Chapter 2

Section 2.1 Practice Exercises

1. $\frac{9}{2}$ ← numerator
← denominator

2. $\frac{10}{17}$ ← numerator
← denominator

3. $\frac{0}{2} = 0$

4. $\frac{8}{8} = 1$

5. $\frac{4}{0}$ is undefined.

6. $\frac{20}{1} = 20$

7. In this figure, 3 of the 8 equal parts are shaded.
Thus, the fraction is $\frac{3}{8}$.

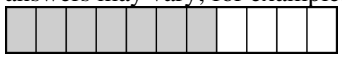
8. In this figure, 1 of the 6 equal parts is shaded.
Thus, the fraction is $\frac{1}{6}$.

9. Of the 10 parts of the syringe, 7 parts are filled.
Thus, the fraction is $\frac{7}{10}$.

10. Of the 16 parts of one inch, 9 parts are measured.
Thus, the fraction is $\frac{9}{16}$.

11. answers may vary; for example,

12. answers may vary; for example,



13. number of planets farther $\rightarrow 5$
number of planets in our solar system $\rightarrow 8$
$\frac{5}{8}$ of the planets in our solar system are farther from the Sun than Earth is.

14. a. $\frac{5}{8}$ is a proper fraction.

b. $\frac{7}{7}$ is an improper fraction.

c. $\frac{14}{13}$ is an improper fraction.

d. $\frac{13}{14}$ is a proper fraction.

e. $5\frac{1}{4}$ is a mixed number.

f. $\frac{100}{49}$ is an improper fraction.

15. Each part is $\frac{1}{3}$ of a whole. There are 8 parts shaded, or 2 wholes and 2 more parts.
improper fraction: $\frac{8}{3}$
mixed number: $2\frac{2}{3}$

16. Each part is $\frac{1}{4}$ of a whole. There are 5 parts shaded, or 1 whole and 1 more part.
improper fraction: $\frac{5}{4}$
mixed number: $1\frac{1}{4}$

17. a. $2\frac{5}{7} = \frac{7 \cdot 2 + 5}{7} = \frac{14 + 5}{7} = \frac{19}{7}$

b. $5\frac{1}{3} = \frac{3 \cdot 5 + 4}{3} = \frac{15 + 1}{3} = \frac{16}{3}$

c. $9\frac{3}{10} = \frac{10 \cdot 9 + 3}{10} = \frac{90 + 3}{10} = \frac{93}{10}$

d. $1\frac{1}{5} = \frac{5 \cdot 1 + 1}{5} = \frac{5 + 1}{5} = \frac{6}{5}$

18. a. $5\overline{)9}$ $\quad 1$

$\underline{5}$

4

$\frac{9}{5} = 1\frac{4}{5}$

b. $9\overline{)23}$ $\quad 2$

$\underline{18}$

5

$\frac{23}{9} = 2\frac{5}{9}$

c. $4\overline{)48}$ $\quad 12$

$\underline{4}$

8

$\underline{8}$

0

$\frac{48}{4} = 12$

d. $13\overline{)62}$ $\quad 4$

$\underline{52}$

10

$\frac{62}{13} = 4\frac{10}{13}$

e. $7\overline{)51}$ $\quad 7$

$\underline{49}$

2

$\frac{51}{7} = 7\frac{2}{7}$

f. $20\overline{)21}$ $\quad 1$

$\underline{20}$

1

$\frac{21}{20} = 1\frac{1}{20}$

Vocabulary, Readiness & Video Check 2.1

1. The number $\frac{17}{31}$ is called a fraction. The number 31 is called its denominator and 17 is called its numerator.

2. If we simplify each fraction, $\frac{9}{9} = 1$, $\frac{0}{4} = 0$, and we say $\frac{4}{0}$ is undefined.

3. The fraction $\frac{8}{3}$ is called an improper fraction, the fraction $\frac{3}{8}$ is called a proper fraction, and $10\frac{3}{8}$ is called a mixed number.

4. The value of an improper fraction is always ≥ 1 and the value of a proper fraction is always < 1.

5. The fraction is equal to 1.

6. The total number of marbles in the bag.

7. Each shape is divided into 3 parts.

8. The operation of addition is understood in a mixed number; for example, $1\frac{1}{3}$ means $1 + \frac{1}{3}$.

9. division

Exercise Set 2.1

2. In the fraction $\frac{1}{4}$, the numerator is 1 and the denominator is 4. Since $1 < 4$, the fraction is proper.

4. In the fraction $\frac{53}{21}$, the numerator is 53 and the denominator is 21. Since $53 > 21$, the fraction is improper.

6. In the fraction $\frac{26}{26}$, the numerator is 26 and the denominator is 26. Since $26 \geq 26$, the fraction is improper.

8. $\frac{14}{14} = 1$

10. $\frac{1}{0}$ is undefined.

12. $\frac{14}{1} = 14$

14. $\frac{0}{17} = 0$

16. $\frac{0}{18} = 0$

18. $\frac{18}{18} = 1$

20. 4 of the 7 parts are shaded: $\frac{4}{7}$

22. 5 of the 8 equal parts are shaded: $\frac{5}{8}$

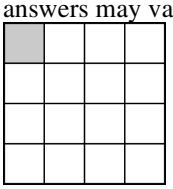
24. 5 of the 12 equal parts are shaded: $\frac{5}{12}$

26. 7 of the 8 equal parts are shaded: $\frac{7}{8}$

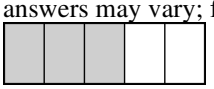
28. 3 of the 8 equal parts are shaded: $\frac{3}{8}$

30. 13 of the 16 equal parts are shaded: $\frac{13}{16}$

32. answers may vary; for example,

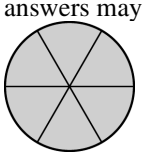


34. answers may vary; for example,



36. answers may vary; for example,

38. answers may vary; for example,



40. men $\rightarrow 22$
employees $\rightarrow \overline{63}$

$\frac{22}{63}$ of the employees are men.

42. a. number of women employees $= 63 - 22$
$= 41$

b. women $\rightarrow 41$
employees $\rightarrow \overline{63}$

$\frac{41}{63}$ of the employees are women.

44. planets with longer days $\rightarrow 4$
number of planets in solar system $\rightarrow \overline{8}$

$\frac{4}{8}$ of the planets in our solar system have longer days than Earth has.

46. 5 of 12 inches is $\frac{5}{12}$ of a foot.

48. 37 of 60 minutes is $\frac{37}{60}$ of an hour.

50. number of boys $\rightarrow 9$
number on team $\rightarrow \overline{20}$

$\frac{9}{20}$ of the team is boys.

52. There are 50 states total. Consumer fireworks are legal in 46 states.

a. Consumer fireworks are legal in $\frac{46}{50}$ of the states.

b. $50 - 46 = 4$
Consumer fireworks are illegal in 4 states.

c. Consumer fireworks are illegal in $\frac{4}{50}$ of the states.

54. There are 37 total pieces. 15 are watercolor paintings and 17 are oil paintings.

a. $\frac{15}{37}$ of the inventory is watercolor paintings.

b. $\frac{17}{37}$ of the inventory is oil paintings.

c. $37 - 15 - 17 = 5$
There are 5 sculptures.

d. $\frac{5}{37}$ of the inventory is sculptures.

56. Each part is $\frac{1}{4}$ of a whole and 10 parts are shaded, or 2 wholes and 2 more parts.

a. $\frac{10}{4}$ **b.** $2\frac{2}{4}$

58. Each part is $\frac{1}{3}$ of a whole and 11 parts are shaded, or 3 wholes and 2 more parts.

a. $\frac{11}{3}$ **b.** $3\frac{2}{3}$

60. Each part is $\frac{1}{5}$ of a whole and 6 parts are shaded, or 1 whole and 1 more part.

a. $\frac{6}{5}$ **b.** $1\frac{1}{5}$

62. Each part is $\frac{1}{5}$ of a whole and 23 parts are shaded, or 4 wholes and 3 more parts.

a. $\frac{23}{5}$ **b.** $4\frac{3}{5}$

64. $6\frac{3}{4} = \frac{4 \cdot 6 + 3}{4} = \frac{27}{4}$

66. $2\frac{5}{9} = \frac{9 \cdot 2 + 5}{9} = \frac{23}{9}$

68. $7\frac{3}{8} = \frac{8 \cdot 7 + 3}{8} = \frac{59}{8}$

70. $1\frac{13}{17} = \frac{17 \cdot 1 + 13}{17} = \frac{30}{17}$

72. $12\frac{2}{5} = \frac{5 \cdot 12 + 2}{5} = \frac{62}{5}$

74. $8\frac{9}{10} = \frac{10 \cdot 8 + 9}{10} = \frac{89}{10}$

76. $5\frac{17}{25} = \frac{25 \cdot 5 + 17}{25} = \frac{142}{25}$

78. $12\frac{7}{15} = \frac{15 \cdot 12 + 7}{15} = \frac{187}{15}$

80. $10\frac{14}{27} = \frac{27 \cdot 10 + 14}{27} = \frac{284}{27}$

82. $3\frac{27}{125} = \frac{125 \cdot 3 + 27}{125} = \frac{402}{125}$

84. $114\frac{2}{7} = \frac{7 \cdot 114 + 2}{7} = \frac{800}{7}$

86.
$$\begin{array}{r} 1 \text{ R } 6 \\ 7\overline{)13} \\ \underline{-7} \\ 6 \end{array}$$
$\frac{13}{7} = 1\frac{6}{7}$

88.
$$\begin{array}{r} 7 \text{ R } 1 \\ 9\overline{)64} \\ \underline{-63} \\ 1 \end{array}$$
$\frac{64}{9} = 7\frac{1}{9}$

90.
$$\begin{array}{r} 5 \text{ R } 5 \\ 12\overline{)65} \\ \underline{-60} \\ 5 \end{array}$$
$\frac{65}{12} = 5\frac{5}{12}$

92.
$$\begin{array}{r} 3 \text{ R } 16 \\ 17\overline{)\ 67} \\ \underline{-51} \\ 16 \end{array}$$

$$\frac{67}{17} = 3\frac{16}{17}$$

94.
$$\begin{array}{r} 16 \\ 7\overline{)\ 112} \\ \underline{-7} \\ 42 \\ \underline{-42} \\ 0 \end{array}$$

$$\frac{112}{7} = 16$$

96.
$$\begin{array}{r} 14 \\ 14\overline{)\ 196} \\ \underline{-14} \\ 56 \\ \underline{-56} \\ 0 \end{array}$$

$$\frac{196}{14} = 14$$

98.
$$\begin{array}{r} 42 \text{ R } 6 \\ 7\overline{)\ 300} \\ \underline{-28} \\ 20 \\ \underline{-14} \\ 6 \end{array}$$

$$\frac{300}{7} = 42\frac{6}{7}$$

100.
$$\begin{array}{r} 8 \text{ R } 13 \\ 53\overline{)\ 437} \\ \underline{-424} \\ 18 \end{array}$$

$$\frac{437}{53} = 8\frac{13}{53}$$

102.
$$\begin{array}{r} 19 \text{ R } 5 \\ 21\overline{)\ 404} \\ \underline{-21} \\ 194 \\ \underline{-189} \\ 5 \end{array}$$

$$\frac{404}{21} = 19\frac{5}{21}$$

104.
$$\begin{array}{r} 1 \text{ R } 6 \\ 143\overline{)\ 149} \\ \underline{-143} \\ 6 \end{array}$$

$$\frac{149}{143} = 1\frac{6}{143}$$

106.
$$\begin{array}{r} 7 \text{ R } 40 \\ 123\overline{)\ 901} \\ \underline{-861} \\ 40 \end{array}$$

$$\frac{901}{123} = 7\frac{40}{123}$$

108. $4^3 = 4 \cdot 4 \cdot 4 = 64$

110. $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

112. $5 \cdot 5 \cdot 5 \cdot 5 = 5^4$

114. $4 \cdot 4 \cdot 10 \cdot 10 \cdot 10 = 4^2 \cdot 10^3$

116. answers may vary

118. $\frac{7}{4} = 1\frac{3}{4}$

$\frac{3}{5} = \frac{3}{5}$

$\frac{7}{4}$ is the larger fraction.

120.

122. 84 + 52 + 20 + 5 = 161
52 of the 161 licensees are universities or colleges: $\frac{52}{161}$

124. 1 + 1 + 4 = 6
Four of the six United States Mint facilities produce coins: $\frac{4}{6}$

Section 2.2 Practice Exercises

1. a. First we write all the two-number factors of 15.
$1 \cdot 15 = 15$
$3 \cdot 5 = 15$
The factors of 15 are 1, 3, 5, and 15.

b. First we write all the two-number factors of 7.
$1 \cdot 7 = 7$
The factors of 7 are 1 and 7.

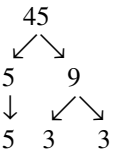
c. First we write all the two-number factors of 24.
$1 \cdot 24 = 24$
$2 \cdot 12 = 24$
$3 \cdot 8 = 24$
$4 \cdot 6 = 24$
The factors of 24 are 1, 2, 3, 4, 6, 8, 12, and 24.

2. The number 21 is composite. Its factors are 1, 3, 7, and 21.
The number 13 is prime. Its only factors are 1 and 13.
The number 18 is composite. Its factors are 1, 2, 3, 6, 9, and 18.
The number 29 is prime. Its only factors are 1 and 29.
The number 39 is composite. Its factors are 1, 3, 13, and 39.

