$
6%	0.06	128	$0.06(128)$

$$0.80x+0(128-x) = 0.06(128)$$
$$0.80x = 7.68$$
$$x = \frac{7.68}{0.80} = 9.6$$

Herb should combine 9.6 ounces of the 80% solution with ounces of water to produce the desired solution.

40. Let x = amount of pure antifreeze to be added.

Type	Strength of Solution	No. of Quarts	Amount
Pure	1.00	x	$1.00x$
20%	0.20	10	$0.20(10)$
Mixture	0.50	$x+10$	$0.50(x+10)$

$$1.00x+0.20(10)=0.50(x+10)$$
$$1.00x+2=0.50x+5$$
$$0.50x=3$$
$$x=\frac{3}{0.50}=6$$

Doreen Kelly should add 6 quarts of pure antifreeze to 10 quarts of 20% antifreeze to produce a mixture (solution) of 16 quarts of 50% antifreeze.

41. Let r = Vince's speed in construction areas.

Note that 15 minutes is $\frac{1}{4}$ hour and that 45 minutes is $\frac{3}{4}$ hour.

	Rate	Time	Distance
Road work	r	$\frac{1}{4}$hr	$\frac{1}{4}r$
Rest of trip	$r+10$	$\frac{1}{2}$hr	$\frac{1}{2}(r+10)$

The total trip distance is 35 miles.

$$\frac{1}{4}r+\frac{1}{2}(r+10)=35$$
$$4\left(\frac{1}{4}r+\frac{1}{2}(r+10)\right)=4(35)$$
$$r+2(r+10)=140$$
$$r+2r+20=140$$
$$3r=120$$
$$r=40$$

Vince's speed in construction areas is 40 mph and his speed elsewhere is $40+10=50$ mph.

42. Let t = time he mowed in second gear.

Gear	Rate	Time	Distance
Second	4.2	t	$4.2t$
Third	7.8	$2-t$	$7.8(2-t)$

The total distance is 13.8 miles.

$$4.2t+7.8(2-t)=13.8$$
$$4.2t+15.6-7.8t=13.8$$
$$-3.6t=-1.8$$
$$t=\frac{-1.8}{-3.6}=0.5$$

Richard mowed 0.5 hour in second gear and $2-0.5=1.5$ hours in third gear.

43. a. Let t = number of full-price tickets sold.

Tickets	Rate	No. of Tickets	Total
Full-price	56.5	t	$56.5t$
Student	49.5	$3250-t$	$49.5(3250-t)$

Total concert ticket sales were \$162,611.

$$56.5t+49.5(3250-t)=162,611$$
$$56.5t+160,875-49.5t=162,611$$
$$7t+160,875=162,611$$
$$7t+160,875-160,875=162,611-160,875$$
$$7t=1736$$
$$\frac{7t}{7}=\frac{1736}{7}$$
$$t=248$$

There were 248 full-price tickets sold.

b. $3250-248=3002$

There were 3002 student tickets sold.

44. Let t = number of tickets sold online.

	Rate	No. of Tickets	Total
Online	7.5	t	$7.5t$
In person	9	$270-t$	$9(270-t)$

$$7.5t+9(270-t)=2359.5$$
$$7.5t+2430-9t=2359.5$$
$$-1.5t+2430=2359.5$$
$$-1.5t+2430=2359.5$$
$$-1.5t=-70.5$$
$$\frac{-1.5t}{-1.5}=\frac{-70.5}{-1.5}$$
$$t=47$$

There were 47 online tickets sold and $270-47=223$ tickets sold at the box office.

45. Let t = the amount of time after the faster copier begins that Shywanda has printed 1500 fliers.

Copier	Rate	Time	Fliers
Faster	43	t	$43t$
Slower	22	$t+15$	$22(t+15)$

$$43t+22(t+15)=1500$$
$$43t+22t+330=1500$$
$$65t+330=1500$$
$$65t=1150$$
$$\frac{65t}{65}=\frac{1150}{65}$$
$$t\approx 18$$

It will be 18 minutes after the faster copier begins that Shywanda has printed 1500 fliers.

46. The old machine will have run for $1000\div 50=20$ minutes when the new machine is turned on. Let t = the amount of time after the new machine begins that the number of cartons produced by both machines is equal.

Machine	Rate	Time	No. of Cartons
Old	50	t	$1000+50t$
New	70	t	$70t$

$$1000+50t=70t$$
$$1000=20t$$
$$\frac{1000}{20}=\frac{20t}{20}$$
$$50=t$$

The time needed is 50 minutes.

47. Let x = amount of 2% solution needed.

Solution	Strength of Solution	No. of ml	Amount of Acid
2%	0.02	x	$0.02x$
14%	0.14	$45-x$	$0.14(45-x)$
6%	0.06	45	$0.06(45)$

$$0.02x+0.14(45-x)=0.06(45)$$
$$0.02x+6.3-0.14x=2.7$$
$$0.02x+6.3-0.14x=2.7$$
$$-0.12x+6.3=2.7$$
$$-0.12x=-3.6$$
$$\frac{-0.12x}{-0.12}=\frac{-3.6}{-0.12}$$
$$x=30$$

Catherine should mix 30 ml of the 2% solution with 45 – 30 = 15 ml of the 14% solution.

48. Let x = amount of 2% solution needed.

Solution	Strength of Solution	No. of Liters	Amount of Acid
10%	0.1	x	$0.01x$
48%	0.48	$950-x$	$0.48(950-x)$
30%	0.3	950	$0.3(950)$

$$0.1x+0.48(950-x)=0.3(950)$$
$$0.1x+456-0.48x=285$$
$$-0.38x+456=285$$
$$-0.38x=-171$$
$$\frac{-0.38x}{-0.38}=\frac{-171}{-0.38}$$
$$x=450$$

Kathy should mix 450 liters of the 10% solution with 950 – 450 = 500 liters of the 48% solution.

49. It is possible to determine the times for the 2nd and 3rd parts of the trip.

2nd Part: $t=\frac{d}{r}=\frac{31}{90}\approx 0.344$ hour

3rd Part: $t=\frac{d}{r}=\frac{68}{45}\approx 1.511$ hours

The time for the first part (Paris to Calais) is $3.000-0.344-1.511=1.145$ hours. The distance is

$(130 \text{ mph})(1.145 \text{ hours})\approx 149$ miles

50. **a.** Car A has completed half the race which is 250 laps. Since each lap is 1 mile, Car A has traveled 250 miles. To find the time use $t=\frac{d}{r}=\frac{250}{125}=2$ hours. The cars have been racing for 2 hours. Now, Car B is 6.2 laps or 6.2 miles behind Car A. Thus, Car B has traveled $250-6.2=243.8$ miles. To find the rate use $r=\frac{d}{t}=\frac{243.8}{2}=121.9$ mph.

The rate for Car B is 121.9 mph.

b. To catch up to Car A, Car B must travel 6.2 miles. The time required to do this is $t=\frac{d}{r}=\frac{6.2}{121.9}\approx 0.0509$ hour or

$$0.0509 \text{ hour}\times\frac{3600 \text{ seconds}}{1 \text{ hour}}$$

= 183.2 seconds.

51. Let x be the amount of 20% solution which must be drained. Then, $16-x$ is the amount remaining.

$$0.20(16-x)+1.00x=0.50(16)$$
$$3.2-0.20x+1.00x=8$$
$$3.2+0.80x=8$$
$$0.80x=4.8$$
$$x=\frac{4.8}{0.80}=6$$

Thus, 6 quarts must be drained before adding the same amount of antifreeze.

52.
$$\frac{2.16\times10^5}{3.6\times10^8}=\frac{2.16}{3.6}\times\frac{10^5}{10^8}$$
$$=0.6\times10^{5-8}$$
$$=0.6\times10^{-3}$$
$$=6.0\times10^{-3}\times10^{-1}$$
$$=6.0\times10^{-3-1}$$
$$=6.0\times10^{-4}$$

53.
$$0.6x+0.22=0.4(x-2.3)$$
$$0.6x+0.22=0.4x-0.92$$
$$0.6x-0.4x+0.22=0.4x-0.4x-0.92$$
$$0.2x+0.22=-0.92$$
$$0.2x+0.22-0.22=-0.92-0.22$$
$$0.2x=-1.14$$
$$\frac{0.2x}{0.2}=\frac{-1.14}{0.2}$$
$$x=-5.7$$

54.
$$\frac{2}{3}x+8=x+\frac{25}{4}$$
$$12\left(\frac{2}{3}x\right)+12(8)=12(x)+12\left(\frac{25}{4}\right)$$
$$8x+96=12x+75$$
$$8x-8x+96=12x-8x+75$$
$$96=4x+75$$
$$96-75=4x+75-75$$
$$21=4x$$
$$\frac{21}{4}=\frac{4x}{4}$$
$$\frac{21}{4}=x$$

55. $\frac{3}{5}(x-2)=\frac{2}{7}(2x+3y)$

$35\left[\frac{3}{5}(x-2)\right]=35\left[\frac{2}{7}(2x+3y)\right]$

$21(x-2)=10(2x+3y)$

$21x-42=20x+30y$

$21x-20x-42=20x-20x+30y$

$x-42=30y$

$\frac{x-42}{30}=\frac{30y}{30}$

$\frac{x-42}{30}=y$ or $y=\frac{x-42}{30}$

56. Let x be the distance driven in one day.

$35+0.75x=20+0.80x$

$35=20+0.05x$

$15=0.05x$

$\frac{15}{0.05}=x$

$x=300$ miles

The costs are the same when 300 miles are driven per day.

Exercise Set 2.5

1. A compound inequality is formed by joining two inequalities with the word *and* or *or*.

2. A(n) open circle on the number line indicates that the endpoint is not part of the solution.

3. A(n) closed circle on the number line indicates that the endpoint is part of the solution.

4. To find the solution set of an inequality containing the word *and*, take the intersection of the solution sets of the two inequalities.

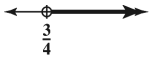
5. To find the solution set of an inequality containing the word *or*, take the union of the solution sets of the two inequalities.

6. Whenever you multiply or divide both sides of an inequality by a negative number, you must change the direction of the inequality symbol.

7. a. 

b. $(-3,\infty)$

c. $\{x \mid x>-3\}$

8. a. 

b. $\left(\frac{3}{4},\infty\right)$

c. $\left\{t\middle|t>\frac{3}{4}\right\}$

9. a. 

b. $(-\infty,\ \pi]$

c. $\{w|w\le\pi\}$

10. a. 

b. $\left[-\frac{6}{5},\infty\right)$

c. $\left\{x\middle|x\ge-\frac{6}{5}\right\}$

11. a. 

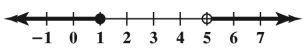
b. $(-7,\ -4]$

c. $\{x|-7<x\le-4\}$

12. a. 

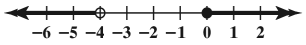
b. $(-4,\ 3)$

c. $\{x|-4<x<3\}$

13. a. 

b. $(-\infty,\ 1]\cup(5,\ \infty)$

c. $\{k \mid k \le 1 \text{ or } > 5\}$

14. a. 

b. $(-\infty, -4) \cup [0, \infty)$

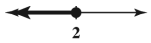
c. $\{c \mid c < -4 \text{ or } c \ge 0\}$

15. $3x + 2 \le 8$

$3x \le 6$

$\frac{3x}{3} \le \frac{6}{3}$

$x \le 2$

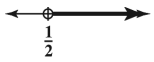


16. $2x + 3 > 4$

$2x > 1$

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

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



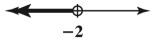
17. $-4x + 3 > 11$

$-4x > 8$

Reverse the inequality.

$\frac{-4x}{-4} < \frac{8}{-4}$

$x < -2$



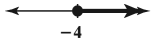
18. $-2x - 3 \le 5$

$-2x \le 8$

Reverse the inequality.

$\frac{-2x}{-2} \ge \frac{8}{-2}$

$x \ge -4$



19. $-2(3z + 4) \ge 4z - 23$

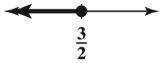
$-6z - 8 \ge 4z - 23$

$-8 \ge 10z - 23$

$15 \ge 10z$

$\frac{15}{10} \ge \frac{10z}{10}$

$\frac{3}{2} \ge z$



20. $-5(4y - 2) < 5 - 4y$

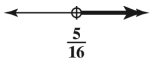
$-20y + 10 < 5 - 4y$

$10 < 5 + 16y$

$5 < 16y$

$\frac{5}{16} < \frac{16y}{16}$

$\frac{5}{16} < y$

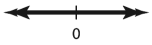


21. $2y - 6y + 8 \le 2(-2y + 9)$

$-4y + 8 \le -4y + 18$

$8 \le 18$

Since this is a true statement, the solution is all real numbers.



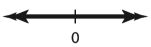
22. $-6(d + 2) < -9d + 3(d - 1)$

$-6d - 12 < -9d + 3d - 3$

$-6d - 12 < -6d - 3$

$-12 < -3$

Since this is a true statement, the solution is all real numbers.



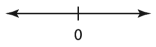
23. $5b-6\ge 3(b+3)+2b$

$5b-6\ge 3b+9+2b$

$5b-6\ge 5b+9$

$-6\ge 9$

Since this is a false statement, there is no solution.

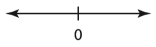


24. $8(2x+3)\le 4(4x-7)$

$16x+24\le 16x-28$

$24\le -28$

Since this is a false statement, there is no solution.



