

Chapter 1: Introduction to Algebra**Section 1.1: Numbers, Variables, and Expressions**

1. natural
2. 0
3. 1
4. composite
5. factors
6. formula
7. variable
8. equal sign
9. sum
10. product
11. quotient
12. difference
13. The number 4 is a composite number because it has factors other than itself and 1; $4 = 2 \cdot 2$.
14. The number 36 is a composite number because it has factors other than itself and 1; $36 = 2 \cdot 2 \cdot 3 \cdot 3$.
15. The number 1 is neither a prime nor a composite number.
16. The number 0 is neither a prime nor a composite number.
17. The number 29 is a prime number because its only factors are itself and 1.
18. The number 13 is a prime number because its only factors are itself and 1.
19. The number 92 is a composite number because it has factors other than itself and 1; $92 = 2 \cdot 2 \cdot 23$.
20. The number 69 is a composite number because it has factors other than itself and 1; $69 = 3 \cdot 23$.
21. The number 225 is a composite number because it has factors other than itself and 1; $225 = 3 \cdot 3 \cdot 5 \cdot 5$.
22. The number 900 is a composite number because it has factors other than itself and 1;
 $900 = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \cdot 5$.
23. The number 149 is a prime number because its only factors are itself and 1.
24. The number 101 is a prime number because its only factors are itself and 1.
25. $6 = 2 \cdot 3$
26. $8 = 2 \cdot 2 \cdot 2$
27. $12 = 2 \cdot 2 \cdot 3$
28. $20 = 2 \cdot 2 \cdot 5$
29. $32 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
30. $100 = 2 \cdot 2 \cdot 5 \cdot 5$
31. $39 = 3 \cdot 13$
32. $51 = 3 \cdot 17$

33. $294 = 2 \cdot 3 \cdot 7 \cdot 7$
34. $175 = 5 \cdot 5 \cdot 7$
35. $300 = 2 \cdot 2 \cdot 3 \cdot 5 \cdot 5$
36. $455 = 5 \cdot 7 \cdot 13$
37. Yes, the population of a country could be described by the whole numbers because we cannot have a fraction of a person.
38. No, the cost of a gallon of gas could not be described by the whole numbers because the cost of a gallon of gas is not usually an even dollar amount.
39. No, a student's grade point average could not be described by the whole numbers because a grade point average usually contains a decimal point.
40. No, the Fahrenheit temperature in Antarctica could not be described by the whole numbers because a temperature reading contains a decimal point.
41. Yes, the number of apps stored on an iPad could be described by the whole numbers because the number of apps does not contain a fraction or a decimal point.
42. Yes, the number of students in a class could be described by the whole numbers because we cannot have a fraction of a person.
43. No, the winning time in a 100-meter sprint, could not be described by the whole numbers because the winning time would be expressed in the number of seconds plus a fraction of an seconds.
44. Yes, the number of bald eagles living in the United States could be described by the whole numbers because we cannot have a fraction of an eagle.
45. The value of the expression $3x$, when $x = 5$, is $3x = 3(5) = 15$.
46. The value of the expression $x + 10$, when $x = 8$, is $x + 10 = 8 + 10 = 18$.
47. The value of the expression $9 - x$, when $x = 4$, is $9 - x = 9 - 4 = 5$.
48. The value of the expression $13x$, when $x = 0$, is $13x = 13(0) = 0$.
49. The value of the expression $\frac{x}{8}$, when $x = 32$, is $\frac{x}{8} = \frac{32}{8} = 4$.
50. The value of the expression $\frac{5}{x-3}$, when $x = 8$, is $\frac{5}{x-3} = \frac{5}{8-3} = \frac{5}{5} = 1$.
51. The value of the expression $3(x+1)$, when $x = 5$, is $3(x+1) = 3(5+1) = (3)(6) = 18$.
52. The value of the expression $7(6-x)$, when $x = 3$, is $7(6-x) = 7(6-3) = (7)(3) = 21$.
53. The value of the expression $\frac{x}{2} + 1$, when $x = 6$, is $\frac{x}{2} + 1 = \frac{6}{2} + 1 = 3 + 1 = 4$.
54. The value of the expression $3 - \frac{6}{x}$, when $x = 2$, is $3 - \frac{6}{x} = 3 - \frac{6}{2} = 3 - 3 = 0$.
55. When $x = 8$ and $y = 14$, $x + y = 8 + 14 = 22$.

56. When $x = 2$ and $y = 3$, $5xy = (5)(2)(3) = 30$.
57. When $x = 8$ and $y = 4$, $6 \cdot \frac{x}{y} = 6 \cdot \frac{8}{4} = 6 \cdot 2 = 12$.
58. When $x = 8$ and $y = 11$, $y - x = 11 - 8 = 3$.
59. When $x = 5$ and $y = 3$, $y(x - 2) = 3(5 - 2) = (3)(3) = 9$.
60. When $x = 6$ and $y = 3$, $(x + y) - 5 = (6 + 3) - 5 = 9 - 5 = 4$.
61. When $x = 0$, $y = x + 5 = 0 + 5 = 5$.
62. When $x = 7$, $y = x \cdot x = 7 \cdot 7 = 49$.
63. When $x = 7$, $y = 4x = 4 \cdot 7 = 28$.
64. When $x = 3$, $y = 2(x - 3) = 2(3 - 3) = 2 \cdot 0 = 0$.
65. When $z = 12$, $F = z - 5 = 12 - 5 = 7$.
66. When $z = 40$, $F = \frac{z}{4} = \frac{40}{4} = 10$.
67. When $z = 6$, $F = \frac{30}{z} = \frac{30}{6} = 5$.
68. When $z = 5$, $F = z \cdot z \cdot z = 5 \cdot 5 \cdot 5 = 125$.
69. When $x = 2$ and $z = 0$, $y = 3xz = 3 \cdot 2 \cdot 0 = 0$.
70. When $x = 3$ and $z = 15$, $y = x + z = 3 + 15 = 18$.
71. When $x = 9$ and $z = 3$, $y = \frac{x}{z} = \frac{9}{3} = 3$.
72. When $x = 9$ and $z = 1$, $y = x - z = 9 - 1 = 8$.
73. If x is the number, $x + 5$ is five more than the number.
74. If x is the number, $x - 4$ is four less than the number.
75. If s is the cost of a soda, then three times this cost is $3s$.
76. If g is the cost of a gallon of gas, then twice this cost is $2g$.
77. If n is the number, $n + 5$ is the sum of the number and 5.
78. If x and y are the numbers, then $\frac{x}{y}$ is the quotient of the two numbers.
79. If p is the population of a town, $p - 200$ is two hundred less than the population.
80. If d is the number of dogs and c is the number of cats, $d + c$ is the total number of dogs and cats in the city.
81. If z is the number, $\frac{z}{6}$ is the number divided by 6.

82. If x is one number and y is another number, $\frac{x}{y}$ is a number divided by another number.
83. If s is the speed and t is the time, then st is the product of the speed and the time.
84. If r is the heart rate, then $220-r$ is the difference between 220 and the person's heart rate.
85. If x is one number and y is another number, $\frac{x+7}{y}$ is a number plus 7, all divided by another number.
86. If x is one number and y is another number, $\frac{1}{4}x + \frac{1}{10}y$ is one-fourth of a number plus one-tenth of another number.
87. $P = 100D$ because there are one hundred pennies in one dollar.
88. $N = 5Q$ because there are five nickels in one quarter.
89. See Figure 89. $F = 3y$ because there are three feet in one yard.
90. See Figure 90. $Q = 4g$ because there are four quarts in one gallon.

Yards (y)	1	2	3	4	5	6	7
Feet (F)	3	6	9	12	15	18	21

Figure 89

Gallons (g)	1	2	3	4	5	6
Quarts (Q)	4	8	12	16	20	24

Figure 90

91. $M = 3x$; M is miles and x is minutes. If $x = 36$, then $M = 3x = 3(36) = 108$ mi.
92. $M = 2x$; M is miles and x is minutes. If $x = 42$, then $M = 2x = 2(42) = 84$ mi.
93. $B = 6D$; for each drop there are 6 blims so there are 6 times as many blims as there are drops.
94. $B = 70x$. If $x = 60$, then $B = 70x = 70(60) = 4200$ beats.
95. Each album costs \$12. Thus, $C = 12x$ where C is cost and x is number of albums.
96. Water is flowing at four gallons per minute. $G = 4m$, where G is gallons and m is minutes.
97. Since the area of a rectangle equals its length times its width, $22 \text{ ft} \times 9 \text{ ft} = 198$ square feet.
98. Since the length and width of a square have equal measure, its area equals the length of a side times itself; $14 \text{ in.} \cdot 14 \text{ in.} = 196$ square inches.

Section 1.2 Fractions

1. The person ate $\frac{3}{4}$ of the pie. $\frac{1}{4}$ of the pie remains.
2. The numerator is 11, and the denominator is 21.
3. The variable b cannot equal 0.
4. lowest
5. True
6. False

7. $\frac{ac}{bc} = \frac{a}{b}$

8. multiply

9. The reciprocal of a with $a \neq 0$ is $\frac{1}{a}$.

10. $\frac{1}{5}$

11. $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$

12. $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c} = \frac{ad}{bc}$

13. $\frac{a}{b} + \frac{c}{b} = \frac{a+c}{b}$

14. $\frac{a}{b} - \frac{c}{b} = \frac{a-c}{b}$

15. The largest number that divides evenly into 4 and 12 is 4, so the GCF is 4.

16. The largest number that divides evenly into 3 and 27 is 3, so the GCF is 3.

17. The largest number that divides evenly into 50 and 75 is 25, so the GCF is 25.

18. The largest number that divides evenly into 45 and 105 is 15, so the GCF is 15.

19. The largest number that divides evenly into 100, 60 and 70 is 10, so the GCF is 10.

20. The largest number that divides evenly into 36, 48 and 72 is 12, so the GCF is 12.

21. $\frac{3 \cdot 4}{5 \cdot 4} = \frac{3}{5} \cdot \frac{4}{4} = \frac{3}{5} \cdot 1 = \frac{3}{5}$

22. $\frac{2 \cdot 7}{9 \cdot 7} = \frac{2}{9} \cdot \frac{7}{7} = \frac{2}{9} \cdot 1 = \frac{2}{9}$

23. $\frac{3 \cdot 8}{8 \cdot 5} = \frac{3 \cdot 8}{5 \cdot 8} = \frac{3}{5} \cdot \frac{8}{8} = \frac{3}{5} \cdot 1 = \frac{3}{5}$

24. $\frac{7 \cdot 16}{16 \cdot 3} = \frac{7 \cdot 16}{3 \cdot 16} = \frac{7}{3} \cdot \frac{16}{16} = \frac{7}{3} \cdot 1 = \frac{7}{3}$

25. $\frac{4}{8} = \frac{1 \cdot 4}{2 \cdot 4} = \frac{1}{2} \cdot \frac{4}{4} = \frac{1}{2} \cdot 1 = \frac{1}{2}$

26. $\frac{4}{12} = \frac{1 \cdot 4}{3 \cdot 4} = \frac{1}{3} \cdot \frac{4}{4} = \frac{1}{3} \cdot 1 = \frac{1}{3}$

27. $\frac{10}{25} = \frac{2 \cdot 5}{5 \cdot 5} = \frac{2}{5} \cdot \frac{5}{5} = \frac{2}{5} \cdot 1 = \frac{2}{5}$

28. $\frac{5}{20} = \frac{1 \cdot 5}{4 \cdot 5} = \frac{1}{4} \cdot \frac{5}{5} = \frac{1}{4} \cdot 1 = \frac{1}{4}$

$$29. \frac{12}{36} = \frac{1 \cdot 12}{3 \cdot 12} = \frac{1}{3} \cdot \frac{12}{12} = \frac{1}{3} \cdot 1 = \frac{1}{3}$$

$$30. \frac{16}{24} = \frac{2 \cdot 8}{3 \cdot 8} = \frac{2}{3} \cdot \frac{8}{8} = \frac{2}{3} \cdot 1 = \frac{2}{3}$$

$$31. \frac{12}{30} = \frac{2 \cdot 6}{5 \cdot 6} = \frac{2}{5} \cdot \frac{6}{6} = \frac{2}{5} \cdot 1 = \frac{2}{5}$$

$$32. \frac{60}{105} = \frac{4 \cdot 15}{7 \cdot 15} = \frac{4}{7} \cdot \frac{15}{15} = \frac{4}{7} \cdot 1 = \frac{4}{7}$$

$$33. \frac{19}{76} = \frac{1 \cdot 19}{4 \cdot 19} = \frac{1}{4} \cdot \frac{19}{19} = \frac{1}{4} \cdot 1 = \frac{1}{4}$$

$$34. \frac{17}{51} = \frac{1 \cdot 17}{3 \cdot 17} = \frac{1}{3} \cdot \frac{17}{17} = \frac{1}{3} \cdot 1 = \frac{1}{3}$$

$$35. \frac{3}{4} \cdot \frac{1}{5} = \frac{3 \cdot 1}{4 \cdot 5} = \frac{3}{20}$$

$$36. \frac{3}{2} \cdot \frac{5}{8} = \frac{3 \cdot 5}{2 \cdot 8} = \frac{15}{16}$$

$$37. \frac{5}{3} \cdot \frac{3}{5} = \frac{5 \cdot 3}{3 \cdot 5} = \frac{15}{15} = 1$$

$$38. \frac{21}{32} \cdot \frac{32}{21} = \frac{21 \cdot 32}{32 \cdot 21} = \frac{672}{672} = 1$$

$$39. \frac{5}{6} \cdot \frac{18}{25} = \frac{5 \cdot 18}{6 \cdot 25} = \frac{90}{150} = \frac{3 \cdot 30}{5 \cdot 30} = \frac{3}{5} \cdot \frac{30}{30} = \frac{3}{5} \cdot 1 = \frac{3}{5}$$

$$40. \frac{7}{9} \cdot \frac{3}{14} = \frac{7 \cdot 3}{9 \cdot 14} = \frac{21}{126} = \frac{1 \cdot 21}{6 \cdot 21} = \frac{1}{6} \cdot \frac{21}{21} = \frac{1}{6} \cdot 1 = \frac{1}{6}$$

$$41. \frac{4}{1} \cdot \frac{3}{5} = \frac{4 \cdot 3}{1 \cdot 5} = \frac{12}{5}$$

$$42. \frac{5}{1} \cdot \frac{7}{9} = \frac{5 \cdot 7}{1 \cdot 9} = \frac{35}{9}$$

$$43. \frac{2}{1} \cdot \frac{3}{8} = \frac{2 \cdot 3}{1 \cdot 8} = \frac{6}{8} = \frac{3 \cdot 2}{4 \cdot 2} = \frac{3}{4} \cdot \frac{2}{2} = \frac{3}{4} \cdot 1 = \frac{3}{4}$$

$$44. \frac{10}{1} \cdot \frac{1}{100} = \frac{10 \cdot 1}{1 \cdot 100} = \frac{10}{100} = \frac{1 \cdot 10}{10 \cdot 10} = \frac{1}{10} \cdot \frac{10}{10} = \frac{1}{10} \cdot 1 = \frac{1}{10}$$

$$45. \frac{x}{y} \cdot \frac{y}{x} = \frac{xy}{yx} = \frac{xy}{xy} = \frac{x}{x} \cdot \frac{y}{y} = \frac{x}{x} \cdot 1 = \frac{x}{x}$$

$$46. \frac{x}{y} \cdot \frac{y}{z} = \frac{xy}{yz} = \frac{xy}{zy} = \frac{x}{z} \cdot \frac{y}{y} = \frac{x}{z} \cdot 1 = \frac{x}{z}$$

$$47. \frac{a}{b} \cdot \frac{3}{2} = \frac{a \cdot 3}{b \cdot 2} = \frac{3a}{2b}$$

$$48. \frac{5}{8} \cdot \frac{4x}{5y} = \frac{5 \cdot 4x}{8 \cdot 5y} = \frac{20x}{40y} = \frac{1 \cdot 20 \cdot x}{2 \cdot 20 \cdot y} = \frac{1}{2} \cdot \frac{20}{20} \cdot \frac{x}{y} = \frac{1}{2} \cdot 1 \cdot \frac{x}{y} = \frac{1}{2} \cdot \frac{x}{y} = \frac{1 \cdot x}{2 \cdot y} = \frac{x}{2y}$$

$$49. \frac{1}{4} \cdot \frac{3}{4} = \frac{1 \cdot 3}{4 \cdot 4} = \frac{3}{16}$$

$$50. \frac{3}{7} \cdot \frac{9}{16} = \frac{3 \cdot 9}{7 \cdot 16} = \frac{27}{112}$$

$$51. \frac{2}{3} \cdot \frac{6}{1} = \frac{2 \cdot 6}{3 \cdot 1} = \frac{12}{3} = \frac{4 \cdot 3}{1 \cdot 3} = \frac{4}{1} \cdot \frac{3}{3} = \frac{4}{1} \cdot 1 = 4$$

$$52. \frac{3}{4} \cdot \frac{7}{1} = \frac{3 \cdot 7}{4 \cdot 1} = \frac{21}{4}$$

$$53. \frac{1}{2} \cdot \frac{2}{3} = \frac{1 \cdot 2}{2 \cdot 3} = \frac{2}{6} = \frac{1 \cdot 2}{3 \cdot 2} = \frac{1}{3} \cdot \frac{2}{2} = \frac{1}{3} \cdot 1 = \frac{1}{3}$$