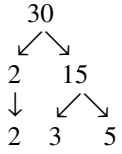
3.
$$2\overline{)14}$$
$$2\overline{)28}$$
$28 = 2 \cdot 2 \cdot 7 = 2^2 \cdot 7$

4.
$$3\overline{)15}$$
$$2\overline{)30}$$
$$2\overline{)60}$$
$$2\overline{)120}$$
$120 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 5 = 2^3 \cdot 3 \cdot 5$

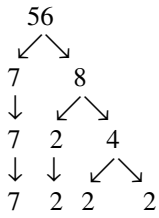
5.
$$3\overline{)21}$$
$$3\overline{)63}$$
$$3\overline{)189}$$
$$3\overline{)378}$$
$$2\overline{)756}$$
$756 = 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 7 = 2^2 \cdot 3^3 \cdot 7$

6.


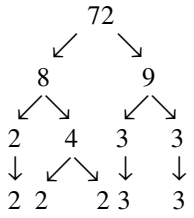
$45 = 3 \cdot 3 \cdot 5 = 3^2 \cdot 5$

7. a.


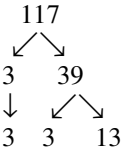
$30 = 2 \cdot 3 \cdot 5$

b.


$56 = 2 \cdot 2 \cdot 2 \cdot 7 = 2^3 \cdot 7$

c.


$72 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 = 2^3 \cdot 3^2$

8.


$117 = 3 \cdot 3 \cdot 13 = 3^2 \cdot 13$

Vocabulary, Readiness & Video Check 2.2

1. The number 40 equals $2 \cdot 2 \cdot 2 \cdot 5$. Since each factor is prime, we call $2 \cdot 2 \cdot 2 \cdot 5$ the prime factorization of 40.

2. A natural number, other than 1, that is not prime is called a composite number.

3. A natural number that has exactly two different factors, 1 and itself, is called a prime number.

4. The numbers 1, 2, 3, 4, 5, ... are called the natural numbers.

5. Since $30 = 5 \cdot 6$, the numbers 5 and 6 are factors of 30.

6. True or false: $5 \cdot 6$ is the prime factorization of 30. false

7. Because order doesn't matter when we multiply, and switching order doesn't give us any new factors of 12.

8. No, the natural number 1 is neither prime nor composite.

9. You may write factors in different order, but every natural number has only one prime factorization.

Exercise Set 2.2

2. $1 \cdot 6 = 6$
$2 \cdot 3 = 6$
The factors of 6 are 1, 2, 3, and 6.

4. $1 \cdot 30 = 30$
$2 \cdot 15 = 30$
$3 \cdot 10 = 30$
$5 \cdot 6 = 30$
The factors of 30 are 1, 2, 3, 5, 6, 10, 15, and 30.

6. $1 \cdot 9 = 9$
$3 \cdot 3 = 9$
The factors of 9 are 1, 3, and 9.

8. $1 \cdot 48 = 48$
$2 \cdot 24 = 48$
$3 \cdot 16 = 48$
$4 \cdot 12 = 48$
$6 \cdot 8 = 48$
The factors of 48 are 1, 2, 3, 4, 6, 8, 12, 16, 24 and 48.

10. $1 \cdot 37 = 37$
The factors of 37 are 1 and 37.

12. $1 \cdot 100 = 100$
$2 \cdot 50 = 100$
$4 \cdot 25 = 100$
$5 \cdot 20 = 100$
$10 \cdot 10 = 100$
The factors of 100 are 1, 2, 4, 5, 10, 20, 25, 50, and 100.

14. $1 \cdot 28 = 28$
$2 \cdot 14 = 28$
$4 \cdot 7 = 28$
The factors of 28 are 1, 2, 4, 7, 14 and 28.

16. $1 \cdot 26 = 26$
$2 \cdot 13 = 26$
The factors of 26 are 1, 2, 13, and 26.

18. Prime, since its only factors are 1 and 5.

20. Composite, since its factors are 1, 2, 5, and 10.

22. Prime, since its only factors are 1 and 13.

24. Composite, since its factors are 1, 3, 5, 9, 15 and 45.

26. Prime, since its only factors are 1 and 89.

28. Composite, since its factors are 1, 3, 7, and 21.

30. Composite, since its factors are 1, 3, 9, and 27.

32. Composite, since its factors are 1, 3, 17, and 51.

34. Composite, since its factors are 1, 3, 7, 21, 49, and 147.

36.
$$\begin{array}{r} 2 \\ 2\overline{)4} \\ 2\overline{)8} \\ 2\overline{)16} \\ 2\overline{)32} \\ 2\overline{)64} \end{array}$$
$64 = 2^6$

38.
$$\begin{array}{r} 7 \\ 3\overline{)21} \end{array}$$
$21 = 3 \cdot 7$

40.
$$\begin{array}{r} 7 \\ 3\overline{)21} \\ 3\overline{)63} \end{array}$$
$63 = 3^2 \cdot 7$

42.
$$\begin{array}{r} 5 \\ 2\overline{)10} \\ 2\overline{)20} \\ 2\overline{)40} \\ 2\overline{)80} \end{array}$$
$80 = 2^4 \cdot 5$

44.
$$\begin{array}{r} 7 \\ 2\overline{)14} \\ 2\overline{)28} \\ 2\overline{)56} \end{array}$$

$56 = 2^3 \cdot 7$

46.
$$\begin{array}{r} 7 \\ 3\overline{)21} \\ 2\overline{)42} \\ 2\overline{)84} \end{array}$$

$84 = 2^2 \cdot 3 \cdot 7$

48.
$$\begin{array}{r} 13 \\ 5\overline{)65} \\ 2\overline{)130} \end{array}$$

$130 = 2 \cdot 5 \cdot 13$

50.
$$\begin{array}{r} 31 \\ 3\overline{)93} \end{array}$$

$93 = 3 \cdot 31$

52.
$$\begin{array}{r} 3 \\ 3\overline{)9} \\ 3\overline{)27} \\ 3\overline{)81} \end{array}$$

$81 = 3^4$

54.
$$\begin{array}{r} 11 \\ 3\overline{)33} \\ 3\overline{)99} \\ 2\overline{)198} \end{array}$$

$198 = 2 \cdot 3^2 \cdot 11$

56.
$$\begin{array}{r} 5 \\ 3\overline{)15} \\ 3\overline{)45} \\ 2\overline{)90} \\ 2\overline{)180} \\ 2\overline{)360} \end{array}$$

$360 = 2^3 \cdot 3^2 \cdot 5$

58.
$$\begin{array}{r} 19 \\ 11\overline{)209} \\ 2\overline{)418} \\ 2\overline{)836} \end{array}$$

$826 = 2^2 \cdot 11 \cdot 19$

60.
$$\begin{array}{r} 7 \\ 3\overline{)21} \\ 3\overline{)63} \\ 2\overline{)126} \\ 2\overline{)252} \\ 2\overline{)504} \end{array}$$

$504 = 2^3 \cdot 3^2 \cdot 7$

62.
$$\begin{array}{r} 5 \\ 3\overline{)15} \\ 3\overline{)45} \\ 3\overline{)135} \\ 3\overline{)405} \end{array}$$

$405 = 3^4 \cdot 5$

64.
$$\begin{array}{r} 11 \\ 7\overline{)77} \\ 7\overline{)539} \end{array}$$

$539 = 7^2 \cdot 11$

66.
$$\begin{array}{r} 3 \\ 2\overline{)6} \\ 2\overline{)12} \\ 2\overline{)24} \\ 2\overline{)48} \end{array}$$

$48 = 2^4 \cdot 3$

68.
$$\begin{array}{r} 3 \\ 3\overline{)9} \\ 3\overline{)27} \\ 2\overline{)54} \end{array}$$

$54 = 2 \cdot 3^3$

70. 59 is prime since its only factors are 1 and 59.

72.
$$\begin{array}{r} 13 \\ 2\overline{)\,26} \\ 2\overline{)\,52} \\ 2\overline{)104} \\ 2\overline{)208} \end{array}$$

$208 = 2^4 \cdot 13$

74. 103 is prime since its only factors are 1 and 103.

76.
$$\begin{array}{r} 5 \\ 5\overline{)\,25} \\ 5\overline{)\,125} \\ 2\overline{)\,250} \\ 2\overline{)\,500} \\ 2\overline{)1000} \end{array}$$

$1000 = 2^3 \cdot 5^3$

78. To round 32,465 to the nearest thousand, observe that the digit in the hundreds place is 4. Since this digit is less than 5, we do not add 1 to the digit in the thousands place. The number 32,465 rounded to the nearest thousand is 32,000.

80. To round 4,286,340 to the nearest ten, observe that the digit in the ones place is 0. Since this digit is less than 5, we do not add 1 to the digit in the tens place. The number 4,286,340 rounded to the nearest ten is 4,286,340.

82. To round 10,292,876 to the nearest million, observe that the digit in the hundred-thousands place is 2. Since this digit is less than 5, we do not add 1 to the digit in the millions place. The number 10,292,876 rounded to the nearest million is 10,000,000.

84. 563 patents were granted in 2010 and 1136 patents were granted in 2012.
1136 – 563 = 573
573 fewer patents were granted in 2010 than in 2012.

86. Of the 2375 total patents, 676 were granted in 2011. $\frac{676}{2375}$ of the patents were granted in 2011.

88.
$$\begin{array}{r} 13 \\ 5\overline{)\,65} \\ 5\overline{)\,325} \\ 5\overline{)\,1625} \\ 3\overline{)\,4875} \\ 3\overline{)\,14,625} \\ 3\overline{)\,43,875} \\ 3\overline{)131,625} \end{array}$$

$131,625 = 3^4 \cdot 5^3 \cdot 13$

90. answers may vary

92. no; answers may vary

Section 2.3 Practice Exercises

1. Notice that 30 and 45 have a common factor of 15.
$$\frac{30}{45} = \frac{15 \cdot 2}{15 \cdot 3} = \frac{15}{15} \cdot \frac{2}{3} = 1 \cdot \frac{2}{3} = \frac{2}{3}$$

2. $$\frac{39}{51} = \frac{3 \cdot 13}{3 \cdot 17} = \frac{3}{3} \cdot \frac{13}{17} = 1 \cdot \frac{13}{17} = \frac{13}{17}$$

3. $$\frac{9}{50} = \frac{3 \cdot 3}{2 \cdot 5 \cdot 5}$$
Since 9 and 50 have no common factors, $\frac{9}{50}$ is already in simplest form.

4. $$\frac{49}{112} = \frac{7 \cdot 7}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 7} = \frac{7}{7} \cdot \frac{7}{2 \cdot 2 \cdot 2 \cdot 2} = 1 \cdot \frac{7}{16} = \frac{7}{16}$$

5. $$\frac{64}{20} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot 2 \cdot 2 \cdot 2 \cdot 2}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 5} = \frac{1 \cdot 1 \cdot 2 \cdot 2 \cdot 2 \cdot 2}{1 \cdot 1 \cdot 5} = \frac{16}{5} \text{ or } 3\frac{1}{5}$$

6. $$\frac{8}{56} = \frac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 7} = \frac{1 \cdot 1 \cdot 1}{1 \cdot 1 \cdot 1 \cdot 7} = \frac{1}{7}$$

7. $$\frac{42}{48} = \frac{\overset{1}{\cancel{6}} \cdot 7}{\underset{1}{\cancel{6}} \cdot 8} = \frac{1 \cdot 7}{1 \cdot 8} = \frac{7}{8}$$

8. $\frac{7}{9}$ is in simplest form.

$$\frac{21}{27}=\frac{\overset{1}{\cancel{3}}\cdot 7}{\underset{1}{\cancel{3}}\cdot 3\cdot 3}=\frac{1\cdot 7}{1\cdot 3\cdot 3}=\frac{7}{9}$$

Since these fractions are the same, $\frac{7}{9}=\frac{21}{27}$. The fractions are equivalent.

9. Check the cross products:
$4 \cdot 18 = 72$ and $13 \cdot 5 = 65$
Since $72 \neq 65$, the fractions are not equivalent.

10. $$\frac{\text{4 parks in Virginia}}{\text{46 national historical parks}}=\frac{2\cdot 2}{2\cdot 23}=\frac{\overset{1}{\cancel{2}}\cdot 2}{\underset{1}{\cancel{2}}\cdot 23}=\frac{2}{23}$$

$\frac{2}{23}$ of the national historical parks are in Virginia.

Calculator Explorations

1. $\frac{128}{224}=\frac{4}{7}$

2. $\frac{231}{396}=\frac{7}{12}$

3. $\frac{340}{459}=\frac{20}{27}$

4. $\frac{999}{1350}=\frac{37}{50}$

5. $\frac{810}{432}=\frac{15}{8}$

6. $\frac{315}{225}=\frac{7}{5}$

7. $\frac{243}{54}=\frac{9}{2}$

8. $\frac{689}{455}=\frac{53}{35}$

Vocabulary, Readiness & Video Check 2.3

1. In $\frac{11}{48}$, since 11 and 48 have no common factors other than 1, $\frac{11}{48}$ is in simplest form.

2. Fractions that represent the same portion of a whole are called equivalent fractions.

3. In the statement $\frac{5}{12}=\frac{15}{36}$, $5 \cdot 36$ and $12 \cdot 15$ are called cross products.

4. The fraction $\frac{7}{7}$ simplifies to 1.

5. The fraction $\frac{0}{7}$ simplifies to 0.

6. The fraction $\frac{n}{1}$ simplifies to n.

7. A special form of an equivalent form of a fraction is called simplest form.

8. Two fractions are equivalent if they simplify to the same fraction. $\frac{3}{9}$ and $\frac{6}{18}$ both simplify to $\frac{1}{3}$, so the original fractions are equal.