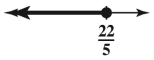
25. $\frac{y}{2}+\frac{4}{5}\le 3$

$10\left(\frac{y}{2}\right)+10\left(\frac{4}{5}\right)\le 10(3)$

$5y+8\le 30$

$5y\le 22$

$y\le \frac{22}{5}$



26. $\frac{m}{3}-\frac{7}{8}>\frac{m}{12}$

$24\left(\frac{m}{3}\right)-24\left(\frac{7}{8}\right)>24\left(\frac{m}{12}\right)$

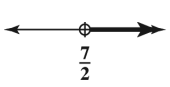
$8m-21>2m$

$6m-21>0$

$6m>21$

$\frac{6m}{6}>\frac{21}{6}$

$m>\frac{7}{2}$



27. $5-2z+8\ge 5z-8$

$13-2z\ge 5z-8$

$13\ge 7z-8$

$21\ge 7z$

$\frac{21}{7}\ge \frac{7z}{7}$

$3\ge z$

$(-\infty,\ 3]$

28. $4-3x<5+2x+17$

$4-3x<2x+22$

$4<5x+22$

$-18<5x$

$\frac{-18}{5}<\frac{5x}{5}$

$-\frac{18}{5}<x$

$\left(-\frac{18}{5},\infty\right)$

29. $\frac{h}{2}-\frac{5}{6}<\frac{7}{8}+h$

$24\left(\frac{h}{2}-\frac{5}{6}\right)<24\left(\frac{7}{8}+h\right)$

$12h-20<21+24h$

$-12h-20<21$

$-12h<41$

$\frac{-12h}{-12}>\frac{41}{-12}$

$h>-\frac{41}{12}$

$\left(-\frac{41}{12},\infty\right)$

30.
$$\frac{d}{5}-\frac{8}{15}>\frac{2}{3}d+2$$
$$15\left(\frac{d}{5}-\frac{8}{15}\right)>15\left(\frac{2}{3}d+2\right)$$
$$3d-8>10d+30$$
$$3d-38>10d$$
$$-38>7d$$
$$\frac{-38}{7}>\frac{7d}{7}$$
$$d<-\frac{38}{7}$$
$$\left(-\infty,\ -\frac{38}{7}\right)$$

31.
$$-\frac{3}{4}(2x-1)=\frac{15}{8}(x+4)$$
$$-\frac{6x}{4}+\frac{3}{4}=\frac{15x}{8}+\frac{15}{2}$$
$$8\left(-\frac{6x}{4}+\frac{3}{4}\right)=8\left(\frac{15x}{8}+\frac{15}{2}\right)$$
$$-12x+6=15x+60$$
$$6=27x+60$$
$$-54=27x$$
$$\frac{-54}{27}=\frac{27x}{27}$$
$$-2=x$$
$$[-2,\ \infty)$$

32.
$$\frac{6(x-2)}{5}>\frac{10(2-x)}{3}$$
$$15\left[\frac{6(x-2)}{5}\right]>15\left[\frac{10(2-x)}{3}\right]$$
$$18(x-2)>50(2-x)$$
$$18x-36>100-50x$$
$$68x-36>100$$
$$68x>136$$
$$\frac{68x}{68}>\frac{136}{68}$$
$$x>2$$
$$(2,\ \infty)$$

33.
$$-3x+1<3[(x+2)-2x]-1$$
$$-3x+1<3[x+2-2x]-1$$
$$-3x+1<3[2-x]-1$$
$$-3x+1<6-3x-1$$
$$-3x+1<5-3x$$
$$1<5$$
Since this is a true statement, the solution is all real numbers.
$$(-\infty,\ \infty)$$

34.
$$-2[x+3(x-4)]\geq 5(x+3)-13(x+1)$$
$$-2[x+3x-12]\geq 5x+15-13x-13$$
$$-2[4x-12]\geq -8x+2$$
$$-8x+24\geq -8x+2$$
$$24\geq 2$$
Since this is a true statement, the solution is all real numbers.
$$(-\infty,\ \infty)$$

35.
$$-2\leq t+3<4$$
$$-2-3\leq t+3-3<4-3$$
$$-5\leq t<1$$
$$[-5,\ 1)$$

36.
$$-7<p-6\leq -5$$
$$-7+6<p-6+6\leq -5+6$$
$$-1<p\leq 1$$
$$(-1,\ 1]$$

37.
$$-15\leq -3z\leq 12$$
Divide by -3 and reverse inequalities.
$$\frac{-15}{-3}\geq\frac{-3z}{-3}\geq\frac{12}{-3}$$
$$5\geq z\geq -4$$
$$-4\leq z\leq 5$$
$$[-4,\ 5]$$

38. $-45 < -5x \le 15$

Divide by -5 and reverse the inequalities.

$$\frac{-45}{-5} > \frac{-5x}{-5} \ge \frac{15}{-5}$$

$$9 > x \ge -3$$

$$[-3,\ 9)$$

39. $4 \le 2x - 4 < 7$

$$4 + 4 \le 2x - 4 + 4 < 7 + 4$$

$$8 \le 2x < 11$$

$$\frac{8}{2} \le \frac{2x}{2} < \frac{11}{2}$$

$$4 \le x < \frac{11}{2}$$

$$\left[4,\ \frac{11}{2}\right)$$

40. $-12 < 3x - 5 \le -1$

$$-12 + 5 < 3x - 5 + 5 \le -1 + 5$$

$$-7 < 3x \le 4$$

$$\frac{-7}{3} < \frac{3x}{3} \le \frac{4}{3}$$

$$-\frac{7}{3} < x \le \frac{4}{3}$$

$$\left(-\frac{7}{3},\ \frac{4}{3}\right]$$

41. $14 \le 2 - 3g < 15$

$$14 - 2 \le 2 - 3g - 2 < 15 - 2$$

$$12 \le -3g < 13$$

Divide by -3 and reverse inequalities.

$$\frac{12}{-3} \ge \frac{-3g}{-3} > \frac{13}{-3}$$

$$-4 \ge g > -\frac{13}{3}$$

$$-\frac{13}{3} < g \le -4$$

$$\left(-\frac{13}{3},\ -4\right]$$

42. $-16 < 5 - 3n \le 13$

$$-16 - 5 < 5 - 3n - 5 \le 13 - 5$$

$$-21 < -3n \le 8$$

Divide by -3 and reverse the inequalities.

$$\frac{-21}{-3} > \frac{-3n}{-3} \ge \frac{8}{-3}$$

$$7 > n \ge -\frac{8}{3}$$

$$-\frac{8}{3} \le n < 7$$

$$\left[-\frac{8}{3},\ 7\right)$$

43. $-6 \le -3(2x - 4) < 12$

$$-6 \le -6x + 12 < 12$$

$$-6 - 12 \le -6x + 12 - 12 < 12 - 12$$

$$-18 \le -6x < 0$$

Divide by -6 and reverse inequalities

$$\frac{-18}{-6} \ge \frac{-6x}{-6} > \frac{0}{-6}$$

$$3 \ge x > 0$$

$$0 < x \le 3$$

$$\{x \mid 0 < x \le 3\}$$

44. $2 \le -2(5x - 1) < 11$

$$2 \le -10x + 2 < 11$$

$$0 \le -10x < 9$$

Divide by -10 and reverse the inequalities.

$$\frac{0}{-10} \ge \frac{-10x}{-10} > \frac{9}{-10}$$

$$0 \ge x > -\frac{9}{10}$$

$$\left\{x \mid -\frac{9}{10} < x \le 0\right\}$$

45. $5 \le \frac{3x+1}{2} < 11$

$2(5) \le 2\left(\frac{3x+1}{2}\right) < 2(11)$

$10 \le 3x+1 < 22$

$10-1 \le 3x+1-1 < 22-1$

$9 \le 3x < 21$

$\frac{9}{3} \le \frac{3x}{3} < \frac{21}{3}$

$3 \le x < 7$

$\{x \mid 3 \le x < 7\}$

46. $0 \le \frac{3(u-4)}{7} \le 1$

$7(0) \le 7\left(\frac{3(u-4)}{7}\right) \le 7(1)$

$0 \le 3(u-4) \le 7$

$0 \le 3u-12 \le 7$

$12 \le 3u \le 19$

$\frac{12}{3} \le \frac{3u}{3} \le \frac{19}{3}$

$4 \le u \le \frac{19}{3}$

$\left\{u \middle| 4 \le u \le \frac{19}{3}\right\}$

47. $\frac{3}{5} < \frac{-x-5}{3} < 2$

$15\left(\frac{3}{5}\right) < 15\left(\frac{-x-5}{3}\right) < 15(2)$

$9 < 5(-x-5) < 30$

$9 < -5x-25 < 30$

$9+25 < -5x-25+25 < 30+25$

$34 < -5x < 55$

Divide by –5 and reverse inequalities

$\frac{34}{-5} > \frac{-5x}{-5} > \frac{55}{-5}$

$-\frac{34}{5} > x > -11$

$-11 < x < -\frac{34}{5}$

$\left\{x \mid -11 < x < -\frac{34}{5}\right\}$

48. $-6 < \frac{4-3x}{2} < \frac{2}{3}$

$6(-6) < 6\left(\frac{4-3x}{2}\right) < 6\left(\frac{2}{3}\right)$

$-36 < 3(4-3x) < 2(2)$

$-36 < 12-9x < 4$

$-36-12 < 12-9x-12 < 4-12$

$-48 < -9x < -8$

Divide by – 9 and reverse inequalities.

$\frac{-48}{-9} > \frac{-9x}{-9} > \frac{-8}{-9}$

$\frac{16}{3} > x > \frac{8}{9}$

$\frac{8}{9} < x < \frac{16}{3}$

$\left\{x \middle| \frac{8}{9} < x < \frac{16}{3}\right\}$

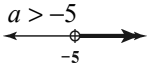
49. $c \le 1$

$c > -3$

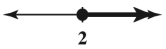
$c \le 1$ and $c > -3 \quad \Rightarrow \quad -3 < c \le 1$

$\{c \mid -3 < c \le 1\}$

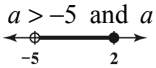
50. $a > -5$



$a \le 2$

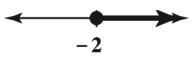


$a > -5$ and $a \le 2$

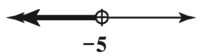


$\{a \mid -5 < a \le 2\}$

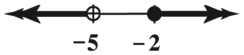
51. $p \ge -2$



$p < -5$



$p \ge -2$ or $p < -5$

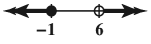


$\{p \mid p < -5 \text{ or } p \ge -2\}$

52. $w \le -1$

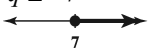
$w > 6$

$w \le -1$ or $w > 6$

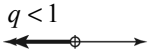


$\{w \mid w \le -1 \text{ or } w > 6\}$

53. $q \ge -7$



$q < 1$



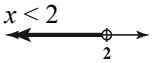
The union is the entire real number line.
Therefore, the solution set is all real numbers, or $\mathbb{R}$.

54. $d > 0$

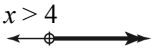
$d \le 8$

The union is the entire real number line.
Therefore, the solution set is all real numbers, or $\mathbb{R}$.

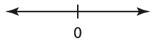
55. $x < 2$



$x > 4$

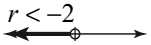


$x < 2$ and $x > 4$

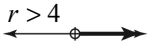


There is no overlap so the solution is the empty set, $\varnothing$.

56. $r < -2$



$r > 4$



There is no overlap so the solution is the empty set, $\varnothing$.

57. $2s + 3 < 7$ or $-3s + 4 \le -17$

$2s < 4$ or $-3s \le -21$

$\frac{2s}{2} < \frac{4}{2}$ or $\frac{-3s}{-3} \ge \frac{-21}{-3}$

$s < 2$ $\qquad s \ge 7$

$s < 2$ or $s \ge 7$ which is $(-\infty, 2) \cup [7, \infty)$.

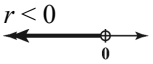
58. $4 - r < -2$ or $3r - 1 < -1$

$-r < -6$ $\qquad 3r < 0$

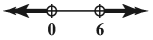
$r > 6$ $\qquad r < 0$

$r > 6$

$r < 0$



$r > 6$ or $r < 0$



In interval notation: $(-\infty, 0) \cup (6, \infty)$

59. $4x + 5 \ge 5$ and $3x - 7 \le -1$

$4x \ge 0$ and $3x \le 6$

$x \ge 0$ and $x \le 2$

$x \ge 0$

$x \le 2$

$x \ge 0$ and $x \le 2$ which is $0 \le x \le 2$

In interval notation: $[0, 2]$

60. $7x - 9 > -23$ and $5x + 8 < 23$

$7x > -14$ and $5x < 15$

$x > -2$ and $x < 3$

$(-2, 3)$

61. $-3y + 8 > -4$ and $-2y - 5 \le 3$

$-3y > -12$ and $-2y \le 8$

$y < 4$ and $y \ge -4$

$[-4, 4)$

62. $-4z - 7 \le 5$ and $2z - 7 < 7$

$-4z \le 12$ and $2z < 14$

$z \ge -3$ and $z < 7$

$[-3, 7)$

63. $-2v + 5 \le -7$ or $-3v - 8 \ge 16$

$-2v \le -12$ or $-3v \ge 24$

$v \ge 6$ or $v \le -8$

$(-\infty, -8] \cup [6, \infty)$

64. $-5u+6\ge 21$ or $-7u-5<9$

$-5u\ge 15$ or $-7u<14$

$u\le -3$ or $u>-2$

$(-\infty,\ -3]\cup(-2,\ \infty)$

65. $4a+7\ge 9$ and $-3a+4\le -17$

$4a\ge 2$ $\quad -3a\le -21$

$\frac{4a}{4}\ge\frac{2}{4}$ $\quad \frac{-3a}{-3}\ge\frac{-21}{-3}$

$a\ge\frac{1}{2}$ $\quad a\ge 7$

$a\ge\frac{1}{2}$ and $a\ge 7$ $\Rightarrow$ $a\ge 7$

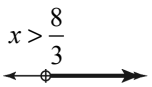
In interval notation: $[7,\ \infty)$

66. $5-3x<-3$ and $5x-3>10$

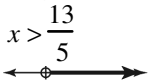
$-3x<-8$ and $5x>13$

$x>\frac{8}{3}$ and $x>\frac{13}{5}$

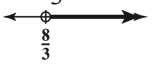
$x>\frac{8}{3}$



$x>\frac{13}{5}$



$x>\frac{8}{3}$ and $x>\frac{13}{5}$ which is $x>\frac{8}{3}$



In interval notation: $\left(\frac{8}{3},\infty\right)$

67. $5t-3<12$ or $-3t+4\ge 16$

$5t<15$ or $-3t\ge 12$

$t<3$ or $t\le -4$

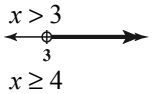
$(-\infty,\ -3]$

68. $-x+3<0$ or $2x-5\ge 3$

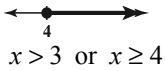
$-x<-3$ or $2x\ge 8$

$x>3$ or $x\ge 4$

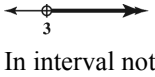
$x>3$



$x\ge 4$



$x>3$ or $x\ge 4$ which is $x>3$



In interval notation: $(3,\ \infty)$

69. $4s+3>9$ or $2s-7\le 12$

$4s>6$ or $2s\le 19$

$s>\frac{3}{2}$ or $s\le\frac{19}{2}$

$(-\infty,\ \infty)$

70. $2q-11\le -7$ or $2-3q<11$

$2q\le 4$ $\quad -3q<9$

$\frac{2q}{2}\le\frac{4}{2}$ $\quad \frac{-3q}{-3}>\frac{9}{-3}$

$q\le 2$ $\quad q>-3$

$q\le 2$ or $q>-3$ $\Rightarrow$ $(-\infty,\ \infty)$

71. $-2r+8<5$ or $-5r-6\ge 17$

$-2r<-3$ or $-5r\ge 23$

$r>\frac{3}{2}$ or $r\le -\frac{23}{5}$

There is no overlap so the solution is the empty set, $\varnothing$.

72. $3r+5\le -17$ or $-4r+1<13$

$3r\le -22$ or $-4r<12$

$r\le -\frac{22}{3}$ or $r>-3$

There is no overlap so the solution is the empty set, $\varnothing$.]

73. a. $l + g \le 165$

b. $g = 2w + 2h$

$$l + g \le 165$$
$$l + 2w + 2h \le 165$$

c. $l = 40,\ w = 20.5$

$$l + 2w + 2h \le 165$$
$$40 + 2(20.5) + 2h \le 165$$
$$40 + 41 + 2h \le 165$$
$$81 + 2h \le 165$$
$$2h \le 84$$
$$h \le 42$$

The maximum height is 42 inches.

74. a. $l + w + d \le 45$

b. Substitute 23 for *l*, and 12 for *w,* then solve for *d.*

$$l + w + d \le 45$$
$$23 + 12 + d \le 45$$
$$35 + d \le 45$$
$$d \le 10$$

The maximum depth is 10 inches.