$$54. \frac{4}{11} \cdot \frac{9}{8} = \frac{4 \cdot 9}{11 \cdot 8} = \frac{36}{88} = \frac{4 \cdot 9}{4 \cdot 22} = \frac{9}{22}$$

$$55. \text{ (a) } \frac{1}{5} \quad \text{ (b) } \frac{1}{7} \quad \text{ (c) } \frac{7}{4} \quad \text{ (d) } \frac{8}{9}$$

$$56. \text{ (a) } \frac{1}{3} \quad \text{ (b) } \frac{1}{2} \quad \text{ (c) } \frac{5}{6} \quad \text{ (d) } \frac{8}{3}$$

$$57. \text{ (a) } \frac{2}{1} = 2 \quad \text{ (b) } \frac{9}{1} = 9 \quad \text{ (c) } \frac{101}{12} \quad \text{ (d) } \frac{17}{31}$$

$$58. \text{ (a) } \frac{5}{1} = 5 \quad \text{ (b) } \frac{3}{7} \quad \text{ (c) } \frac{64}{23} \quad \text{ (d) } \frac{29}{63}$$

$$59. \frac{1}{2} \div \frac{1}{3} = \frac{1}{2} \cdot \frac{3}{1} = \frac{1 \cdot 3}{2 \cdot 1} = \frac{3}{2}$$

$$60. \frac{3}{4} \div \frac{1}{5} = \frac{3}{4} \cdot \frac{5}{1} = \frac{3 \cdot 5}{4 \cdot 1} = \frac{15}{4}$$

$$61. \frac{3}{4} \div \frac{1}{8} = \frac{3}{4} \cdot \frac{8}{1} = \frac{3 \cdot 8}{4 \cdot 1} = \frac{24}{4} = 6$$

$$62. \frac{6}{7} \div \frac{3}{14} = \frac{6}{7} \cdot \frac{14}{3} = \frac{6 \cdot 14}{7 \cdot 3} = \frac{84}{21} = \frac{4 \cdot 21}{1 \cdot 21} = \frac{4}{1} \cdot \frac{21}{21} = \frac{4}{1} \cdot 1 = 4$$

$$63. \frac{4}{3} \div \frac{4}{3} = \frac{4}{3} \cdot \frac{3}{4} = \frac{4 \cdot 3}{3 \cdot 4} = \frac{12}{12} = 1$$

$$64. \frac{12}{21} \div \frac{4}{7} = \frac{12}{21} \cdot \frac{7}{4} = \frac{12 \cdot 7}{21 \cdot 4} = \frac{84}{84} = 1$$

65. $\frac{32}{27} \div \frac{8}{9} = \frac{32}{27} \cdot \frac{9}{8} = \frac{32 \cdot 9}{27 \cdot 8} = \frac{288}{216} = \frac{4 \cdot 72}{3 \cdot 72} = \frac{4}{3} \cdot \frac{72}{72} = \frac{4}{3} \cdot 1 = \frac{4}{3}$
66. $\frac{8}{15} \div \frac{2}{25} = \frac{8}{15} \cdot \frac{25}{2} = \frac{8 \cdot 25}{15 \cdot 2} = \frac{200}{30} = \frac{20 \cdot 10}{3 \cdot 10} = \frac{20}{3} \cdot \frac{10}{10} = \frac{20}{3} \cdot 1 = \frac{20}{3}$
67. $\frac{10}{1} \div \frac{5}{6} = \frac{10}{1} \cdot \frac{6}{5} = \frac{10 \cdot 6}{1 \cdot 5} = \frac{60}{5} = \frac{12 \cdot 5}{1 \cdot 5} = \frac{12}{1} \cdot \frac{5}{5} = \frac{12}{1} \cdot 1 = 12$
68. $\frac{8}{1} \div \frac{4}{3} = \frac{8}{1} \cdot \frac{3}{4} = \frac{8 \cdot 3}{1 \cdot 4} = \frac{24}{4} = \frac{6 \cdot 4}{1 \cdot 4} = \frac{6}{1} \cdot \frac{4}{4} = \frac{6}{1} \cdot 1 = 6$
69. $\frac{9}{10} \div \frac{3}{1} = \frac{9}{10} \cdot \frac{1}{3} = \frac{9 \cdot 1}{10 \cdot 3} = \frac{9}{30} = \frac{3 \cdot 3}{10 \cdot 3} = \frac{3}{10} \cdot \frac{3}{3} = \frac{3}{10} \cdot 1 = \frac{3}{10}$
70. $\frac{32}{27} \div \frac{16}{1} = \frac{32}{27} \cdot \frac{1}{16} = \frac{32 \cdot 1}{27 \cdot 16} = \frac{32}{432} = \frac{2 \cdot 16}{27 \cdot 16} = \frac{2}{27} \cdot \frac{16}{16} = \frac{2}{27} \cdot 1 = \frac{2}{27}$
71. $\frac{a}{b} \div \frac{2}{b} = \frac{a}{b} \cdot \frac{b}{2} = \frac{ab}{2b} = \frac{a}{2} \cdot \frac{b}{b} = \frac{a}{2} \cdot 1 = \frac{a}{2}$
72. $\frac{3a}{b} \div \frac{3}{c} = \frac{3a}{b} \cdot \frac{c}{3} = \frac{3ac}{3b} = \frac{ac}{b} \cdot \frac{3}{3} = \frac{ac}{b} \cdot 1 = \frac{ac}{b}$
73. $\frac{x}{y} \div \frac{x}{y} = \frac{x}{y} \cdot \frac{y}{x} = \frac{xy}{xy} = 1$
74. $\frac{x}{3y} \div \frac{x}{3} = \frac{x}{3y} \cdot \frac{3}{x} = \frac{3x}{3xy} = \frac{1 \cdot 3x}{y \cdot 3x} = \frac{1}{y} \cdot \frac{3x}{3x} = \frac{1}{y} \cdot 1 = \frac{1}{y}$
75. (a) $\frac{5}{12} + \frac{1}{12} = \frac{5+1}{12} = \frac{6}{12} = \frac{1 \cdot 6}{2 \cdot 6} = \frac{1}{2} \cdot \frac{6}{6} = \frac{1}{2} \cdot 1 = \frac{1}{2}$
- (b) $\frac{5}{12} - \frac{1}{12} = \frac{5-1}{12} = \frac{4}{12} = \frac{1 \cdot 4}{3 \cdot 4} = \frac{1}{3} \cdot \frac{4}{4} = \frac{1}{3} \cdot 1 = \frac{1}{3}$
76. (a) $\frac{3}{2} + \frac{1}{2} = \frac{3+1}{2} = \frac{4}{2} = 2$
- (b) $\frac{3}{2} - \frac{1}{2} = \frac{3-1}{2} = \frac{2}{2} = 1$
77. (a) $\frac{18}{29} + \frac{7}{29} = \frac{18+7}{29} = \frac{25}{29}$
- (b) $\frac{18}{29} - \frac{7}{29} = \frac{18-7}{29} = \frac{11}{29}$
78. (a) $\frac{5}{33} + \frac{2}{33} = \frac{5+2}{33} = \frac{7}{33}$
- (b) $\frac{5}{33} - \frac{2}{33} = \frac{5-2}{33} = \frac{3}{33} = \frac{1 \cdot 3}{11 \cdot 3} = \frac{1}{11} \cdot \frac{3}{3} = \frac{1}{11} \cdot 1 = \frac{1}{11}$

79. Prime factorizations are $9 = 3 \cdot 3$ and $15 = 3 \cdot 5$. The LCD is $3 \cdot 3 \cdot 5 = 45$.

80. Prime factorizations are 11 and 2. The LCD is $11 \cdot 2 = 22$.
81. Prime factorizations are 5 and $15 = 5 \cdot 3$. The LCD is $5 \cdot 3 = 15$.
82. Prime factorizations are $21 = 3 \cdot 7$ and 7. The LCD is $3 \cdot 7 = 21$.
83. Prime factorizations are $6 = 2 \cdot 3$ and $8 = 2 \cdot 2 \cdot 2$. The LCD is $2 \cdot 2 \cdot 2 \cdot 3 = 24$.
84. Prime factorizations are $9 = 3 \cdot 3$ and $12 = 3 \cdot 2 \cdot 2$. The LCD is $3 \cdot 3 \cdot 2 \cdot 2 = 36$.
85. Prime factorizations are 2, 3 and $4 = 2 \cdot 2$. The LCD is $2 \cdot 2 \cdot 3 = 12$.
86. Prime factorizations are 5, 3 and $6 = 2 \cdot 3$. The LCD is $5 \cdot 3 \cdot 2 = 30$.
87. Prime factorizations are $4 = 2 \cdot 2$, $8 = 2 \cdot 2 \cdot 2$ and $12 = 2 \cdot 2 \cdot 3$. The LCD is $2 \cdot 2 \cdot 2 \cdot 3 = 24$.
88. Prime factorizations are $15 = 3 \cdot 5$, $20 = 2 \cdot 2 \cdot 5$ and $30 = 2 \cdot 3 \cdot 5$. The LCD is $3 \cdot 5 \cdot 2 \cdot 2 = 60$.
89. The LCD is 6. $\frac{1}{2} = \frac{1}{2} \cdot \frac{3}{3} = \frac{3}{6}$; $\frac{2}{3} = \frac{2}{3} \cdot \frac{2}{2} = \frac{4}{6}$
90. The LCD is 20. $\frac{3}{4} = \frac{3}{4} \cdot \frac{5}{5} = \frac{15}{20}$; $\frac{1}{5} = \frac{1}{5} \cdot \frac{4}{4} = \frac{4}{20}$
91. The LCD is 36. $\frac{7}{9} = \frac{7}{9} \cdot \frac{4}{4} = \frac{28}{36}$; $\frac{5}{12} = \frac{5}{12} \cdot \frac{3}{3} = \frac{15}{36}$
92. The LCD is 26. $\frac{5}{13} = \frac{5}{13} \cdot \frac{2}{2} = \frac{10}{26}$; $\frac{1}{2} = \frac{1}{2} \cdot \frac{13}{13} = \frac{13}{26}$
93. The LCD is 48. $\frac{1}{16} = \frac{1}{16} \cdot \frac{3}{3} = \frac{3}{48}$; $\frac{7}{12} = \frac{7}{12} \cdot \frac{4}{4} = \frac{28}{48}$
94. The LCD is 72. $\frac{5}{18} = \frac{5}{18} \cdot \frac{4}{4} = \frac{20}{72}$; $\frac{1}{24} = \frac{1}{24} \cdot \frac{3}{3} = \frac{3}{72}$
95. The LCD is 12. $\frac{1}{3} = \frac{1}{3} \cdot \frac{4}{4} = \frac{4}{12}$; $\frac{3}{4} = \frac{3}{4} \cdot \frac{3}{3} = \frac{9}{12}$; $\frac{5}{6} = \frac{5}{6} \cdot \frac{2}{2} = \frac{10}{12}$
96. The LCD is 45. $\frac{4}{15} = \frac{4}{15} \cdot \frac{3}{3} = \frac{12}{45}$; $\frac{2}{9} = \frac{2}{9} \cdot \frac{5}{5} = \frac{10}{45}$; $\frac{3}{5} = \frac{3}{5} \cdot \frac{9}{9} = \frac{27}{45}$
97. $\frac{5}{8} + \frac{3}{16} = \frac{5}{8} \cdot \frac{2}{2} + \frac{3}{16} = \frac{5 \cdot 2}{8 \cdot 2} + \frac{3}{16} = \frac{10}{16} + \frac{3}{16} = \frac{10+3}{16} = \frac{13}{16}$
98. $\frac{1}{9} + \frac{2}{15} = \frac{1}{9} \cdot \frac{5}{5} + \frac{2}{15} \cdot \frac{3}{3} = \frac{1 \cdot 5}{9 \cdot 5} + \frac{2 \cdot 3}{15 \cdot 3} = \frac{5}{45} + \frac{6}{45} = \frac{5+6}{45} = \frac{11}{45}$
99. $\frac{25}{24} - \frac{7}{8} = \frac{25}{24} - \frac{7}{8} \cdot \frac{3}{3} = \frac{25}{24} - \frac{7 \cdot 3}{8 \cdot 3} = \frac{25}{24} - \frac{21}{24} = \frac{25-21}{24} = \frac{4}{24} = \frac{1 \cdot 4}{6 \cdot 4} = \frac{1}{6} \cdot \frac{4}{4} = \frac{1}{6} \cdot 1 = \frac{1}{6}$
100. $\frac{4}{5} - \frac{1}{4} = \frac{4}{5} \cdot \frac{4}{4} - \frac{1}{4} \cdot \frac{5}{5} = \frac{4 \cdot 4}{5 \cdot 4} - \frac{1 \cdot 5}{4 \cdot 5} = \frac{16}{20} - \frac{5}{20} = \frac{16-5}{20} = \frac{11}{20}$
101. $\frac{11}{14} + \frac{2}{35} = \frac{11}{14} \cdot \frac{5}{5} + \frac{2}{35} \cdot \frac{2}{2} = \frac{11 \cdot 5}{14 \cdot 5} + \frac{2 \cdot 2}{35 \cdot 2} = \frac{55}{70} + \frac{4}{70} = \frac{55+4}{70} = \frac{59}{70}$

$$102. \frac{7}{8} + \frac{4}{15} = \frac{7}{8} \cdot \frac{15}{15} + \frac{4}{15} \cdot \frac{8}{8} = \frac{7 \cdot 15}{8 \cdot 15} + \frac{4 \cdot 8}{15 \cdot 8} = \frac{105}{120} + \frac{32}{120} = \frac{105+32}{120} = \frac{137}{120}$$

$$103. \frac{5}{12} - \frac{1}{18} = \frac{5}{12} \cdot \frac{3}{3} - \frac{1}{18} \cdot \frac{2}{2} = \frac{5 \cdot 3}{12 \cdot 3} - \frac{1 \cdot 2}{18 \cdot 2} = \frac{15}{36} - \frac{2}{36} = \frac{15-2}{36} = \frac{13}{36}$$

$$104. \frac{9}{20} - \frac{7}{30} = \frac{9}{20} \cdot \frac{3}{3} - \frac{7}{30} \cdot \frac{2}{2} = \frac{9 \cdot 3}{20 \cdot 3} - \frac{7 \cdot 2}{30 \cdot 2} = \frac{27}{60} - \frac{14}{60} = \frac{27-14}{60} = \frac{13}{60}$$

$$105. \frac{3}{100} + \frac{1}{300} - \frac{1}{200} = \frac{3}{100} \cdot \frac{6}{6} + \frac{1}{300} \cdot \frac{2}{2} - \frac{1}{200} \cdot \frac{3}{3} = \frac{3 \cdot 6}{100 \cdot 6} + \frac{1 \cdot 2}{300 \cdot 2} - \frac{1 \cdot 3}{200 \cdot 3} =$$

$$\frac{18}{600} + \frac{2}{600} - \frac{3}{600} = \frac{18+2-3}{600} = \frac{17}{600}$$

$$106. \frac{43}{36} + \frac{4}{9} + \frac{1}{4} = \frac{43}{36} + \frac{4}{9} \cdot \frac{4}{4} + \frac{1}{4} \cdot \frac{9}{9} = \frac{43}{36} + \frac{4 \cdot 4}{9 \cdot 4} + \frac{1 \cdot 9}{4 \cdot 9} = \frac{43}{36} + \frac{16}{36} + \frac{9}{36} = \frac{43+16+9}{36} = \frac{68}{36} =$$

$$\frac{17 \cdot 4}{9 \cdot 4} = \frac{17}{9} \cdot \frac{4}{4} = \frac{17}{9} \cdot 1 = \frac{17}{9}$$

$$107. \frac{7}{8} - \frac{1}{6} + \frac{5}{12} = \frac{7}{8} \cdot \frac{3}{3} - \frac{1}{6} \cdot \frac{4}{4} + \frac{5}{12} \cdot \frac{2}{2} = \frac{7 \cdot 3}{8 \cdot 3} - \frac{1 \cdot 4}{6 \cdot 4} + \frac{5 \cdot 2}{12 \cdot 2} =$$

$$\frac{21}{24} - \frac{4}{24} + \frac{10}{24} = \frac{21-4+10}{24} = \frac{27}{24} = \frac{9 \cdot 3}{8 \cdot 3} = \frac{9}{8} \cdot \frac{3}{3} = \frac{9}{8} \cdot 1 = \frac{9}{8}$$

$$108. \frac{9}{40} - \frac{3}{50} - \frac{1}{100} = \frac{9}{40} \cdot \frac{5}{5} - \frac{3}{50} \cdot \frac{4}{4} - \frac{1}{100} \cdot \frac{2}{2} = \frac{9 \cdot 5}{40 \cdot 5} - \frac{3 \cdot 4}{50 \cdot 4} - \frac{1 \cdot 2}{100 \cdot 2} =$$

$$\frac{45}{200} - \frac{12}{200} - \frac{2}{200} = \frac{45-12-2}{200} = \frac{31}{200}$$

$$109. \text{ Find the product of } 2\frac{1}{2} \text{ and } 1\frac{9}{10}. \text{ First convert } 2\frac{1}{2} \text{ to } \frac{5}{2} \text{ and } 1\frac{9}{10} \text{ to } \frac{19}{10}.$$

$$\frac{5}{2} \cdot \frac{19}{10} = \frac{95}{20} = \frac{19 \cdot 5}{4 \cdot 5} = \frac{19}{4} = 4\frac{3}{4} \text{ ft.}$$

$$110. \text{ Find the product of } \frac{7}{13} \text{ and } 32\frac{1}{2}. \text{ First convert } 32\frac{1}{2} \text{ to } \frac{65}{2}. \frac{7}{13} \cdot \frac{65}{2} = \frac{455}{26} = 17\frac{1}{2} \text{ in.}$$

$$111. \text{ Find the value of one-half of } 64\frac{5}{8}. \text{ First convert } 64\frac{5}{8} \text{ to } \frac{517}{8}. \frac{517}{8} \div 2 = \frac{517}{8} \cdot \frac{1}{2} = \frac{517}{16} = 32\frac{5}{16} \text{ in.}$$

$$112. \text{ Find the value of one-fourth of } 15\frac{1}{2}. \text{ First convert } 15\frac{1}{2} \text{ to } \frac{31}{2}. \frac{31}{2} \div 4 = \frac{31}{2} \cdot \frac{1}{4} = \frac{31}{8} = 3\frac{7}{8} \text{ ft.}$$

$$113. \text{ Convert the base of the triangle from } 1\frac{2}{3} \text{ to } \frac{5}{3}.$$

$$\frac{1}{2} \cdot \frac{5}{3} \cdot \frac{3}{4} = \frac{1 \cdot 5 \cdot 3}{2 \cdot 3 \cdot 4} = \frac{15}{24} = \frac{5 \cdot 3}{8 \cdot 3} = \frac{5}{8} \cdot \frac{3}{3} = \frac{5}{8} \cdot 1 = \frac{5}{8} \text{ square yards.}$$

114. Area of a rectangle is length times width. $\frac{5}{4} \cdot \frac{1}{2} = \frac{5 \cdot 1}{4 \cdot 2} = \frac{5}{8}$ square feet.