9. $\frac{10}{24}$ is not in simplest form; $\frac{5}{12}$

Exercise Set 2.3

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

4. $\frac{9}{48}=\frac{3\cdot 3}{3\cdot 16}=\frac{3}{16}$

6. $\frac{22}{34}=\frac{2\cdot 11}{2\cdot 17}=\frac{11}{17}$

8. $\frac{70}{80}=\frac{7\cdot 10}{8\cdot 10}=\frac{7}{8}$

10. $\frac{25}{55}=\frac{5\cdot 5}{5\cdot 11}=\frac{5}{11}$

12. $\frac{21}{49}=\frac{3\cdot 7}{7\cdot 7}=\frac{3}{7}$

14. $\frac{36}{54}=\frac{2\cdot 18}{3\cdot 18}=\frac{2}{3}$

16. $\frac{32}{63}=\frac{32}{63}$
32 and 63 have no common factors other than 1.

18. $\frac{36}{42}=\frac{6\cdot 6}{6\cdot 7}=\frac{6}{7}$

20. $\frac{28}{60}=\frac{4\cdot 7}{4\cdot 15}=\frac{7}{15}$

22. $\frac{39}{42}=\frac{3\cdot 13}{3\cdot 14}=\frac{13}{14}$

24. $\frac{60}{36}=\frac{5\cdot 12}{3\cdot 12}=\frac{5}{3}$ or $1\frac{2}{3}$

26. $\frac{60}{150}=\frac{2\cdot 30}{5\cdot 30}=\frac{2}{5}$

28. $\frac{98}{126}=\frac{14\cdot 7}{14\cdot 9}=\frac{7}{9}$

30. $\frac{65}{234}=\frac{13\cdot 5}{13\cdot 18}=\frac{5}{18}$

32. $\frac{78}{90}=\frac{6\cdot 13}{6\cdot 15}=\frac{13}{15}$

34. $\frac{72}{420}=\frac{12\cdot 6}{12\cdot 35}=\frac{6}{35}$

36. $\frac{144}{162}=\frac{18\cdot 8}{18\cdot 9}=\frac{8}{9}$

38. $\frac{135}{585}=\frac{45\cdot 3}{45\cdot 13}=\frac{3}{13}$

40. $\frac{270}{15}=\frac{15\cdot 18}{15}=\frac{18\cdot 15}{1\cdot 15}=\frac{18}{1}=18$

42. Equivalent, since the cross products are equal: $9 \cdot 2 = 18$ and $6 \cdot 3 = 18$.

44. Not equivalent, since the cross products are not equal: $5 \cdot 4 = 20$ and $11 \cdot 2 = 22$.

46. Equivalent, since the cross products are equal: $10 \cdot 6 = 60$ and $15 \cdot 4 = 60$.

48. Equivalent, since the cross products are equal: $8 \cdot 7 = 56$ and $28 \cdot 2 = 56$.

50. Not equivalent, since the cross products are not equal: $20 \cdot 9 = 180$ and $12 \cdot 16 = 192$.

52. Not equivalent, since the cross products are not equal: $21 \cdot 14 = 294$ and $35 \cdot 6 = 210$.

54. $\frac{200 \text{ caps}}{2000 \text{ caps}}=\frac{1\cdot 200}{10\cdot 200}=\frac{1}{10}$

200 caps represents $\frac{1}{10}$ of the cups sold.

56. $\frac{20 \text{ centimeters}}{100 \text{ centimeters}}=\frac{1\cdot 20}{5\cdot 20}=\frac{1}{5}$

20 centimeters is $\frac{1}{5}$ of a meter.

58. a. $\frac{10 \text{ monuments}}{78 \text{ monuments}}=\frac{2\cdot 5}{2\cdot 39}=\frac{5}{39}$

$\frac{5}{39}$ of the national monuments are located in New Mexico.

b. $78 - 10 = 68$
68 national monuments are found outside New Mexico.

c. $\frac{68}{78}=\frac{2\cdot 34}{2\cdot 39}=\frac{34}{39}$

$\frac{34}{39}$ of the national monuments are found in states other than New Mexico.

60. $\frac{10 \text{ students}}{35 \text{ students}}=\frac{5\cdot 2}{5\cdot 7}=\frac{2}{7}$

$\frac{2}{7}$ of the students made and A on the first test.

62. a. $28{,}000 - 12{,}000 = 16{,}000$
\$16,000 was not covered by her trade-in.

b. $\frac{\$16,000}{\$28,000} = \frac{4000 \cdot 4}{4000 \cdot 7} = \frac{4}{7}$

$\frac{4}{7}$ of the purchase price was not covered by the trade-in.

64. $\frac{3200 \text{ employees}}{12,000 \text{ employees}} = \frac{800 \cdot 4}{800 \cdot 15} = \frac{4}{15}$

$\frac{4}{15}$ of the employees work at the Hallmark headquarters in Kansas City, Missouri.

66.
$$\begin{array}{r} 73 \\ \times\ 8 \\ \hline 584 \end{array}$$

68.
$$\begin{array}{r} 562 \\ \times\ 9 \\ \hline 5058 \end{array}$$

70.
$$\begin{array}{r} 238 \\ \times\ 26 \\ \hline 1428 \\ 4760 \\ \hline 6188 \end{array}$$

72. answers may vary

74. $\frac{9506}{12,222} = \frac{1358 \cdot 7}{1358 \cdot 9} = \frac{7}{9}$

76. $37 + 7 = 44$

$\frac{44 \text{ donors}}{100 \text{ donors}} = \frac{4 \cdot 11}{4 \cdot 25} = \frac{11}{25}$

$\frac{11}{25}$ of blood donors have an O blood type.

78. $9 + 1 = 10$

$\frac{10 \text{ donors}}{100 \text{ donors}} = \frac{1 \cdot 10}{10 \cdot 10} = \frac{1}{10}$

$\frac{1}{10}$ of blood donors have B blood type.

80. The piece representing biological sciences is labeled $\frac{2}{25}$, so $\frac{2}{25}$ of entering college freshmen plan to major in the biological sciences.

82. answers may vary

84. The piece representing National Parks is labeled $\frac{3}{20}$, so $\frac{3}{20}$ of National Park Service areas are National Parks.

86. answers may vary

88. 1235, 2235, 85, 105, 900, and 1470 are divisible by 5 because each number ends with a 0 or 5.
8691, 786, 2235, 105, 222, 900, and 1470 are divisible by 3 because the sum of each number's digits is divisible by 3.
2235, 105, 900, and 1470 are divisible by both 3 and 5.

90. 15; answers may vary

Integrated Review

1. 3 of the 6 parts are shaded: $\frac{3}{6}$

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

2. Each part is $\frac{1}{4}$ of a whole and 7 parts are shaded, or 1 whole and 3 more parts: $\frac{7}{4}$ or $1\frac{3}{4}$

3. People getting fewer than 8 hours of sleep $\rightarrow 73$
People in survey $\rightarrow 85$

$\frac{73}{85}$ of the people in a survey get fewer than 8 hours of sleep.

4. 

5. $\frac{11}{11} = 1$

6. $\frac{17}{1} = 17$

7. $\frac{0}{3} = 0$

8. $\frac{7}{0}$ is undefined.

9. $3\frac{1}{8} = \frac{8 \cdot 3 + 1}{8} = \frac{25}{8}$

10. $5\frac{3}{5} = \frac{5 \cdot 5 + 3}{5} = \frac{28}{5}$

11. $9\frac{6}{7} = \frac{7 \cdot 9 + 6}{7} = \frac{69}{7}$

12. $20\frac{1}{7} = \frac{7 \cdot 20 + 1}{7} = \frac{141}{7}$

13.
$$\begin{array}{r} 2 \text{ R } 6 \\ 7\overline{)\,20} \\ \underline{-14} \\ 6 \end{array}$$

$\frac{20}{7} = 2\frac{6}{7}$

14.
$$\begin{array}{r} 5 \\ 11\overline{)\,55} \\ \underline{-55} \\ 0 \end{array}$$

$\frac{55}{11} = 5$

15.
$$\begin{array}{r} 4 \text{ R } 7 \\ 8\overline{)\,39} \\ \underline{-32} \\ 7 \end{array}$$

$\frac{39}{8} = 4\frac{7}{8}$

16.
$$\begin{array}{r} 8 \text{ R } 10 \\ 11\overline{)\,98} \\ \underline{-88} \\ 10 \end{array}$$

$\frac{98}{11} = 8\frac{10}{11}$

17. $1 \cdot 35 = 35$
$5 \cdot 7 = 35$
The factors of 35 are 1, 5, 7, and 35.

18. $1 \cdot 40 = 40$
$2 \cdot 20 = 40$
$4 \cdot 10 = 40$
$5 \cdot 8 = 40$
The factors of 40 are 1, 2, 4, 5, 8, 10, 20, and 40.

19. Composite since its factors are 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, and 72.

20. Prime, since its only factors are 1 and 13.

21.
$$\begin{array}{r} 13 \\ 5\overline{)\,65} \end{array}$$

$65 = 5 \cdot 13$

22.
$$\begin{array}{r} 7 \\ 5\overline{)\,35} \\ 2\overline{)\,70} \end{array}$$

$70 = 2 \cdot 5 \cdot 7$

23.
$$\begin{array}{r} 3 \\ 2\overline{)\,6} \\ 2\overline{)\,12} \\ 2\overline{)\,24} \\ 2\overline{)\,48} \\ 2\overline{)\,96} \end{array}$$

$96 = 2^5 \cdot 3$

24.
$$\begin{array}{r} 11 \\ 3\overline{)\,33} \\ 2\overline{)\,66} \\ 2\overline{)\,132} \end{array}$$

$132 = 2^2 \cdot 3 \cdot 11$

25.
$$\begin{array}{r} 7 \\ 3\overline{)\,21} \\ 3\overline{)\,63} \\ 3\overline{)\,126} \\ 2\overline{)\,252} \end{array}$$

$252 = 2^2 \cdot 3^2 \cdot 7$

26. Prime, since its only factors are 1 and 31.

27.
$$\begin{array}{r} 7 \\ 5\overline{)\,35} \\ 3\overline{)\,105} \\ 3\overline{)\,315} \end{array}$$

$315 = 3^2 \cdot 5 \cdot 7$

28.
$$\begin{array}{r} 7 \\ 7\overline{)\,49} \\ 3\overline{)\,147} \\ 3\overline{)\,441} \end{array}$$

$441 = 3^2 \cdot 7^2$

29. $11\overline{)143}$, $2\overline{)286}$

$286 = 2 \cdot 11 \cdot 13$

30. Prime, since its only factor are 1 and 41.

31. $\frac{2}{14} = \frac{2 \cdot 1}{2 \cdot 7} = \frac{1}{7}$

32. $\frac{24}{20} = \frac{4 \cdot 6}{4 \cdot 5} = \frac{6}{5}$ or $1\frac{1}{5}$

33. $\frac{18}{38} = \frac{2 \cdot 9}{2 \cdot 19} = \frac{9}{19}$

34. $\frac{42}{110} = \frac{2 \cdot 21}{2 \cdot 55} = \frac{21}{55}$

35. $\frac{56}{60} = \frac{4 \cdot 14}{4 \cdot 15} = \frac{14}{15}$

36. $\frac{72}{80} = \frac{8 \cdot 9}{8 \cdot 10} = \frac{9}{10}$

37. $\frac{54}{135} = \frac{27 \cdot 2}{27 \cdot 5} = \frac{2}{5}$

38. $\frac{90}{240} = \frac{30 \cdot 3}{30 \cdot 8} = \frac{3}{8}$

39. $\frac{165}{210} = \frac{15 \cdot 11}{15 \cdot 14} = \frac{11}{14}$

40. $\frac{245}{385} = \frac{35 \cdot 7}{35 \cdot 11} = \frac{7}{11}$

41. Not equivalent, since the cross products are not equal: $8 \cdot 9 = 72$ and $10 \cdot 7 = 70$

42. Equivalent, since the cross products are equal: $12 \cdot 15 = 180$ and $18 \cdot 10 = 180$

43. a. $\frac{2 \text{ states}}{50 \text{ states}} = \frac{2 \cdot 1}{2 \cdot 25} = \frac{1}{25}$

$\frac{1}{25}$ of the states are not adjacent to any other states.

b. $50 - 2 = 48$

48 states are adjacent to other states.

c. $\frac{48 \text{ states}}{50 \text{ states}} = \frac{24 \cdot 2}{25 \cdot 2} = \frac{24}{25}$

$\frac{24}{25}$ of the states are adjacent to other states.

44. a. $\frac{145 \text{ films}}{540 \text{ films}} = \frac{5 \cdot 29}{5 \cdot 108} = \frac{29}{108}$

$\frac{29}{108}$ of the films were rated PG-13.

b. $540 - 145 = 395$

395 films were rated other than PG-13.

c. $\frac{395 \text{ films}}{540 \text{ films}} = \frac{5 \cdot 79}{5 \cdot 108} = \frac{79}{108}$

$\frac{79}{108}$ of the films were rated other than PG-13.