75. a. The taxable income of $78,221 places a married couple filing jointly in the 25% tax bracket. The tax is $9,735 plus 25% of the taxable income over $70,700.
The tax is:

$$9735 + 0.25(78,221 - 70,700)$$
$$= 9735 + 0.25(7521)$$
$$= 9735 + 1880.25$$
$$= 11,615.25$$

They will owe $11,615.25 in taxes.

b. The taxable income of $301,233 places a married couple filing jointly in the 33% tax bracket. The tax is $48,665 plus 33% of the taxable income over $217,450.
The tax is:

$$48,665 + 0.33(301,233 - 217,450)$$
$$= 48,665 + 0.33(83,783)$$
$$= 48,665 + 27,648.39$$
$$= 76,313.39$$

They will owe $76,313.39 in taxes.

76. a. The taxable income of $149,347 places a married couple filing jointly in the 28% tax bracket. The tax is $27,735 plus 28% of the taxable income over $142,700.
The tax is:

$$= 27,735 + 0.28(149,347 - 142,700)$$
$$= 27,735 + 0.28(6647)$$
$$= 27,735 + 1861.16$$
$$= 29,596.16$$

They will owe $29,596.16 in taxes.

b. The taxable income of $403,221 places a married couple filing jointly in the 35% tax bracket. The tax is $105,062 plus 35% of the taxable income over $388,350.
The tax is:

$$105,062 + 0.35(403,221 - 388,350)$$
$$= 105,062 + 0.35(14871)$$
$$= 105,062 + 5204.85$$
$$= 110,266.85$$

They will owe $110,266.85 in taxes.

77. Let *x* be the maximum number of boxes.

$$70x \le 800$$
$$x \le \frac{800}{70}$$
$$x \le 11.43$$

The maximum number of boxes is 11.

78. Let *x* be the maximum number of boxes.

$$70x + 195 \le 800$$
$$70x \le 605$$
$$x \le \frac{605}{70} = \frac{121}{14} \approx 8.64$$

The maximum number of boxes is 8.

79. Let *x* be the additional number of text messages.

$$10 + 0.1x < 25$$
$$0.1x < 15$$
$$x < 150$$

She can purchase fewer than 150 messages beyond the initial 1000 for a maximum of 1149 messages.

80. Let x be the additional hours to park in the garage.

$$1.25 + 0.75x \le 3.75$$
$$0.75x \le 2.5$$
$$x \le \frac{2.5}{0.75}$$
$$x \le 3.\overline{3}$$

You can park in the garage for the first (initial) hour plus 3 additional hours for a total of 4 hours.

81. To make a profit, the cost must be less than the revenue: cost < revenue.

$$10{,}025 + 1.09x < 6.42x$$
$$10{,}025 < 5.33x$$
$$\frac{10{,}025}{5.33} < x$$
$$1880.86 < x$$

She needs to sell a minimum of 1881 books to make a profit.

82. To make a profit, the cost must be less than the revenue: cost < revenue.

$$8000 + 0.08x < 1.85x$$
$$8000 < 1.77x$$
$$\frac{8000}{1.77} < x$$
$$4519.77 < x$$

He must clean a minimum of 4520 garments to make a profit.

83. Let x = the number of additional ounces beyond the first ounce.

$$0.9 + 0.2x \le 2.70$$
$$0.2x \le 1.8$$
$$\frac{0.2x}{0.2} \le \frac{1.8}{0.2}$$
$$x \le 9$$

The maximum weight is 10 ounces (the first ounce plus up to 9 additional ounces).

84. Let x = the number of pieces of mail sent. The cost of mailing x pieces of mail using *presorted first-class* mail is $190 + 0.433x$ dollars and the cost of mailing x pieces of mail without the bulk permit is $0.46x$ dollars. We want to know when "cost with permit" < "cost without permit."

$$190 + 0.433x < 0.46x$$
$$190 < 0.27x$$
$$\frac{190}{0.027} < \frac{0.027x}{0.027}$$
$$x > \frac{190}{0.027} \approx 7038$$

The company must send a minimum of 7038 pieces of mail in order for the bulk permit to be financially worthwhile.

85. Let x be the minimum score for the sixth exam.

$$\frac{66 + 72 + 90 + 49 + 59 + x}{6} \ge 60$$
$$\frac{336 + x}{6} \ge 60$$
$$6\left(\frac{336 + x}{6}\right) \ge 6(60)$$
$$336 + x \ge 360$$
$$x \ge 24$$

She must make a 24 or higher on the sixth exam to pass the course.

86. Let x be the grade on the fifth exam. The average of the five grades must be greater than or equal to 90.

$$\frac{92 + 87 + 96 + 77 + x}{5} \ge 90$$
$$\frac{352 + x}{5} \ge 90$$
$$5\left(\frac{352 + x}{5}\right) \ge 5(90)$$
$$352 + x \ge 450$$
$$x \ge 98$$

Stephen must make a 98 or higher on the fifth exam to earn a final grade of A in the course.

87. Let x be the score on the fifth exam.

$$80 \le \frac{85+92+72+75+x}{5} < 90$$

$$80 \le \frac{324+x}{5} < 90$$

$$5(80) \le 5\left(\frac{324+x}{5}\right) < 5(90)$$

$$400 \le 324 + x < 450$$

$$76 \le x < 126$$

To receive a final grade of B, Ms. Mahoney must score 76 or higher on the fifth exam. That is, the score must be $76 \le x \le 100$ (maximum grade is 100).

88. Let x be the value of the third pollutant. The inequality is

$$\frac{2.7+3.42+x}{3} < 3.2$$

$$\frac{6.12+x}{3} < 3.2$$

$$3\left(\frac{6.12+x}{3}\right) < 3(3.2)$$

$$6.12 + x < 9.6$$

$$x < 3.48$$

Any value less than 3.48 parts per million of the third pollutant will result in the air being considered "clean."

89. Let x be the value of the third reading.

$$7.2 < \frac{7.48+7.15+x}{3} < 7.8$$

$$7.2 < \frac{14.63+x}{3} < 7.8$$

$$3(7.2) < 3\left(\frac{14.63+x}{3}\right) < 3(7.8)$$

$$21.6 < 14.63 + x < 23.4$$

$$6.97 < x < 8.77$$

Any value between 6.97 and 8.77 would result in a normal pH reading.

90. Let x be the value of the third reading.

$$7.2 < \frac{7.06+7.31+x}{3} < 7.8$$

$$7.2 < \frac{14.37+x}{3} < 7.8$$

$$3(7.2) < 3\left(\frac{14.37+x}{3}\right) < 3(7.8)$$

$$21.6 < 14.37 + x < 23.4$$

$$7.23 < x < 9.03$$

Any value between 7.23 and 9.03 would result in a normal pH reading.

91. a.

$$v > 0$$

$$-32t + 96 > 0$$

$$-32t > -96$$

$$t < 3$$

The object is traveling upward on the interval $[0,\ 3)$.

b.

$$v < 0$$

$$-32t + 96 < 0$$

$$-32t < -96$$

$$t > 3$$

The object is traveling downward on the interval $(3,\ 10]$.

92. a.

$$v > 0$$

$$-32t + 172.8 > 0$$

$$-32t > -172.8$$

$$t < 5.4$$

The object is traveling upward on the interval $[0,\ 5.4)$.

b.

$$v < 0$$

$$-32t + 172.8 < 0$$

$$-32t < -172.8$$

$$t > 5.4$$

The object is traveling downward on the interval $(5.4,\ 12]$.

93. a. $v > 0$

$-9.8t + 49 > 0$

$-9.8t > -49$

$t < 5$

The object is traveling upward on the interval $[0,\ 5)$.

b. $v < 0$

$-9.8t + 49 < 0$

$-9.8t < -49$

$t > 5$

The object is traveling downward on the interval $(5, 13]$.

94. a. $v > 0$

$-9.8t + 31.36 > 0$

$-9.8t > -31.36$

$t < 3.2$

The object is traveling upward on the interval $[0,\ 3.2)$.

b. $v < 0$

$-9.8t + 31.36 < 0$

$-9.8t < -31.36$

$t > 3.2$

The object is traveling downward on the interval $(3.2,\ 6]$.

95. a. The 10th percentile is approximately 17.5 pounds and the 90th percentile is approximately 23.5 pounds. Therefore, 80% of the weights for 9 month old boys are in the interval $[17.5, 23.5]$ (in pounds).

b. The 10th percentile is approximately 23.5 pounds and the 90th percentile is approximately 31 pounds. Therefore, 80% of the weights for 21 month old boys are in the interval $[23.5,\ 31]$ (in pounds).

c. The 10th percentile is approximately 27.2 pounds and the 90th percentile is approximately 36.5 pounds. Therefore, 80% of the weights for 36 month old boys are in the interval $[27.2,\ 36.5]$ (in pounds).

96. a. From the chart, the 10th percentile is approximately 16.2 pounds and the 90th percentile is approximately 21.5 pounds. Therefore, 80% of the weights for 9 month old girls are in the interval $[16.2,\ 21.5]$ (in pounds).

b. From the chart, the 10th percentile is approximately 22.4 pounds and the 90th percentile is approximately 29.4 pounds. Therefore, 80% of the weights for 21 month old girls are in the interval $[22.4,\ 29.4]$ (in pounds).

c. From the chart, the 10th percentile is approximately 26.5 pounds and the 90th percentile is approximately 36 pounds. Therefore, 80% of the weights for 36 month old girls are in the interval $[26.5,\ 36]$ (in pounds).

97. No, $-1 > -2$ but $(-1)^2 < (-2)^2$.

98. The solution will involve dividing through by b. The direction of the inequalities will need to be changed if we divide by a negative number, but not if we divide by a positive number. Therefore, one needs to know whether $b > 0$ or $b < 0$.

99. First find the average of 82, 90, 74, 76, and 68.

$$\frac{82+90+74+76+68}{5} = \frac{390}{5} = 78$$

This represents $\frac{2}{3}$ of the final grade.

Let x be the score from the final exam. Since this represents $\frac{1}{3}$ of the final grade, the inequality is

$$80 \le \frac{2}{3}(78) + \frac{1}{3}x < 90$$

$$3(80) \le 3\left[\frac{2}{3}(78) + \frac{1}{3}x\right] \le 3(90)$$

$$240 \le 2(78) + x \le 270$$

$$240 \le 156 + x \le 270$$

$$84 \le x \le 114$$

Stephen must score at least 84 points on the final exam to have a final grade of B. The range is $84 \le x \le 100$.

100. Answers may vary. One possible answer is:
Write $x < 3x - 10 < 2x$ as
$x < 3x - 10$ and $3x - 10 < 2x$
Solve each of the inequalities.

$x < 3x - 10$ and $3x - 10 < 2x$

$-2x < -10$ $\quad\quad$ $-10 < -x$

$x > 5$ $\quad\quad$ $10 > x$

The final answer is $x > 5$ and $10 > x$ which is $5 < x < 10$ or $(5, 10)$.

101. Answers may vary. One possible answer is:
Write $x < 2x + 3 < 2x + 5$ as $x < 2x + 3$ and $2x + 3 < 2x + 5$
Solve each of the inequalities.

$x < 2x + 3$ and $2x + 3 < 2x + 5$

$-x < 3$ $\quad\quad$ $3 < 5$

$x > -3$ $\quad\quad$ All real numbers

The final answer is $x > -3$ or $(-3, \infty)$.

102. Answers may vary. One possible answer is:
Write $x + 5 < x + 3 < 2x + 2$ as
$x + 5 < x + 3$ and $x + 3 < 2x + 2$
Solve each of the inequalities

$x + 5 < x + 3$ and $x + 3 < 2x + 2$

$5 < 3$ $\quad\quad$ $1 < x$

False $\quad\quad$ $x > 1$

The solution is the empty set or $\varnothing$.

103. **a.** $A \cup B = \{1,\ 2,\ 3,\ 4,\ 5,\ 6,\ 8,\ 9\}$

b. $A \cap B = \{1,\ 8\}$

104. **a.** 4 is a counting number.

b. 0 and 4 are whole numbers.

c. $-3, 4, \frac{5}{2}, 0,$ and $-\frac{13}{29}$ are rational numbers.

d. $-3, 4, \frac{5}{2}, \sqrt{7}, 0,$ and $-\frac{13}{29}$ are real numbers.

105. associative property of addition.

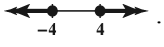
106. commutative property of addition

107.
$$R = L + (V - D)r$$
$$R = L + Vr - Dr$$
$$R - L + Dr = Vr$$
$$\frac{R - L + Dr}{r} = V \text{ or } V = \frac{R - L + Dr}{r}$$

Exercise Set 2.6

1. The graph of the solution to $|x| \le 4$ on the number line is 

.

2. The graph of the solution to $|x| \ge 4$ on the number line is 

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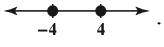
3. The graph of the solution to $|x| = 4$ on the number line is 

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4. The graph of the solution to $|x| < 4$ on the number line is 

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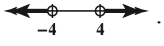
5. The graph of the solution to $|x| > 4$ on the number line is 

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6. The solution set of $|x| \le 5$ is $\{x \mid -5 \le x \le 5\}$.

7. The solution set of $|x| \ge 5$ is $\{x \mid x \le -5 \text{ or } x \ge 5\}$.

8. The solution set of $|x| = 5$ is $\{-5,\ 5\}$.

9. The solution set of $|x| < 5$ is $\{x \mid -5 < x < 5\}$.

10. The solution set of $|x| > 5$ is $\{x \mid x < -5 \text{ or } x > 5\}$.

11. The solution set of $|x| > -6$ is $\mathbb{R}$.

12. The solution set of $|x| < -6$ is $\varnothing$.

13. $|a| = 7$

$a = 7$ or $a = -7$

The solution set is $\{-7, 7\}$.

14. $|b| = 17$

$b = 17$ or $b = -17$

The solution set is $\{-17, 17\}$.

15. $|c| = \frac{1}{2}$

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

The solution set is $\left\{-\frac{1}{2}, \frac{1}{2}\right\}$.

16. $|d| = \frac{3}{8}$

$d = \frac{3}{8}$ or $d = -\frac{3}{8}$

The solution set is $\left\{-\frac{3}{8}, \frac{3}{8}\right\}$.

17. $|d| = -\frac{5}{6}$

There is no solution since the right side is a negative number and the absolute value can never be equal to a negative number. The solution set $\varnothing$.

18. $|x| = 0$

$x = 0$ or $x = -0$

The solution set is $\{0\}$.

19. $|x + 5| = 8$

$x + 5 = 8$ $\qquad$ $x + 5 = -8$

$x = 3$ or $\qquad$ $x = -13$

The solution set is $\{-13, 13\}$.

20. $|l + 4| = 6$

$l + 4 = 6$ $\qquad$ $l + 4 = -6$

$x = 2$ or $\qquad$ $x = -10$

The solution set is $\{-10, 2\}$.

21. $|2x - 3| = 9$

$2x - 3 = 9$ or $2x - 3 = -9$

$2x = 12$ $\qquad$ $2x = -6$

$x = 6$ $\qquad$ $x = -3$

The solution set is $\{-3, 6\}$.

22. $|3x - 2| = 8$

$3x - 2 = 8$ or $3x - 2 = -8$

$3x = 10$ $\qquad$ $3x = -6$

$x = \frac{10}{3}$ $\qquad$ $x = -2$

The solution set is $\left\{-2, \frac{10}{3}\right\}$.