115. Add the distance from Smalltown to Middletown and Middletown to Bigtown.

$$3\frac{1}{2} + 4\frac{3}{4} = \frac{7}{2} + \frac{19}{4} = \frac{7}{2} \cdot \frac{2}{2} + \frac{19}{4} = \frac{7 \cdot 2}{2 \cdot 2} + \frac{19}{4} = \frac{14}{4} + \frac{19}{4} = \frac{14+19}{4} = \frac{33}{4} = 8\frac{1}{4} \text{ miles.}$$

116. Add the distance to find total miles. $1\frac{3}{8} + 5\frac{3}{4} + 3\frac{5}{8} = \frac{11}{8} + \frac{23}{4} + \frac{29}{8} = \frac{11}{8} + \frac{23}{4} \cdot \frac{2}{2} + \frac{29}{8} =$

$$\frac{11}{8} + \frac{23 \cdot 2}{4 \cdot 2} + \frac{29}{8} = \frac{11}{8} + \frac{46}{8} + \frac{29}{8} = \frac{11+46+29}{8} = \frac{86}{8} = 10\frac{3}{4} \text{ miles.}$$

117. Multiply the fraction of U.S. vegetarian adults by the fraction of U.S. vegan adults.

$$\frac{4}{125} \cdot \frac{1}{200} = \frac{1 \cdot 4}{4 \cdot 50 \cdot 125} = \frac{1}{6250}$$

118. Multiply the fraction women college students by the fraction of part-time women college students

$$\frac{29}{50} \cdot \frac{13}{20} = \frac{29 \cdot 13}{50 \cdot 20} = \frac{377}{1000}$$

119. Find the sum of the motor vehicle deaths and the firearms deaths as a fraction of all accidental

deaths. $\frac{31}{42} + \frac{31}{1260} = \frac{31}{42} \cdot \frac{30}{30} + \frac{31}{1260}$. It follows that

$$\frac{31 \cdot 30}{42 \cdot 30} + \frac{31}{1260} = \frac{930}{1260} + \frac{31}{1260} = \frac{930+31}{1260} = \frac{961}{1260}.$$

120. Find the fraction of people in the age group 18 to 25 who have used illicit drugs in their lifetime but

not during the past year. It follows that $\frac{3}{5} - \frac{7}{20} = \frac{3}{5} \cdot \frac{4}{4} - \frac{7}{20} = \frac{12}{20} - \frac{7}{20} = \frac{5}{20} = \frac{1}{4}$.

Checking Basic Concepts Sections 1.1 and 1.2

1. (a) Prime
(b) Composite; $28 = 2 \cdot 2 \cdot 7$
(c) Neither
(d) Composite; $180 = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5$
2. $\frac{10}{3+2} = \frac{10}{5} = 2$
3. $y = 6 \cdot 5 = 30$
4. $x + 5$
5. $I = 12F$, because there are 12 inches in 1 foot.

6. (a) The largest number that divides evenly into 3 and 18 is 3, so the GCF is 3.
 (b) The largest number that divides evenly into 40 and 72 is 8, so the GCF is 8.
7. (a) $\frac{25}{35} = \frac{5 \cdot 5}{7 \cdot 5} = \frac{5}{7} \cdot \frac{5}{5} = \frac{5}{7} \cdot 1 = \frac{5}{7}$
 (b) $\frac{26}{39} = \frac{2 \cdot 13}{3 \cdot 13} = \frac{2}{3} \cdot \frac{13}{13} = \frac{2}{3} \cdot 1 = \frac{2}{3}$
8. $\frac{3}{4}$
9. (a) $\frac{2}{3} \cdot \frac{3}{4} = \frac{2 \cdot 3}{3 \cdot 4} = \frac{6}{12} = \frac{1 \cdot 6}{2 \cdot 6} = \frac{1}{2} \cdot \frac{6}{6} = \frac{1}{2} \cdot 1 = \frac{1}{2}$
 (b) $\frac{5}{6} \div \frac{10}{3} = \frac{5}{6} \cdot \frac{3}{10} = \frac{5 \cdot 3}{6 \cdot 10} = \frac{15}{60} = \frac{1 \cdot 15}{4 \cdot 15} = \frac{1}{4} \cdot \frac{15}{15} = \frac{1}{4} \cdot 1 = \frac{1}{4}$
 (c) $\frac{3}{10} + \frac{1}{10} = \frac{3+1}{10} = \frac{4}{10} = \frac{2 \cdot 2}{5 \cdot 2} = \frac{2}{5} \cdot \frac{2}{2} = \frac{2}{5} \cdot 1 = \frac{2}{5}$
 (d) $\frac{3}{4} - \frac{1}{6} = \frac{3}{4} \cdot \frac{3}{3} - \frac{1}{6} \cdot \frac{2}{2} = \frac{3 \cdot 3}{4 \cdot 3} - \frac{1 \cdot 2}{6 \cdot 2} = \frac{9}{12} - \frac{2}{12} = \frac{9-2}{12} = \frac{7}{12}$
10. Multiply $1\frac{2}{3}$ by $2\frac{5}{3}$. $\frac{5}{3} \cdot \frac{2}{1} = \frac{5 \cdot 2}{3 \cdot 1} = \frac{10}{3} = 3\frac{1}{3}$ cups.

Section 1.3 Exponents and Order of Operations

1. multiply
2. 2
3. base; exponent
4. 6^2
5. 8^3
6. 17; multiplication; addition
7. 2; exponents; subtraction
8. 4; left; right
9. False
10. False
11. 3^4
12. 10^2
13. 2^5
14. 4^3

15. $\left(\frac{1}{2}\right)^4$

16. $\left(\frac{5}{7}\right)^5$

17. a^5

18. b^4

19. $(x+3)^2$

20. $(x-4)^3$

21. (a) $2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16$

(b) $4^2 = 4 \cdot 4 = 16$

22. (a) $3^2 = 3 \cdot 3 = 9$

(b) $5^3 = 5 \cdot 5 \cdot 5 = 125$

23. (a) $6^1 = 6$

(b) $1^6 = 1$

24. (a) $17^1 = 17$

(b) $1^{17} = 1$

25. (a) $2^5 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32$

(b) $10^3 = 10 \cdot 10 \cdot 10 = 1000$

26. (a) $10^5 = 10 \cdot 10 \cdot 10 \cdot 10 \cdot 10 = 100,000$

(b) $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

27. (a) $\left(\frac{2}{3}\right)^2 = \frac{2}{3} \cdot \frac{2}{3} = \frac{2 \cdot 2}{3 \cdot 3} = \frac{4}{9}$

(b) $\left(\frac{1}{2}\right)^5 = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \frac{1 \cdot 1 \cdot 1 \cdot 1 \cdot 1}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{1}{32}$

28. (a) $\left(\frac{1}{10}\right)^3 = \frac{1}{10} \cdot \frac{1}{10} \cdot \frac{1}{10} = \frac{1 \cdot 1 \cdot 1}{10 \cdot 10 \cdot 10} = \frac{1}{1000}$

(b) $\left(\frac{4}{3}\right)^1 = \frac{4}{3}$

29. $8 = 2 \cdot 2 \cdot 2 = 2^3$

30. $9 = 3 \cdot 3 = 3^2$

31. $25 = 5 \cdot 5 = 5^2$

32. $32 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^5$

33. $49 = 7 \cdot 7 = 7^2$

34. $81 = 3 \cdot 3 \cdot 3 \cdot 3 = 3^4$

35. $1000 = 10 \cdot 10 \cdot 10 = 10^3$

36. $256 = 4 \cdot 4 \cdot 4 \cdot 4 = 4^4$

37. $\frac{1}{16} = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} = \left(\frac{1}{2}\right)^4$

38. $\frac{9}{25} = \frac{3 \cdot 3}{5 \cdot 5} = \frac{3}{5} \cdot \frac{3}{5} = \left(\frac{3}{5}\right)^2$

39. $\frac{32}{243} = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \left(\frac{2}{3}\right)^5$

40. $\frac{216}{343} = \frac{6}{7} \cdot \frac{6}{7} \cdot \frac{6}{7} = \left(\frac{6}{7}\right)^3$

41. Perform multiplication before addition: $5 + 4 \cdot 6 = 5 + 24 = 29$

42. Perform multiplication before subtraction: $6 \cdot 7 - 8 = 42 - 8 = 34$

43. Perform division before addition: $6 \div 3 + 2 = 2 + 2 = 4$

44. Perform division before subtraction: $20 - 10 \div 5 = 20 - 2 = 18$

45. Perform division before subtraction: $100 - \frac{50}{5} = 100 - 10 = 90$

46. $\frac{200}{100} + 6 = 2 + 6 = 8$

47. $10 - 6 - 1 = 3$

48. $30 - 9 - 5 = 16$

49. $20 \div 5 \div 2 = 4 \div 2 = 2$

50. $500 \div 100 \div 5 = 5 \div 5 = 1$

51. $3 + 2^4 = 3 + 2 \cdot 2 \cdot 2 \cdot 2 = 3 + 16 = 19$

52. $10 - 3^2 + 1 = 10 - 3 \cdot 3 + 1 = 10 - 9 + 1 = 2$

53. $4 \cdot 2^3 = 4 \cdot 2 \cdot 2 \cdot 2 = 4 \cdot 8 = 32$

54. $100 - 2 \cdot 3^3 = 100 - 2 \cdot 3 \cdot 3 \cdot 3 = 100 - 2 \cdot 27 = 100 - 54 = 46$

55. $(3 + 2)^3 = 5^3 = 5 \cdot 5 \cdot 5 = 125$

56. $5 \cdot (3 - 2)^8 - 5 = 5 \cdot 1^8 - 5 = 5 \cdot 1 - 5 = 5 - 5 = 0$

$$57. \frac{4+8}{1+3} = \frac{12}{4} = \frac{3 \cdot 4}{1 \cdot 4} = \frac{3}{1} \cdot \frac{4}{4} = \frac{3}{1} \cdot 1 = 3$$

$$58. 5 - \frac{3+1}{3-1} = 5 - \frac{4}{2} = 5 - \frac{2 \cdot 2}{1 \cdot 2} = 5 - \frac{2}{1} \cdot \frac{2}{2} = 5 - \frac{2}{1} \cdot 1 = 5 - 2 = 3$$

$$59. \frac{2^3}{4-2} = \frac{2 \cdot 2 \cdot 2}{2} = \frac{8}{2} = 4$$

$$60. \frac{10-3^2}{2 \cdot 4^2} = \frac{10-3 \cdot 3}{2 \cdot 4 \cdot 4} = \frac{10-9}{32} = \frac{1}{32}$$

$$61. 10^2 - (30 - 2 \cdot 5) = 10^2 - (30 - 10) = 10^2 - 20 = 10 \cdot 10 - 20 = 100 - 20 = 80$$

$$62. 5^2 + 3 \cdot 5 \div 3 - 1 = 5 \cdot 5 + 3 \cdot 5 \div 3 - 1 = 25 + 15 \div 3 - 1 = 25 + 5 - 1 = 29$$

$$63. \left(\frac{1}{2}\right)^4 + \frac{5+4}{3} = \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2} + \frac{9}{3} = \frac{1}{16} + 3 = \frac{1}{16} + \frac{3}{1} \cdot \frac{16}{16} = \frac{1}{16} + \frac{48}{16} = \frac{1+48}{16} = \frac{49}{16}$$

$$64. \left(\frac{7}{9}\right)^2 - \frac{6-5}{3} = \frac{7}{9} \cdot \frac{7}{9} - \frac{1}{3} = \frac{49}{81} - \frac{1}{3} = \frac{49}{81} - \frac{1}{3} \cdot \frac{27}{27} = \frac{49}{81} - \frac{27}{81} = \frac{49-27}{81} = \frac{22}{81}$$

$$65. 2^3 - 8 = 2 \cdot 2 \cdot 2 - 8 = 8 - 8 = 0$$

$$66. 5^2 + 9 = 5 \cdot 5 + 9 = 25 + 9 = 34$$

$$67. 30 - 4 \cdot 3 = 30 - 12 = 18$$

$$68. 100 + 5 \cdot 6 = 100 + 30 = 130$$

$$69. \frac{4^2}{2^3} = \frac{4 \cdot 4}{2 \cdot 2 \cdot 2} = \frac{16}{8} = \frac{2 \cdot 8}{1 \cdot 8} = \frac{2}{1} \cdot \frac{8}{8} = \frac{2}{1} \cdot 1 = 2$$

$$70. 3^3 \cdot 2^2 = 3 \cdot 3 \cdot 3 \cdot 2 \cdot 2 = 27 \cdot 4 = 108$$

$$71. \frac{40}{10} + 2 = \frac{4 \cdot 10}{1 \cdot 10} + 2 = \frac{4}{1} \cdot \frac{10}{10} + 2 = \frac{4}{1} \cdot 1 + 2 = 4 + 2 = 6$$

$$72. 30 \cdot 10 - 3 = 300 - 3 = 297$$

$$73. 100(2+3) = 100 \cdot 5 = 500$$

$$74. 50 \div (8+2) = 50 \div 10 = 5$$

$$75. 512 \text{ MB} = 512 \cdot 2^{20} \text{ bytes} = 536,870,912 \text{ bytes}$$

$$76. 60 \text{ GB} = 60 \cdot 2^{30} \text{ bytes} = 64,424,509,440 \text{ bytes}$$

$$77. (a) \text{ Because } 2^7 = 128, k = 7.$$

$$(b) \frac{128}{100} = \frac{32 \cdot 4}{25 \cdot 4} = \frac{32}{25}. \text{ There were 32 males for every 25 females.}$$

$$78. \text{ Because } 2^{11} = 2048, k = 11.$$

79. (a) $72 \div 9 = 8$ years
- (b) The investment doubles every $72 \div 12 = 6$ years, so in 18 years the amount will double 3 times.
- The investment will increase by $2^3 = 8$ times \$10,000 and will equal \$80,000.
80. Because $\frac{28}{7} = 4$, the money will double four times. The money in the account will increase by
- $2^4 = 16$ times \$1000 and will equal \$16,000.

Group Activity Working with Real Data.