Section 2.4 Practice Exercises

1. $\frac{3}{8} \cdot \frac{5}{7} = \frac{3 \cdot 5}{8 \cdot 7} = \frac{15}{56}$

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

3. $\frac{6}{55} \cdot \frac{5}{8} = \frac{6 \cdot 5}{55 \cdot 8} = \frac{\overset{1}{\cancel{2}} \cdot 3 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot 11 \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 2} = \frac{3}{11 \cdot 2 \cdot 2} = \frac{3}{44}$

4. $\frac{4}{15} \cdot \frac{3}{8} = \frac{4 \cdot 3}{15 \cdot 8} = \frac{\overset{1}{\cancel{4}} \cdot \overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}} \cdot 5 \cdot 2 \cdot \underset{1}{\cancel{4}}} = \frac{1}{5 \cdot 2} = \frac{1}{10}$

5. $\frac{2}{5} \cdot \frac{20}{7} = \frac{2 \cdot 20}{5 \cdot 7} = \frac{2 \cdot 4 \cdot \overset{1}{\cancel{5}}}{\underset{1}{\cancel{5}} \cdot 7} = \frac{8}{7}$

6. $\frac{4}{11} \cdot \frac{33}{16} = \frac{4 \cdot 33}{11 \cdot 16} = \frac{\overset{1}{\cancel{4}} \cdot 3 \cdot \overset{1}{\cancel{11}}}{\underset{1}{\cancel{11}} \cdot \underset{1}{\cancel{4}} \cdot 4} = \frac{3}{4}$

7. $\frac{1}{6}\cdot\frac{3}{10}\cdot\frac{25}{16}=\frac{1\cdot3\cdot25}{6\cdot10\cdot16}=\frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{5}}\cdot5}{2\cdot\underset{1}{\cancel{3}}\cdot2\cdot\underset{1}{\cancel{5}}\cdot16}=\frac{5}{64}$

8. $2\frac{1}{2}=\frac{5}{2}$

$2\frac{1}{2}\cdot\frac{8}{15}=\frac{5}{2}\cdot\frac{8}{15}=\frac{\overset{1}{\cancel{5}}\cdot\overset{1}{\cancel{2}}\cdot4}{\underset{1}{\cancel{2}}\cdot3\cdot\underset{1}{\cancel{5}}}=\frac{4}{3}$ or $1\frac{1}{3}$

9. $\frac{2}{3}\cdot18=\frac{2}{3}\cdot\frac{18}{1}=\frac{2\cdot18}{3\cdot1}=\frac{2\cdot\overset{1}{\cancel{3}}\cdot6}{\underset{1}{\cancel{3}}\cdot1}=\frac{12}{1}=12$

10. $3\frac{1}{5}\cdot2\frac{3}{4}=\frac{16}{5}\cdot\frac{11}{4}=\frac{16\cdot11}{5\cdot4}=\frac{\overset{1}{\cancel{4}}\cdot4\cdot11}{5\cdot\underset{1}{\cancel{4}}}=\frac{44}{5}$ or $8\frac{4}{5}$

11. $5\cdot3\frac{11}{15}=\frac{5}{1}\cdot\frac{56}{15}=\frac{5\cdot56}{1\cdot15}=\frac{\overset{1}{\cancel{5}}\cdot56}{1\cdot3\cdot\underset{1}{\cancel{5}}}=\frac{56}{3}$ or $18\frac{2}{3}$

12. $\frac{9}{11}\cdot0=0$

13. $0\cdot4\frac{1}{8}=0$

14. $\frac{5}{16}\cdot48=\frac{5}{16}\cdot\frac{48}{1}=\frac{5\cdot48}{16\cdot1}=\frac{5\cdot3\cdot16}{16\cdot1}=\frac{5\cdot3}{1}=15$
Thus, there are 15 roller coasters in Kings Dominion.

Vocabulary, Readiness & Video Check 2.4

1. To multiply two fractions, we write $\frac{a}{b}\cdot\frac{c}{d}=\underline{\frac{a\cdot c}{b\cdot d}}$.

2. Using the definition of an exponent, the expression $\frac{2^3}{7}=\underline{\frac{2\cdot2\cdot2}{7}}$ while $\left(\frac{2}{7}\right)^3=\underline{\frac{2}{7}\cdot\frac{2}{7}\cdot\frac{2}{7}}$.

3. The word "of" indicates <u>multiplication</u>.

4. $\frac{1}{5}\cdot0=\underline{0}$

5. There's a common factor of 2 in the numerator and denominator which can be divided out first.

6. To multiply mixed numbers, we first write them as equivalent improper fractions and then multiply as we multiply for fractions.

7. radius is $\frac{1}{2}$ diameter

Exercise Set 2.4

2. $\frac{2}{3}\cdot\frac{4}{7}=\frac{2\cdot4}{3\cdot7}=\frac{8}{21}$

4. $\frac{7}{3}\cdot\frac{1}{4}=\frac{7\cdot1}{3\cdot4}=\frac{7}{12}$

6. $\frac{2}{5}\cdot\frac{7}{11}=\frac{2\cdot7}{5\cdot11}=\frac{14}{55}$

8. $\frac{7}{8}\cdot\frac{2}{3}=\frac{7\cdot2}{8\cdot3}=\frac{7\cdot2}{4\cdot2\cdot3}=\frac{7}{4\cdot3}=\frac{7}{12}$

10. $\frac{8}{3}\cdot\frac{5}{12}=\frac{8\cdot5}{3\cdot12}=\frac{4\cdot2\cdot5}{3\cdot4\cdot3}=\frac{2\cdot5}{3\cdot3}=\frac{10}{9}$ or $1\frac{1}{9}$

12. $\frac{4}{35}\cdot\frac{5}{24}=\frac{4\cdot5}{35\cdot24}=\frac{4\cdot5\cdot1}{5\cdot7\cdot4\cdot6}=\frac{1}{7\cdot6}=\frac{1}{42}$

14. $\frac{11}{12}\cdot0=0$

16. $\frac{1}{9}\cdot\frac{1}{13}=\frac{1\cdot1}{9\cdot13}=\frac{1}{117}$

18. $\frac{5}{32}\cdot\frac{64}{100}=\frac{5\cdot2\cdot32}{32\cdot5\cdot2\cdot10}=\frac{1}{10}$

20. $\frac{4}{5}\cdot\frac{8}{25}=\frac{4\cdot8}{5\cdot25}=\frac{32}{125}$

22. $\frac{27}{32}\cdot\frac{10}{13}\cdot\frac{16}{30}=\frac{27\cdot10\cdot16}{32\cdot13\cdot30}$
$=\frac{3\cdot9\cdot10\cdot16}{2\cdot16\cdot13\cdot3\cdot10}$
$=\frac{9}{2\cdot13}$
$=\frac{9}{26}$

24. $\frac{3}{5}\cdot\frac{1}{2}\cdot\frac{3}{7}=\frac{3\cdot1\cdot3}{5\cdot2\cdot7}=\frac{9}{70}$

26. $\frac{8}{11}\cdot\frac{4}{7}\cdot0=0$

28. $\frac{7}{8}\cdot\frac{9}{20}\cdot\frac{12}{22}\cdot\frac{11}{14}=\frac{7\cdot9\cdot12\cdot11}{8\cdot20\cdot22\cdot14}$
$=\frac{7\cdot9\cdot3\cdot4\cdot11}{2\cdot4\cdot20\cdot2\cdot11\cdot2\cdot7}$
$=\frac{9\cdot3}{2\cdot20\cdot2\cdot2}$
$=\frac{27}{160}$

30. $11\frac{3}{4}$ rounds to 12.

32. $4\frac{1}{9}$ rounds to 4.

34. $18\frac{12}{22}$ rounds to 19.

36. $\frac{2}{3}\cdot6=\frac{2}{3}\cdot\frac{6}{1}=\frac{2\cdot6}{3\cdot1}=\frac{2\cdot2\cdot3}{3\cdot1}=\frac{2\cdot2}{1}=\frac{4}{1}=4$

38. $10\cdot\frac{7}{8}=\frac{10}{1}\cdot\frac{7}{8}$
$=\frac{10\cdot7}{1\cdot8}$
$=\frac{2\cdot5\cdot7}{1\cdot2\cdot4}$
$=\frac{5\cdot7}{1\cdot4}$
$=\frac{35}{4}$ or $8\frac{3}{4}$

40. $\frac{3}{22}\cdot3\frac{2}{3}=\frac{3}{22}\cdot\frac{11}{3}=\frac{3\cdot11}{22\cdot3}=\frac{3\cdot11}{2\cdot11\cdot3}=\frac{1}{2}$

42. $2\frac{1}{9}\cdot\frac{6}{7}=\frac{19}{9}\cdot\frac{6}{7}$
$=\frac{19\cdot6}{9\cdot7}$
$=\frac{19\cdot2\cdot3}{3\cdot3\cdot7}$
$=\frac{19\cdot2}{3\cdot7}$
$=\frac{38}{21}$ or $1\frac{17}{21}$

44. $1\cdot\frac{5}{9}=\frac{5}{9}$

46. Exact: $2\frac{1}{4}\cdot7\frac{1}{8}=\frac{9}{4}\cdot\frac{57}{8}=\frac{513}{32}$ or $16\frac{1}{32}$

Estimate: $2\frac{1}{4}$ rounds to 2, $7\frac{1}{8}$ rounds to 7.

$2 \cdot 7 = 14$, so the answer is reasonable.

48. Exact: $5\frac{5}{6}\cdot7\frac{3}{5}=\frac{35}{6}\cdot\frac{38}{5}$
$=\frac{35\cdot38}{6\cdot5}$
$=\frac{5\cdot7\cdot2\cdot19}{2\cdot3\cdot5}$
$=\frac{7\cdot19}{3}$
$=\frac{133}{3}$ or $44\frac{1}{3}$

Estimate: $5\frac{5}{6}$ rounds to 6, $7\frac{3}{5}$ rounds to 8.

$6 \cdot 8 = 48$, so the answer is reasonable.

50. $6\cdot3\frac{1}{3}=\frac{6}{1}\cdot\frac{10}{3}$
$=\frac{6\cdot10}{1\cdot3}$
$=\frac{2\cdot3\cdot10}{1\cdot3}$
$=\frac{2\cdot10}{1}$
$=\frac{20}{1}$
$=20$

52. $1\frac{1}{6}\cdot 7\frac{1}{5}=\frac{7}{6}\cdot\frac{36}{5}$
$=\frac{7\cdot 36}{6\cdot 5}$
$=\frac{7\cdot 6\cdot 6}{6\cdot 5}$
$=\frac{7\cdot 6}{5}$
$=\frac{42}{5}$ or $8\frac{2}{5}$

54. $\frac{7}{8}\cdot 24\cdot\frac{1}{3}=\frac{7}{8}\cdot\frac{24}{1}\cdot\frac{1}{3}$
$=\frac{7\cdot 24\cdot 1}{8\cdot 1\cdot 3}$
$=\frac{7\cdot 8\cdot 3\cdot 1}{8\cdot 3\cdot 1}$
$=\frac{7}{1}$
$=7$

56. $\frac{11}{20}\cdot 12\cdot 3\frac{1}{3}=\frac{11}{20}\cdot\frac{12}{1}\cdot\frac{10}{3}$
$=\frac{11\cdot 12\cdot 10}{20\cdot 1\cdot 3}$
$=\frac{11\cdot 2\cdot 3\cdot 2\cdot 10}{2\cdot 10\cdot 1\cdot 3}$
$=\frac{11\cdot 2}{1}$
$=\frac{22}{1}$
$=22$

58. $4\frac{1}{2}\cdot 2\frac{1}{9}\cdot 1\frac{1}{5}=\frac{9}{2}\cdot\frac{19}{9}\cdot\frac{6}{5}$
$=\frac{9\cdot 19\cdot 6}{2\cdot 9\cdot 5}$
$=\frac{9\cdot 19\cdot 2\cdot 3}{2\cdot 9\cdot 5}$
$=\frac{19\cdot 3}{5}$
$=\frac{57}{5}$ or $11\frac{2}{5}$

60. $\frac{3}{8}\cdot\frac{5}{12}=\frac{3\cdot 5}{8\cdot 12}=\frac{3\cdot 5}{8\cdot 3\cdot 4}=\frac{5}{8\cdot 4}=\frac{5}{32}$

62. $0\cdot\frac{3}{31}=0$

64. $3\frac{1}{5}\cdot 2\frac{11}{32}=\frac{16}{5}\cdot\frac{75}{32}$
$=\frac{16\cdot 75}{5\cdot 32}$
$=\frac{16\cdot 5\cdot 15}{5\cdot 16\cdot 2}$
$=\frac{15}{2}$ or $7\frac{1}{2}$

66. $\frac{15}{2}\cdot\frac{3}{5}=\frac{15\cdot 3}{2\cdot 5}=\frac{5\cdot 3\cdot 3}{2\cdot 5}=\frac{3\cdot 3}{2}=\frac{9}{2}$ or $4\frac{1}{2}$

68. $\frac{9}{20}\cdot\frac{10}{90}=\frac{9\cdot 10}{20\cdot 90}=\frac{9\cdot 10}{20\cdot 9\cdot 10}=\frac{1}{20}$

70. $\frac{3}{80}\cdot\frac{2}{27}=\frac{3\cdot 2}{80\cdot 27}=\frac{3\cdot 2}{2\cdot 40\cdot 3\cdot 9}=\frac{1}{40\cdot 9}=\frac{1}{360}$

72. $30\cdot\frac{8}{9}=\frac{30}{1}\cdot\frac{8}{9}$
$=\frac{30\cdot 8}{1\cdot 9}$
$=\frac{3\cdot 10\cdot 8}{1\cdot 3\cdot 3}$
$=\frac{10\cdot 8}{1\cdot 3}$
$=\frac{80}{3}$ or $26\frac{2}{3}$

74. $4\frac{11}{13}\cdot 0\cdot 12\frac{1}{13}=0$

76. $14\frac{2}{5}\cdot 8\frac{1}{3}\cdot\frac{11}{16}=\frac{72}{5}\cdot\frac{25}{3}\cdot\frac{11}{16}$
$=\frac{72\cdot 25\cdot 11}{5\cdot 3\cdot 16}$
$=\frac{3\cdot 3\cdot 8\cdot 5\cdot 5\cdot 11}{5\cdot 3\cdot 2\cdot 8}$
$=\frac{3\cdot 5\cdot 11}{2}$
$=\frac{165}{2}$ or $82\frac{1}{2}$

78. $\frac{1}{5}\cdot 200=\frac{1}{5}\cdot\frac{200}{1}=\frac{1\cdot 200}{5\cdot 1}=\frac{1\cdot 5\cdot 40}{5\cdot 1}=\frac{40}{1}=40$

$\frac{1}{5}$ of 200 is 40.

80. $\frac{5}{8}\cdot 24=\frac{5}{8}\cdot\frac{24}{1}=\frac{5\cdot 24}{8\cdot 1}=\frac{5\cdot 3\cdot 8}{8\cdot 1}=\frac{5\cdot 3}{1}=\frac{15}{1}=15$

$\frac{5}{8}$ of 24 is 15.