23. $|3x - 8| + 5 = 9$

$|3x - 8| = 4$

$3x - 8 = 4$ or $3x - 8 = -4$

$3x = 12$ $\qquad$ $3x = 4$

$x = 4$ $\qquad$ $x = \frac{4}{3}$

The solution set is $\left\{\frac{4}{3}, 4\right\}$.

24. $|5x - 1| + 3 = 12$

$|5x - 1| = 9$

$5x - 1 = 9$ or $5x - 1 = -9$

$5x = 10$ $\qquad$ $5x = -8$

$x = 2$ $\qquad$ $x = -\frac{8}{5}$

The solution set is $\left\{-\frac{8}{5}, 2\right\}$.

25. $\left|\frac{x-3}{4}\right| = 5$

$\frac{x-3}{4} = 5$ $\qquad$ or $\qquad$ $\frac{x-3}{4} = -5$

$4\left(\frac{x-3}{4}\right) = 4(5)$ $\qquad$ $4\left(\frac{x-3}{4}\right) = 4(-5)$

$x - 3 = 20$ $\qquad$ $x - 3 = -20$

$x = 23$ $\qquad$ $x = -17$

The solution set is $\{-17, 23\}$.

26. $\left|\frac{c-2}{5}\right|=1$

$\frac{c-2}{5}=1$ or $\frac{c-2}{5}=-1$

$5\left(\frac{c-2}{5}\right)=5(1)$ $\quad$ $5\left(\frac{c-2}{5}\right)=5(-1)$

$c-2=5$ $\quad$ $c-2=-5$

$c=7$ $\quad$ $c=-3$

The solution set is $\{-3, 7\}$.

27. $\left|\frac{x-3}{4}\right|+8=8$

$\left|\frac{x-3}{4}\right|=0$

$\frac{x-3}{4}=0$

$4\left(\frac{x-3}{4}\right)=4(0)$

$x-3=0$

$x=3$

The solution set is $\{3\}$.

28. $\left|\frac{3x-4}{2}\right|-3=-3$

$\left|\frac{3x-4}{2}\right|=0$

$\frac{3x-4}{2}=0$

$3x-4=0$

$3x=4$

$x=\frac{4}{3}$

The solution set is $\left\{\frac{4}{3}\right\}$.

29. $|x-5|+4=3$

$|x-5|=-1$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

30. $|2x+3|-5=-8$

$|2x+3|=-3$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

31. $|w|<1$

$-1<w<1$

The solution set is $\{w\,|\,-1<w<1\}$.

32. $|p|\le 9$

$-9\le p\le 9$

The solution set is $\{p\,|\,-9\le p\le 9\}$.

33. $|q+5|\le 8$

$-8\le q+5\le 8$

$-8-5\le q+5-5\le 8-5$

$-13\le q\le 3$

The solution set is $\{q\,|\,-13\le q\le 3\}$.

34. $|r-2|<7$

$-7<r-2<7$

$-5<r<9$

The solution set is $\{r\,|\,-5<r<9\}$.

35. $|a+7|-5\le -3$

$|a+7|\le 2$

$-2\le a+7\le 2$

$-9\le a\le -5$

The solution set is $\{a\,|\,-9\le a\le -5\}$.

36. $|x-3|-7<-2$

$|x-3|<5$

$-5<x-3<5$

$-5+3<x-3+3<5+3$

$-2<x<8$

The solution set is $\{x\,|\,-2<x<8\}$.

37. $|2x+3|-5 \le 10$

$|2x+3| \le 15$

$-15 \le 2x+3 \le 15$

$-15-3 \le 2x+3-3 \le 15-3$

$-18 \le 2x \le 12$

$\frac{-18}{2} \le \frac{2x}{2} \le \frac{12}{2}$

$-9 \le x \le 6$

The solution set is $\{x \mid -9 \le x \le 6\}$.

38. $|2y-7|+3 < 12$

$|2y-7| < 9$

$-9 < 2y-7 < 9$

$-2 < 2y < 16$

$-1 < y < 8$

The solution set is $\{y \mid -1 < y < 8\}$.

39. $|3x-7|+8 < 14$

$|3x-7| < 6$

$-6 < 3x-7 < 6$

$-6+7 < 3x-7+7 < 6+7$

$1 < 3x < 13$

$\frac{1}{3} < \frac{3x}{3} < \frac{13}{3}$

$\frac{1}{3} < x < \frac{13}{3}$

The solution set is $\left\{x \mid \frac{1}{3} < x < \frac{13}{3}\right\}$.

40. $|5x+3|-11 \le -3$

$|5x+3| \le 8$

$-8 \le 5x+3 \le 8$

$-11 \le 5x \le 5$

$-\frac{11}{5} \le x \le 1$

The solution set is $\left\{x \mid -\frac{11}{5} \le x \le 1\right\}$.

41. $|2x-6|+5 \le 1$

$|2x-6| \le -4$

There is no solution since the right side is negative whereas the left side is non-negative; zero or a positive number is never less than a negative number. The solution set is $\varnothing$.

42. $|7x-9|-3 < -11$

$|7x-9| < -8$

There is no solution since the right side is negative whereas the left side is positive or zero, hence, never less than a negative number. The solution set is $\varnothing$.

43. $\left|\frac{m}{3}-\frac{7}{9}\right| \le \frac{7}{27}$

$-\frac{7}{27} \le \frac{m}{3}-\frac{7}{9} \le \frac{7}{27}$

$27\left(-\frac{7}{27}\right) \le 27\left(\frac{m}{3}-\frac{7}{9}\right) \le 27\left(\frac{7}{27}\right)$

$-7 \le 9m-21 \le 7$

$14 \le 9m \le 28$

$\frac{14}{9} \le m \le \frac{28}{9}$

The solution set is $\left\{m \mid \frac{14}{9} \le m \le \frac{28}{9}\right\}$.

44. $\left|\frac{k}{4}-\frac{3}{8}\right| < \frac{7}{16}$

$-\frac{7}{16} < \frac{k}{4}-\frac{3}{8} < \frac{7}{16}$

$16\left(-\frac{7}{16}\right) < 16\left(\frac{k}{4}-\frac{3}{8}\right) < 16\left(\frac{7}{16}\right)$

$-7 < 4k-6 < 7$

$-7+6 < 4k-6+6 < 7+6$

$-1 < 4k < 13$

$-\frac{1}{4} < k < \frac{13}{4}$

The solution is $\left\{k \mid -\frac{1}{4} < k < \frac{13}{4}\right\}$.

45. $\left|\frac{x-3}{2}\right|-4\le -2$

$\left|\frac{x-3}{2}\right|\le 2$

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

$2(-2)\le 2\left(\frac{x-3}{2}\right)\le 2(2)$

$-4\le x-3\le 4$

$-4+3\le x-3+3\le 4+3$

$-1\le x\le 7$

The solution set is $\{x\,|\,-1\le x\le 7\}$.

46. $\left|\frac{y+3}{5}\right|+2<7$

$\left|\frac{y+3}{5}\right|<5$

$-5<\frac{y+3}{5}<5$

$5(-5)<5\left(\frac{y+3}{5}\right)<5(5)$

$-25<y+3<25$

$-28<y<22$

The solution set is $\{y\,|\,-28<y<22\}$.

47. $|a|\ge 13$

$a\le -13$ or $a\ge 13$

The solution set is $\{a\,|\,a\le -13 \text{ or } a\ge 13\}$.

48. $|y|>8$

$y<-8$ or $y>8$

The solution set is $\{y\,|\,y<-8 \text{ or } y>8\}$.

49. $|x+4|>5$

$x+4<-5$ or $x+4>5$

$x<-9$ $\qquad$ $x>1$

The solution set is $\{x\,|\,x<-9 \text{ or } x>1\}$.

50. $|x-5|>3$

$x-5>3$ or $x-5<-3$

$x>8$ $\qquad$ $x<2$

The solution set is $\{x\,|\,x<2 \text{ or } x>8\}$.

51. $|2b-7|>3$

$2b-7<-3$ or $2b-7>3$

$2b<4$ $\qquad$ $2b>10$

$b<\frac{4}{2}$ $\qquad$ $b>\frac{10}{2}$

$b<2$ $\qquad$ $b>5$

The solution set is $\{b\,|\,b<2 \text{ or } b>5\}$.

52. $|2b+5|\ge 7$

$2b+5\ge 7$ or $2b+5\le -7$

$2b\ge 2$ $\qquad$ $2b\le -12$

$b\ge 1$ $\qquad$ $b\le -6$

The solution set is $\{b\,|\,b\le -6 \text{ or } b\ge 1\}$.

53. $|3d-8|>5$

$3d-8>5$ or $3d-8<-5$

$3d>13$ $\qquad$ $3d<3$

$d>\frac{13}{3}$ $\qquad$ $d<1$

The solution set is $\left\{d\,\middle|\,d<1 \text{ or } d>\frac{13}{3}\right\}$.

54. $|2x-1|\ge 12$

$2x-1\le -12$ or $2x-1\ge 12$

$2x\le -11$ or $2x\ge 13$

$x\le -\frac{11}{2}$ $\qquad$ $x\ge \frac{13}{2}$

The solution set is $\left\{x\,\middle|\,x\le -\frac{11}{2} \text{ or } x\ge \frac{13}{2}\right\}$.

55. $|0.1x-0.4|+0.4>0.6$

$|0.1x-0.4|>0.2$

$0.1x-0.4<-0.2$ or $0.1x-0.4>0.2$

$0.1x<0.2$ $\quad$ $0.1x>0.6$

$x<\frac{0.2}{0.1}$ $\quad$ $x>\frac{0.6}{0.1}$

$x<2$ $\quad$ $x>6$

The solution set is $\{x|x<2 \text{ or } x>6\}$.

56. $|0.2x+0.5|-0.3\geq 0.8$

$|0.2x+0.5|\geq 1.1$

$0.2x+0.5\geq 1.1$ or $0.2x+0.5\leq -1.1$

$0.2x\geq 0.6$ $\quad$ $0.2x\leq -1.6$

$\frac{0.2x}{0.2}\geq\frac{0.6}{0.2}$ $\quad$ $\frac{0.2x}{0.2}\leq\frac{-1.6}{0.2}$

$x\geq 0.3$ $\quad$ $x\leq -0.8$

The solution set is $\{x|x\leq -8 \text{ or } x\geq 3\}$.

57. $\left|\frac{x}{2}+4\right|\geq 5$

$\frac{x}{2}+4\leq -5$ or $\frac{x}{2}+4\geq 5$

$2\left(\frac{x}{2}+4\right)\leq 2(-5)$ $\quad$ $2\left(\frac{x}{2}+4\right)\geq 2(5)$

$x+8\leq -10$ $\quad$ $x+8\geq 10$

$x\leq -18$ $\quad$ $x\geq 2$

The solution set is $\{x|x\leq -18 \text{ or } x\geq 2\}$.

58. $\left|4-\frac{3x}{5}\right|\geq 9$

$4-\frac{3x}{5}\leq -9$ or $4-\frac{3x}{5}\geq 9$

$-\frac{3x}{5}\leq -13$ $\quad$ $-\frac{3x}{5}\geq 5$

$-\frac{5}{3}\left(-\frac{3x}{5}\right)\geq -\frac{5}{3}(-13)$ $\quad$ $-\frac{5}{3}\left(-\frac{3x}{5}\right)\leq -\frac{5}{3}(5)$

$x\geq\frac{65}{3}$ $\quad$ $x\leq -\frac{25}{3}$

The solution set is $\left\{x\middle|x\leq -\frac{25}{3} \text{ or } x\geq\frac{65}{3}\right\}$.

59. $|7w+3|-12\geq -12$

$|7w+3|\geq 0$

Observe that the absolute value of a number is always greater than or equal to 0. Thus, the solution is the set of real numbers, or $\mathbb{R}$.

60. $|3.7d+6.9|-2.1>-5.4$

$|3.7d+6.9|>-3.3$

Since the right side is negative whereas the left side is positive or zero and always greater than a negative number, the solution is the entire real number line. Thus, the solution is all real numbers, or $\mathbb{R}$.

61. $|4-2x|>0$

$4-2x<0$ or $4-2x>0$

$-2x<-4$ $\quad$ $-2x>-4$

$x>\frac{-4}{-2}$ $\quad$ $x<\frac{-4}{-2}$

$x>2$ $\quad$ $x<2$

The solution set is $\{x|x<2 \text{ or } x>2\}$.

62. $|2c-8|>0$

$2c-8<0$ or $2c-8>0$

$2c<8$ $\quad$ $2c>8$

$c<\frac{8}{2}$ $\quad$ $c>\frac{8}{2}$

$c<4$ $\quad$ $c>4$

The solution set is $\{c|c<4 \text{ or } c>4\}$.

63. $|3p-5|=|2p+10|$

$3p-5=-(2p+10)$ or $3p-5=2p+10$

$3p-5=-2p-10$ $\quad$ $p-5=10$

$5p-5=-10$ $\quad$ $p=15$

$5p=-5$

$p=-1$

The solution set is $\{-1,\ 15\}$.

64. $|6n+3|=|4n-13|$

$6n+3=-(4n-13)$ or $6n+3=(4n-13)$

$6n+3=-4n+13$ $6n+3=4n-13$

$10n+3=13$ $2n+3=-13$

$10n=10$ $2n+-16$

$n=1$ $n=-8$

The solution set is $\{-8,\ 1\}$.

65. $\left|\frac{2r}{3}+\frac{5}{6}\right|=\left|\frac{r}{2}-3\right|$

$\frac{2r}{3}+\frac{5}{6}=-\left(\frac{r}{2}-3\right)$ or $\frac{2r}{3}+\frac{5}{6}=\frac{r}{2}-3$

$\frac{2r}{3}+\frac{5}{6}=-\frac{r}{2}+3$ $6\left(\frac{2r}{3}+\frac{5}{6}\right)=6\left(\frac{r}{2}-3\right)$

$6\left(\frac{2r}{3}+\frac{5}{6}\right)=6\left(-\frac{r}{2}+3\right)$ $4r+5=3r-18$

$4r+5=-3r+18$ $r+5=-18$

$7r+5=18$ $r=-23$

$7r=13$

$r=\frac{13}{7}$

The solution set is $\left\{-23,\ \frac{13}{7}\right\}$.

66. $\left|\frac{3r}{4}+\frac{1}{8}\right|=\left|\frac{r}{2}-\frac{3}{8}\right|$

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

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

$6r+1=4r-3$ $8\left(\frac{3r}{4}+\frac{1}{8}\right)=8\left(-\frac{r}{2}+\frac{3}{8}\right)$

$2r+1=-3$ $6r+1=-4r+3$

$2r=-4$ $10r+1=3$

$r=-2$ $10r=2$

$r=\frac{1}{5}$

The solution set is $\left\{-2,\ \frac{1}{5}\right\}$.

67. $|5t-10|=|10-5t|$

$|5t-10|=|-(5t-10)|$

Since the $5t-10$ and $-(5t-10)$ are opposites, the absolute value of each are equivalent. Therefore, the solution is all real numbers or $\mathbb{R}$.