1. (a)

Celsius	$F = (32 + \frac{9}{5}C)$	$F = 32 + (\frac{9}{5}C)$
-40°C	-1352°F	-40°F
0°C	0°F	32°F
5°C	169°F	41°F
20°C	676°F	68°F
30°C	1014°F	86°F
100°C	3380°F	212°F

- (b) Water freezes at at 0° Celsius and at 32° Fahrenheit.
- (c) The correct formula to convert Celsius to Fahrenheit is given as $F = 32 + \frac{9}{5}C$. This formula corresponds to the far right column.
- (d) Without an agreed order, the same equation would result in different answers, depending on which operation was performed first. *Answers may vary.*

Section 1.4 Real Numbers and the Number Line

1. $-b$
2. natural
3. rational
4. real
5. irrational
6. True
7. True
8. $0.\overline{27}$
9. 1; 4
10. 4
11. principal

12. not equal
13. approximately equal
14. 0
15. left
16. origin
17. (a) The opposite of 9 is -9 .
(b) The opposite of -9 is $-(-9) = 9$.
18. (a) The opposite of -6 is $-(-6) = 6$.
(b) The opposite of 6 is -6 .
19. (a) The opposite of $\frac{2}{3}$ is $-\frac{2}{3}$.
(b) The opposite of $-\frac{2}{3}$ is $-(-\frac{2}{3}) = \frac{2}{3}$.
20. (a) $-\left(\frac{-4}{5}\right) = \frac{4}{5}$, so the opposite of $\frac{4}{5}$ is $-\frac{4}{5}$.
(b) $-\left(\frac{-4}{-5}\right) = -\frac{4}{5}$, so the opposite of $-\frac{4}{5}$ is $-(-\frac{4}{5}) = \frac{4}{5}$.
21. (a) $-(-8) = 8$, so the opposite of 8 is -8 .
(b) $-(-(-8)) = -8$, so the opposite of -8 is $-(-8) = 8$.
22. (a) $-(-(-2)) = -2$, so the opposite of -2 is $-(-2) = 2$.
(b) $-(-2) = 2$, so the opposite of 2 is -2 .
23. (a) The opposite of a is $-a$.
(b) The opposite of $-a$ is $-(-a) = a$.
24. (a) The opposite of $-b$ is $-(-b) = b$.
(b) $-(-b) = b$, so the opposite of b is $-b$.
25. The additive inverse of t is $-t$. $-t = 6$
26. The additive inverse of $-t$ is $-(-t) = t$. $t = -\frac{4}{5}$
27. The additive inverse of $-b$ is $-(-b) = b$. $b = \frac{1}{2}$
28. The additive inverse of b is $-b$. $-b = \frac{5}{-6} = -\frac{5}{6}$
29. $\frac{1}{4} = 0.25$

30. $\frac{3}{5} = 0.6$

31. $\frac{7}{8} = 0.875$

32. $\frac{3}{10} = 0.3$

33. $\frac{3}{2} = 1.5$

34. $\frac{3}{50} = 0.06$

35. $\frac{1}{20} = 0.05$

36. $\frac{3}{16} = 0.1875$

37. $\frac{2}{3} = 0.\overline{6}$

38. $\frac{2}{9} = 0.\overline{2}$

39. $\frac{7}{9} = 0.\overline{7}$

40. $\frac{5}{11} = 0.\overline{45}$

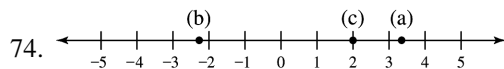
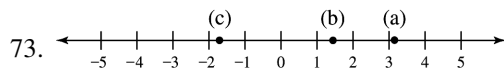
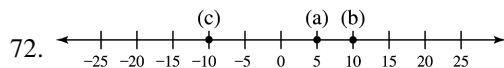
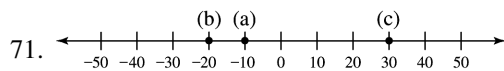
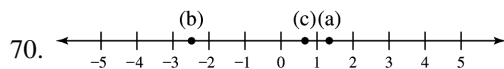
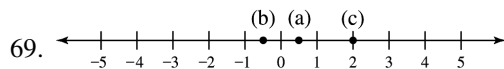
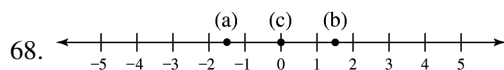
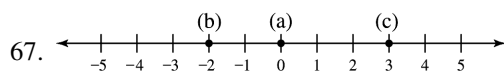
41. 8 is a natural, whole and rational number, and is an integer.

42. -8 is a rational number, and is an integer.43. $\frac{16}{4} = 4$ is a natural, whole and rational number, and is an integer.44. $\frac{5}{7}$ is a rational number.

45. 0 is a whole and rational number, and is an integer.

46. $-\frac{15}{31}$ is a rational number.47. $-\frac{7}{6}$ is a rational number.48. $-\frac{10}{5} = -2$ is a rational number and an integer.49. $\sqrt{25} = 5$ because $5 \cdot 5 = 25$ and 5 is positive.50. $\sqrt{81} = 9$ because $9 \cdot 9 = 81$ and 9 is positive.

51. $\sqrt{49} = 7$ because $7 \cdot 7 = 49$ and 7 is positive.
52. $\sqrt{64} = 8$ because $8 \cdot 8 = 64$ and 8 is positive.
53. We can estimate the value of $\sqrt{7}$ with a calculator. $\sqrt{7} \approx 2.646$
54. We can estimate the value of $\sqrt{11}$ with a calculator. $\sqrt{11} \approx 3.317$
55. $-4.5 = -4\frac{1}{2} = -\frac{9}{2}$ is a rational number.
56. π is an irrational number.
57. $\frac{3}{7}$ is a rational number.
58. $\sqrt{25} = 5$ is a natural and rational number, and is an integer.
59. $\sqrt{11}$ is an irrational number.
60. $-\sqrt{3}$ is an irrational number.
61. $\frac{8}{4} = 2$ is a natural and rational number, and is an integer.
62. -5 is a rational number and is an integer.
63. $\sqrt{49} = 7$ is a natural and rational number, and is an integer.
64. $3.\bar{3}$ is a rational number because its decimal repeats the same number.
65. $1.\bar{8}$ is a rational number because its decimal repeats the same number.
66. $\frac{9}{3} = 3$ is a natural and rational number, and is an integer.



75. $|5.23| = 5.23$

76. $|\pi| = \pi$

77. $|-8| = 8$

78. $|\sqrt{2}| = \sqrt{2}$

79. $|2 - 2| = |0| = 0$

80. $\left|\frac{2}{3} - \frac{1}{3}\right| = \left|\frac{2-1}{3}\right| = \left|\frac{1}{3}\right| = \frac{1}{3}$

81. $|\pi - 3| = \pi - 3$

82. $|3 - \pi| = |\pi - 3| = \pi - 3$

83. $|b|$, if b is negative, $= -b$

84. $|-b|$, if b is positive, $= b$

85. $5 < 7$

86. $-5 < 7$

87. $-5 > -7$

88. $\frac{3}{5} > \frac{2}{5}$

89. $-\frac{1}{3} > -\frac{2}{3}$

90. $-\frac{1}{10} < 0$

91. $-1.9 < -1.3$

92. $5.1 > -6.2$

93. $|-8| = 8$ and $8 > 3$ so $|-8| > 3$.

94. $|-1| = 1$ and $4 > 1$ so $4 > |-1|$.

95. $|-2| = 2$ and $|-7| = 7$ and $2 < 7$ so $|-2| < |-7|$.

96. $|-15| = 15$ and $|32| = 32$ and $15 < 32$ so $|-15| < |32|$.

97. $>$

98. $>$

99. $=$

100. $=$

101. $-9, -2^3, -3, 0, 1$

102. $-2^3, -\frac{3}{2}, \frac{1}{2}, \frac{3}{2}, 4$

103. $-2, -\frac{3}{2}, \frac{1}{3}, \sqrt{5}, \pi$

104. $-\frac{3}{16}, -\frac{1}{12}, \sqrt{7}, 9, 14$

105. (a) The age in 2005 was 25.5.

(b) *Answers may vary.*

(c) The average age was $\frac{25.1 + 25.3 + 25.5 + 25.9}{4} = \frac{101.8}{4} = 25.45$.

106. (a) The percentage in 2006 was 6.8%.

(b) *Answers may vary.*

(c) The average percentage was $\frac{6.0 + 6.8 + 12.0 + 13.5}{4} = \frac{38.3}{4} = 9.575\%$.

Checking Basic Concepts Sections 1.3 and 1.4

1. (a) $5 \cdot 5 \cdot 5 \cdot 5 = 5^4$

(b) $7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 = 7^5$

2. (a) $2^3 = 2 \cdot 2 \cdot 2 = 8$

(b) $10^4 = 10 \cdot 10 \cdot 10 \cdot 10 = 10,000$

(c) $\left(\frac{2}{3}\right)^3 = \frac{2}{3} \cdot \frac{2}{3} \cdot \frac{2}{3} = \frac{2 \cdot 2 \cdot 2}{3 \cdot 3 \cdot 3} = \frac{8}{27}$

3. (a) $64 = 4 \cdot 4 \cdot 4 = 4^3$

(b) $64 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 2^6$

4. (a) $6 + 5 \cdot 4 = 6 + 20 = 26$

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

(c) $5 - 2 - 1 = 2$

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

(e) $12 \div (6 \div 2) = 12 \div 3 = 4$

(f) $2^3 - 2\left(2 + \frac{4}{2}\right) = 8 - 2(2 + 2) = 8 - 2(4) = 8 - 8 = 0$

5. $5^3 \div 3$, or $\frac{5^3}{3}$

6. (a) The opposite of -17 is $-(-17) = 17$.

(b) The opposite of a is $-a$.

7. (a) $\frac{3}{20} = \frac{3 \cdot 5}{20 \cdot 5} = \frac{15}{100} = 0.15$

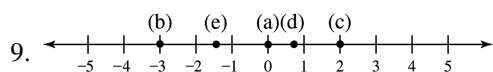
(b) $\frac{5}{8} = \frac{5 \cdot 125}{8 \cdot 125} = \frac{625}{1000} = 0.625$

8. (a) $\frac{10}{2} = 5$ is a natural and rational number, and is an integer.

(b) -5 is a rational number and is an integer.

(c) $\sqrt{5}$ is an irrational number.

(d) $-\frac{5}{6}$ is a rational number.



10. (a) $|-12| = -(-12) = 12$

(b) $|6-6| = |0| = 0$

11. (a) $4 < 9$

(b) $-1.3 < -0.5$

(c) $|-3| = 3$ and $|-5| = 5$ and $3 < 5$ so $|-3| < |-5|$.

12. $-7, -1.6, 0, \frac{1}{3}, \sqrt{3}, 3^2$

Section 1.5 Addition and Subtraction of Real Numbers

1. sum

2. zero

3. True

4. True

5. absolute value

6. difference

7. addition

8. opposite; $(-b)$

9. addition

10. subtraction

11. The opposite of 25 is -25 . $25 + (-25) = 0$

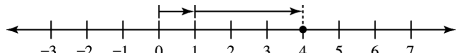
12. The opposite of $-\frac{1}{2}$ is $\frac{1}{2}$. $-\frac{1}{2} + \frac{1}{2} = 0$

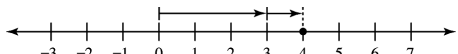
13. The opposite of $-\sqrt{21}$ is $\sqrt{21}$. $-\sqrt{21} + \sqrt{21} = 0$


14. The opposite of $-\pi$ is π . $-\pi + \pi = 0$


15. The opposite of 5.63 is -5.63 . $5.63 + (-5.63) = 0$

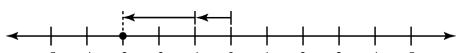
16. The opposite of -6^2 is 6^2 . $-6^2 + 6^2 = 0$

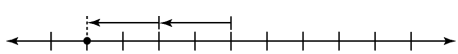
17.  ; $1 + 3 = 4$


18.  ; $3 + 1 = 4$

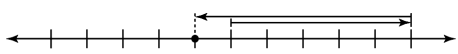
19.  ; $4 + (-2) = 2$


20.  ; $-4 + 6 = 2$

21.  ; $-1 + (-2) = -3$

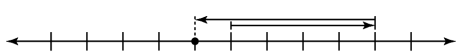
22.  ; $-2 + (-2) = -4$

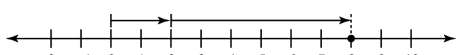
23.  ; $-3 + 7 = 4$

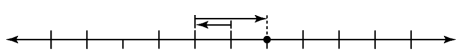
24.  ; $5 + (-6) = -1$


25.  ; $-1 + 3 = 2$


26.  ; $3 + (-1) = 2$


27.  ; $4 + (-5) = -1$

28.  ; $2 + 6 = 8$

29.  ; $-10 + 20 = 10$

30.  ; $15 + (-5) = 10$

31.  ; $-50 + (-100) = -150$

32.  ; $-100 + 100 = 0$

33. $5 + (-4) = 1$

34. $-9 + 7 = -2$

35. $-1 + (-6) = -7$

36. $-10 + (-23) = -33$

37. $\frac{3}{4} + \left(-\frac{1}{2}\right) = \frac{3}{4} - \frac{1}{2} \cdot \frac{2}{2} = \frac{3}{4} - \frac{2}{4} = \frac{1}{4}$
38. $-\frac{5}{12} + \left(-\frac{1}{6}\right) = -\frac{5}{12} - \frac{1}{6} = -\frac{5}{12} - \frac{2}{12} = -\frac{7}{12}$
39. $-\frac{6}{7} + \frac{3}{14} = -\frac{6}{7} + \frac{3}{14} = -\frac{12}{14} + \frac{3}{14} = -\frac{9}{14}$
40. $-\frac{2}{9} + \left(-\frac{1}{12}\right) = -\frac{2}{9} - \frac{1}{12} = -\frac{2}{9} \cdot \frac{4}{4} - \frac{1}{12} = -\frac{8}{36} - \frac{3}{36} = -\frac{11}{36}$
41. $0.6 + (-1.7) = 0.6 - 1.7 = -1.1$
42. $4.3 + (-2.4) = 4.3 - 2.4 = 1.9$
43. $-52 + 86 = 86 - 52 = 34$
44. $-103 + (-134) = -103 - 134 = -237$
45. $5 - 8 = 5 + (-8) = -3$
46. $3 - 5 = 3 + (-5) = -2$
47. $-2 - (-9) = -2 + 9 = 7$
48. $-10 - (-19) = -10 + 19 = 9$
49. $\frac{6}{7} - \frac{13}{14} = \frac{12}{14} - \frac{13}{14} = \frac{12}{14} + \left(-\frac{13}{14}\right) = -\frac{1}{14}$
50. $-\frac{5}{6} - \frac{1}{6} = -\frac{5}{6} + \left(-\frac{1}{6}\right) = -\frac{6}{6} = -1$
51. $-\frac{1}{10} - \left(-\frac{3}{5}\right) = -\frac{1}{10} - \left(-\frac{6}{10}\right) = -\frac{1}{10} + \frac{6}{10} = \frac{5}{10} = \frac{1}{2}$
52. $-\frac{2}{11} - \left(-\frac{5}{11}\right) = -\frac{2}{11} + \frac{5}{11} = \frac{3}{11}$
53. $0.8 - (-2.1) = 0.8 + 2.1 = 2.9$
54. $-9.6 - (-5.7) = -9.6 + 5.7 = -3.9$
55. $-73 - 91 = -73 + (-91) = -164$
56. $201 - 502 = 201 + (-502) = -301$
57. $10 - 19 = 10 + (-19) = -9$
58. $5 + (-9) = 5 - 9 = -4$
59. $19 - (-22) + 1 = 19 + 22 + 1 = 42$
60. $53 + (-43) - 10 = 10 - 10 = 0$
61. $-3 + 4 - 6 = -3 + 4 + (-6) = 4 - 3 + (-6) = 1 + (-6) = -5$

62. $-11 + 8 - 10 = -11 + 8 + (-10) = -13$

63. $100 - 200 + 100 - (-50) = 100 + 100 - 200 + 50 = 200 - 200 + 50 = 50$

64. $-50 - (-40) + (-60) + 80 = -50 + 40 + (-60) + 80 = -10 + 20 = 10$

65. $1.5 - 2.3 + 9.6 = 1.5 + (-2.3) + 9.6 = -0.8 + 9.6 = 8.8$

66. $10.5 - (-5.5) + (-1.5) = 10.5 + 5.5 + (-1.5) = 16 + (-1.5) = 14.5$

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

68. $\frac{1}{4} - \left(-\frac{2}{5}\right) + \left(-\frac{3}{20}\right) = \frac{5}{20} + \frac{8}{20} + \left(-\frac{3}{20}\right) = \frac{10}{20} = \frac{1}{2}$

69. $|4 - 9| - |1 - 7| = |-5| - |-6| = 5 - 6 = -1$

70. $|-5 - (-3)| - |-6 + 8| = |-2| - |2| = 2 - 2 = 0$

71. $2 + (-5) = -3$

72. $-6 - 10 = -6 + (-10) = -16$

73. $-5 + 7 = 2$

74. $-20 - 8 = -20 + (-8) = -28$

75. $-2^3 = -(2 \cdot 2 \cdot 2) = -8.$

76. $5 - 2^3 = 5 - 8 = 5 + (-8) = -3$

77. $-6 - 7 = -6 + (-7) = -13$

78. $\frac{1}{2} - \frac{3}{4} = \frac{2}{4} - \frac{3}{4} = -\frac{1}{4}$

79. $6 + (-10) - 5 = 6 + (-10) + (-5) = -4 + (-5) = -9$

80. $10 - 7 + (-20) = 10 + (-7) + (-20) = 3 + (-20) = -17$

81. The highest point in the continental United States is Mt. Whitney at 14,497 feet.

The lowest point in the continental United States is Death Valley at 282 feet below sea level.

The difference is $14,497 - (-282) = 14,779$ feet.