82. $\frac{1}{5}$ of $3000=\frac{1}{5}\cdot 3000$

$=\frac{1}{5}\cdot\frac{3000}{1}$

$=\frac{1\cdot 3000}{5\cdot 1}$

$=\frac{1\cdot 5\cdot 600}{5\cdot 1}$

$=600$

The diet can contain 600 calories from fat per day.

84. $\frac{57}{100}$ of 1400 million $=\frac{57}{100}\cdot 1,400,000,000$

$=\frac{57}{100}\cdot\frac{1,400,000,000}{1}$

$=\frac{57\cdot 1,400,000,000}{100\cdot 1}$

$=\frac{57\cdot 14,000,000\cdot 100}{100\cdot 1}$

$=\frac{57\cdot 14,000,000}{1}$

$=798,000,00$

In 2012, 798 million movie tickets were purchased by frequent moviegoers.

86. $\frac{3}{16}$ of $8=\frac{3}{16}\cdot 8$

$=\frac{3}{16}\cdot\frac{8}{1}$

$=\frac{3\cdot 8}{16\cdot 1}$

$=\frac{3\cdot 8}{8\cdot 2\cdot 1}$

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

$=\frac{3}{2}$

The screw sinks $\frac{3}{2}$ or $1\frac{1}{2}$ inches deep after 8 turns.

88. $d=2\cdot r$

$=2\cdot\frac{7}{20}$

$=\frac{2}{1}\cdot\frac{7}{20}$

$=\frac{2\cdot 7}{1\cdot 20}$

$=\frac{2\cdot 7}{1\cdot 2\cdot 10}$

$=\frac{7}{10}$

The diameter is $\frac{7}{10}$ foot.

90. $\frac{2}{5}\cdot 4=\frac{2}{5}\cdot\frac{4}{1}=\frac{2\cdot 4}{5\cdot 1}=\frac{8}{5}=1\frac{3}{5}$

$\frac{8}{5}$ or $1\frac{3}{5}$ feet of the post is to be buried.

92. $2\cdot 17\frac{1}{2}=2\cdot\frac{35}{2}=\frac{2}{1}\cdot\frac{35}{2}=\frac{2\cdot 35}{1\cdot 2}=\frac{35}{1}=35$

Jock's waist measurement is 35 inches.

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

$\frac{1}{6}$ of a cup of flour should be used.

96. $\frac{7}{10}\cdot 31,050=\frac{7}{10}\cdot\frac{31,050}{1}$

$=\frac{7\cdot 31,050}{10\cdot 1}$

$=\frac{7\cdot 3105\cdot 10}{10\cdot 1}$

$=\frac{7\cdot 3105}{1}$

$=\frac{21,735}{1}$

$=21,735$

21,735 tornadoes occurred during these four months.

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

The area is $\frac{3}{16}$ of a square mile.

100. $5 \cdot 3\frac{1}{2} = \frac{5}{1} \cdot \frac{7}{2} = \frac{5 \cdot 7}{1 \cdot 2} = \frac{35}{2}$ or $17\frac{1}{2}$

The area is $\frac{35}{2}$ or $17\frac{1}{2}$ square inches.

102. $\frac{3}{25} \cdot 12{,}000 = \frac{3}{25} \cdot \frac{12{,}000}{1}$

$= \frac{3 \cdot 12{,}000}{25 \cdot 1}$

$= \frac{3 \cdot 25 \cdot 480}{25 \cdot 1}$

$= \frac{3 \cdot 480}{1}$

$= 1440$

The family drove 1440 miles for shopping.

104. $\frac{1}{100} \cdot 12{,}000 = \frac{1}{100} \cdot \frac{12{,}000}{1}$

$= \frac{1 \cdot 12{,}000}{100 \cdot 1}$

$= \frac{1 \cdot 120 \cdot 100}{100 \cdot 1}$

$= 120$

The family drove 120 miles for medical needs.

106.
$$\begin{array}{r} 560 \\ 7\overline{)\,3920} \\ \underline{-35} \\ 42 \\ \underline{-42} \\ 00 \\ \underline{-0} \\ 0 \end{array}$$

108.
$$\begin{array}{r} 80 \text{ R } 20 \\ 31\overline{)\,2500} \\ \underline{-248} \\ 20 \\ \underline{-0} \\ 20 \end{array}$$

110. answers may vary

112. $5 \cdot 2\frac{1}{4} = \frac{5}{1} \cdot \frac{9}{4} = \frac{45}{4} = 11\frac{1}{4}$

114. $\frac{11}{12}$ rounds to 1

$4\frac{1}{16}$ rounds to 4

$1 \cdot 4 = 4$

The best estimate is c.

116. $7\frac{1}{4}$ rounds to 7

$4\frac{1}{5}$ rounds to 4

$7 \cdot 4 = 28$

The best estimate is d.

118. $\frac{11}{20}$ of 240 million $= \frac{11}{20} \cdot 240{,}000{,}000$

$= \frac{11}{20} \cdot \frac{240{,}000{,}000}{1}$

$= \frac{11 \cdot 240{,}000{,}000}{20}$

$= \frac{11 \cdot 12{,}000{,}000 \cdot 20}{20}$

$= \frac{11 \cdot 12{,}000{,}000}{1}$

$= 132{,}000{,}000$

Approximately 132 million U.S. adults owned a smartphone in 2013.

120. $\frac{1}{8} \cdot 313{,}914{,}000 = \frac{1}{8} \cdot \frac{313{,}914{,}000}{1}$

$= \frac{313{,}914{,}000}{8}$

$= \frac{8 \cdot 39{,}239{,}250}{8}$

$= \frac{39{,}239{,}250}{1}$

$= 39{,}239{,}250$

The approximate population of California is 39,239,250.

Section 2.5 Practice Exercises

1. The reciprocal of $\frac{4}{9}$ is $\frac{9}{4}$.

2. The reciprocal of $\frac{15}{7}$ is $\frac{7}{15}$.

3. The reciprocal of 9, or $\frac{9}{1}$, is $\frac{1}{9}$.

4. The reciprocal of $\frac{1}{8}$ is $\frac{8}{1}$ or 8.

5. $\frac{3}{2} \div \frac{14}{5} = \frac{3}{2} \cdot \frac{5}{14} = \frac{3 \cdot 5}{2 \cdot 14} = \frac{15}{28}$

6. $\frac{8}{7} \div \frac{2}{9} = \frac{8}{7} \cdot \frac{9}{2} = \frac{8 \cdot 9}{7 \cdot 2} = \frac{4 \cdot \cancel{2}^{1} \cdot 9}{7 \cdot \cancel{2}_{1}} = \frac{36}{7}$ or $5\frac{1}{7}$

7. $\frac{4}{9} \div \frac{1}{2} = \frac{4}{9} \cdot \frac{2}{1} = \frac{4 \cdot 2}{9 \cdot 1} = \frac{8}{9}$

8. $\frac{4}{9} \div 7 = \frac{4}{9} \div \frac{7}{1} = \frac{4}{9} \cdot \frac{1}{7} = \frac{4 \cdot 1}{9 \cdot 7} = \frac{4}{63}$

9. $\frac{8}{15} \div 3\frac{4}{5} = \frac{8}{15} \div \frac{19}{5}$

$= \frac{8}{15} \cdot \frac{5}{19}$

$= \frac{8 \cdot 5}{15 \cdot 19}$

$= \frac{8 \cdot \cancel{5}^{1}}{3 \cdot \cancel{5}_{1} \cdot 19}$

$= \frac{8}{57}$

10. $3\frac{2}{7} \div 2\frac{3}{14} = \frac{23}{7} \div \frac{31}{14}$

$= \frac{23}{7} \cdot \frac{14}{31}$

$= \frac{23 \cdot 14}{7 \cdot 31}$

$= \frac{23 \cdot 2 \cdot \cancel{7}^{1}}{\cancel{7}_{1} \cdot 31}$

$= \frac{46}{31}$ or $1\frac{15}{31}$

11. $\frac{14}{17} \div 0$ is undefined.

12. $0 \div 2\frac{1}{8} = 0 \div \frac{17}{8} = 0$

13. Number of outfits | is | 30 | divided by | $2\frac{1}{7}$

↓ ↓ ↓ ↓ ↓

Number of outfits = 30 ÷ $2\frac{1}{7}$

$30 \div 2\frac{1}{7} = 30 \div \frac{15}{7}$

$= \frac{30}{1} \cdot \frac{7}{15}$

$= \frac{30 \cdot 7}{1 \cdot 15}$

$= \frac{2 \cdot \cancel{15}^{1} \cdot 7}{1 \cdot \cancel{15}_{1}} = \frac{14}{1}$

$= 14$

14 outfits can be made from a 30-yard bolt of material.

Vocabulary, Readiness & Video Check 2.5

1. Two numbers are reciprocals of each other if their product is 1.

2. Every number has a reciprocal except 0.

3. To divide two fractions, we write $\frac{a}{b} \div \frac{c}{d} = \frac{a \cdot d}{b \cdot c}$.

4. The word "per" usually indicates division.

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

6. 0

7. Because we still have a division problem and we can't divide out common factors until we rewrite the division as a multiplication.

8. equally divided

Exercise Set 2.5

2. The reciprocal of $\frac{9}{10}$ is $\frac{10}{9}$.

4. The reciprocal of $\frac{1}{20}$ is $\frac{20}{1}$ or 20.

6. The reciprocal of $13 = \frac{13}{1}$ is $\frac{1}{13}$.

8. The reciprocal of $\frac{10}{3}$ is $\frac{3}{10}$.

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

12. $\frac{10}{11} \div \frac{4}{5} = \frac{10}{11} \cdot \frac{5}{4}$
$= \frac{10 \cdot 5}{11 \cdot 4}$
$= \frac{2 \cdot 5 \cdot 5}{11 \cdot 2 \cdot 2}$
$= \frac{5 \cdot 5}{11 \cdot 2}$
$= \frac{25}{22}$ or $1\frac{3}{22}$

14. $\frac{16}{27} \div \frac{8}{15} = \frac{16}{27} \cdot \frac{15}{8}$
$= \frac{16 \cdot 15}{27 \cdot 8}$
$= \frac{8 \cdot 2 \cdot 3 \cdot 5}{3 \cdot 9 \cdot 8}$
$= \frac{2 \cdot 5}{9}$
$= \frac{10}{9}$ or $1\frac{1}{9}$

16. $\frac{11}{16} \div \frac{13}{16} = \frac{11}{16} \cdot \frac{16}{13} = \frac{11 \cdot 16}{16 \cdot 13} = \frac{11}{13}$

18. $\frac{3}{13} \div \frac{13}{3} = \frac{3}{13} \cdot \frac{3}{13} = \frac{3 \cdot 3}{13 \cdot 13} = \frac{9}{169}$

20. $\frac{6}{11} \div \frac{6}{5} = \frac{6}{11} \cdot \frac{5}{6} = \frac{6 \cdot 5}{11 \cdot 6} = \frac{5}{11}$

22. $\frac{7}{8} \div \frac{5}{6} = \frac{7}{8} \cdot \frac{6}{5}$
$= \frac{7 \cdot 6}{8 \cdot 5}$
$= \frac{7 \cdot 2 \cdot 3}{2 \cdot 4 \cdot 5}$
$= \frac{7 \cdot 3}{4 \cdot 5}$
$= \frac{21}{20}$ or $1\frac{1}{20}$

24. $\frac{14}{52} \div \frac{1}{13} = \frac{14}{52} \cdot \frac{13}{1}$
$= \frac{14 \cdot 13}{52 \cdot 1}$
$= \frac{2 \cdot 7 \cdot 13}{2 \cdot 2 \cdot 13 \cdot 1}$
$= \frac{7}{2 \cdot 1}$
$= \frac{7}{2}$ or $3\frac{1}{2}$

26. $\frac{100}{158} \div \frac{10}{79} = \frac{100}{158} \cdot \frac{79}{10}$
$= \frac{100 \cdot 79}{158 \cdot 10}$
$= \frac{2 \cdot 5 \cdot 10 \cdot 79}{2 \cdot 79 \cdot 10}$
$= \frac{5}{1}$
$= 5$

28. $\frac{6}{15} \div \frac{7}{10} = \frac{6}{15} \cdot \frac{10}{7} = \frac{6 \cdot 10}{15 \cdot 7} = \frac{2 \cdot 3 \cdot 2 \cdot 5}{3 \cdot 5 \cdot 7} = \frac{2 \cdot 2}{7} = \frac{4}{7}$

30. $\frac{7}{13} \div \frac{7}{13} = \frac{7}{13} \cdot \frac{13}{7} = \frac{7 \cdot 13}{13 \cdot 7} = 1$

32. $0 \div \frac{4}{11} = 0 \cdot \frac{11}{4} = 0$

34. $\frac{2}{3} \div 0$ is undefined.