68. $\left|\frac{2x}{3}-\frac{7}{8}\right|=\left|\frac{7}{8}-\frac{2}{3}x\right|$

$\left|\frac{2x}{3}-\frac{7}{8}\right|=\left|-\left(\frac{2}{3}x-\frac{7}{8}\right)\right|$

Since the $\frac{2}{3}x-\frac{7}{8}$ and $-\left(\frac{2}{3}x-\frac{7}{8}\right)$ are opposites, the absolute value of each are equivalent. Therefore, the solution is all real numbers or $\mathbb{R}$.

69. $|2v+5|=|2v-3|$

$2v+5=-(2v-3)$ or $2v+5=2v-3$

$2v+5=-2v+3$ $5=-3$ False

$4v+5=3$

$4v=-2$

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

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

70. $|5-2m|=|2m+13|$

$5-2m=-(2m+13)$ or $5-2m=2m+13$

$5-2m=-2m-13$ $5=4m+13$

$5=-13$ False $-8=4m$

$-2=m$

The solution set is $\{-2\}$.

71. $|h|=9$

$h=9$ or $h=-9$

The solution set is $\{-9,\ 9\}$.

72. $|y|\le 8$

$-8\le y\le 8$

The solution set is $\{y\,|\,-8\le y\le 8\}$.

73. $|q+6|>2$

$q+6<-2$ or $q+6>2$

$q<-8$ $q>-4$

The solution set is $\{q \mid q<-8 \text{ or } q>-4\}$.

74. $|9d+7|\le -9$

There is no solution since the right side is negative whereas the left side is non-negative and, therefore, never less than a negative number. The solution set is $\varnothing$.

75. $|2w-7|\le 9$

$-9\le 2w-7\le 9$

$-9+7\le 2w-7+7\le 9+7$

$-2\le 2w\le 16$

$\frac{-2}{2}\le \frac{2w}{2}\le \frac{16}{2}$

$-1\le w\le 8$

The solution set is $\{w \mid -1\le w\le 8\}$.

76. $|2z-7|+5>8$

$|2z-7|>3$

$2z-7<-3$ or $2z-7>3$

$2z<4$ $2z>10$

$z<2$ $z>5$

The solution set is $\{z \mid z<2 \text{ or } z>5\}$.

77. $|5a-1|=9$

$5a-1=-9$ or $5a-1=9$

$5a=-8$ $5a=10$

$a=-\frac{8}{5}$ $a=2$

The solution set is $\left\{-\frac{8}{5},\ 2\right\}$.

78. $|2x-4|+5=13$

$|2x-4|=8$

$2x-4=-8$ or $2x-4=8$

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

$x=-2$ $x=6$

The solution set is $\{-2,\ 6\}$.

79. $|5x+2|>0$

$5+2x<0$ or $5+2x>0$

$2x<-5$ $2x>-5$

$x<-\frac{5}{2}$ $x>-\frac{5}{2}$

The solution set is $\left\{x \mid x<-\frac{5}{2} \text{ or } x>-\frac{5}{2}\right\}$.

80. $|7-3b|=|5b+15|$

$7-3b=-(5b+15)$ or $7-3b=5b+15$

$7-3b=-5b-15$ $-8b=8$

$2b=-22$ $b=-1$

$b=-11$

The solution set is $\{-11,\ -1\}$.

81. $|4+3x|\le 9$

$-9\le 4+3x\le 9$

$-13\le 3x\le 5$

$-\frac{13}{3}\le x\le \frac{5}{3}$

The solution set is $\left\{x \mid -\frac{13}{3}\le x\le \frac{5}{3}\right\}$.

82. $|2.4x+4|+4.9>3.9$

$|2.4x+4|>-1.0$

Since the right side is negative whereas the left side is non-negative and always greater than a negative number, the solution is the entire real number line. Thus, the solution is the set of all real numbers or $\mathbb{R}$.

83. $|3n+8|-4=-10$

$|3n+8|=-6$

Since the right side is negative and the left side is non-negative, there is no solution since the absolute value can never equal a negative number. The solution set is $\varnothing$.

84. $|4-2x|-3=7$

$|4-2x|=10$

$4-2x=-10$ or $4-2x=10$

$-2x=-14$ $-2x=6$

$x=7$ $x=-3$

The solution set is $\{-3,\ 7\}$.

85. $\left|\frac{w+4}{3}\right|+5<9$

$\left|\frac{w+4}{3}\right|<4$

$-4<\frac{w+4}{3}<4$

$3(-4)<3\left(\frac{w+4}{3}\right)<3(4)$

$-12<w+4<12$

$-16<w<8$

The solution set is $\{w\,|\,-16<w<8\}$.

86. $\left|\frac{5t-10}{6}\right|>\frac{5}{3}$

$\frac{5t-10}{6}<-\frac{5}{3}$ or $\frac{5t-10}{6}>\frac{5}{3}$

$6\left(\frac{5t-10}{6}\right)<6\left(-\frac{5}{3}\right)$ $\quad$ $6\left(\frac{5t-10}{6}\right)>6\left(\frac{5}{3}\right)$

$5t-10<-10$ $\quad$ $5t-10>10$

$5t<0$ $\quad$ $5t>20$

$t<0$ $\quad$ $t>4$

The solution set is $\{t\,|\,t<0 \text{ or } t>4\}$.

87. $\left|\frac{3x-2}{4}\right|-\frac{1}{3}\geq-\frac{1}{3}$

$\left|\frac{3x-2}{4}\right|\geq 0$

Since the absolute value of a number is always greater than or equal to zero, the solution is the set of all real numbers or $\mathbb{R}$.

88. $\left|\frac{2x-4}{5}\right|=14$

$\frac{2x-4}{5}=-14$ or $\frac{2x-4}{5}=14$

$5\left(\frac{2x-4}{5}\right)=5(-14)$ $\quad$ $5\left(\frac{2x-4}{5}\right)=5(14)$

$2x-4=-70$ $\quad$ $2x-4=70$

$2x=-66$ $\quad$ $2x=74$

$x=-33$ $\quad$ $x=37$

The solution set is $\{-33,\ 37\}$.

89. $|2x-8|=\left|\frac{1}{2}x+3\right|$

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

$2x-8=-\frac{1}{2}x-3$ $\quad$ $\frac{3}{2}x-8=3$

$\frac{5}{2}x-8=-3$ $\quad$ $\frac{3}{2}x=11$

$\frac{5}{2}x=5$ $\quad$ $\frac{2}{3}\left(\frac{3}{2}x\right)=\frac{2}{3}(11)$

$\frac{2}{5}\left(\frac{5}{2}x\right)=\frac{2}{5}(5)$ $\quad$ $x=\frac{22}{3}$

$x=2$

The solution set is $\left\{2,\ \frac{22}{3}\right\}$.

90. $\left|\frac{1}{3}y+3\right|=\left|\frac{2}{3}y-1\right|$ $\quad$ $\frac{1}{3}y+3=\frac{2}{3}y-1$ or $\frac{1}{3}y+3=-\left(\frac{2}{3}y-1\right)$

$3=\frac{1}{3}y-1$ $\quad$ $\frac{1}{3}y+3=-\frac{2}{3}y+1$

$4=\frac{1}{3}y$ $\quad$ $y+3=1$

$3(4)=3\left(\frac{1}{3}y\right)$ $\quad$ $y=-2$

$12=y$

The solution set is $\{-2,\ 12\}$.

91. $|2-3x| = \left|4-\frac{5}{3}x\right|$

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

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

$-3x = -6+\frac{5}{3}x$ $\quad -\frac{4}{3}x = 2$

$-\frac{14}{3}x = -6$ $\quad -\frac{3}{4}\left(-\frac{4}{3}x\right) = -\frac{3}{2}(2)$

$\left(-\frac{3}{14}\right)\left(-\frac{14}{3}\right)x = \left(-\frac{3}{14}\right)(-6)$ $\quad x = -\frac{3}{2}$

$x = \frac{9}{7}$

The solution set is $\left\{-\frac{3}{2},\ \frac{9}{7}\right\}$.

92. $\left|\frac{-2u+3}{7}\right| \le 5$

$-5 \le \frac{-2u+3}{7} \le 5$

$21(5) \le 21\left(\frac{-2u+3}{7}\right) \le 21(5)$

$-105 \le -6u+9 \le 105$

$-105-9 \le -6u+9-9 \le 105-9$

$-114 \le -6u \le 96$

$\frac{-114}{-6} \ge \frac{-6u}{-6} \ge \frac{96}{-6}$

$19 \ge u \ge -16$

$-16 \le u \le 19$

The solution set is $\{u \mid -16 \le u \le 19\}$.

93. a. $|t-0.089| \le 0.004$

$-0.004 \le t-0.089 \le 0.004$

$-0.004+0.089 \le t-0.089+0.089 \le 0.004+0.089$

$0.085 \le t \le 0.093$

The solution is $[0.085, 0.093]$.

b. 0.085 inches

c. 0.093 inches

94. a. $\left|t-\frac{5}{8}\right| \le \frac{1}{56}$

$-\frac{1}{56} \le t-\frac{5}{8} \le \frac{1}{56}$

$56\left(-\frac{1}{56}\right) \le 56\left(t-\frac{5}{8}\right) \le 56\left(\frac{1}{56}\right)$

$-1 \le 56t-35 \le 1$

$-1+35 \le 56t-35+35 \le 1+35$

$34 \le 56t \le 36$

$\frac{34}{56} \le \frac{56t}{56} \le \frac{36}{56}$

$\frac{17}{28} \le t \le \frac{9}{14}$

The solution is $\left[\frac{17}{28}, \frac{9}{14}\right]$.

b. $\frac{17}{28}$ inches

c. $\frac{9}{14}$ inches

95. a. $|d-160| \le 28$

$-28 \le d-160 \le 28$

$-28+160 \le d-160+160 \le 28+160$

$132 \le d \le 188$

The solution is $[132,\ 188]$.

b. The submarine can move between 132 feet and 188 feet below sea level, inclusive.

96. a. $|d-4| \le \frac{1}{2}$

$$-\frac{1}{2} \le d-4 \le \frac{1}{2}$$
$$-\frac{1}{2}+4 \le d-4+4 \le \frac{1}{2}+4$$
$$\frac{7}{2} \le d \le \frac{9}{2}$$

The solution is $\left[\frac{7}{2}, \frac{9}{2}\right]$ or $[3.5,\ 4.5]$.

b. The spring will oscillate between 3.5 feet and 4.5 feet, inclusive.

97. If $a \neq 0$, and $k > 0$,

a. $|ax+b| = k$ has 2 solutions.

b. $|ax+b| < k$ has an infinite number of solutions.

c. $|ax+b| > k$ has an infinite number of solutions.

98. a. $x > y$

b. One example is $x = -1$ and $y = -2$. Note that $|-1| < |-2|$, but $-1 > -2$.

99. a. $|ax+b| = k, a \neq 0$

If $k < 0$, there are no solutions.

b. $|ax+b| = k, a \neq 0$

If $k = 0$, there is one solution.

c. $|ax+b| = k, a \neq 0$

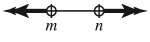
If $k > 0$, there are two solutions.

100. a. $|ax+b| < c$

The solution is $m < x < n$ or

b. $|ax+b| > c$

The solution is $x < m$ or $x > n$ or



101. $|ax+b| \le 0$

$0 \le ax+b \le 0$

which is the same as

$ax+b = 0$

$ax = -b$

$x = -\frac{b}{a}$

102. $|ax+b| > 0$ is not true when $|ax+b| = 0$

$ax+b = 0$

$ax = -b$

$x = -\frac{b}{a}$

103. a. Set $ax+b = -c$ or $ax+b = c$ and solve each equation for x.

b.

$ax+b = -c$	or	$ax+b = c$
$ax = -c-b$		$ax = c-b$
$x = \frac{-c-b}{a}$		$x = \frac{c-b}{a}$

The solution is $x = \frac{-c-b}{a}$ or $x = \frac{c-b}{a}$.

104. a. Write the inequality as $-c < ax + b < c$ and then solve for x.

b.

$$-c < ax+b < c$$
$$-c-b < ax+b-b < c-b$$
$$-c-b < ax < c-b$$
$$\frac{-c-b}{a} < \frac{ax}{a} < \frac{c-b}{a}$$
$$\frac{-c-b}{a} < x < \frac{c-b}{a}$$

The solution is $\frac{-c-b}{a} < x < \frac{c-b}{a}$.

105. a. Write $ax+b = -c$ or $ax+b = c$ and solve each inequality for x.

b.

$ax+b < -c$	or	$ax+b > c$
$ax < -c-b$		$ax > c-b$
$x < \frac{-c-b}{a}$		$x > \frac{c-b}{a}$

The solution is $x < \frac{-c-b}{a}$ or $x > \frac{c-b}{a}$.

106. **a.** Divide both sides by –4 and change the direction of the inequality.

b. $-4|3x-5| \le -12$

$$\frac{-4|3x-5|}{-4} \ge \frac{-12}{-4}$$

$$|3x-5| \ge 3$$

$3x-5 \le -3$ or $3x-5 \ge 3$

$3x \le 2$ $\qquad$ $3x \ge 8$

$x \le \frac{2}{3}$ $\qquad$ $x \ge \frac{8}{3}$

The solution set is $\left\{x \middle| x \le \frac{2}{3} \text{ or } x \ge \frac{8}{3}\right\}$ or $\left(-\infty, \frac{2}{3}\right] \cup \left[\frac{8}{3}, \infty\right)$.

107. $|x-4| = |4-x|$

$x-4 = -(4-x)$ or $x-4 = 4-x$

$x-4 = -4+x$ $\qquad$ $2x-4 = 4$

$0 = 0$ $\qquad$ $2x = 8$

True $\qquad$ $x = 4$

Since the first statement is always true all real values work. The solution set is $\mathbb{R}$.

108. $|x-4| = -|x-4|$

This occurs only if $|x-4| = 0$.

$x-4 = 0$

$x = 4$

The solution set is $\{4\}$.

109. $|x| = x$

By definition $|x| = \begin{cases} x, & x \ge 0 \\ -x, & x < 0 \end{cases}$

Thus, $|x| = x$ when $x \ge 0$.

The solution set is $\{x | x \ge 0\}$.

110. $|x+2| = x+2$

By definition, $|x+2| = \begin{cases} x+2, & x+2 \ge 0 \\ -(x+2), & x+2 < 0 \end{cases}$

$$= \begin{cases} x+2, & x \ge -2 \\ -(x+2), & x < -2 \end{cases}$$

Thus, $|x+2| = x+2$ when $x \ge -2$.

The solution set is $\{x | x \ge -2\}$.

111. $|x+1| = 2x-1$

$x+1 = -(2x-1)$ or $x+1=2x-1$

$x+1 = -2x+1$ $\qquad$ $1 = x-1$

$3x+1 = 1$ $\qquad$ $2 = x$

$3x = 0$

$x = 0$

Checking both possible solutions, only $x = 2$ checks. The solution set is $\{2\}$.

112. $|3x+1| = x-3$

$3x+1 = x-3$ or $3x+1 = -(x-3)$

$2x+1 = -3$ $\qquad$ $3x+1 = -x+3$

$2x = -4$ $\qquad$ $4x+1 = 3$

$x = -2$ $\qquad$ $4x = 2$

$x = \frac{2}{4} = \frac{1}{2}$

Neither possible solution checks.
Thus, there are no values for x that make the equation true. The solution set is $\varnothing$.