82. The high temperature was $49^\circ F$ and the low temperature was $-54^\circ F$. $49 - (-54) = 103^\circ F$

$$358 - 45 + 37 + 120 - 240 = 358 + 37 + 120 + (-45) + (-240) = \$230$$

84. Take the initial balance and then add to it the deposits and subtract from it the withdrawals.

$$1245 - 189 + 975 - 226 - 876 = 1245 + (-189) + 975 + (-226) + (-876) = \$929$$

85. Add the yardage gained or lost in each play. $9 + (-2) + (-1) + 14 + 5 = 28 + (-3) = 25$ yd.

86. a) $1 + (-3) + 2 + (-1) = 3 + (-4) = -1$
- b) According to the result obtained in part (a), the result will be one pound less than the original weight. Therefore, the person who started at 170 pounds will weigh 169 pounds at the end.
87. The word height is in reference to sea level, the height of Mount Everest is 29,029 feet and the height of the Mariana Trench is $(-35,839)$.
- To find the difference take $29,029 - (-35,839) = 29,029 + 35,839 = 64,868$ feet.
88. Take the summer temperature and subtract the winter temperature. $98 - (-90) = 98 + 90 = 188^\circ\text{F}$

Section 1.6 Multiplication and Division of Real Numbers

1. product
2. negative
3. positive
4. quotient
5. $\frac{1}{a}$
6. reciprocal
7. reciprocal or multiplicative inverse
8. $-a$
9. $\frac{1}{b}$
10. positive
11. negative
12. 5; 8
13. $-3 \cdot 4 = -12$
14. $-5 \cdot 7 = -35$
15. $6 \cdot (-3) = -18$
16. $2 \cdot (-1) = -2$
17. $0 \cdot (-2.13) = 0$
18. $-2 \cdot (-7) = 14$
19. $-6 \cdot (-10) = 60$
20. $-3 \cdot (-1.7) \cdot 0 = 0$

$$21. -\frac{1}{2} \cdot \left(-\frac{2}{4}\right) = \frac{2}{8} = \frac{1}{4}$$

$$22. -\frac{3}{4} \cdot \left(-\frac{5}{12}\right) = \frac{15}{48} = \frac{5}{16}$$

$$23. -\frac{3}{7} \cdot \frac{7}{3} = -\frac{21}{21} = -1$$

$$24. \frac{5}{8} \cdot \left(-\frac{4}{15}\right) = -\frac{20}{120} = -\frac{1}{6}$$

$$25. -10 \cdot (-20) = 200$$

$$26. 1000 \cdot (-70) = -70,000$$

$$27. -0.5 \cdot 100 = -50$$

$$28. -0.5 \cdot (-0.3) = 0.15$$

$$29. -2 \cdot 3 \cdot (-4) \cdot 5 = -6 \cdot (-20) = 120$$

$$30. -3 \cdot (-5) \cdot (-2) \cdot 10 = 15 \cdot (-20) = -300$$

$$31. -6 \cdot \frac{1}{6} \cdot \frac{7}{9} \cdot \left(-\frac{9}{7}\right) \cdot \left(-\frac{3}{2}\right) = -\frac{6}{6} \cdot \left(-\frac{63}{63}\right) \cdot \left(-\frac{3}{2}\right) = -1 \cdot (-1) \cdot \left(-\frac{3}{2}\right) = 1 \cdot \left(-\frac{3}{2}\right) = -\frac{3}{2}$$

$$32. -\frac{8}{5} \cdot \frac{1}{8} \cdot \left(-\frac{5}{7}\right) \cdot (-7) = -\frac{8}{40} \cdot \frac{35}{7} = -\frac{8}{40} \cdot 5 = -\frac{40}{40} = -1$$

33. Negative, because there is an odd number of negative factors

34. Positive, because there is an even number of negative factors

$$35. (-5)^2 = (-5)(-5) = 25$$

$$36. -5^2 = -5 \cdot 5 = -25$$

$$37. (-1)^3 = (-1)(-1)(-1) = -1$$

$$38. (-6)^2 = (-6)(-6) = 36$$

$$39. -2^4 = -2 \cdot 2 \cdot 2 \cdot 2 = -16$$

$$40. -(-4)^2 = -(-4)(-4) = -16$$

$$41. -(-2)^3 = -(-2)(-2)(-2) = -(-8) = 8$$

$$42. 3 \cdot (-3)^2 = 3 \cdot [(-3)(-3)] = 3 \cdot 9 = 27$$

$$43. 5 \cdot (-2)^3 = 5 \cdot [(-2)(-2)(-2)] = 5 \cdot (-8) = -40$$

$$44. -1^4 = -1 \cdot 1 \cdot 1 \cdot 1 = -1$$

$$45. -10 \div 5 = -\frac{10}{1} \cdot \frac{1}{5} = -\frac{10}{5} = -2$$

$$46. -8 \div 4 = -\frac{8}{1} \cdot \frac{1}{4} = -\frac{8}{4} = -2$$

$$47. -20 \div (-2) = -\frac{20}{1} \cdot \left(-\frac{1}{2}\right) = \frac{20}{2} = 10$$

$$48. -15 \div (-3) = -\frac{15}{1} \cdot \left(-\frac{1}{3}\right) = \frac{15}{3} = 5$$

$$49. -\frac{12}{3} = -4$$

$$50. \frac{-25}{-5} = 5$$

$$51. -16 \div \frac{1}{2} = -\frac{16}{1} \cdot \frac{2}{1} = -\frac{32}{1} = -32$$

$$52. 10 \div \left(-\frac{1}{3}\right) = \frac{10}{1} \cdot -\frac{3}{1} = -\frac{30}{1} = -30$$

$$53. 0 \div 3 = 0$$

$$54. \frac{0}{-5} = 0$$

$$55. \frac{-1}{0} = \text{undefined, because division by 0 is not allowed.}$$

$$56. \frac{0}{-2} = 0$$

$$57. \frac{1}{2} \div (-11) = \frac{1}{2} \cdot -\frac{1}{11} = -\frac{1}{22}$$

$$58. -\frac{3}{4} \div (-6) = -\frac{3}{4} \cdot \left(-\frac{1}{6}\right) = \frac{3}{24} = \frac{1}{8}$$

$$59. -\frac{4}{5} \div (-3) = -\frac{4}{5} \cdot \left(-\frac{1}{3}\right) = \frac{4}{15}$$

$$60. \frac{7}{8} \div (-7) = \frac{7}{8} \cdot \left(-\frac{1}{7}\right) = -\frac{7}{56} = -\frac{1}{8}$$

$$61. \frac{5}{6} \div \left(-\frac{8}{9}\right) = \frac{5}{6} \cdot \left(-\frac{9}{8}\right) = -\frac{45}{48} = -\frac{15}{16}$$

$$62. -\frac{11}{12} \div \left(-\frac{11}{4}\right) = -\frac{11}{12} \cdot \left(-\frac{4}{11}\right) = \frac{44}{132} = \frac{1}{3}$$

$$63. -\frac{1}{2} \div 0 = \text{undefined, because division by 0 is not allowed.}$$

$$64. -9 \div 0 = \text{undefined, because division by 0 is not allowed.}$$

$$65. -0.5 \div \frac{1}{2} = -\frac{5}{10} \div \frac{1}{2} = -\frac{5}{10} \cdot \frac{2}{1} = -\frac{10}{10} = -1$$

$$66. -0.25 \div \left(-\frac{3}{4}\right) = -\frac{25}{100} \div \left(-\frac{3}{4}\right) = -\frac{25}{100} \cdot \left(-\frac{4}{3}\right) = \frac{100}{300} = \frac{1}{3}$$

$$67. -\frac{2}{3} \div 0.5 = -\frac{2}{3} \div \frac{5}{10} = -\frac{2}{3} \cdot \frac{10}{5} = -\frac{20}{15} = -\frac{4}{3}$$

$$68. \frac{1}{6} \div 1.5 = \frac{1}{6} \div \frac{15}{10} = \frac{1}{6} \div \frac{3 \cdot 5}{2 \cdot 5} = \frac{1}{6} \div \frac{3}{2} = \frac{1}{6} \cdot \frac{2}{3} = \frac{2}{18} = \frac{1}{9}$$

$$69. \frac{1}{2} = 0.5$$

$$70. \frac{3}{4} = 0.75$$

$$71. \frac{3}{16} = 0.1875$$

$$72. \frac{1}{9} = 0.\overline{1}$$

$$73. \text{ Because } 1 \div 2 = 0.5, 3\frac{1}{2} = 3.5$$

$$74. \text{ Because } 1 \div 4 = 0.25, 2\frac{1}{4} = 2.25$$

$$75. \text{ Because } 2 \div 3 = 0.\overline{6}, 5\frac{2}{3} = 5.\overline{6}$$

$$76. \text{ Because } 7 \div 9 = 0.\overline{7}, 6\frac{7}{9} = 6.\overline{7}$$

$$77. \text{ Because } 7 \div 16 = 0.4375, 1\frac{7}{16} = 1.4375$$

$$78. 6\frac{1}{12} = 6.08\overline{3} \text{ because } 1 \div 12 = 0.08\overline{3}$$

$$79. \frac{7}{8} = 7 \div 8 = 0.875$$

$$80. \frac{11}{16} = 11 \div 16 = 0.6875$$

$$81. 0.25 = \frac{25}{100} = \frac{1 \cdot 25}{4 \cdot 25} = \frac{1}{4}$$

$$82. 0.8 = \frac{8}{10} = \frac{4 \cdot 2}{5 \cdot 2} = \frac{4}{5}$$

$$83. 0.16 = \frac{16}{100} = \frac{4 \cdot 4}{25 \cdot 4} = \frac{4}{25}$$

$$84. 0.35 = \frac{35}{100} = \frac{7 \cdot 5}{20 \cdot 5} = \frac{7}{20}$$

$$85. 0.625 = \frac{625}{1000} = \frac{5 \cdot 125}{8 \cdot 125} = \frac{5}{8}$$

$$86. 0.0125 = \frac{125}{10,000} = \frac{1 \cdot 125}{80 \cdot 125} = \frac{1}{80}$$

$$87. 0.6875 = \frac{6875}{10,000} = \frac{11 \cdot 625}{16 \cdot 625} = \frac{11}{16}$$

$$88. 0.21875 = \frac{21,875}{100,000} = \frac{7 \cdot 3125}{32 \cdot 3125} = \frac{7}{32}$$

$$89. \left(\frac{1}{3} + \frac{5}{6} \right) \div \frac{1}{2} = 2.\bar{3} \text{ or } \frac{7}{3}$$

$$90. \frac{4}{9} - \frac{1}{6} + \frac{2}{3} = 0.9\bar{4} \text{ or } \frac{17}{18}$$

$$91. \frac{4}{5} \div \frac{2}{3} \cdot \frac{7}{4} = 2.1 \text{ or } \frac{21}{10}$$

$$92. 4 - \frac{7}{4} \cdot 2 = 0.5 \text{ or } \frac{1}{2}$$

$$93. \frac{15}{2} - 4 \cdot \frac{7}{3} = -1.8\bar{3} \text{ or } -\frac{11}{6}$$

$$94. \frac{1}{6} - \frac{3}{5} + \frac{7}{8} = 0.441\bar{6} \text{ or } \frac{53}{120}$$

$$95. \frac{17}{40} + 3 \div 8 = 0.8 \text{ or } \frac{4}{5}$$

$$96. \frac{3}{4} \cdot \left(6 + \frac{1}{2} \right) = 4.875 \text{ or } \frac{39}{8}$$

$$97. \text{ Multiply the real numbers } 202 \text{ and } \frac{13}{20} \text{ to obtain } 202 \cdot \frac{13}{20} = 131.3. \text{ Total admissions for } \textit{The Ten}$$

Commandments were about 131 million.

$$98. -220 \left(\frac{3}{2} \right) = \frac{-220 \cdot 3}{2} = -330^{\circ}\text{F}$$

$$99. \frac{21}{125} = 21 \div 125 = 0.168$$

$$100. \frac{23}{250} = 23 \div 250 = 0.092$$

Checking Basic Concepts Sections 1.5 and 1.6

1. (a) $-4 + 4 = 0$
(b) $-10 + (-12) + 3 = -22 + 3 = -19$
2. (a) $\frac{2}{3} - \left(-\frac{2}{9}\right) = \frac{2}{3} + \frac{2}{9} = \frac{6}{9} + \frac{2}{9} = \frac{8}{9}$
(b) $-1.2 - 5.1 + 3.1 = -1.2 + (-5.1) + 3.1 = -6.3 + 3.1 = -3.2$
3. (a) $-1 + 5 = 4$
(b) $4 - (-3) = 4 + 3 = 7$
4. $99 - (-46) = 99 + 46 = 145^\circ\text{F}$ is the difference between these two temperatures.
5. (a) $-5 \cdot (-7) = 35$
(b) $-\frac{1}{2} \cdot \frac{2}{3} \cdot \left(-\frac{4}{5}\right) = -\frac{2}{6} \cdot \left(-\frac{4}{5}\right) = \frac{8}{30} = \frac{4}{15}$
6. (a) $-3^2 = -3 \cdot 3 = -9$
(b) $4 \cdot (-2)^3 = 4 \cdot [(-2)(-2)(-2)] = 4 \cdot (-8) = -32$
(c) $(-5)^2 = (-5)(-5) = 25$
7. (a) $-5 \div \frac{2}{3} = -\frac{5}{1} \cdot \frac{3}{2} = -\frac{15}{2}$
(b) $-\frac{5}{8} \div \left(-\frac{4}{3}\right) = -\frac{5}{8} \cdot \left(-\frac{3}{4}\right) = \frac{15}{32}$
8. The reciprocal of $-\frac{7}{6}$ is $-\frac{6}{7}$.
9. (a) $\frac{-10}{2} = \frac{-5 \cdot 2}{1 \cdot 2} = \frac{-5}{1} = -5$
(b) $\frac{10}{-2} = \frac{5 \cdot 2}{-1 \cdot 2} = \frac{5}{-1} = -5$
(c) $-\frac{10}{2} = -\frac{5 \cdot 2}{1 \cdot 2} = -\frac{5}{1} = -5$
(d) $\frac{-10}{-2} = \frac{-5 \cdot 2}{-1 \cdot 2} = \frac{-5}{-1} = 5$
10. (a) $\frac{3}{5} = 0.6$
(b) $3\frac{7}{8} = 3.875$ because $\frac{7}{8} = 0.875$

Section 1.7 Properties of Real Numbers

1. commutative; addition
2. commutative; multiplication
3. associative; addition
4. associative; multiplication
5. True
6. False
7. distributive
8. distributive
9. identity; addition
10. identity; multiplication
11. $-a$
12. $\frac{1}{a}$
13. $-6 + 10 = 10 + (-6)$
14. $23 + 7 = 7 + 23$
15. $-5 \cdot 6 = 6 \cdot (-5)$
16. $25 \cdot (-46) = -46 \cdot 25$
17. $a + 10 = 10 + a$
18. $b + c = c + b$
19. $b \cdot 7 = 7 \cdot b$
20. $a \cdot 23 = 23 \cdot a$
21. $(1 + 2) + 3 = 1 + (2 + 3)$
22. $-7 + (5 + 15) = (-7 + 5) + 15$
23. $2 \cdot (3 \cdot 4) = (2 \cdot 3) \cdot 4$
24. $(9 \cdot (-4)) \cdot 5 = 9 \cdot (-4 \cdot 5)$
25. $(a + 5) + c = a + (5 + c)$
26. $(10 + b) + a = 10 + (b + a)$
27. $(x \cdot 3) \cdot 4 = x \cdot (3 \cdot 4)$
28. $5 \cdot (x \cdot y) = (5 \cdot x) \cdot y$
29. $a + b + c = (a + b) + c = c + (a + b) = c + (b + a) = c + b + a$
30. $a \cdot b \cdot c = (a \cdot b) \cdot c = c \cdot (a \cdot b) = c \cdot (b \cdot a) = c \cdot b \cdot a$

31. $4(3+2) = (4 \cdot 3) + (4 \cdot 2) = 12 + 8 = 20$
32. $5(6-9) = (5 \cdot 6) - (5 \cdot 9) = 30 - 45 = -15$
33. $a(b-8) = ab - 8a$
34. $3(x+y) = 3x + 3y$
35. $-4(t-z) = -4t - 4(-z) = -4t + 4z$
36. $-1(a+6) = -1a - (1)(6) = -a - 6$
37. $-(5-a) = -(1)(5) - 1(-a) = -5 + a$
38. $12 - (4u - b) = 12 - 4u + b$
39. $(a+5)3 = 3a + (3)(5) = 3a + 15$
40. $(x+y)7 = 7x + 7y$
41. $12 - (a-5) = 12 - a - (-5) = 12 - a + 5 = 17 - a$
42. $4x - 2(3y-5) = 4x - 6y + 10$
43. $a \cdot (b+c+d) = a \cdot ((b+c)+d) = a \cdot (b+c) + ad = ab + ac + ad$
44. $a \cdot (b-c-d) = a \cdot (b+(-c)+(-d)) = a \cdot ((b+(-c))+(-d)) = a \cdot (b+(-c)) + a \cdot (-d) =$
 $ab + a \cdot (-c) + a \cdot (-d) = ab - ac - ad$
45. $6x + 5x = (6+5)x = 11x$
46. $4y - y = (4-1)y = 3y$
47. $-4b + 3b = (-4+3)b = (-1)b = -b$
48. $2b + 8b = (2+8)b = 10b$
49. $3a - a = (3-1)a = 2a$
50. $-2x + 5x = (-2+5)x = 3x$
51. $13w - 27w = (13-27)w = (13+(-27))w = -14w$
52. $25a - 21a = (25-21)a = 4a$
53. Commutative (multiplication)
54. Commutative (addition)
55. Associative (addition)
56. Commutative (addition), Associative (addition)
57. Distributive
58. Distributive, Commutative (addition)
59. Distributive, Commutative (multiplication)
60. Distributive