36. $\frac{65}{495} \div \frac{26}{231} = \frac{65}{495} \cdot \frac{231}{26}$
$= \frac{65 \cdot 231}{495 \cdot 26}$
$= \frac{5 \cdot 13 \cdot 3 \cdot 7 \cdot 11}{3 \cdot 3 \cdot 5 \cdot 11 \cdot 2 \cdot 13}$
$= \frac{7}{2 \cdot 3}$
$= \frac{7}{6}$ or $1\frac{1}{6}$

38. $\frac{5}{6} \div 10 = \frac{5}{6} \cdot \frac{1}{10} = \frac{5 \cdot 1}{6 \cdot 10} = \frac{5 \cdot 1}{6 \cdot 2 \cdot 5} = \frac{1}{6 \cdot 2} = \frac{1}{12}$

40. $7 \div \frac{2}{11} = \frac{7}{1} \cdot \frac{11}{2} = \frac{7 \cdot 11}{1 \cdot 2} = \frac{77}{2}$ or $38\frac{1}{2}$

42. $4\frac{2}{3} \div \frac{2}{5} = \frac{14}{3} \div \frac{2}{5}$
$= \frac{14}{3} \cdot \frac{5}{2}$
$= \frac{14 \cdot 5}{3 \cdot 2}$
$= \frac{2 \cdot 7 \cdot 5}{3 \cdot 2}$
$= \frac{7 \cdot 5}{3}$
$= \frac{35}{3}$ or $11\frac{2}{3}$

44. $\frac{4}{15} \div 2\frac{1}{2} = \frac{4}{15} \div \frac{5}{2} = \frac{4}{15} \cdot \frac{2}{5} = \frac{4 \cdot 2}{15 \cdot 5} = \frac{8}{75}$

46. $2\frac{5}{6} \div 4\frac{6}{7} = \frac{17}{6} \div \frac{34}{7}$
$= \frac{17}{6} \cdot \frac{7}{34}$
$= \frac{17 \cdot 7}{6 \cdot 34}$
$= \frac{17 \cdot 7}{6 \cdot 2 \cdot 17}$
$= \frac{7}{6 \cdot 2}$
$= \frac{7}{12}$

48. $3\frac{1}{10} \div 2\frac{1}{5} = \frac{31}{10} \div \frac{11}{5}$
$= \frac{31}{10} \cdot \frac{5}{11}$
$= \frac{31 \cdot 5}{10 \cdot 11}$
$= \frac{31 \cdot 5}{2 \cdot 5 \cdot 11}$
$= \frac{31}{2 \cdot 11}$
$= \frac{31}{22}$ or $1\frac{9}{22}$

50. $\frac{33}{50} \div 1 = \frac{33}{50} \div \frac{1}{1} = \frac{33}{50} \cdot \frac{1}{1} = \frac{33 \cdot 1}{50 \cdot 1} = \frac{33}{50}$

52. $0 \div 7\frac{9}{10} = 0 \div \frac{79}{10} = 0 \cdot \frac{10}{79} = 0$

54. $\frac{17}{75} \div 1 = \frac{17}{75} \div \frac{1}{1} = \frac{17}{75} \cdot \frac{1}{1} = \frac{17 \cdot 1}{75 \cdot 1} = \frac{17}{75}$

56. $20\frac{5}{6} \div 137\frac{1}{2} = \frac{125}{6} \div \frac{275}{2}$
$= \frac{125}{6} \cdot \frac{2}{275}$
$= \frac{125 \cdot 2}{6 \cdot 275}$
$= \frac{5 \cdot 25 \cdot 2}{2 \cdot 3 \cdot 25 \cdot 11}$
$= \frac{5}{3 \cdot 11}$
$= \frac{5}{33}$

58. $\frac{4}{15} \div \frac{8}{3} = \frac{4}{15} \cdot \frac{3}{8} = \frac{4 \cdot 3}{15 \cdot 8} = \frac{4 \cdot 3}{5 \cdot 3 \cdot 4 \cdot 2} = \frac{1}{5 \cdot 2} = \frac{1}{10}$

60. $\frac{9}{20} \div \frac{2}{9} = \frac{9}{20} \cdot \frac{9}{2} = \frac{9 \cdot 9}{20 \cdot 2} = \frac{81}{40}$ or $2\frac{1}{40}$

62. $9 \div \frac{1}{6} = \frac{9}{1} \div \frac{1}{6} = \frac{9}{1} \cdot \frac{6}{1} = \frac{9 \cdot 6}{1 \cdot 1} = \frac{54}{1} = 54$

64. $\frac{3}{8} \div \frac{5}{8} = \frac{3}{8} \cdot \frac{8}{5} = \frac{3 \cdot 8}{8 \cdot 5} = \frac{3}{5}$

66. $20\frac{1}{5} \div 0$ is undefined.

68. $\frac{13}{84} \div \frac{3}{16} = \frac{13}{84} \cdot \frac{16}{3} = \frac{13 \cdot 16}{84 \cdot 3} \cdot \frac{13 \cdot 4 \cdot 4}{4 \cdot 21 \cdot 3} = \frac{13 \cdot 4}{21 \cdot 3} = \frac{52}{63}$

70. $8\frac{2}{7} \div 3\frac{1}{7} = \frac{58}{7} \div \frac{22}{7}$
$= \frac{58}{7} \cdot \frac{7}{22}$
$= \frac{58 \cdot 7}{7 \cdot 22}$
$= \frac{2 \cdot 29 \cdot 7}{7 \cdot 2 \cdot 11}$
$= \frac{29}{11}$ or $2\frac{7}{11}$

72. $\frac{25}{128} \div \frac{5}{32} = \frac{25}{128} \cdot \frac{32}{5}$
$= \frac{25 \cdot 32}{128 \cdot 5}$
$= \frac{5 \cdot 5 \cdot 32}{32 \cdot 4 \cdot 5}$
$= \frac{5}{4}$ or $1\frac{1}{4}$

74. $27\frac{3}{4} \div \frac{1}{4} = \frac{111}{4} \div \frac{1}{4} = \frac{111}{4} \cdot \frac{4}{1} = \frac{111}{1} = 111$

This will make 111 quarter-pound hamburgers.

76. $13\frac{1}{3} \div 4 = \frac{40}{3} \div \frac{4}{1}$

$= \frac{40}{3} \cdot \frac{1}{4}$

$= \frac{40 \cdot 1}{3 \cdot 4}$

$= \frac{4 \cdot 10 \cdot 1}{3 \cdot 4}$

$= \frac{10 \cdot 1}{3}$

$= \frac{10}{3}$ or $3\frac{1}{3}$

Each ounce of lean hamburger meat has $\frac{10}{3}$ or $3\frac{1}{3}$ grams of fat.

78. $125 \div 2\frac{3}{5} = \frac{125}{1} \div \frac{13}{5}$

$= \frac{125}{1} \cdot \frac{5}{13}$

$= \frac{125 \cdot 5}{1 \cdot 13}$

$= \frac{625}{13}$ or $48\frac{1}{13}$

The worker can complete the order in $\frac{625}{13}$ or $48\frac{1}{13}$ hours.

80. $450 \div \frac{3}{4} = \frac{450}{1} \cdot \frac{4}{3}$

$= \frac{450 \cdot 4}{1 \cdot 3}$

$= \frac{3 \cdot 150 \cdot 4}{1 \cdot 3}$

$= \frac{150 \cdot 4}{1}$

$= \frac{600}{1}$

$= 600$

The cost of one carat is \$600.

82. $23\frac{1}{2} \div 4 = \frac{47}{2} \div \frac{4}{1} = \frac{47}{2} \cdot \frac{1}{4} = \frac{47 \cdot 1}{2 \cdot 4} = \frac{47}{8}$ or $5\frac{7}{8}$

The length of each side of the square is $5\frac{7}{8}$ feet.

84. $\frac{2}{5} \div \frac{4}{7} = \frac{2}{5} \cdot \frac{7}{4} = \frac{2 \cdot 7}{5 \cdot 4} = \frac{2 \cdot 7}{5 \cdot 2 \cdot 2} = \frac{7}{5 \cdot 2} = \frac{7}{10}$

86. $2\frac{2}{3} \cdot 1\frac{1}{16} = \frac{8}{3} \cdot \frac{17}{16}$

$= \frac{8 \cdot 17}{3 \cdot 16}$

$= \frac{8 \cdot 17}{3 \cdot 8 \cdot 2}$

$= \frac{17}{3 \cdot 2}$

$= \frac{17}{6}$ or $2\frac{5}{6}$

88. $8\frac{1}{6} \cdot \frac{3}{7} \cdot \frac{18}{25} = \frac{49}{6} \cdot \frac{3}{7} \cdot \frac{18}{25}$

$= \frac{49 \cdot 3 \cdot 18}{6 \cdot 7 \cdot 25}$

$= \frac{7 \cdot 7 \cdot 3 \cdot 6 \cdot 3}{6 \cdot 7 \cdot 25}$

$= \frac{7 \cdot 3 \cdot 3}{25}$

$= \frac{63}{25}$ or $2\frac{13}{25}$

90. $2\frac{1}{5} \div 1\frac{7}{10} = \frac{11}{5} \div \frac{17}{10}$

$= \frac{11}{5} \cdot \frac{10}{17}$

$= \frac{11 \cdot 10}{5 \cdot 17}$

$= \frac{11 \cdot 2 \cdot 5}{5 \cdot 17}$

$= \frac{11 \cdot 2}{17}$

$= \frac{22}{17}$ or $1\frac{5}{17}$

92.
$$\begin{array}{r} {\scriptstyle 11} \\ 811 \\ 42 \\ +\ 69 \\ \hline 922 \end{array}$$

94.
$$\begin{array}{r} 882 \\ -\ 773 \\ \hline 109 \end{array}$$

96.
$$\begin{array}{r} 500 \\ -\ 92 \\ \hline 408 \end{array}$$

98. $6\frac{1}{4} \div \frac{1}{2} = \frac{25}{4} \cdot \frac{2}{1} = \frac{50}{4} = 12\frac{2}{4}$ or $12\frac{1}{2}$

100. $\frac{11}{12}$ rounds to 1

$16\frac{1}{5}$ rounds to 16

$1 \div 16 = \frac{1}{1} \div \frac{16}{1} = \frac{1}{1} \cdot \frac{1}{16} = \frac{1 \cdot 1}{1 \cdot 16} = \frac{1}{16}$

The best estimate is a.

102. $10\frac{1}{4}$ rounds to 10

$2\frac{1}{16}$ rounds to 2

$10 \div 2 = 5$

The best estimate is b.

104.
$$\begin{aligned} \left(\frac{8}{13} \cdot \frac{39}{16} \cdot \frac{8}{9}\right)^2 \div \frac{1}{2} &= \left(\frac{8 \cdot 39 \cdot 8}{13 \cdot 16 \cdot 9}\right)^2 \div \frac{1}{2} \\ &= \left(\frac{2 \cdot 4 \cdot 13 \cdot 3 \cdot 8}{13 \cdot 2 \cdot 8 \cdot 3 \cdot 3}\right)^2 \div \frac{1}{2} \\ &= \left(\frac{4}{3}\right)^2 \div \frac{1}{2} \\ &= \frac{4}{3} \cdot \frac{4}{3} \div \frac{1}{2} \\ &= \frac{4 \cdot 4}{3 \cdot 3} \div \frac{1}{2} \\ &= \frac{16}{9} \div \frac{1}{2} \\ &= \frac{16}{9} \cdot \frac{2}{1} \\ &= \frac{16 \cdot 2}{9 \cdot 1} \\ &= \frac{32}{9} \text{ or } 3\frac{5}{9} \end{aligned}$$

106.
$$\begin{aligned} 5144 \div \frac{1}{3} &= \frac{5144}{1} \cdot \frac{3}{1} \\ &= \frac{5144 \cdot 3}{1 \cdot 1} \\ &= \frac{15,432}{1} \\ &= 15,432 \end{aligned}$$

There are 15,432 flowering plant species native to the United States.

108. answers may vary

Chapter 2 Vocabulary Check

1. Two numbers are reciprocals of each other if their product is 1.

2. A composite number is a natural number greater than 1 that is not prime.

3. Fractions that represent the same portion of a whole are called equivalent fractions.

4. An improper fraction is a fraction whose numerator is greater than or equal to its denominator.

5. A prime number is a natural number greater than 1 whose only factors are 1 and itself.

6. A fraction is in simplest form when the numerator and the denominator have no factors in common other than 1.

7. A proper fraction is one whose numerator is less than its denominator.

8. A mixed number contains a whole number part and a fraction part.

9. In the fraction $\frac{7}{9}$, the 7 is called the numerator and the 9 is called the denominator.

10. The prime factorization of a number is the factorization in which all the factors are prime numbers.

11. The fraction $\frac{3}{0}$ is undefined.

12. The fraction $\frac{0}{5} = 0$.

13. In $\frac{a}{b}=\frac{c}{d}$, $a \cdot d$ and $b \cdot c$ are called cross products.

Chapter 2 Review

1. $\frac{11}{23}$ is a proper fraction.

2. $\frac{9}{8}$ is an improper fraction.

3. $\frac{1}{2}$ is a proper fraction.

4. $2\frac{1}{4}$ is a mixed number.

5. 2 of the 6 equal parts are shaded: $\frac{2}{6}$

6. 4 of the 7 equal parts are shaded: $\frac{4}{7}$

7. Each part is $\frac{1}{3}$ of a whole and 7 parts are shaded: $\frac{7}{3}$

8. Each part is $\frac{1}{4}$ of a whole and 13 parts are shaded: $\frac{13}{4}$

9. free throws made $\rightarrow$ 11
free throws during game $\rightarrow$ 12
The player made $\frac{11}{12}$ of his free throws.

10. a. 131 − 23 = 108
108 cars on the lot are not blue.

b. There are 131 cars, of which 108 are not blue. $\frac{108}{131}$ of the cars are not blue.