113. $|x-4| = -(x-4)$

By the definition, $|x-4| = \begin{cases} x-4, & x-4 \ge 0 \\ -(x-4), & x-4 \le 0 \end{cases}$

$$= \begin{cases} x-4, & x \ge 4 \\ -(x-4), & x \le 4 \end{cases}$$

Thus, $|x-4| = -(x-4)$ for $x \le 4$.

The solution set is $\{x | x \le 4\}$.

114. $|x|+x=8$

For $x \geq 0$: $|x|+x=8$

$x+x=8$

$2x=8$

$x=4$

For $x<0$: $|x|+x=8$

$-x+x=8$

$0=8$ False

The solution set is $\{4\}$.

115. $x+|-x|=8$

For $x \geq 0$, $x+|-x|=8$

$x+x=8$

$2x=8$

$x=4$

For $x<0$, $x+|-x|=8$

$x-x=8$

$0=8$ False

The solution set is $\{4\}$.

116. $|x|-x=8$

For $x \geq 0$, $|x|-x=8$

$x-x=8$

$0=8$ False

For $x<0$, $|x|-x=8$

$-x-x=8$

$-2x=8$

$x=-4$

The solution set is $\{-4\}$.

117. $x-|x|=8$

For $x \geq 0$, $x-|x|=8$

$x-x=8$

$0=8$ False

For $x<0$, $x-|x|=8$

$x-(-x)=8$

$x+x=8$

$2x=8$

$x=4$ Contradicts $x<0$

There are no values of x, so the solution set is $\varnothing$.

118. **a.** Answers will vary.

b. All real numbers x and y.

c. Only when $x = y$.

119. $\frac{1}{3}+\frac{1}{4}\div\frac{2}{5}\left(\frac{1}{3}\right)^2=\frac{1}{3}+\frac{1}{4}\div\frac{2}{5}\cdot\frac{1}{9}$

$=\frac{1}{3}+\frac{1}{4}\cdot\frac{5}{2}\cdot\frac{1}{9}$

$=\frac{1}{3}+\frac{5}{72}$

$=\frac{1}{3}\cdot\frac{24}{24}+\frac{5}{72}$

$=\frac{24}{72}+\frac{5}{72}$

$=\frac{29}{72}$

120. Substitute 1 for x and 3 for y.

$4(x+3y)-5xy=4(1+3\cdot3)-5(1)(3)$

$=4(1+9)-5(1)(3)$

$=4(10)-5(1)(3)$

$=40-15$

$=25$

121. Let x be the time needed to swim across the lake. Then $1.5-x$ is the time needed to make the return trip.

	Rate	**Time**	**Distance**
First Trip	2	x	$2x$
Return Trip	1.6	$1.5-x$	$1.6(1.5-x)$

The distances are the same.

$2x=1.6(1.5-x)$

$2x=2.4-1.6x$

$3.6x=2.4$

$x=\frac{2.4}{3.6}=\frac{2}{3}$

The total distance across the lake is

$2x=2\left(\frac{2}{3}\right)=\frac{4}{3}$ or 1.33 miles.

122. $-7(x-3)+5(x+1)\geq 20$

$-7x+21+5x+5\geq 20$

$-2x+26\geq 20$

$-2x+26-26\geq 20-26$

$-2x\geq -6$

$\frac{-2x}{-2}\leq\frac{-6}{-2}$

$x\leq 3$

The solution set is $\{x|x\leq 3\}$.

Chapter 2 Review Exercises

1. $9a^2b^6$ has degree eight since the sum of the exponents is $2+6=8$.

2. $2y$ has degree one since $2y$ can be written as $2y^1$ and the only exponent is 1.

3. $-21xyz^5$ has degree seven since $-21xyz^5$ can be written as $-21x^1y^1z^5$ and the sum of the exponents is $1+1+5=7$.

4. $7(z+3)-2(z+4)$

$=7z+21-2z-8$

$=5z+13$

5. $x^2+2xy+6x^2-13=x^2+6x^2+2xy-13$

$=7x^2+2xy-13$

6. b^2+b-9 cannot be simplified since there are no like terms.

7. $2\left[-(x-y)+3x\right]-5y+10$

$=2\left[-x+y+3x\right]-5y+10$

$=2\left[2x+y\right]-5y+10$

$=4x+2y-5y+10$

$=4x-3y+10$

8. $4(a+3)-6=2(a+1)$

$4a+12-6=2a+2$

$4a+6=2a+2$

$4a=2a-4$

$2a=-4$

$a=-2$

9. $3(x+1)-3=4(x-5)$

$3x+3-3=4x-20$

$3x+0=4x-20$

$3x=4x-20$

$3x-4x=4x-4x-20$

$-x=-20$

$\frac{-1x}{-1}=\frac{-20}{-1}$

$x=20$

10. $3+\frac{x}{2}=\frac{5}{6}$

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

$18+3x=5$

$18-18+3x=5-18$

$3x=-13$

$\frac{3x}{3}=\frac{-13}{3}$

$x=-\frac{13}{3}$

11. $\frac{1}{2}(3t+4)=\frac{1}{3}(4t+1)$

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

$3(3t+4)=2(4t+1)$

$9t+12-8t=8t+2-8t$

$t+12=2$

$t+12-12=2-12$

$t=-10$

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

$x-8=3x+1$

$x-8+8=3x+1+8$

$x=3x+9$

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

$-2x=9$

$\frac{-2x}{-2}=\frac{9}{-2}$

$x=-\frac{9}{2}$

13. $3x-7=9x+8-6x$

$3x-7=3x+8$

$3x-3x-7=3x-3x+8$

$-7=8$

This is a false statement which means there is no solution, or $\varnothing$.

14. $2(x-6)=5-\{2x-[4(x-2)-9]\}$

$2x-12=5-\{2x-[4x-8-9]\}$

$2x-12=5-\{2x-[4x-17]\}$

$2x-12=5-\{2x-4x+17\}$

$2x-12=5-\{-2x+17\}$

$2x-12=5+2x-17$

$2x-12=2x-12$

$2x-12-2x=2x-12-2x$

$12=12$

Since this is a true statement, the solution set is all real numbers, or $\mathbb{R}$.

15. $r=\sqrt{x^2+y^2}$

$=\sqrt{3^2+4^2}$

$=\sqrt{9+16}$

$=\sqrt{25}$

$=5$

16. $x=\dfrac{-b+\sqrt{b^2-4ac}}{2a}$

$=\dfrac{-10+\sqrt{(10)^2-4(8)(-3)}}{2(8)}$

$=\dfrac{-10+\sqrt{100+96}}{16}$

$=\dfrac{-10+\sqrt{196}}{16}$

$=\dfrac{-10+14}{16}$

$=\dfrac{4}{16}$

$=\dfrac{1}{4}$

17. $h=\dfrac{1}{2}at^2+v_0t+h_0$

$=\dfrac{1}{2}(-32)(1)^2+0(2)+85$

$=\dfrac{1}{2}(-32)(1)+0+85$

$=-16(1)+0+85$

$=-16+0+85$

$=69$

18. $z=\dfrac{\overline{x}-\mu}{\frac{\sigma}{\sqrt{n}}}=\dfrac{50-54}{\frac{5}{\sqrt{25}}}=\dfrac{50-54}{\frac{5}{5}}=\dfrac{50-54}{1}=-4$

19. $D=r\cdot t$

$\dfrac{D}{r}=\dfrac{r\cdot t}{t}$

$\dfrac{D}{r}=t$ or $t=\dfrac{D}{r}$

20. $P=2l+2w$

$P-2l=2l-2l+2w$

$P=2l=2w$

$\dfrac{P-2l}{2}=\dfrac{2w}{2}$

$\dfrac{P-2l}{2}=w$ or $w=\dfrac{P-2l}{2}$

21. $A=\pi r^2h$

$\dfrac{A}{\pi r^2}=\dfrac{\pi r^2}{\pi r^2}$

$\dfrac{A}{\pi r^2}=h$ or $h=\dfrac{A}{\pi r^2}$

22. $A=\dfrac{1}{2}bh$

$2(A)=2\left(\dfrac{1}{2}bh\right)$

$2A=bh$

$\dfrac{2A}{b}=\dfrac{bh}{b}$

$\dfrac{2A}{b}=h$ or $h=\dfrac{2A}{b}$

23.
$$y = mx + b$$
$$y - b = mx + b - b$$
$$y - b = mx$$
$$\frac{y-b}{x} = \frac{mx}{x}$$
$$\frac{y-b}{x} = m \text{ or } m = \frac{y-b}{x}$$

24.
$$2x - 3y = 5$$
$$2x - 2x - 3y = -2x + 5$$
$$-3y = -2x + 5$$
$$\frac{-3y}{-3} = \frac{-2x+5}{-3}$$
$$y = \frac{-2x+5}{-3} \text{ or } y = \frac{2x-5}{3}$$

25.
$$R_T = R_1 + R_2 + R_3$$
$$R_T - R_1 - R_3 = R_1 + R_2 + R_3 - R_1 - R_3$$
$$R_T - R_1 - R_3 = R_2$$
$$\text{or } R_2 = R_T - R_1 - R_3$$

26.
$$S = \frac{3a+b}{2}$$
$$2(S) = 2\left(\frac{3a+b}{2}\right)$$
$$2S = 3a + b$$
$$2S - b = 3a + b - b$$
$$2S - b = 3a$$
$$\frac{2S-b}{3} = \frac{3a}{3}$$
$$\frac{2S-b}{3} = a \text{ or } a = \frac{2S-b}{3}$$

27.
$$K = 2(d + l)$$
$$K = 2d + 2l$$
$$K - 2d = 2d - 2d + 2l$$
$$K - 2d = 2l$$
$$\frac{K-2d}{2} = \frac{2l}{2}$$
$$\frac{D-2d}{2} = l \text{ or } l = \frac{K-2d}{2}$$

28. Let x be the original price.
$$x - 0.1x = 630$$
$$0.9x = 630$$
$$\frac{0.9x}{0.9} = \frac{630}{0.9}$$
$$x = 700$$
The original price was \$700.

29. Let x be the number of years for the population to reach 5800.
$$4750 + 350x = 7200$$
$$350x = 2450$$
$$x = \frac{2450}{350}$$
$$x = 7$$
It will take 7 years for the population to grow from 4750 people to 7200 people.

30. Let x be the amount of sales.
$$300 + 0.06x = 708$$
$$0.06x = 408$$
$$\frac{0.06x}{0.06} = \frac{408}{0.06}$$
$$x = 6800$$
Celeste's sales must be \$6800 to earn \$708 in a week.

31. Let x be the number of miles she drives.
$$3(24.99) = 3(19.99) + 0.10x$$
$$74.97 = 59.97 + 0.10x$$
$$15.00 = 0.10x$$
$$\frac{15.00}{0.10} = \frac{0.10x}{0.10}$$
$$150 = x$$
The cost would be the same if she drives 150 miles.

32. Let x be the regular price.
$$x - 0.40x - 20 = 136$$
$$0.60x - 20 = 136$$
$$0.60x = 156$$
$$\frac{0.60x}{0.60} = \frac{156}{0.60}$$
$$x = 260$$
The regular price was \$260.

33. Let x = the amount invested at 3.5%. Then $5000 - x$ is the amount invested at 4.0%.

Account	Principal	Rate	Time	Interest
3.5%	x	0.035	1	$0.035x$
4.0%	$5000 - x$	0.04	1	$0.04(5000 - x)$

$$0.035x + 0.04(5000 - x) = 187.15$$
$$0.035x + 200 - 0.04x = 187.15$$
$$-0.005x + 200 = 187.15$$
$$-0.005x = -12.85$$
$$x = \frac{-12.85}{-0.005}$$
$$x = 2570$$

Thus, Mr. Olden invested \$2570 at 3.5% and \$5000 – \$2570 = \$2430 at 4.0%.

34. Let x = the amount of 20% solution.

Solution	Strength of Solution	No. of Gallons	Amount
20%	0.20	x	$0.20x$
60%	0.06	$250 - x$	$0.60(250 - x)$
Mixture	0.30	250	$0.30(250)$

$$0.20x + 0.60(250 - x) = 0.30(250)$$
$$0.20x + 150 - 0.60x = 75$$
$$-0.40x + 150 = 75$$
$$-0.40x = -75$$
$$x = \frac{-75}{-0.40}$$
$$x = 187.5$$

Dale must combine 187.5 gallons of the 20% solution with $250 - 187.5 = 62.5$ gallons of the 60% solution to obtain the 30% solution.

35. Let t be the amount of time needed.

Type	Rate	Time	Distance
One Train	60	t	$60t$
Other Train	80	t	$80t$

The total distance is 910 miles.

$$60t + 80t = 910$$
$$140t = 910$$
$$t = \frac{910}{140} = \frac{13}{2} = 6\frac{1}{2}$$

In $6\frac{1}{2}$ hours, the trains are 910 miles apart.

36. a. Let x be the speed of Shuttle 1. Then $x + 300$ is the speed of Shuttle 2.

Type	Rate	Time	Distance
Shuttle 1	x	5.5	$5.5x$
Shuttle 2	$x+300$	5.0	$5.0(x+300)$

The distances are the same.

$$5.5x = 5.0(x+300)$$
$$5.5x = 5.0x + 1500$$
$$0.5x = 1500$$
$$x = \frac{1500}{0.5} = 3000$$

The speed of Shuttle 1 is 3000 mph.

b. The distance is $5.5(3000) = 16{,}500$ miles.

37. Let x be the amount of \$6.00 coffee needed. Then $40 - x$ is the amount of \$6.80 coffee needed.

Item	Cost per Pound	No. of Pounds	Total Value
\$6.00 Coffee	\$6.00	x	$6.00x$
\$6.80 Coffee	\$6.80	$40-x$	$6.80(40-x)$
Mixture	\$6.50	40	$6.50(40)$

$$6.00x + 6.80(40-x) = 6.50(40)$$
$$6.00x + 272 - 6.80x = 260$$
$$-0.80x + 272 = 260$$
$$-0.80x = -12$$
$$x = \frac{-12}{-0.80} = 15$$

Mr. Tomlins needs to combine 15 pounds of \$6.00 coffee with 40 – 15 = 25 pounds of \$6.80 coffee to produce the mixture.

38. Let x = the original price of the telephone.

$$x - 0.20x = 28.80$$
$$0.80x = 28.80$$
$$x = \frac{28.80}{0.80} = 36$$

The original price of the telephone was \$36.

39. Let x be the time spent jogging. Then $4 - x$ is the time spent walking.

Trip	Rate	Time	Distance
Jogging	7.2	x	$7.2x$
Walking	2.4	$4-x$	$2.4(4-x)$

a. The distances are the same.

$$7.2x = 2.4(4-x)$$
$$7.2x = 9.6 - 2.4x$$
$$9.6x = 9.6$$
$$x = \frac{9.6}{9.6} = 1$$

Nicolle jogged for 1 hour.

b. The distance one-way is 7.2(1) = 7.2 miles. The total distance is twice this value or 2(7.2) = 14.4 miles.

40. Let x be the measure of the smallest angle. The measure of the other two angles are $x+25$ and $2x-5$.

$$x+(x+25)+(2x-5)=180$$
$$4x+20=180$$
$$4x=160$$
$$x=\frac{160}{4}=40$$

The measures of the angles are 40°, $40+25=65°$, and $2(40)-5=80-5=75°$.