61. Distributive
62. Distributive
63. Associative (multiplication)
64. Associative (multiplication), Commutative (multiplication)
65. Distributive
66. Commutative (multiplication)
67. Identity (addition)
68. Identity (addition)
69. Identity (multiplication)
70. Associative (multiplication), Inverse (multiplication), Identity (multiplication)
71. Identity (multiplication)
72. Identity (multiplication)
73. Inverse (multiplication)
74. Inverse (multiplication)
75. Inverse (addition)
76. Inverse (addition)
77. $(4+2)+(9+8)+(1+6)=(4+6)+(2+8)+(9+1)=30$
78. $(21+32)+(19+8)=(21+19)+(32+8)=80$
79. $(45+43)+(5+7)=(45+5)+(43+7)=100$
80. $(5+7)+(12+13+8)=5+(7+13)+(12+8)=45$
81. $129+50-1=179-1=178$
82. $87+100-1=187-1=186$
83. $178-100+1=78+1=79$
84. $500-100-1=400-1=399$
85. $6 \cdot 10 + 6 \cdot 5 = 60 + 30 = 90$
86. $4 \cdot 60 - 4 \cdot 4 = 240 - 16 = 224$
87. $8 \cdot 100 + 8 \cdot 2 = 800 + 16 = 816$
88. $5 \cdot 1000 - 5 \cdot 1 = 5000 - 5 = 4995$
89. $\left(\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}\right) \cdot 2 \cdot 2 \cdot 2 = \left(\frac{1}{8}\right) \cdot 8 = 1$
90. $\left(\frac{1}{2} \cdot \frac{2}{1}\right) \cdot \left(\frac{4}{5} \cdot \frac{5}{4}\right) \cdot \frac{7}{3} = 1 \cdot 1 \cdot \frac{7}{3} = \frac{7}{3}$
91. $\frac{7}{6} \cdot \left(\frac{1}{2} \cdot \frac{1}{2} \cdot \frac{1}{2}\right) \cdot \frac{8}{7} = \frac{7}{6} \cdot \left(\frac{1}{8} \cdot \frac{8}{7}\right) = \frac{7}{6} \cdot \frac{1}{7} = \frac{1}{6}$
92. $\left(\frac{4}{11} \cdot \frac{11}{6}\right) \cdot \left(\frac{6}{7} \cdot \frac{7}{4}\right) = \frac{4}{6} \cdot \frac{6}{4} = 1$

93. (a) $10 \cdot 41 = 410$
(b) $10 \cdot 997 = 9970$
(c) $-630 \cdot 10 = -6300$
(d) $-14,000 \cdot 10 = -140,000$
94. (a) $10 \cdot 101.68 = 1016.8$
(b) $10 \cdot (-1.235) = -12.35$
(c) $-113.4 \cdot 10 = -1134$
(d) $0.567 \cdot 10 = 5.67$
(e) $10 \cdot 0.0045 = 0.045$
(f) $-0.05 \cdot 10 = -0.5$
95. (a) $1000 \cdot 19 = 19,000$
(b) $100 \cdot (-451) = -45,100$
(c) $10,000 \cdot 6 = 60,000$
(d) $-79 \cdot 100,000 = -7,900,000$
96. (a) $1000 \cdot 1.2345 = 1234.5$
(b) $100 \cdot (-5.1) = -510$
(c) $45.67 \cdot 1000 = 45,670$
(d) $0.567 \cdot 10,000 = 5670$
(e) $100 \cdot 0.0005 = 0.05$
(f) $-0.05 \cdot 100,000 = -5000$
97. (a) $12.56 \div 10 = 1.256$
(b) $9.6 \div 10 = 0.96$
(c) $0.987 \div 10 = 0.0987$
(d) $-0.056 \div 10 = -0.0056$
(e) $1200 \div 10 = 120$
(f) $4578 \div 10 = 457.8$
98. (a) $78.89 \div 100 = 0.7889$
(b) $0.05 \div 1000 = 0.00005$
(c) $5678 \div 10,000 = 0.5678$
(d) $-9.8 \div 1000 = -0.0098$
(e) $-101 \div 100,000 = -0.00101$
(f) $7.8 \div 100 = 0.078$
99. Because $100 + 75 = 75 + 100$, this shows the commutative property of addition.

100. Calculate the sum of the down payment and the product of the monthly payments. Thus, the car will cost $2480 + 201 \cdot 20 = \$6500$. *Answers may vary.*
101. Because 1 gallon is $10 \div 10$ gallons, divide 198 by 10 to get 19.8 miles.
102. (a) Multiply the length by the width by the height to get the volume. Thus, $50 \cdot 20 \cdot 1 = 1000 \text{ ft}^3$.
 (b) Because there are 1000 cubic feet of water in the pool, take $1000 \cdot 7.5$ to get 7,500 gallons.
103. (a) Because multiplying by 10 is easy, multiply $13 \cdot (5 \cdot 2) = 13 \cdot 10 = 130 \text{ ft}^3$.
 (b) The associative property of multiplication.
104. (a) Because of the commutative property of multiplication, $500 \cdot 400 = 400 \cdot 500$. Thus, the number of pixels in an image 400 pixels wide and 500 pixels high is $400 \cdot 500 = 200,000$ pixels.
 (b) The commutative property of multiplication.

Group Activity: Working with Real Data

(a) $120,526,770 \text{ sec} \cdot \frac{1 \text{ min}}{60 \text{ sec}} \cdot \frac{1 \text{ hr}}{60 \text{ min}} = 33,479.65833 \text{ hr} \cdot \frac{1 \text{ day}}{24 \text{ hr}} \cdot \frac{1 \text{ yr}}{365 \text{ day}} \approx 3.8 \text{ yr}$

It would take the individual about 33,480 hours or about 3.8 years to buy all of the tickets.

- (b) The winner must pay taxes. There may be more than one winner. *Answers may vary.*

Section 1.8 Simplifying and Writing Algebraic Expressions

1. term
2. coefficient
3. factors; terms
4. like
5. like
6. distributive
7. The expression 91 is a term; its coefficient is 91.
8. The expression -12 is a term; its coefficient is -12 .
9. The expression $-6b$ is a term; its coefficient is -6 .
10. The expression $9z$ is a term; its coefficient is 9.
11. The expression $x + 10$ is not a term because it is the sum of two terms.
12. The expression $20 - 2y$ is not a term because it is the difference of two terms.
13. The expression x^2 is a term; its coefficient is 1.

14. The expression $4x^3$ is a term; its coefficient is 4.
15. The expression $4x - 5$ is not a term because it is the difference of two terms.
16. The expression $5z + 6x$ is not a term because it is the sum of two terms.
17. The terms 6 and -8 are like because neither term contains a variable.
18. The terms $2x$ and 19 are unlike because one contains a variable while the other does not.
19. The terms $5x$ and $-22x$ are like because each term contains the same variable raised to the same power.
20. The terms $19y$ and $-y$ are like because each term contains the same variable raised to the same power.
21. The terms 14 and $14a$ are unlike because one contains a variable while the other does not.
22. The terms $-33b$ and $-3b$ are like because each term contains the same variable raised to the same power.
23. The terms $18x$ and $18y$ are unlike because the first term contains a different variable than the second term.
24. The terms $-6a$ and $-6b$ are unlike because the first term contains a different variable than the second term.
25. The terms x^2 and $-15x^2$ are like because each term contains the same variable raised to the same power.
26. The terms y and $19y$ are like because each term contains the same variables raised to the same power.
27. The terms $3x^2$ and $\frac{1}{5}x$ are unlike because the variables are the same but they are raised to different powers.
28. The terms $12y^2$ and $-y^2$ are like because each term contains the same variables raised to the same powers.
29. The terms $4ab$ and $-3ba$ are like because each term contains the same variables raised to the same powers.
30. The terms $-xyz^2$ and $3yz^2x$ are like because each term contains the same variables raised to the same powers.
31. $-4x + 7x = (-4 + 7)x = 3x$
32. $6x - 8x = (6 - 8)x = (-2)x = -2x$
33. $19y - 5y = (19 - 5)y = 14y$
34. $22z + z = (22 + 1)z = 23z$

$$35. 28a + 13a = (28 + 13)a = 41a$$

$$36. 41b - 17b = (41 - 17)b = 24b$$

$$37. 11z - 11z = (11 - 11)z = 0z = 0$$

$$38. 4y + 4y = (4 + 4)y = 8y$$

39. It is not possible to combine terms because the first term contains a different variable than the second term.

40. It is not possible to combine terms because the first term contains a different variable than the second term.

41. It is not possible to combine terms because the first term does not contain a variable and the second term does.

42. It is not possible to combine terms because the first term is raised to a different power than the second term.

$$43. 5x^2 - 2x^2 = (5 - 2)x^2 = 3x^2$$

$$44. 25z^3 - 10z^3 = (25 - 10)z^3 = 15z^3$$

$$45. 8y - 10y + y = (8 - 10 + 1)y = -1y = -y$$

$$46. 4x^2 + x^2 - 5x^2 = (4 + 1 - 5)x^2 = 0x^2 = 0$$

$$47. 5 + x - 3 + 2x = 5 - 3 + x + 2x = 5 - 3 + (1 + 2)x = 2 + 3x = 3x + 2$$

$$48. x - 5 - 5x + 7 = x - 5x - 5 + 7 = (1 - 5)x - 5 + 7 = -4x + 2$$

$$49. -\frac{3}{4} + z - 3z + \frac{5}{4} = z - 3z + \frac{5}{4} - \frac{3}{4} = (1 - 3)z + \frac{5}{4} - \frac{3}{4} = -2z + \frac{2}{4} = -2z + \frac{1}{2}$$

$$50. \frac{4}{3}z - 100 + 200 - \frac{1}{3}z = \frac{4}{3}z - \frac{1}{3}z - 100 + 200 = \left(\frac{4}{3} - \frac{1}{3}\right)z - 100 + 200 = 1z + 100 = z + 100$$

$$51. 4y - y + 8y = (4 - 1 + 8)y = 11y$$

$$52. 14z - 15z - z = (14 - 15 - 1)z = -2z$$

$$53. -3 + 6z + 2 - 2z = 6z - 2z - 3 + 2 = (6 - 2)z - 3 + 2 = 4z - 1$$

$$54. 19a - 12a + 5 - 6 = (19 - 12)a + 5 - 6 = 7a - 1$$

$$55. -2(3z - 6y) - z = -6z + 12y - z = -6z - z + 12y = (-6 - 1)z + 12y = -7z + 12y = 12y - 7z$$

$$56. 6\left(\frac{1}{2}a - \frac{1}{6}b\right) - 3b = \frac{6}{2}a - \frac{6}{6}b - 3b = 3a - 1b - 3b = -1b - 3b + 3a = (-1 - 3)b + 3a = -4b + 3a = 3a - 4b$$

$$57. 2 - \frac{3}{4}(4x + 8) = 2 - \frac{3 \cdot 4}{4}x - \frac{3 \cdot 8}{4} = 2 - \frac{12}{4}x - \frac{24}{4} = 2 - 3x - 6 = 2 - 6 - 3x = -4 - 3x = -3x - 4$$

$$58. -5 - (5x - 6) = -5 - 5x + 6 = -5x - 5 + 6 = -5x + 1$$

$$59. -x - (5x + 1) = -x - 5x - 1 = (-1 - 5)x - 1 = -6x - 1$$

$$60. 2x - 4(x + 2) = 2x - 4x - 8 = (2 - 4)x - 8 = -2x - 8$$

$$61. 1 - \frac{1}{3}(x + 1) = 1 - \frac{1}{3}x - \frac{1}{3} = -\frac{1}{3}x + 1 - \frac{1}{3} = -\frac{1}{3}x + \frac{3}{3} - \frac{1}{3} = -\frac{1}{3}x + \frac{2}{3}$$

$$62. -3 - 3(4 - x) = -3 - 12 + 3x = -15 + 3x = 3x - 15$$

$$63. \frac{3}{5}(x + y) - \frac{1}{5}(x - 1) = \frac{3}{5}x + \frac{3}{5}y - \frac{1}{5}x + \frac{1}{5} = \frac{3}{5}x - \frac{1}{5}x + \frac{3}{5}y + \frac{1}{5} = \left(\frac{3}{5} - \frac{1}{5}\right)x + \frac{3}{5}y + \frac{1}{5} = \frac{2}{5}x + \frac{3}{5}y + \frac{1}{5}$$

$$64. -5(a + b) - (a + b) = -5a - 5b - a - b = -5a - a - 5b - b = (-5 - 1)a - (5 + 1)b = -6a - 6b$$

$$65. 0.2x^2 + 0.3x^2 - 0.1x^2 = (0.2 + 0.3 - 0.1)x^2 = 0.4x^2$$

$$66. 32z^3 - 52z^3 + 20z^3 = (32 - 52 + 20)z^3 = 0z^3 = 0$$

$$67. 2x^2 - 3x + 5x^2 - 4x = 2x^2 + 5x^2 - 3x - 4x = (2 + 5)x^2 - (3 + 4)x = 7x^2 - 7x$$

$$68. \frac{5}{6}y^2 - 4 + \frac{1}{12}y^2 + 3 = \frac{5}{6}y^2 + \frac{1}{12}y^2 - 4 + 3 = \left(\frac{5}{6} + \frac{1}{12}\right)y^2 - 4 + 3 = \left(\frac{10}{12} + \frac{1}{12}\right)y^2 - 4 + 3 = \frac{11}{12}y^2 - 1$$

$$69. a + 3b - a - b = a - a + 3b - b = (1 - 1)a + (3 - 1)b = 0a + 2b = 2b$$

$$70. 2z^2 - z - z^2 + 3z = 2z^2 - z^2 - z + 3z = (2 - 1)z^2 + (-1 + 3)z = 1z^2 + 2z = z^2 + 2z$$

$$71. 8x^3 + 7y - x^3 - 5y = 8x^3 - x^3 + 7y - 5y = (8 - 1)x^3 + (7 - 5)y = 7x^3 + 2y$$

$$72. 4y - 6z + 2y - 3z = 4y + 2y - 6z - 3z = (4 + 2)y - (6 + 3)z = 6y - 9z$$

$$73. \frac{8x}{8} = \frac{8}{8} \cdot \frac{x}{1} = 1 \cdot \frac{x}{1} = 1 \cdot x = x$$

$$74. \frac{-0.1y}{-0.1} = \frac{-0.1}{-0.1} \cdot \frac{y}{1} = 1 \cdot \frac{y}{1} = 1 \cdot y = y$$

$$75. \frac{-3y}{-y} = \frac{-3}{1} \cdot \frac{y}{-y} = -3 \cdot (-1) = 3$$

$$76. \frac{2x}{7x} = \frac{2}{7} \cdot \frac{x}{x} = \frac{2}{7} \cdot 1 = \frac{2}{7}$$

$$77. \frac{-108z}{-108} = \frac{-108}{-108} \cdot \frac{z}{1} = 1 \cdot \frac{z}{1} = 1 \cdot z = z$$

$$78. \frac{3xy}{-6xy} = \frac{3}{-6} \cdot \frac{xy}{xy} = -\frac{3}{6} \cdot 1 = -\frac{3}{6} = -\frac{1}{2}$$

$$79. \frac{9x - 6}{3} = \frac{9x}{3} - \frac{6}{3} = \frac{9}{3} \cdot \frac{x}{1} - \frac{6}{3} = 3x - 2$$

$$80. \frac{18y + 9}{9} = \frac{18y}{9} + \frac{9}{9} = \frac{18}{9} \cdot \frac{y}{1} + \frac{9}{9} = 2y + 1$$

$$81. \frac{14z+21}{7} = \frac{14z}{7} + \frac{21}{7} = \frac{14}{7} \cdot \frac{z}{1} + \frac{21}{7} = 2z+3$$

$$82. \frac{15x-20}{5} = \frac{15x}{5} - \frac{20}{5} = \frac{15}{5} \cdot \frac{x}{1} - \frac{20}{5} = 3x-4$$

$$83. 5x+6x=(5+6)x=11x$$

$$84. x+3x=(1+3)x=4x$$

$$85. x^2+2x^2=(1+2)x^2=3x^2$$

$$86. \frac{1}{2}x - \frac{3}{4}x = \left(\frac{1}{2} - \frac{3}{4}\right)x = \left(\frac{2}{4} - \frac{3}{4}\right)x = -\frac{1}{4}x$$

$$87. 6x-4x=(6-4)x=2x$$

$$88. 2^3x - 3^2x = 8x - 9x = (8-9)x = -1x = -x$$

89. (a) Let w be the constant width of the street in feet. The area of each street section equals its length times its width. The total area of the street is

$$400w + 350w + 220w + 600w = (400 + 350 + 220 + 600)w = 1570w.$$

- (b) If the width = 42 feet, $w = 42$. Then, $1570w = 1570 \cdot 42 = 65,940 \text{ ft}^2$.

90. (a) Let w be the constant width of the sidewalk in feet. The area of each sidewalk section equals its length times its width. The total area of the sidewalk is

$$12w + 14w + 10w = (12 + 14 + 10)w = 36w.$$

- (b) If the width = 5 feet, $w = 5$. Then, $36w = 36 \cdot 5 = 180 \text{ ft}^2$.

91. (a) Let x be the number of minutes. Then, $20x + 30x = 50x$ = the number of cubic feet of snow removed in x minutes.