11.
$$\begin{array}{r} 3 \text{ R } 3 \\ 4\overline{)\,15} \\ \underline{-12} \\ 3 \end{array}$$
$\frac{15}{4}=3\frac{3}{4}$

12.
$$\begin{array}{r} 45 \text{ R } 5 \\ 6\overline{)\,275} \\ \underline{-24} \\ 35 \\ \underline{-30} \\ 5 \end{array}$$
$\frac{275}{6}=45\frac{5}{6}$

13.
$$\begin{array}{r} 3 \\ 13\overline{)\,39} \\ \underline{-39} \\ 0 \end{array}$$
$\frac{39}{13}=3$

14.
$$\begin{array}{r} 5 \\ 12\overline{)\,60} \\ \underline{-60} \\ 0 \end{array}$$
$\frac{60}{12}=5$

15. $1\frac{1}{5}=\frac{5\cdot 1+1}{5}=\frac{6}{5}$

16. $1\frac{1}{21}=\frac{21\cdot 1+1}{21}=\frac{22}{21}$

17. $2\frac{8}{9}=\frac{9\cdot 2+8}{9}=\frac{26}{9}$

18. $3\frac{11}{12}=\frac{12\cdot 3+11}{12}=\frac{47}{12}$

19. Composite, since the factors of 51 are 1, 3, 17, and 51.

20. Prime, since the only factors of 17 are 1 and 17.

21. $1 \cdot 42 = 42$
$2 \cdot 21 = 42$
$3 \cdot 14 = 42$
$6 \cdot 7 = 42$
The factors of 42 are 1, 2, 3, 6, 7, 14, 21, and 42.

22. $1 \cdot 20 = 20$
$2 \cdot 10 = 20$
$4 \cdot 5 = 20$
The factors of 20 are 1, 2, 4, 5, 10, and 20.

23.
$$\begin{array}{r} 17 \\ 2\overline{)34} \\ 2\overline{)68} \end{array}$$
$68 = 2^2 \cdot 17$

24.
$$\begin{array}{r} 5 \\ 3\overline{)15} \\ 3\overline{)45} \\ 2\overline{)90} \end{array}$$
$90 = 2 \cdot 3^2 \cdot 5$

25.
$$\begin{array}{r} 157 \\ 5\overline{)785} \end{array}$$
$785 = 5 \cdot 157$

26.
$$\begin{array}{r} 17 \\ 5\overline{)\ 85} \\ 3\overline{)255} \end{array}$$
$255 = 3 \cdot 5 \cdot 17$

27. $\dfrac{12}{28} = \dfrac{3 \cdot 4}{7 \cdot 4} = \dfrac{3}{7}$

28. $\dfrac{15}{27} = \dfrac{3 \cdot 5}{3 \cdot 9} = \dfrac{5}{9}$

29. $\dfrac{25}{75} = \dfrac{25 \cdot 1}{25 \cdot 3} = \dfrac{1}{3}$

30. $\dfrac{36}{72} = \dfrac{36 \cdot 1}{36 \cdot 2} = \dfrac{1}{2}$

31. $\dfrac{29}{32} = \dfrac{29}{32}$
29 and 32 have no common factors other than 1.

32. $\dfrac{18}{23} = \dfrac{18}{23}$
18 and 23 have no common factors other than 1.

33. $\dfrac{48}{6} = \dfrac{6 \cdot 8}{6 \cdot 1} = \dfrac{8}{1} = 8$

34. $\dfrac{54}{9} = \dfrac{6 \cdot 9}{1 \cdot 9} = \dfrac{6}{1} = 6$

35. $\dfrac{8 \text{ inches}}{12 \text{ inches}} = \dfrac{8}{12} = \dfrac{4 \cdot 2}{4 \cdot 3} = \dfrac{2}{3}$
8 inches represents $\dfrac{2}{3}$ of a foot.

36. $15 - 6 = 9$ cars are not white.
$\dfrac{9 \text{ non-white cars}}{15 \text{ total cars}} = \dfrac{9}{15} = \dfrac{3 \cdot 3}{3 \cdot 5} = \dfrac{3}{5}$
$\dfrac{3}{5}$ of the cars are not white.

37. Not equivalent, since the cross products are not equal: $34 \cdot 4 = 136$ and $14 \cdot 10 = 140$

38. Equivalent, since the cross products are equal: $50 \cdot 9 = 450$ and $15 \cdot 30 = 450$

39. $\dfrac{3}{5} \cdot \dfrac{1}{2} = \dfrac{3 \cdot 1}{5 \cdot 2} = \dfrac{3}{10}$

40. $\dfrac{6}{7} \cdot \dfrac{5}{12} = \dfrac{6 \cdot 5}{7 \cdot 12} = \dfrac{6 \cdot 5}{7 \cdot 6 \cdot 2} = \dfrac{5}{7 \cdot 2} = \dfrac{5}{14}$

41. $\dfrac{24}{5} \cdot \dfrac{15}{8} = \dfrac{24 \cdot 15}{5 \cdot 8} = \dfrac{3 \cdot 8 \cdot 3 \cdot 5}{5 \cdot 8} = \dfrac{3 \cdot 3}{1} = 9$

42. $\dfrac{27}{21} \cdot \dfrac{7}{18} = \dfrac{27 \cdot 7}{21 \cdot 18} = \dfrac{9 \cdot 3 \cdot 7}{7 \cdot 3 \cdot 9 \cdot 2} = \dfrac{1}{2}$

43. $5 \cdot \dfrac{7}{8} = \dfrac{5}{1} \cdot \dfrac{7}{8} = \dfrac{5 \cdot 7}{1 \cdot 8} = \dfrac{35}{8}$ or $4\dfrac{3}{8}$

44. $6 \cdot \dfrac{5}{12} = \dfrac{6}{1} \cdot \dfrac{5}{12} = \dfrac{6 \cdot 5}{1 \cdot 12} = \dfrac{6 \cdot 5}{1 \cdot 6 \cdot 2} = \dfrac{5}{1 \cdot 2} = \dfrac{5}{2}$ or $2\dfrac{1}{2}$

45. $\dfrac{39}{3} \cdot \dfrac{7}{13} \cdot \dfrac{5}{21} = \dfrac{39 \cdot 7 \cdot 5}{3 \cdot 13 \cdot 21} = \dfrac{3 \cdot 13 \cdot 7 \cdot 5}{3 \cdot 13 \cdot 7 \cdot 3} = \dfrac{5}{3}$ or $1\dfrac{2}{3}$

46. $\frac{42}{5}\cdot\frac{15}{6}\cdot\frac{7}{9}=\frac{42\cdot15\cdot7}{5\cdot6\cdot9}$
$=\frac{6\cdot7\cdot3\cdot5\cdot7}{5\cdot6\cdot3\cdot3}$
$=\frac{7\cdot7}{3}$
$=\frac{49}{3}$ or $16\frac{1}{3}$

47. Exact: $1\frac{5}{8}\cdot3\frac{1}{5}=\frac{13}{8}\cdot\frac{16}{5}$
$=\frac{13\cdot16}{8\cdot5}$
$=\frac{13\cdot8\cdot2}{8\cdot5}$
$=\frac{13\cdot2}{5}$
$=\frac{26}{5}$ or $5\frac{1}{5}$

Estimate: $1\frac{5}{8}$ rounds to 2, $3\frac{1}{5}$ rounds to 3.
$2\cdot3=6$

48. Exact: $3\frac{6}{11}\cdot1\frac{7}{13}=\frac{39}{11}\cdot\frac{20}{13}$
$=\frac{39\cdot20}{11\cdot13}$
$=\frac{13\cdot3\cdot20}{11\cdot13}$
$=\frac{3\cdot20}{11}$
$=\frac{60}{11}$ or $5\frac{5}{11}$

Estimate: $3\frac{6}{11}$ rounds to 4, $1\frac{7}{13}$ rounds to 2.
$4\cdot2=8$

49. $\frac{3}{4}\cdot8\cdot4\frac{1}{8}=\frac{3}{4}\cdot\frac{8}{1}\cdot\frac{33}{8}$
$=\frac{3\cdot8\cdot33}{4\cdot1\cdot8}$
$=\frac{3\cdot33}{4\cdot1}$
$=\frac{99}{4}$ or $24\frac{3}{4}$

50. $2\frac{1}{9}\cdot3\cdot\frac{1}{38}=\frac{19}{9}\cdot\frac{3}{1}\cdot\frac{1}{38}$
$=\frac{19\cdot3\cdot1}{9\cdot1\cdot38}$
$=\frac{19\cdot3\cdot1}{3\cdot3\cdot1\cdot2\cdot19}$
$=\frac{1}{3\cdot1\cdot2}$
$=\frac{1}{6}$

51. $5\cdot7\frac{1}{3}=\frac{5}{1}\cdot\frac{22}{3}=\frac{5\cdot22}{1\cdot3}=\frac{110}{3}$ or $36\frac{2}{3}$

A 5-ounce hamburger patty has $\frac{110}{3}$ or $36\frac{2}{3}$ grams of fat.

52. $45\cdot\frac{3}{4}=\frac{45}{1}\cdot\frac{3}{4}=\frac{45\cdot3}{1\cdot4}=\frac{135}{4}$ or $33\frac{3}{4}$

The art teacher needs $\frac{135}{4}$ or $33\frac{3}{4}$ inches of piping.

53. $\frac{7}{10}\cdot2\frac{1}{8}=\frac{7}{10}\cdot\frac{17}{8}=\frac{7\cdot17}{10\cdot8}=\frac{119}{80}$ or $1\frac{39}{80}$

The area is $\frac{119}{80}$ or $1\frac{39}{80}$ square inches.

54. $6\frac{7}{8}\cdot5=\frac{55}{8}\cdot\frac{5}{1}=\frac{55\cdot5}{8\cdot1}=\frac{275}{8}$ or $34\frac{3}{8}$

The area is $\frac{275}{8}$ or $34\frac{3}{8}$ square meters.

55. The reciprocal of 7, or $\frac{7}{1}$, is $\frac{1}{7}$.

56. The reciprocal of $\frac{1}{8}$ is $\frac{8}{1}$ or 8.

57. The reciprocal of $\frac{14}{23}$ is $\frac{23}{14}$.

58. The reciprocal of $\frac{17}{5}$ is $\frac{5}{17}$.

59. $\frac{3}{4}\div\frac{3}{8}=\frac{3}{4}\cdot\frac{8}{3}=\frac{3\cdot8}{4\cdot3}=\frac{3\cdot4\cdot2}{4\cdot3}=\frac{2}{1}=2$

60. $\frac{21}{4} \div \frac{7}{5} = \frac{21}{4} \cdot \frac{5}{7}$
$= \frac{21 \cdot 5}{4 \cdot 7}$
$= \frac{3 \cdot 7 \cdot 5}{4 \cdot 7}$
$= \frac{3 \cdot 5}{4}$
$= \frac{15}{4}$ or $3\frac{3}{4}$

61. $\frac{5}{3} \div 2 = \frac{5}{3} \div \frac{2}{1} = \frac{5}{3} \cdot \frac{1}{2} = \frac{5 \cdot 1}{3 \cdot 2} = \frac{5}{6}$

62. $5 \div \frac{15}{8} = \frac{5}{1} \cdot \frac{8}{15} = \frac{5 \cdot 8}{1 \cdot 15} = \frac{5 \cdot 8}{1 \cdot 5 \cdot 3} = \frac{8}{1 \cdot 3} = \frac{8}{3}$ or $2\frac{2}{3}$

63. $6\frac{3}{4} \div 1\frac{2}{7} = \frac{27}{4} \div \frac{9}{7}$
$= \frac{27}{4} \cdot \frac{7}{9}$
$= \frac{27 \cdot 7}{4 \cdot 9}$
$= \frac{3 \cdot 9 \cdot 7}{4 \cdot 9}$
$= \frac{3 \cdot 7}{4}$
$= \frac{21}{4}$ or $5\frac{1}{4}$

64. $5\frac{1}{2} \div 2\frac{1}{11} = \frac{11}{2} \div \frac{23}{11}$
$= \frac{11}{2} \cdot \frac{11}{23}$
$= \frac{11 \cdot 11}{2 \cdot 23}$
$= \frac{121}{46}$ or $2\frac{29}{46}$

65. $341 \div 15\frac{1}{2} = \frac{341}{1} \div \frac{31}{2}$
$= \frac{341}{1} \cdot \frac{2}{31}$
$= \frac{341 \cdot 2}{1 \cdot 31}$
$= \frac{11 \cdot 31 \cdot 2}{1 \cdot 31}$
$= \frac{11 \cdot 2}{1}$
$= 22$
We might expect the truck to travel 22 miles on 1 gallon of gas.

66. $5\frac{1}{4} \div 5 = \frac{21}{4} \div \frac{5}{1} = \frac{21}{4} \cdot \frac{1}{5} = \frac{21 \cdot 1}{4 \cdot 5} = \frac{21}{20}$ or $1\frac{1}{20}$
He walks $\frac{21}{20}$ or $1\frac{1}{20}$ miles each day.

67. $\frac{0}{3}$ is a proper fraction.

68. $\frac{12}{12}$ is an improper fraction.

69. $5\frac{6}{7}$ is a mixed number.

70. $\frac{13}{9}$ is an improper fraction.