41. Let x be the flow rate of the smaller hose.

Type	Rate	Time	Amount (No. of Gallons)
Smaller	r	3	$3r$
Larger	$1.5r$	5	$5(1.5r)$

The total number of gallons of water is 3150 gallons.

$$3r+5(1.5r)=3150$$
$$3r+7.5r=3150$$
$$10.5r=3150$$
$$r=\frac{3150}{10.5}=300$$

The flow rate for the smaller hose is 300 gallons per hour and the flow rate for the larger hose is $1.5(300)=450$ gallons per hour.

42. Let x = measure of one of the angles. Then the other angle measure is $2x-30$. The sum of the measures of complementary angles is 90º.

$$x+(2x-30)=90$$
$$3x-30=90$$
$$3x=120$$
$$x=\frac{120}{3}$$
$$x=40$$

The measures of the angles are 40º and $2(40°)-30°=50°$.

43. Let x be the amount of 20% solution.

Solution	Strength of Solution	No. of Ounces	Amount
20%	0.20	x	$0.20x$
6%	0.06	10	$0.06(10)$
Mixture	0.12	$x+10$	$0.12(x+10)$

$$0.20x+0.06(10)=0.12(x+10)$$
$$0.20x+0.6=0.12x+1.2$$
$$0.08x+0.6=1.2$$
$$0.08x=0.6$$
$$x=\frac{0.6}{0.08}=7.5$$

The clothier must combine 7.5 ounces of the 20% solution with 10 ounces of the 6% solution to obtain the 12% solution.

44. Let x be the amount invested at 10%. Then $12{,}000-x$ is the amount invested at 6%.

Acct	Principal	Rate	Time	Interest
10%	x	0.10	1	$0.10x$
6%	$12{,}000-x$	0.06	1	$0.06(12{,}000-x)$

$$0.10x=0.06(12{,}000-x)$$
$$0.10x=720-0.06x$$
$$0.16x=720$$
$$x=\frac{720}{0.16}=4500$$

Thus, David invested \$4500 at 10% and $12{,}000-4500=\$7500$ at 6%.

45. Let x be the number of visits. The cost of the first plan = cost of second plan gives the equation

$$40+1(x)=25+4(x)$$
$$40+x=25+4x$$
$$15+x=4x$$
$$15=3x$$
$$\frac{15}{3}=x \text{ or } x=5$$

Jeff needs to make more than 5 visits for the first plan to be advantageous.

46. Let x be the speed of the faster train. Then $x - 10$ is the speed of the slower train.

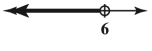
Train	Rate	Time	Distance
Faster	x	3	$3x$
Slower	$x-10$	3	$3(x-10)$

$$3x + 3(x-10) = 270$$
$$3x + 3x - 30 = 270$$
$$6x - 30 = 270$$
$$6x = 300$$
$$x = \frac{300}{6} = 50$$

The speed of the faster train is 50 mph and the speed of the slower train is 40 mph.

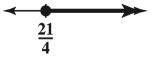
47. $3z + 9 \le 15$
$$3z \le 6$$
$$z \le 2$$

48. $8 - 2w > -4$
$$-2w > -12$$
$$\frac{-2w}{-2} < \frac{-12}{-2}$$
$$w < 6$$

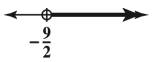


49. $2x + 1 > 6$
$$2x > 5$$
$$x > \frac{5}{2}$$

50. $26 \le 4x + 5$
$$21 \le 4x$$
$$\frac{21}{4} \le x$$



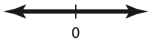
51. $\frac{4x+3}{3} > -5$
$$3\left(\frac{4x+3}{3}\right) > 3(-5)$$
$$4x + 3 > -15$$
$$4x > -18$$
$$x > \frac{-18}{4}$$
$$x > -\frac{9}{2}$$



52. $2(x-1) > 3x + 8$
$$2x - 2 > 3x + 8$$
$$2x - 10 > 3x$$
$$-10 > x$$

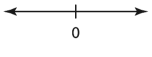
53. $-4(x-2) \ge 6x + 8 - 10x$
$$-4x + 8 \ge -4x + 8$$
$$8 \ge 8 \quad \text{a true statement}$$

The solution is all real numbers.



54. $\frac{x}{2} + \frac{3}{4} > x - \frac{x}{2} + 1$
$$4\left(\frac{x}{2} + \frac{3}{4}\right) > 4\left(x - \frac{x}{2} + 1\right)$$
$$2x + 3 > 4x - 2x + 4$$
$$2x + 3 > 2x + 4$$
$$3 > 4$$

This is a contradiction, so the solution is { }.



55. Let x be the maximum number of 40-pound boxes. Since the maximum load is 560 pounds, the total weight of Bob, Kathy, and the boxes must be less than or equal to 560 pounds.
$$300 + 40x \le 560$$
$$40x \le 260$$
$$x \le \frac{260}{40}$$
$$x \le 6.5$$

The maximum number of boxes that Bob and Kathy can carry in the canoe is 6.

56. Let x be the number of additional hours (beyond the first hour) of the bike rental.

$$14+7x \le 63$$
$$7x \le 4.15$$
$$x \le \frac{49}{7}$$
$$x \le 7$$

The Wetters can rent the bike for 7 hours plus the first hour for a total of 8 hours.

57. Let x be the number of weeks (after the first week) needed to lose 27 pounds.

$$5+1.5x \ge 27$$
$$1.5x \ge 22$$
$$x \ge \frac{22}{1.5}$$
$$x \ge 14\frac{2}{3} \approx 14.67$$

The number of weeks is about 14.67 plus the initial week for a total of 15.67 weeks.

58. Let x be the grade from the 5th exam. The inequality is

$$80 \le \frac{94+73+72+80+x}{5} < 90$$
$$80 \le \frac{319+x}{5} < 90$$
$$5(80) \le 5\left(\frac{319+x}{5}\right) < 5(90)$$
$$400 \le 319+x < 450$$
$$400-319 \le 319+x-319 < 450-319$$
$$81 \le x < 131$$

(We must use 100 here since it is not possible to score 131.)
Thus, Patrice needs to score 81 or higher on the 5th exam to receive a B.

$$\{x \mid 81 \le x \le 100\}$$

59. $-2 < z-5 < 3$
$-2+5 < z-5+5 < 3+5$
$3 < z < 8$
$(3,\ 8)$

60. $8 < p+11 \le 16$
$8-11 < p+11-11 \le 16-11$
$-3 < p \le 5$
$(-3,\ 5]$

61. $3 < 2x-4 < 12$
$3+4 < 2x-4+4 < 12+4$
$7 < 2x < 16$
$\frac{7}{2} < \frac{2x}{2} < \frac{16}{2}$
$\frac{7}{2} < x < 8$
$\left(\frac{7}{2}, 8\right)$

62. $-12 < 6-3x < -2$
$-12-6 < 6-3x-6 < -2-6$
$-18 < -3x < -8$
$\frac{-18}{-3} > \frac{-3x}{-3} > \frac{-8}{-3}$
$6 > x > \frac{8}{3}$
$\frac{8}{3} < x < 6$
$\left(\frac{8}{3}, 6\right)$

63. $-1 < \frac{5}{9}x+\frac{2}{3} \le \frac{11}{9}$
$9(-1) < 9\left(\frac{5}{9}x+\frac{2}{3}\right) \le 9\left(\frac{11}{9}\right)$
$-9 < 5x+6 \le 11$
$-9-6 < 5x+6-6 \le 11-6$
$-15 < 5x \le 5$
$\frac{-15}{5} < \frac{5x}{5} \le \frac{5}{5}$
$-3 < x \le 1$
$(-3,\ 1]$

64. $-8 < \dfrac{4-2x}{3} < 0$

$3(-8) < 3\left(\dfrac{4-2x}{3}\right) < 3(0)$

$-24 < 4-2x < 0$

$-24-4 < 4-4-2x < 0-4$

$-28 < -2x < -4$

$\dfrac{-28}{-2} > \dfrac{-2x}{-2} > \dfrac{-4}{-2}$

$14 > x > 2$

$2 < x < 14$

$(2, 14)$

65. $2x+1 \le 7$ and $7x-3 > 11$

$2x \le 6$ and $7x > 14$

$x \le 3$ and $x > 2$

$x \le 3$

$x > 2$

$x > 2$ and $x \le 3$ which is $2 < x \le 3$.

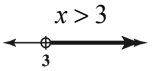
The solution set is $\{x \mid 2 < x \le 3\}$.

66. $2x-1 > 5$ or $3x-2 \le 10$

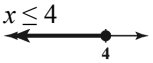
$2x > 6$ or $3x \le 12$

$x > 3$ or $x \le 4$

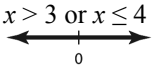
$x > 3$



$x \le 4$



$x > 3$ or $x \le 4$



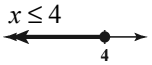
which is the entire real number line or $\mathbb{R}$.

67. $4x-5 < 11$ and $-3x-4 \ge 8$

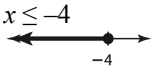
$4x < 16$ and $-3x \ge 12$

$x < 4$ and $x \le -4$

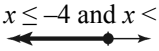
$x \le 4$



$x \le -4$



$x \le -4$ and $x < 4$ which is $x \le -4$



$\{x \mid x \le -4\}$

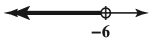
68. $\dfrac{7-2g}{3} \le -5$ or $\dfrac{3-g}{9} > 1$

$7-2g \le -15$ or $3-g > 9$

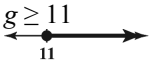
$-2g \le -22$ or $-g > 6$

$g \ge 11$ or $g < -6$

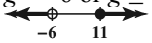
$g < -6$



$g \ge 11$



$g < -6$ or $g \ge 11$



$\{g \mid g < -6 \text{ or } g \ge 11\}$

69. $|h| = 4$

$h = 4$ or $h = -4$

The solution set is $\{-4, 4\}$.

70. $|x| < 8$

$-8 < x < 8$

The solution set is $\{x \mid -8 < x < 8\}$.

71. $|x| \ge 9$

$x \le -9$ or $x \ge 9$

The solution set is $\{x \mid x \le -9 \text{ or } x \ge 9\}$.

72. $|l+5| = 13$

$l+5 = -13$ or $l+5 = 13$

$l = -18$ $\quad$ $l = 8$

The solution set is $\{-18, 8\}$.

73. $|x-2| \ge 5$

$x-2 \le -5$ or $x-2 \ge 5$

$x \le -3$ $\quad$ $x \ge 7$

The solution set is $\{x \mid x \le -3 \text{ or } x \ge 7\}$.

74. $|4-2x|=5$

$4-2x=5$ or $4-2x=-5$

$-2x=1$ $-2x=-9$

$x=\frac{1}{-2}$ $x=\frac{-9}{-2}$

$x=-\frac{1}{2}$ $x=\frac{9}{2}$

The solution set is $\left\{-\frac{1}{2},\frac{9}{2}\right\}$.

75. $|-2q+9|<7$

$-7<-2q+9<7$

$-7-9<-2q+9-9<7-9$

$-16<-2q<-2$

$\frac{-16}{-2}>\frac{-2q}{-2}>\frac{-2}{-2}$

$8>q>1$

$1<q<8$

The solution set is $\{q\,|\,1<q<8\}$.

76. $\left|\frac{2x-3}{5}\right|=1$

$\frac{2x-3}{5}=1$ or $\frac{2x-3}{5}=-1$

$2x-3=5$ $2x-3=-5$

$2x=8$ $2x=-2$

$x=4$ $x=-1$

The solution set is $\{-1,\ 4\}$.

77. $\left|\frac{x-4}{3}\right|<6$

$-6<\frac{x-4}{3}<6$

$3(-6)<3\left(\frac{x-4}{3}\right)<3(6)$

$-18<x-4<18$

$-14<x<22$

The solution set is $\{x\,|\,-14<x<22\}$.

78. $|4d-1|=|6d+9|$

$4d-1=-(6d+9)$ or $4d-1=6d+9$

$4d-1=-6d-9$ $4d-10=6d$

$10d-1=-9$ $-10=2d$

$10d=-8$ $-5=d$

$d=-\frac{4}{5}$

The solution set is $\left\{-5,-\frac{4}{5}\right\}$.

79. $|2x-3|+4\geq -17$

$|2x-3|\geq -21$

Since the right side is negative and the left side is non-negative, the solution is the entire real number line since the absolute value of a number is always greater than a negative number. The solution set is all real numbers, or $\mathbb{R}$.

80. $|2x-3|\geq 5$

$2x-3\geq 5$ or $2x-3\leq -5$

$2x\geq 8$ or $2x\leq -2$

$x\geq 4$ or $x\leq -1$

The solution set is $(-\infty,-1]\cup[4,\infty)$.

81. $3<2x-5\leq 11$

$3+5<2x-5+5\leq 11+5$

$8<2x\leq 16$

$\frac{8}{2}<\frac{2x}{2}\leq\frac{16}{2}$

$4<x\leq 8$

The solution is $(4,\ 8]$.

82. $-6 \le \dfrac{3-2x}{4} < 5$

$4(-6) \le 4\left(\dfrac{3-2x}{4}\right) < 4(5)$

$-24 \le 3-2x < 20$

$-27 \le -2x < 17$

$\dfrac{-27}{-2} \ge \dfrac{-2x}{-2} > \dfrac{17}{-2}$

$\dfrac{27}{2} \ge x > -\dfrac{17}{2}$

$-\dfrac{17}{2} < x \le \dfrac{27}{2}$

The solution is $\left(-\dfrac{17}{2}, \dfrac{27}{2}\right]$.

83. $2p-5<7$ or $9-3p \le 15$

$2p<12$ or $-3p \le 6$

$p<6$ or $p \ge -2$

$-2 \le p < 6$

The solution is $[-2, 6)$.

84. $x-3 \le 4$ or $2x-5>7$

$x-3+3 \le 4+3$ $2x-5+5>7+5$

$x \le 7$ $2x>12$

$x>6$

The solution is $(-\infty, \infty)$.

85. $-10 < 3(x-4) \le 18$

$-10 < 3x-12 \le 18$

$-10+12 < 3x-12+12 \le 18+121$

$2 < 3x < 30$

$\dfrac{2}{3} < \dfrac{3x}{3} < \dfrac{30}{3}$

$\dfrac{2}{3} < x \le 10$

The solution is $\left(\dfrac{2}{3}, 10\right]$.

Chapter 2 Practice Test

1. $-3a^2bc^4$ is degree seven since $-3a^2bc^4$ can be written as $-3a^2b^1c^4$ and the sum of the exponents is $2+1+4=7$.