- (b) Let $x = 48$. Then, the total number of cubic feet of snow removed in 48 minutes is

$$50x = 50 \cdot 48 = 2400 \text{ ft}^3.$$

- (c) First, calculate how many cubic feet of snow the driveway contains. Volume equals length times width times height; thus, the driveway contains $30 \cdot 20 \cdot 2 = 1200 \text{ ft}^3$ of snow. If 50 cubic feet of snow are removed in 1 minute, then 1200 cubic feet of snow are removed in 24 minutes.

92. (a) Let x equal the number of seconds. Then, $2x + 5x = (2+5)x = 7x$ is an expression that gives the length of the rope wound by both motors in x seconds.

- (b) First find the number of seconds in 3 minutes; $3 \cdot 60 = 180$, so there are 180 seconds in 3 minutes. To find the total length of rope wound up in 180 seconds, take $7x = 7 \cdot 180 = 1260 \text{ ft}$.

(c) Because it takes 1 second for 7 feet of rope to be wound, it takes $\frac{2100}{7}$ seconds for 2100 feet

of rope to be wound; $\frac{2100}{7} = \frac{300 \cdot 7}{1 \cdot 7} = 300$ seconds $= 300 \text{ sec} \cdot \frac{1 \text{ min}}{60 \text{ sec}} = 5$ minutes.

Checking Basic Concepts Sections 1.7 and 1.8

1. (a) $y \cdot 18 = 18y$
 (b) $10 + x = x + 10$
2. $5 \cdot (y \cdot 4) = 5 \cdot (4y) = 20y$
3. (a) $10 - (5 + x) = 10 - 5 - x = 5 - x$
 (b) $5(x - 7) = 5x - 35$
4. Because $5x + 3x = (5 + 3)x = 8x$, this equation illustrates the distributive property.
5. $-4xy + 4xy = (-4 + 4)xy = 0xy = 0$
6. (a) $32 + 17 + 8 + 3 = (32 + 8) + (17 + 3) = 60$
 (b) $\left(\frac{5}{6} \cdot \frac{6}{5}\right) \cdot \left(\frac{7}{8} \cdot \frac{8}{1}\right) = 1 \cdot 7 = 7$
 (c) $567 - 200 + 1 = 367 + 1 = 368$
7. (a) The terms $-3x$ and $-3z$ are unlike because the first term contains a different variable than the second term.
 (b) The terms $4x^2$ and $-2x^2$ are like because each term contains the same variable raised to the same power.
8. (a) $5z + 9z = (5 + 9)z = 14z$
 (b) $5y - 4 - 8y + 7 = 5y - 8y - 4 + 7 = (5 - 8)y - 4 + 7 = -3y + 3$
9. (a) $2y - (5y + 3) = 2y - 5y - 3 = (2 - 5)y - 3 = -3y - 3$
 (b) $-4(x + 3y) + 2(2x - y) = -4x - 12y + 4x - 2y = -4x + 4x - 12y - 2y = (-4 + 4)x - (12 + 2)y = 0x - 14y = -14y$
 (c) $\frac{20x}{20} = \frac{20}{20} \cdot x = 1 \cdot x = x$
 (d) $\frac{35x^2}{x^2} = 35 \cdot \frac{x^2}{x^2} = 35 \cdot 1 = 35$
10. $3x + 5x = (3 + 5)x = 8x$

Chapter 1 Review Exercises

1. The number 29 is prime because its only factors are itself and 1.
2. The number 27 is a composite number because it has factors other than itself and 1; $27 = 3 \cdot 3 \cdot 3$.
3. The number 108 is a composite number because it has factors other than itself and 1;
 $108 = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3$.
4. The number 91 is a composite number because it has factors other than itself and 1; $91 = 7 \cdot 13$.
5. The number 0 is neither a prime nor a composite number.
6. The number 1 is neither a prime nor a composite number.
7. $2x - 5$, when $x = 4$, is $2 \cdot 4 - 5 = 8 - 5 = 3$
8. $7 - \frac{10}{x}$, when $x = 5$, is $7 - \frac{10}{5} = 7 - \frac{2 \cdot 5}{1 \cdot 5} = 7 - \frac{2}{1} \cdot \frac{5}{5} = 7 - 2 \cdot 1 = 7 - 2 = 5$
9. $9x - 2y$, when $x = 2$ and $y = 3$, is $9 \cdot 2 - 2 \cdot 3 = 18 - 6 = 12$
10. $\frac{2x}{x-y}$, when $x = 6$ and $y = 4$, is $\frac{2 \cdot 6}{6-4} = \frac{12}{2} = \frac{6 \cdot 2}{1 \cdot 2} = \frac{6}{1} \cdot \frac{2}{2} = 6 \cdot 1 = 6$
11. $y = x - 5$, when $x = 12$, is $y = 12 - 5 \Rightarrow y = 7$
12. $y = xz + 1$, when $x = 2$ and $z = 3$, is $y = 2 \cdot 3 + 1 \Rightarrow y = 6 + 1 \Rightarrow y = 7$
13. $y = 4(x - z)$, when $x = 7$ and $z = 5$, is $y = 4(7 - 5) \Rightarrow y = 4(2) \Rightarrow y = 8$
14. $y = \frac{x+z}{4}$, when $x = 14$ and $z = 10$, is $y = \frac{14+10}{4} \Rightarrow y = \frac{24}{4} \Rightarrow y = 6$
15. Three squared increased by five is $3^2 + 5$.
16. Two cubed divided by the quantity three plus one is $2^3 \div (3+1)$.
17. Let x be the number. Then, the product of three and the number is $3x$.
18. Let x be the number. Then, the difference between the number and four is $x - 4$.
19. Since $15 = 3 \cdot 5$ and $35 = 5 \cdot 7$ then the GCF of 15 and 35 is 5.
20. Since $12 = 2 \cdot 2 \cdot 3$, $30 = 2 \cdot 3 \cdot 5$ and $42 = 2 \cdot 3 \cdot 7$ then the GCF of 12, 30 and 42 is $2 \cdot 3 = 6$
21. (a) $\frac{5 \cdot 7}{8 \cdot 7} = \frac{5}{8} \cdot \frac{7}{7} = \frac{5}{8} \cdot 1 = \frac{5}{8}$
 (b) $\frac{3a}{4a} = \frac{3}{4} \cdot \frac{a}{a} = \frac{3}{4} \cdot 1 = \frac{3}{4}$
22. (a) $\frac{9}{12} = \frac{3 \cdot 3}{4 \cdot 3} = \frac{3}{4} \cdot \frac{3}{3} = \frac{3}{4} \cdot 1 = \frac{3}{4}$
 (b) $\frac{36}{60} = \frac{3 \cdot 12}{5 \cdot 12} = \frac{3}{5} \cdot \frac{12}{12} = \frac{3}{5} \cdot 1 = \frac{3}{5}$

$$23. \frac{3}{4} \cdot \frac{5}{6} = \frac{3 \cdot 5}{4 \cdot 6} = \frac{15}{24} = \frac{5 \cdot 3}{8 \cdot 3} = \frac{5}{8} \cdot \frac{3}{3} = \frac{5}{8} \cdot 1 = \frac{5}{8}$$

$$24. \frac{1}{2} \cdot \frac{4}{9} = \frac{1 \cdot 4}{2 \cdot 9} = \frac{4}{18} = \frac{2 \cdot 2}{9 \cdot 2} = \frac{2}{9} \cdot \frac{2}{2} = \frac{2}{9} \cdot 1 = \frac{2}{9}$$

$$25. \frac{2}{3} \cdot \frac{9}{10} = \frac{2 \cdot 9}{3 \cdot 10} = \frac{18}{30} = \frac{6 \cdot 3}{6 \cdot 5} = \frac{3}{5}$$

$$26. \frac{12}{11} \cdot \frac{22}{23} = \frac{12 \cdot 22}{11 \cdot 23} = \frac{264}{253} = \frac{11 \cdot 24}{11 \cdot 23} = \frac{24}{23}$$

$$27. 4 \cdot \frac{5}{8} = \frac{4 \cdot 5}{1 \cdot 8} = \frac{20}{8} = \frac{4 \cdot 5}{4 \cdot 2} = \frac{5}{2}$$

$$28. \frac{2}{3} \cdot 9 = \frac{2 \cdot 9}{3 \cdot 1} = \frac{18}{3} = 6$$

$$29. \frac{x}{3} \cdot \frac{6}{x} = \frac{x \cdot 6}{3 \cdot x} = \frac{6}{3} \cdot \frac{x}{x} = 2 \cdot 1 = 2$$

$$30. \frac{2}{3} \cdot \frac{9x}{4y} = \frac{2 \cdot 9x}{3 \cdot 4y} = \frac{18x}{12y} = \frac{3x \cdot 6}{2y \cdot 6} = \frac{3x}{2y} \cdot 1 = \frac{3x}{2y}$$

$$31. \text{One-fifth of three-sevenths equals } \frac{1}{5} \cdot \frac{3}{7} = \frac{1 \cdot 3}{5 \cdot 7} = \frac{3}{35}.$$

$$32. (a) \text{ The reciprocal of 8 equals the reciprocal of } \frac{8}{1}, \text{ which is } \frac{1}{8}.$$

$$(b) \text{ The reciprocal of 1 equals the reciprocal of } \frac{1}{1}, \text{ which is } \frac{1}{1}.$$

$$(c) \text{ The reciprocal of } \frac{5}{19} \text{ which is } \frac{19}{5}.$$

$$(d) \text{ The reciprocal of } \frac{3}{2} \text{ which is } \frac{2}{3}.$$

$$33. \frac{3}{2} \div \frac{1}{6} = \frac{3}{2} \cdot \frac{6}{1} = \frac{3 \cdot 6}{2 \cdot 1} = \frac{18}{2} = \frac{9 \cdot 2}{1 \cdot 2} = \frac{9}{1} \cdot \frac{2}{2} = 9 \cdot 1 = 9$$

$$34. \frac{9}{10} \div \frac{7}{5} = \frac{9}{10} \cdot \frac{5}{7} = \frac{9 \cdot 5}{10 \cdot 7} = \frac{45}{70} = \frac{9 \cdot 5}{14 \cdot 5} = \frac{9}{14} \cdot \frac{5}{5} = \frac{9}{14} \cdot 1 = \frac{9}{14}$$

$$35. 8 \div \frac{2}{3} = \frac{8}{1} \cdot \frac{3}{2} = \frac{8 \cdot 3}{1 \cdot 2} = \frac{24}{2} = \frac{12 \cdot 2}{1 \cdot 2} = \frac{12}{1} \cdot \frac{2}{2} = 12 \cdot 1 = 12$$

$$36. \frac{3}{4} \div 6 = \frac{3}{4} \cdot \frac{1}{6} = \frac{3 \cdot 1}{4 \cdot 6} = \frac{3}{24} = \frac{1 \cdot 3}{8 \cdot 3} = \frac{1}{8} \cdot \frac{3}{3} = \frac{1}{8} \cdot 1 = \frac{1}{8}$$

$$37. \frac{x}{y} \div \frac{3}{y} = \frac{x}{y} \cdot \frac{y}{3} = \frac{x \cdot y}{y \cdot 3} = \frac{xy}{3y} = \frac{x}{3}$$

$$38. \frac{4x}{3y} \div \frac{9x}{5} = \frac{4x}{3y} \cdot \frac{5}{9x} = \frac{4x \cdot 5}{3y \cdot 9x} = \frac{20x}{27xy} = \frac{20}{27y}$$

39. The least common denominator for the fractions $\frac{1}{8}$ and $\frac{5}{12}$ is 24, because 24 is the smallest number that both 8 and 12 divide into evenly.

40. The least common denominator for the fractions $\frac{3}{14}$ and $\frac{1}{21}$ is 42, because 42 is the smallest number that both 14 and 21 divide into evenly.

$$41. \frac{2}{15} + \frac{3}{15} = \frac{2+3}{15} = \frac{5}{15} = \frac{1 \cdot 5}{3 \cdot 5} = \frac{1}{3}$$

$$42. \frac{5}{4} - \frac{3}{4} = \frac{5-3}{4} = \frac{2}{4} = \frac{1 \cdot 2}{2 \cdot 2} = \frac{1}{2}$$

$$43. \frac{11}{12} - \frac{1}{8} = \frac{11 \cdot 2}{12 \cdot 2} - \frac{1 \cdot 3}{8 \cdot 3} = \frac{22}{24} - \frac{3}{24} = \frac{22-3}{24} = \frac{19}{24}$$

$$44. \frac{6}{11} - \frac{3}{22} = \frac{6 \cdot 2}{11 \cdot 2} - \frac{3}{22} = \frac{12}{22} - \frac{3}{22} = \frac{12-3}{22} = \frac{9}{22}$$

$$45. \frac{2}{3} - \frac{1}{2} + \frac{1}{4} = \frac{2 \cdot 4}{3 \cdot 4} - \frac{1 \cdot 6}{2 \cdot 6} + \frac{1 \cdot 3}{4 \cdot 3} = \frac{8}{12} - \frac{6}{12} + \frac{3}{12} = \frac{8-6+3}{12} = \frac{5}{12}$$

$$46. \frac{1}{6} + \frac{2}{3} - \frac{1}{9} = \frac{1 \cdot 3}{6 \cdot 3} + \frac{2 \cdot 6}{3 \cdot 6} - \frac{1 \cdot 2}{9 \cdot 2} = \frac{3}{18} + \frac{12}{18} - \frac{2}{18} = \frac{3+12-2}{18} = \frac{13}{18}$$

$$47. 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 = 5^6$$

$$48. \frac{7}{6} \cdot \frac{7}{6} \cdot \frac{7}{6} = \left(\frac{7}{6}\right)^3$$

$$49. x \cdot x \cdot x \cdot x \cdot x = x^5$$

$$50. 3 \cdot 3 \cdot 3 \cdot 3 = 3^4$$

$$51. (x+1) \cdot (x+1) = (x+1)^2$$

$$52. (a-5) \cdot (a-5) \cdot (a-5) = (a-5)^3$$

$$53. (a) \quad 4^3 = 4 \cdot 4 \cdot 4 = 64$$

$$(b) \quad 7^2 = 7 \cdot 7 = 49$$

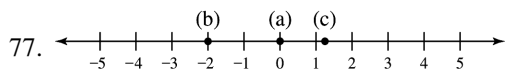
$$(c) \quad 8^1 = 8$$

$$54. 2^n = 32; 2 \cdot 2 \cdot 2 \cdot 2 \cdot 2 = 32, \text{ thus } 2^5 = 32 \text{ and } n = 5$$

$$55. 7 + 3 \cdot 6 = 7 + 18 = 25$$

$$56. 15 - 5 - 3 = (15 - 5) - 3 = 10 - 3 = 7$$

57. $24 \div 4 \div 2 = (24 \div 4) \div 2 = 6 \div 2 = 3$
58. $30 - 15 \div 3 = 30 - (15 \div 3) = 30 - 5 = 25$
59. $18 \div 6 - 2 = (18 \div 6) - 2 = 3 - 2 = 1$
60. $\frac{18}{4+5} = \frac{18}{9} = \frac{2 \cdot 9}{1 \cdot 9} = \frac{2}{1} \cdot \frac{9}{9} = 2 \cdot 1 = 2$
61. $9 - 3^2 = 9 - 9 = 0$
62. $2^3 - 8 = 8 - 8 = 0$
63. $2^4 - 8 + \frac{4}{2} = (2 \cdot 2 \cdot 2 \cdot 2) - 8 + 2 = 16 - 8 + 2 = (16 - 8) + 2 = 8 + 2 = 10$
64. $3^2 - 4(5 - 3) = 3^2 - 4(2) = 9 - 8 = 1$
65. $7 - \frac{4+6}{2+3} = 7 - \frac{10}{5} = 7 - 2 = 5$
66. $3^3 - 2^3 = (3 \cdot 3 \cdot 3) - (2 \cdot 2 \cdot 2) = 27 - 8 = 19$
67. (a) The opposite of -8 is $-(-8) = 8$.
- (b) The opposite of $-(-(-3))$ is $-(-(-(-3))) = 3$.
68. (a) The opposite of $-\left(\frac{-3}{7}\right)$ is $-\left(-\left(\frac{-3}{7}\right)\right) = -\frac{3}{7}$.
- (b) The opposite of $\frac{-2}{-5}$ is $-\left(\frac{-2}{-5}\right) = -\frac{2}{5}$.
69. (a) $\frac{4}{5} = \frac{4}{5} \cdot \frac{2}{2} = \frac{8}{10} = 0.8$
- (b) $\frac{3}{20} = \frac{3}{20} \cdot \frac{5}{5} = \frac{15}{100} = 0.15$
70. (a) $\frac{5}{9} = 0.\overline{5}$
- (b) $\frac{7}{11} = 0.\overline{63}$
71. The number 0 is a whole number and a rational number, and is an integer.
72. The number $-\frac{5}{6}$ is a rational number.
73. The number -7 is a rational number and is an integer.
74. The number $\sqrt{17}$ is an irrational number.
75. The number π is an irrational number.
76. The number 3.4 is a rational number.



78. (a) $|-5| = 5$

(b) $|\pi| = \pi$

(c) $|4 - 4| = |0| = 0$

79. (a) $-5 < 4$

(b) $-\frac{1}{2} > -\frac{5}{2}$

(c) $|-9| = 9$ and $-3 < 9$ so $-3 < |-9|$.

(d) $|-8| = 8$ and $|-1| = 1$ and $8 > 1$ so $|-8| > |-1|$.

80. $-3, -\frac{2}{3}, \sqrt{3}, \pi - 1, 3$

81. $-5 + 9 = 4$

82. $4 + (-7) = -3$

83. $-1 + 2 = 1$

84. $-2 + (-3) = -5$

85. $5 + (-4) = 1$

86. $-9 - (-7) = -9 + 7 = -2$

87. $11 \cdot (-4) = -44$

88. $-8 \cdot (-5) = 40$

89. $11 \div (-4) = -\frac{11}{4}$

90. $-4 \div \frac{4}{7} = -\frac{4}{1} \cdot \frac{7}{4} = -\frac{4 \cdot 7}{4} = -\frac{7 \cdot 4}{1 \cdot 4} = -\frac{7}{1} \cdot \frac{4}{4} = -7 \cdot 1 = -7$

91. $-\frac{5}{9} - \left(-\frac{1}{3}\right) = -\frac{5}{9} + \frac{1}{3} = -\frac{5}{9} + \frac{1 \cdot 3}{3 \cdot 3} = -\frac{5}{9} + \frac{3}{9} = -\frac{2}{9}$

92. $-\frac{1}{2} + \left(-\frac{3}{4}\right) = -\frac{1 \cdot 2}{2 \cdot 2} + \left(-\frac{3}{4}\right) = -\frac{2}{4} + \left(-\frac{3}{4}\right) = -\frac{5}{4}$

93. $-\frac{1}{3} \cdot \left(-\frac{6}{7}\right) = \frac{1 \cdot 6}{3 \cdot 7} = \frac{2 \cdot 3}{7 \cdot 3} = \frac{2}{7} \cdot \frac{3}{3} = \frac{2}{7} \cdot 1 = \frac{2}{7}$

94. $\frac{\frac{4}{5}}{-7} = \frac{4}{5} \div (-7) = \frac{4}{5} \cdot \left(-\frac{1}{7}\right) = -\frac{4}{35}$

$$95. -\frac{3}{2} \div \left(-\frac{3}{8}\right) = -\frac{3}{2} \cdot \left(-\frac{8}{3}\right) = \frac{24}{6} = 4$$

$$96. \frac{3}{8} \div (-0.5) = \frac{3}{8} \div \left(-\frac{1}{2}\right) = \frac{3}{8} \cdot \left(-\frac{2}{1}\right) = -\frac{6}{8} = -\frac{3 \cdot 2}{4 \cdot 2} = -\frac{3}{4} \cdot \frac{2}{2} = -\frac{3}{4} \cdot 1 = -\frac{3}{4}$$

$$97. 3 + (-5) = -2$$

$$98. 2 - (-4) = 2 + 4 = 6$$

$$99. \frac{7}{9} = 0.\overline{7}$$

$$100. 2\frac{1}{5} = 2.2$$

$$101. 0.6 = \frac{6}{10} = \frac{3 \cdot 2}{5 \cdot 2} = \frac{3}{5} \cdot \frac{2}{2} = \frac{3}{5} \cdot 1 = \frac{3}{5}$$

$$102. 0.375 = \frac{375}{1000} = \frac{3 \cdot 125}{8 \cdot 125} = \frac{3}{8} \cdot \frac{125}{125} = \frac{3}{8} \cdot 1 = \frac{3}{8}$$

$$103. 3 + 16 = 16 + 3$$

$$104. 14 \cdot (-x) = -x \cdot 14$$

$$105. -4 + (1 + 3) = (-4 + 1) + 3$$

$$106. (x \cdot y) \cdot 5 = x \cdot (y \cdot 5)$$

$$107. 5(x + 12) = 5 \cdot x + 5 \cdot 12 = 5x + 60$$

$$108. -(a - 3) = -1 \cdot a - 1 \cdot (-3) = -a + 3$$

$$109. \text{The equation } y + 0 = y \text{ is illustrating the identity property of addition.}$$

$$110. \text{The equation } b \cdot 1 = b \text{ is illustrating the identity property of multiplication.}$$

$$111. \text{The equation } \frac{1}{4} \cdot 4 = 1 \text{ is illustrating the inverse property of multiplication.}$$

$$112. \text{The equation } -3a + 3a = 0 \text{ is illustrating the inverse property of addition.}$$

$$113. \text{Commutative (multiplication)}$$

$$114. \text{Associative (addition)}$$

$$115. \text{Distributive}$$

$$116. \text{Commutative (addition)}$$

$$117. \text{Identity (multiplication)}$$

$$118. \text{Associative (multiplication)}$$

$$119. \text{Distributive}$$

$$120. \text{Identity (addition)}$$

$$121. \text{Inverse (addition)}$$

$$122. \text{Inverse (multiplication)}$$

123. $7 + 9 + 12 + 8 + 1 + 3 = (7 + 3) + (9 + 1) + (12 + 8) = 10 + 10 + 20 = 40$
124. $500 - 199 = 500 - 200 + 1 = 300 + 1 = 301$
125. $25 \cdot 99 = 25(100 - 1) = 25(100) - 25(1) = 2500 - 25 = 2475$
126. $4581 + 2000 - 1 = 6581 - 1 = 6580$
127. $54.98 \times 10 = 549.8$ because we move the decimal point to the right one place.
128. $4356 \div 100 = 43.56$ because we move the decimal point to the left two places.
129. $55x$ is a term; its coefficient is 55.
130. $-xy$ is a term; its coefficient is -1 .
131. $9xy + 2z$ is not a term because it is the sum of two terms.
132. $x - 7$ is not a term because it is the difference of two terms.
133. $-10x + 4x = (-10 + 4)x = -6x$
134. $19z - 4z = (19 - 4)z = 15z$
135. $3x^2 + x^2 = (3 + 1)x^2 = 4x^2$
136. $7 + 2x - 6 + x = 7 - 6 + 2x + x = 7 - 6 + (2 + 1)x = 1 + 3x = 3x + 1$
137. $-\frac{1}{2} + \frac{3}{2}z - z + \frac{5}{2} = -\frac{1}{2} + \frac{5}{2} + \frac{3}{2}z - z = \frac{-1 + 5}{2} + \left(\frac{3}{2} - 1\right)z = \frac{4}{2} + \left(\frac{3}{2} - \frac{2}{2}\right)z = 2 + \frac{1}{2}z = \frac{1}{2}z + 2$
138. $5(x - 3) - (4x + 3) = 5x - 15 - 4x - 3 = 5x - 4x - 15 - 3 = (5 - 4)x - 15 - 3 = x - 18$
139. $4x^2 - 3 + 5x^2 - 3 = 4x^2 + 5x^2 - 3 - 3 = (4 + 5)x^2 - (3 + 3) = 9x^2 - 6$
140. $3x^2 + 4x^2 - 7x^2 = (3 + 4 - 7)x^2 = 0x^2 = 0$
141. $\frac{35a}{7a} = \frac{35}{7} \cdot \frac{a}{a} = \frac{35}{7} \cdot 1 = 5 \cdot 1 = 5$
142. $\frac{0.5c}{0.5} = \frac{0.5}{0.5} \cdot c = 1 \cdot c = c$
143. $\frac{15y + 10}{5} = \frac{15y}{5} + \frac{10}{5} = \frac{15}{5} \cdot \frac{y}{1} + \frac{10}{5} = 3y + 2$
144. $\frac{24x - 60}{12} = \frac{24x}{12} - \frac{60}{12} = \frac{24}{12} \cdot \frac{x}{1} - \frac{60}{12} = 2x - 5$
145. (a) Let x be the number of minutes. The first person paints $3 \cdot x$ or $3x$, square feet in x minutes.
The second person paints $4 \cdot x$ or $4x$, square feet in x minutes. Working together the two people paint $3x + 4x = (3 + 4)x = 7x$ square feet in x minutes.
- (b) First convert hours to minutes; 1 hour = 60 minutes. Replace x with 60 to get
 $7x = 7 \cdot 60 = 420 \text{ ft}^2$.

- (c) First find the number of square feet the wall contains. The area of the wall is width times height. The area $= 8 \cdot 21 = 168 \text{ ft}^2$. Because the two people paint 7 square feet in 1 minute, it takes them $168 \div 7 = 24$ minutes to paint the wall.

146. The area of a triangle is $\frac{1}{2} \cdot \text{base} \cdot \text{height}$. The base of the triangle is 8 and the height is 4. Thus,

$$\frac{1}{2} \cdot 8 \cdot 4 = 16 \text{ ft}^2.$$

147. See Figure 147. Since there are 8 pints in 1 gallon, $P = 8G$, where P = pints and G = gallons.

Gallons (G)	1	2	3	4	5	6
Pints (P)	8	16	24	32	40	48

Figure 147

148. Because each text message costs 5 cents, $C = 0.05x$, where C represents cost and x represents the number of text messages

149. Find the fraction of the population that will be over the age of 65 but under the age of 85. Thus,

$$\frac{1}{5} - \frac{1}{20} = \frac{1 \cdot 4}{5 \cdot 4} - \frac{1}{20} = \frac{4}{20} - \frac{1}{20} = \frac{3}{20}.$$

150. The investment doubles every $72 \div 9 = 8$ years, so in 24 years the investment will double 3 times.

The investment will increase by $2^3 = 8$ times \$25,000 and will equal \$200,000.

151. Find the length of each piece when the board is cut into five equal lengths. Because the board

measures $5\frac{3}{4} = \frac{23}{4}$, $\frac{23}{4} \div 5 = \frac{23}{4} \cdot \frac{1}{5} = \frac{23}{20} = 1\frac{3}{20}$ feet per piece.

152. Add the individual distances to find the total distance. Thus,

$$3\frac{1}{8} + 4\frac{3}{8} + 6\frac{1}{4} + 1\frac{5}{8} = \frac{25}{8} + \frac{35}{8} + \frac{25}{4} + \frac{13}{8} = \frac{25}{8} + \frac{35}{8} + \frac{50}{8} + \frac{13}{8} = \frac{25+35+50+13}{8} = \frac{123}{8} = 15\frac{3}{8} \text{ miles.}$$

153. Subtract the withdrawals and add the deposits to the initial balance.

Thus, $1652 - 78 - 91 + 256 - 638 = \1101 .

154. The difference between the two temperatures is $108 - (-16) = 108 + 16 = 124^\circ\text{F}$.

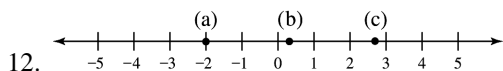
155. Multiply the real numbers 202 and $\frac{16}{25}$ to obtain $202 \cdot \frac{16}{25} = 129.28$. Total admissions for *Titanic* were about 129 million people.

Chapter 1 Test

1. (a) The number 29 is a prime number because its only factors are itself and 1.
 (b) The number 56 is a composite number because it has factors other than itself and 1;
 $56 = 2 \cdot 2 \cdot 2 \cdot 7$.
2. $\frac{5x}{2x-1}$, when $x = -3$, is $\frac{5 \cdot (-3)}{2 \cdot (-3) - 1} = \frac{-15}{-6-1} = \frac{-15}{-7} = \frac{15}{7}$
3. $4^2 - 3 = 16 - 3 = 13$
4. $\frac{24}{32} = \frac{3 \cdot 8}{4 \cdot 8} = \frac{3}{4}$
5. $\frac{2}{10} \cdot \frac{1}{6} = \frac{2 \cdot 1}{10 \cdot 6} = \frac{2}{60} = \frac{2 \cdot 1}{2 \cdot 30} = \frac{1}{30}$
6. The least common denominator for the fractions $\frac{3}{8}$ and $\frac{5}{12}$ is 24, because 24 is the smallest number that both 8 and 12 divide into evenly.
7. (a) $\frac{5}{8} + \frac{1}{8} = \frac{5+1}{8} = \frac{6}{8} = \frac{3 \cdot 2}{4 \cdot 2} = \frac{3}{4}$
 (b) $\frac{5}{9} - \frac{3}{15} = \frac{5 \cdot 5}{9 \cdot 5} - \frac{3 \cdot 3}{15 \cdot 3} = \frac{25}{45} - \frac{9}{45} = \frac{25-9}{45} = \frac{16}{45}$
 (c) $\frac{3}{5} \cdot \frac{10}{21} = \frac{3 \cdot 10}{5 \cdot 21} = \frac{30}{105} = \frac{2 \cdot 15}{7 \cdot 15} = \frac{2}{7}$
 (d) $6 \div \frac{8}{5} = \frac{6}{1} \cdot \frac{5}{8} = \frac{6 \cdot 5}{1 \cdot 8} = \frac{30}{8} = \frac{15 \cdot 2}{4 \cdot 2} = \frac{15}{4}$
 (e) $\frac{5}{12} + \frac{4}{9} = \frac{5 \cdot 3}{12 \cdot 3} + \frac{4 \cdot 4}{9 \cdot 4} = \frac{15}{36} + \frac{16}{36} = \frac{15+16}{36} = \frac{31}{36}$
 (f) $\frac{10}{13} \div 5 = \frac{10}{13} \cdot \frac{1}{5} = \frac{10 \cdot 1}{13 \cdot 5} = \frac{10}{65} = \frac{2 \cdot 5}{13 \cdot 5} = \frac{2}{13}$
8. $y \cdot y \cdot y \cdot y = y^4$
9. (a) $6 + 10 \div 5 = 6 + 2 = 8$
 (b) $4^3 - (3 - 5 \cdot 2) = 64 - (3 - 10) = 64 - (-7) = 64 + 7 = 71$
 (c) $-6^2 - 6 + \frac{4}{2} = -36 - 6 + 2 = -40$
 (d) $11 - \frac{1+3}{6-4} = 11 - \frac{4}{2} = 11 - 2 = 9$
10. $\frac{7}{20} = 7 \div 20 = 0.35$

11. (a) -1 is an integer and a rational number.

(b) $\sqrt{5}$ is an irrational number.



13. (a) $2 < |-5|$ because $|-5| = 5$ and $2 < 5$.

(b) $|-1| > |0|$ because $|-1| = 1$, $|0| = 0$, and $1 > 0$.

14. (a) $-5 \div \frac{5}{6} = \frac{-5}{1} \cdot \frac{6}{5} = \frac{-5 \cdot 6}{1 \cdot 5} = \frac{-6}{1} = -6$

(b) $-7 \cdot (-3) = 21$

15. $0.75 = \frac{75}{100} = \frac{25 \cdot 3}{25 \cdot 4} = \frac{3}{4}$

16. (a) Distributive

(b) Associative (multiplication)

(c) Commutative (addition)

17. $17 \cdot 102 = 17(100 + 2) = 17(100) + 17(2) = 1700 + 34 = 1734$

18. (a) $5 - 5z + 7 + z = 5 + 7 - 5z + z = 12 + (-5 + 1)z = 12 + (-4)z = 12 - 4z$

(b) $12x - (6 - 3x) = 12x - 6 + 3x = 12x + 3x - 6 = (12 + 3)x - 6 = 15x - 6$

(c) $5 - 4(x + 6) + \frac{15x}{3} = 5 - 4x - 24 + \frac{15}{3}x = 5 - 4x - 24 + 5x = 5x - 4x + 5 - 24 =$
 $(5 - 4)x - 19 = 1x - 19 = x - 19$

19. (a) Let x be the number of hours. Then, the first person can mow $\frac{4}{3} \cdot x$ acres in x hours, and the second person can mow $\frac{1}{4} \cdot x$ acres in x hours. Thus,

$$\frac{4}{3}x + \frac{1}{4}x = \frac{16}{12}x + \frac{3}{12}x = \left(\frac{16}{12} + \frac{3}{12}\right)x = \frac{19}{12}x.$$

(b) Let $x = 8$. Then, $\frac{19}{12} \cdot 8 = \frac{19 \cdot 8}{12} = \frac{152}{12} = \frac{38 \cdot 4}{3 \cdot 4} = \frac{38}{3} = 12\frac{2}{3}$ acres.

20. Find $7\frac{4}{5} \div 3$ to find the length of three equal parts.

Because $7\frac{4}{5} = \frac{39}{5}$, $\frac{39}{5} \div 3 = \frac{39}{5} \cdot \frac{1}{3} = \frac{39}{15} = \frac{13 \cdot 3}{5 \cdot 3} = \frac{13}{5} = 2\frac{3}{5}$ feet.

21. (a) Because $39 \div 3 = 13$, each ticket costs \$13.

Then, let C = cost and x be the number of tickets to obtain $C = 13x$.

(b) Let $x = 17$. Thus, $13 \cdot 17 = \$221$.

22. Subtract the withdrawals from and add the deposits to the initial balance.

Thus, $892 - 57 + 150 - 345 = \$640$.

Chapter 1 Extended and Discovery Exercises

1. $2 + 2 - 2 - 2 = 4 - 4 = 0$; $3 \times 3 + 3 \div 3 = 9 + 1 = 10$; $4 \div 4 + 4 - 4 = 1 + 0 = 1$;

$6 \times 6 + 6 - 6 = 36 + 0 = 36$; $7 \times 7 + 7 + 7 = 49 + 14 = 63$ *Answers may vary.*

- 2.

16	2	3	13
5	11	10	8
9	7	6	12
4	14	15	1