2. $2p-3q+2pq-6p(q-3)-4p$

$2p-3q+2pq-6pq+18p-4p$

$(2p+18p-4p)-3q+(2pq-6pq)$

$16p-3q-4pq$

3. $7q-\{2[3-4(q+7)]+5q\}-8$

$=7q-\{2[3-4q-28]+5q\}-8$

$=7q-\{2(-25-4q)+5q\}-8$

$=7q-(-50-8q+5q)-8$

$=7q-(-3q-50)-8$

$=7q+3q+50-8$

$=10q+42$

4. $7(d+2)=3(2d-4)$

$7d+14=6d-12$

$7d+14-6d=6d-12-6d$

$d+14=-12$

$d+14-14=-12-14$

$d=-26$

5. $\dfrac{r}{12}+\dfrac{1}{3}=\dfrac{4}{9}$

$36\left(\dfrac{r}{12}+\dfrac{1}{3}\right)=36\left(\dfrac{4}{9}\right)$

$3r+12=16$

$3r+12-12=16-12$

$3r=4$

$\dfrac{3r}{3}=\dfrac{4}{3}$

$r=\dfrac{4}{3}$

6. $-2(x+3)=4\{3[x-(3x+7)]+2\}$

$-2x-6=4\{3[x-3x-7]+2\}$

$-2x-6=4\{3[-2x-7]+2\}$

$-2x-6=4\{-6x-21+2\}$

$-2x-6=4\{-6x-19\}$

$-2x-6=-24x-76$

$-2x-6+24x=-24x-76+24x$

$22x-6=-76$

$22x-6+6=-76+6$

$22x=-70$

$\frac{22x}{22}=\frac{-70}{22}$

$x=-\frac{35}{11}$

7. $7x-6(2x-4)=3-(5x-6)$

$7x-12x+24=3-5x+6$

$-5x+24=-5x+9$

$-5x+24+5x=-5x+9+5x$

$24=9$

This is a false statement which means there is no solution. $\varnothing$

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

$-2x+3=1-2x+2$

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

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

$3=3$

This is always true which means the solution is any real number or $\mathbb{R}$.

9. $S_n=\frac{a_1(1-r^n)}{1-r}$

$S_3=\frac{3\left[1-\left(\frac{1}{3}\right)^3\right]}{1-\frac{1}{3}}=\frac{3\left[1-\frac{1}{27}\right]}{1-\frac{1}{3}}=\frac{3\left(\frac{26}{27}\right)}{\frac{2}{3}}$

$=\frac{\frac{26}{9}}{\frac{2}{3}}=\frac{26}{9}\cdot\frac{3}{2}=\frac{13}{3}$

10. $c=\frac{a-5b}{2}$

$2(c)=2\left(\frac{a-5b}{2}\right)$

$2c=a-5b$

$2c-a=a-a-5b$

$2c-a=-5b$

$\frac{2c-a}{-5}=\frac{-5b}{-5}$

$\frac{2c-a}{-5}=b$ or $b=\frac{a-2c}{5}$

11. $A=\frac{1}{2}h(b_1+b_2)$

$2(A)=2\left[\frac{1}{2}h(b_1+b_2)\right]$

$2A=h(b_1+b_2)$

$2A=hb_1+hb_2$

$2A-hb_1=hb_1-hb_1+hb_2$

$2A-hb_1=hb_2$

$\frac{2A-hb_1}{h}=\frac{hb_2}{h}$

$\frac{2A-hb_1}{h}=b_2$ or $b_2=\frac{2A-hb_1}{h}$

12. Let x be the cost of the clubs before tax, then $0.07x$ is the tax.

$x+0.07x=668.75$

$1.07x=668.75$

$x=\frac{668.75}{1.07}$

$x=625$

The cost of the clubs before tax is \$625.

13. Let x = the number of visits Jay can make.

$240+2x=400$

$2x=160$

$x=80$

Bill can visit the health club 80 times.

14. Let x = the number of hours in which the will be 147 miles apart.

Person	Rate	Time	Distance
Jeffrey	15	x	$15x$
Roberto	20	x	$20x$

The total distance is the sum of the distances they traveled.

$$15x + 20x = 147$$
$$35x = 147$$
$$x = \frac{147}{35}$$
$$x = 4.2$$

In 4.2 hours, the cyclists will be 147 miles apart.

15. Let x be the amount of 12% solution.

Solution	Strength of Solution	No. of Liters	Amount of Salt
12%	0.12	x	$0.12x$
25%	0.25	10	$0.25(10)$
20%	0.20	$x+10$	$0.20(x+10)$

$$0.12x + 0.25(10) = 0.20(x+10)$$
$$0.12x + 2.50 = 0.20x + 2.00$$
$$0.12x + 0.50 = 0.20x$$
$$0.50 = 0.08x$$
$$\frac{0.50}{0.08} = x$$
$$6.25 = x$$

Combine 6.25 liters of the 12% solution with 10 liters of the 25% solution to obtain the mixture.

16. Let x be the amount invested at 8%. Then $12{,}000 - x$ is the amount invested at 7%.

Account	Principal	Rate	Interest
8%	x	0.08	$0.08x$
7%	$12{,}000 - x$	0.07	$0.07(12{,}000 - x)$

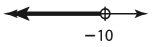
The total interest is \$910.

$$0.08x + 0.07(12{,}000 - x) = 910$$
$$0.08x + 840 - 0.07x = 910$$
$$0.01x + 840 = 910$$
$$0.01x = 70$$
$$x = \frac{70}{0.01}$$
$$x = 7000$$

Thus, \$7000 was invested at 8% and the remaining amount of $12{,}000 - 7000 = \$5000$ was invested at 7%.

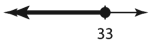
17. $3(2q+4) < 5(q-1) + 7$

$$6q + 12 < 5q - 5 + 7$$
$$6q + 12 < 5q + 2$$
$$q + 12 < 2$$
$$q < -10$$



18. $\frac{6-2x}{5} \geq -12$

$$5\left(\frac{6-2x}{5}\right) \geq 5(-12)$$
$$6 - 2x \geq -60$$
$$-2x \geq -66$$
$$\frac{-2x}{-2} \leq \frac{-66}{-2}$$
$$x \leq 33$$



19. $x-3\le 4$ and $2x+1>10$

$x-3+3\le 4+3$ $\quad$ $2x+1-1>10-1$

$x\le 7$ $\quad$ $2x>9$

$x>\frac{9}{2}$

The solution is $\left(\frac{9}{2}, 7\right]$.

20. $7\le \frac{2u-5}{3}<9$

$3(7)\le 3\left(\frac{2u-5}{3}\right)<3(9)$

$21\le 2u-5<27$

$21+5\le 2u-5+5<27+5$

$26\le 2u<32$

$13\le u<16$

The solution is $[13, 16)$.

21. $|2b+5|=9$

$2b+5=-9$ or $2b+5=9$

$2b=-14$ $\quad$ $2b=4$

$b=-7$ $\quad$ $b=2$

The solution set is $\{-7, 2\}$.

22. $|2x-3|=\left|\frac{1}{2}x-10\right|$

$2x-3=-\left(\frac{1}{2}x-10\right)$ or $2x-3=\frac{1}{2}x-10$

$2x-3=-\frac{1}{2}x+10$ $\quad$ $\frac{3}{2}x-3=-10$

$\frac{5}{2}x-3=10$ $\quad$ $\frac{3}{2}x=-7$

$\frac{5}{2}x=13$ $\quad$ $\frac{2}{3}\left(\frac{3}{2}x\right)=\frac{2}{3}(-7)$

$\frac{2}{5}\left(\frac{5}{2}x\right)=\frac{2}{5}(13)$ $\quad$ $x=-\frac{14}{3}$

$x=\frac{26}{5}$

The solution set is $\left\{-\frac{14}{3}, \frac{26}{5}\right\}$.

23. $|4z+12|=0$

$4z+12=0$

$4z=-12$

$z=-3$

The solution set is $\{-3\}$.

24. $|2x-3|+6>11$

$|2x-3|>5$

$2x-3<-5$ or $2x-3>5$

$2x<-2$ $\quad$ $2x>8$

$x<-1$ $\quad$ $x>4$

The solution set is $\{x \mid x<-1 \text{ or } x>4\}$.

25. $\left|\frac{2x-3}{8}\right|\le\frac{1}{4}$

$-\frac{1}{4}\le\frac{2x-3}{8}\le\frac{1}{4}$

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

$-2\le 2x-3\le 2$

$1\le 2x\le 5$

$\frac{1}{2}\le x\le\frac{5}{2}$

The solution set is $\left\{x \mid \frac{1}{2}\le x\le\frac{5}{2}\right\}$.

Chapter 2 Cumulative Review Test

1. a. $A\cup B=\{1, 2, 3, 5, 7, 9, 11, 13, 15\}$

b. $A\cap B=\{3, 5, 7, 11, 13\}$

2. a. commutative property of addition

b. associative property of multiplication

c. distributive property

3. $-4^3+(-6)^2\div(2^3-2)^2$

$=-4^3+(-6)^2\div(8-2)^2$

$=-4^3+(-6)^2\div(6)^2$

$=-64+36\div 36$

$=-64+1$

$=-63$

4. Substitute –1 for a and –2 for b.

$$\begin{aligned}
&a^2b^3+ab^2-3b\\
&=(-1)^2(-2)^3+(-1)(-2)^2-3(-2)\\
&=(1)(-8)+(-1)(4)-3(-2)\\
&=-8+(-4)-(-6)\\
&=-8+(-4)+6\\
&=-12+6\\
&=-6
\end{aligned}$$

5.
$$\begin{aligned}
\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-\left[5-(12\div 4)\right]^2}&=\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-\left[5-3\right]^2}\\
&=\frac{8-\sqrt[3]{27}\cdot 3\div 9}{|-5|-2^2}\\
&=\frac{8-3\cdot 3\div 9}{5-4}\\
&=\frac{8-9\div 9}{5-4}\\
&=\frac{8-1}{5-4}\\
&=\frac{7}{1}\\
&=7
\end{aligned}$$

6.
$$\begin{aligned}
\left(5x^4y^3\right)^{-2}&=\left(\frac{1}{5x^4y^3}\right)^2\\
&=\frac{1^2}{5^2x^{4\cdot 2}y^{3\cdot 2}}\\
&=\frac{1}{25x^8y^6}
\end{aligned}$$

7.
$$\begin{aligned}
\left(\frac{4m^2n^{-4}}{m^{-3}n^2}\right)^2&=\left(\frac{4m^{2-(-3)}}{n^{2-(-4)}}\right)^2\\
&=\left(\frac{4m^5}{n^6}\right)^2\\
&=\frac{4^2m^{5\cdot 2}}{n^{6\cdot 2}}\\
&=\frac{16m^{10}}{n^{12}}
\end{aligned}$$

8.
$$\begin{aligned}
\frac{5.704\times 10^5}{1.045\times 10^3}&=\frac{5.704}{1.045}\times 10^{5-3}\\
&\approx 5.458\times 10^2\\
&\approx 545.8
\end{aligned}$$

The land area of Alaska is about 545.8 times larger than that of Rhode Island.

9.
$$\begin{aligned}
-3(y+7)&=2(-2y-8)\\
-3y-21&=-4y-16\\
y-21&=-16\\
y&=5
\end{aligned}$$

10.
$$\begin{aligned}
1.2(x-3)&=2.4x-4.98\\
1.2x-3.6&=2.4x-4.98\\
1.2x&=2.4x-1.38\\
-1.2x&=-1.38\\
x&=\frac{-1.38}{-1.2}\\
x&=1.15
\end{aligned}$$

11.
$$\begin{aligned}
\frac{2m}{3}-\frac{1}{6}&=\frac{4}{9}m\\
18\left(\frac{2m}{3}-\frac{1}{6}\right)&=18\left(\frac{4}{9}m\right)\\
12m-3&=8m\\
4m-3&=0\\
4m&=3\\
m&=\frac{3}{4}
\end{aligned}$$

12. A conditional equation is true only under specific conditions. An identity is true for an infinite number of values of the variable. A contradiction is never true. Answers may vary. One possible answer is:

$3x+4=13$ is a conditional linear equation.

$3(x+7)=2(x+10)+x+1$ is an identity.

$3x+4=3x+8$ is a contradiction.

13. $x = \dfrac{-b+\sqrt{b^2-4ac}}{2a}$

$= \dfrac{-(-8)+\sqrt{(-8)^2-4(3)(-3)}}{2(3)}$

$= \dfrac{-(-8)+\sqrt{64+36}}{6} = \dfrac{-(-8)+\sqrt{100}}{6}$

$= \dfrac{8+10}{6} = \dfrac{18}{6} = 3$

14. $y - y_1 = m(x - x_1)$

$\dfrac{y-y_1}{m} = \dfrac{m(x-x_1)}{m}$

$\dfrac{y-y_1}{m} = x - x_1$

$\dfrac{y-y_1}{m} + x_1 = x$

$x = \dfrac{y-y_1}{m} + x_1$ or $x = \dfrac{y-y_1+mx_1}{m}$

15. a. $-4 < \dfrac{5x-2}{3} < 2$

$3(-4) < 3\left(\dfrac{5x-2}{3}\right) < 3(2)$

$-12 < 5x - 2 < 6$

$-12+2 < 5x-2+2 < 6+2$

$-10 < 5x < 8$

$3(-4) < 3\left(\dfrac{5x-2}{3}\right) < 3(2)$

$-12 < 5x - 2 < 6$

$-12+2 < 5x-2+2 < 6+2$

$-10 < 5x < 8$

$\dfrac{-10}{5} < \dfrac{5x}{5} < \dfrac{8}{5}$

$-2 < x < \dfrac{8}{5}$

b. $\left\{x \middle| -2 < x < \dfrac{8}{5}\right\}$

c. $\left(-2, \dfrac{8}{5}\right)$

16. $|3h-1| = 8$

$3h - 1 = -8$ or $3h - 1 = 8$

$3h = -7$ $\quad$ $3h = 9$

$h = -\dfrac{7}{3}$ $\quad$ $h = 3$

Solution is $\left\{-\dfrac{7}{3}, 3\right\}$.

17. $|2x-4| - 6 \geq 18$

$|2x-4| \geq 24$

$2x - 4 \leq -24$ or $2x - 4 \geq 24$

$2x \leq -20$ $\quad$ $2x \geq 28$

$x \leq -10$ $\quad$ $x \geq 14$

The solution set is $\{x \mid x \leq -10 \text{ or } x \geq 14\}$.

18. Let x be the original price.

$x - 0.40x = 21$

$0.60x = 21$

$x = \dfrac{21}{0.60}$

$x = 35$

The original price was \$35.

19. Let x be the speed of the car traveling south. Then $x + 20$ is the speed of the car traveling north.

Car	Rate	Time	Distance
South	x	3	$3x$
North	$x+20$	3	$3(x+20)$

The total distance is 300 miles.

$3x + 3(x+20) = 300$

$3x + 3x + 60 = 300$

$6x + 60 = 300$

$6x = 240$

$x = \dfrac{240}{6}$

$x = 40$

The speed of the car traveling south is 40 mph and the speed of the car traveling north is $40 + 20 = 60$ mph.

20. Let x = the number of pounds of cashews. Then $40 - x$ is the number of pounds of peanuts.

	Cost	Pounds	Cost
cashews	6.50	x	$6.50x$
peanuts	2.50	$40 - x$	$2.50(40 - x)$
mixture	4.00	40	4.00(40)

$$6.50x + 2.50(40 - x) = 4.00(40)$$
$$6.50x + 100 - 2.50x = 160$$
$$4.00x + 100 = 160$$
$$4.00x = 60$$
$$x = 15$$

Molly should combine 15 pounds of cashews with 40 lbs – 15 lbs = 25 lbs of peanuts.