71.
$$\begin{array}{r} 31 \text{ R } 1 \\ 4\overline{)\,125} \\ \underline{-12} \\ 05 \\ \underline{-4} \\ 1 \end{array}$$
$\frac{125}{4} = 31\frac{1}{4}$

72.
$$\begin{array}{r} 6 \\ 9\overline{)\,54} \\ \underline{-54} \\ 0 \end{array}$$
$\frac{54}{9} = 6$

73. $5\frac{10}{17} = \frac{17 \cdot 5 + 10}{17} = \frac{95}{17}$

74. $7\frac{5}{6} = \frac{6\cdot 7+5}{6} = \frac{47}{6}$

75. Composite, since the factors of 27 are 1, 3, 9, and 27.

76. Prime, since the only factors of 23 are 1 and 23.

77.
$$\begin{array}{r} 5 \\ 3\overline{)\,15} \\ 3\overline{)\,45} \\ 2\overline{)\,90} \\ 2\overline{)180} \end{array}$$
$180 = 2^2 \cdot 3^2 \cdot 5$

78.
$$\begin{array}{r} 7 \\ 7\overline{)49} \\ 2\overline{)98} \end{array}$$
$90 = 2 \cdot 7^2$

79. $\frac{45}{50} = \frac{9\cdot 5}{10\cdot 5} = \frac{9}{10}$

80. $\frac{30}{42} = \frac{6\cdot 5}{6\cdot 7} = \frac{5}{7}$

81. $\frac{140}{150} = \frac{14\cdot 10}{15\cdot 10} = \frac{14}{15}$

82. $\frac{84}{140} = \frac{28\cdot 3}{28\cdot 5} = \frac{3}{5}$

83. $\frac{7}{8}\cdot\frac{2}{3} = \frac{7\cdot 2}{8\cdot 3} = \frac{7\cdot 2}{4\cdot 2\cdot 3} = \frac{7}{4\cdot 3} = \frac{7}{12}$

84. $\frac{6}{15}\cdot\frac{5}{8} = \frac{6\cdot 5}{15\cdot 8} = \frac{2\cdot 3\cdot 5}{3\cdot 5\cdot 2\cdot 4} = \frac{1}{4}$

85. $\frac{18}{5}\div\frac{2}{5} = \frac{18}{5}\cdot\frac{5}{2} = \frac{18\cdot 5}{5\cdot 2} = \frac{2\cdot 9\cdot 5}{5\cdot 2} = \frac{9}{1} = 9$

86. $\frac{9}{2}\div\frac{1}{3} = \frac{9}{2}\cdot\frac{3}{1} = \frac{9\cdot 3}{2\cdot 1} = \frac{27}{2}$ or $13\frac{1}{2}$

87. Exact: $4\frac{1}{6}\cdot 2\frac{2}{5} = \frac{25}{6}\cdot\frac{12}{5}$
$= \frac{25\cdot 12}{6\cdot 5}$
$= \frac{5\cdot 5\cdot 6\cdot 2}{6\cdot 5}$
$= \frac{5\cdot 2}{1}$
$= 10$

Estimate: $4\frac{1}{6}$ rounds to 4

$2\frac{2}{5}$ rounds to 2

$4 \cdot 2 = 8$

88. Exact: $5\frac{2}{3}\cdot 2\frac{1}{4} = \frac{17}{3}\cdot\frac{9}{4}$
$= \frac{17\cdot 9}{3\cdot 4}$
$= \frac{17\cdot 3\cdot 3}{3\cdot 4}$
$= \frac{17\cdot 3}{4}$
$= \frac{51}{4}$ or $12\frac{3}{4}$

Estimate: $5\frac{2}{3}$ rounds to 6

$2\frac{1}{4}$ rounds to 2

$6 \cdot 2 = 12$

89. $\frac{7}{2}\div 1\frac{1}{2} = \frac{7}{2}\div\frac{3}{2} = \frac{7}{2}\cdot\frac{2}{3} = \frac{7\cdot 2}{2\cdot 3} = \frac{7}{3}$ or $2\frac{1}{3}$

90. $1\frac{3}{5}\div\frac{1}{4} = \frac{8}{5}\cdot\frac{4}{1} = \frac{8\cdot 4}{5\cdot 1} = \frac{32}{5}$ or $6\frac{2}{5}$

91. $5\frac{1}{2}\cdot 7\frac{4}{11} = \frac{11}{2}\cdot\frac{81}{11} = \frac{11\cdot 81}{2\cdot 11} = \frac{81}{2}$ or $40\frac{1}{2}$

The area is $\frac{81}{2}$ or $40\frac{1}{2}$ square feet.

92. $23\frac{1}{2}\div 30\frac{1}{2} = \frac{47}{2}\div\frac{61}{2} = \frac{47}{2}\cdot\frac{2}{61} = \frac{47\cdot 2}{2\cdot 61} = \frac{47}{61}$

This is $\frac{47}{61}$ inch of rain per 1 hour.

Chapter 2 Test

1. 7 of the 16 equal parts are shaded: $\frac{7}{16}$

2. Each part is $\frac{1}{5}$ of a whole and 13 parts are shaded: $\frac{13}{5}$

3. $7\frac{2}{3} = \frac{3\cdot 7+2}{3} = \frac{23}{3}$

4. $3\frac{6}{11} = \frac{11\cdot 3+6}{11} = \frac{39}{11}$

5.
$$5\overline{)23}\quad 4 \text{ R } 3$$
$$\underline{20}$$
$$3$$

$\frac{23}{5} = 4\frac{3}{5}$

6.
$$4\overline{)75}\quad 18 \text{ R } 3$$
$$\underline{-4}$$
$$35$$
$$\underline{-32}$$
$$3$$

$\frac{75}{4} = 18\frac{3}{4}$

7. $\frac{24}{210} = \frac{6\cdot 4}{6\cdot 35} = \frac{4}{35}$

8. $\frac{42}{70} = \frac{14\cdot 3}{14\cdot 5} = \frac{3}{5}$

9. Not equivalent, since the cross products are not equal: $7 \cdot 8 = 56$ and $11 \cdot 5 = 55$.

10. Equivalent, since the cross products are equal: $27 \cdot 14 = 378$ and $63 \cdot 6 = 378$.

11.
$$3\overline{)21}\quad 7$$
$$2\overline{)42}$$
$$2\overline{)84}$$

$84 = 2^2 \cdot 3 \cdot 7$

12.
$$5\overline{)55}\quad 11$$
$$3\overline{)165}$$
$$3\overline{)495}$$

$495 = 3^2 \cdot 5 \cdot 11$

13. $\frac{4}{4} \div \frac{3}{4} = \frac{4}{4} \cdot \frac{4}{3} = \frac{4\cdot 4}{4\cdot 3} = \frac{4}{3}$ or $1\frac{1}{3}$

14. $\frac{4}{3} \cdot \frac{4}{4} = \frac{4\cdot 4}{3\cdot 4} = \frac{4}{3}$ or $1\frac{1}{3}$

15. $2 \cdot \frac{1}{8} = \frac{2}{1} \cdot \frac{1}{8} = \frac{2\cdot 1}{1\cdot 8} = \frac{2\cdot 1}{1\cdot 2\cdot 4} = \frac{1}{4}$

16. $\frac{2}{3} \cdot \frac{8}{15} = \frac{2\cdot 8}{3\cdot 15} = \frac{16}{45}$

17. $8 \div \frac{1}{2} = \frac{8}{1} \cdot \frac{2}{1} = \frac{8\cdot 2}{1\cdot 1} = 16$

18.
$$13\frac{1}{2} \div 3 = \frac{27}{2} \div \frac{3}{1}$$
$$= \frac{27}{2} \cdot \frac{1}{3}$$
$$= \frac{27\cdot 1}{2\cdot 3}$$
$$= \frac{3\cdot 9\cdot 1}{2\cdot 3}$$
$$= \frac{9}{2} \text{ or } 4\frac{1}{2}$$

19. $\frac{3}{8} \cdot \frac{16}{6} \cdot \frac{4}{11} = \frac{3\cdot 16\cdot 4}{8\cdot 6\cdot 11} = \frac{3\cdot 2\cdot 8\cdot 4}{8\cdot 2\cdot 3\cdot 11} = \frac{4}{11}$

20. $5\frac{1}{4} \div \frac{7}{12} = \frac{21}{4} \cdot \frac{12}{7} = \frac{21\cdot 12}{4\cdot 7} = \frac{3\cdot 7\cdot 3\cdot 4}{4\cdot 7} = \frac{3\cdot 3}{1} = 9$

21.
$$\frac{16}{3} \div \frac{3}{12} = \frac{16}{3} \cdot \frac{12}{3}$$
$$= \frac{16\cdot 12}{3\cdot 3}$$
$$= \frac{16\cdot 3\cdot 4}{3\cdot 3}$$
$$= \frac{16\cdot 4}{3}$$
$$= \frac{64}{3} \text{ or } 21\frac{1}{3}$$

22. $3\frac{1}{3}\cdot 6\frac{3}{4}=\frac{10}{3}\cdot\frac{27}{4}$
$=\frac{10\cdot 27}{3\cdot 4}$
$=\frac{2\cdot 5\cdot 3\cdot 9}{3\cdot 2\cdot 2}$
$=\frac{5\cdot 9}{2}$
$=\frac{45}{2}$ or $22\frac{1}{2}$

23. $12\div 3\frac{1}{3}=\frac{12}{1}\div\frac{10}{3}$
$=\frac{12}{1}\cdot\frac{3}{10}$
$=\frac{12\cdot 3}{1\cdot 10}$
$=\frac{2\cdot 6\cdot 3}{1\cdot 2\cdot 5}$
$=\frac{6\cdot 3}{1\cdot 5}$
$=\frac{18}{5}$ or $3\frac{3}{5}$

24. $\frac{14}{5}\cdot\frac{25}{21}\cdot 2=\frac{14}{5}\cdot\frac{25}{21}\cdot\frac{2}{1}$
$=\frac{14\cdot 25\cdot 2}{5\cdot 21\cdot 1}$
$=\frac{2\cdot 7\cdot 5\cdot 5\cdot 2}{5\cdot 3\cdot 7\cdot 1}$
$=\frac{2\cdot 5\cdot 2}{3\cdot 1}$
$=\frac{20}{3}$ or $6\frac{2}{3}$

25. $\frac{2}{3}\cdot 1\frac{8}{9}=\frac{2}{3}\cdot\frac{17}{9}=\frac{2\cdot 17}{3\cdot 9}=\frac{34}{27}$ or $1\frac{7}{27}$

The area is $\frac{34}{27}$ or $1\frac{7}{27}$ square miles.

26. $258\div 10\frac{3}{4}=\frac{258}{1}\div\frac{43}{4}$
$=\frac{258}{1}\cdot\frac{4}{43}$
$=\frac{258\cdot 4}{1\cdot 43}$
$=\frac{43\cdot 6\cdot 4}{1\cdot 43}$
$=\frac{24}{1}$
$=24$

We expect the car to travel 24 miles on 1 gallon of gas.

27. $100\cdot 53\frac{1}{3}=\frac{100}{1}\cdot\frac{160}{3}$
$=\frac{100\cdot 160}{1\cdot 3}$
$=\frac{16{,}000}{3}$ or $5333\frac{1}{3}$

$\frac{16{,}000}{3}$ or $5333\frac{1}{3}$ square yards of artificial turf are necessary to cover the football field.

28. $120\cdot\frac{3}{4}=\frac{120}{1}\cdot\frac{3}{4}=\frac{120\cdot 3}{1\cdot 4}=\frac{4\cdot 30\cdot 3}{1\cdot 4}=\frac{30\cdot 3}{1}=90$

The stock sold for \$90 per share after the oil spill.

Cumulative Review Chapters 1–2

1. The place value of the 3 in 396,418 is hundred-thousands.

2. 2036 is written as two thousand, thirty-six.

3. Eight hundred five in standard form is 805.

4.
$$\begin{array}{r} {\scriptstyle 2}\\ 7\\ 6\\ 10\\ 3\\ +\ 5\\ \hline 31 \end{array}$$

5.
$$\begin{array}{r} {\scriptstyle 1\,1\ 1}\\ 34,285\\ +\ 149,761\\ \hline 184,046 \end{array}$$

6.
$$\begin{array}{r} {\scriptstyle 1} \\ 56 \\ 18 \\ +\ 43 \\ \hline 117 \end{array}$$

$$3\overline{)117}\quad \begin{array}{r} 39 \\ -9 \\ \hline 27 \\ -27 \\ \hline 0 \end{array}$$

The average is 39.

7.
$$\begin{array}{r} {\scriptstyle 1} \\ 2 \\ 3 \\ 1 \\ 3 \\ +\ 4 \\ \hline 13 \end{array}$$

The perimeter is 13 inches.

8.
$$\begin{array}{r} 25 \\ -\ 8 \\ \hline 17 \end{array}$$

9.
$$\begin{array}{r} 12,734,424 \\ +\ 1,705,636 \\ \hline 14,440,060 \end{array}$$

The total number of passenger vehicles sold in the United States in 2012 was 14,440,060.

10. $\sqrt{25} = 5$, since $5 \cdot 5 = 25$.

11.
$$\begin{array}{r} 7826 \\ -\ 505 \\ \hline 7321 \end{array}$$

Check:
$$\begin{array}{r} 7321 \\ +\ 505 \\ \hline 7826 \end{array}$$

12. $8^2 = 8 \cdot 8 = 64$

13. **a.** The country with the greatest number of threatened mammal species is Indonesia.

b. The number of threatened mammal species for Malaysia is 71, the number of threatened mammal species for China is 75, and the number of threatened mammal species for Indonesia is 185.

$$\begin{array}{r} 71 \\ 75 \\ +\ 185 \\ \hline 331 \end{array}$$

The total number of threatened mammal species for these three countries is 331.

14.
$$8\overline{)205}\quad \begin{array}{r} 25 \text{ R } 5 \\ -16 \\ \hline 45 \\ -40 \\ \hline 5 \end{array}$$

$205 \div 8 = 25$ R 5

15. To round 568 to the nearest ten, observe that the digit in the ones place is 8. Since this digit is at least 5, we add 1 to the tens place. The number 568 rounded to the tens place is 570.

16. To round 2366 to the nearest hundred, observe that the digit in the tens place is 6. Since this digit is at least 5, we add 1 to the hundreds place. The number 2366 rounded to the nearest hundred is 2400.

17.
$$\begin{array}{rcr} 4725 & \text{rounds to} & 4700 \\ -\ 2879 & \text{rounds to} & -\ 2900 \\ & & \hline & & 1800 \end{array}$$

The estimated difference is 1800.

18.
$$\begin{array}{rcr} & & {\scriptstyle 2} \\ 38 & \text{rounds to} & 40 \\ 43 & \text{rounds to} & 40 \\ 126 & \text{rounds to} & 130 \\ +\ 92 & \text{rounds to} & +\ 90 \\ \hline & & 300 \end{array}$$

The estimated sum is 300.

19. **a.** $6 \times 1 = 6$

b. $0(8) = 0$

c. $1 \cdot 45 = 45$

d. $(75)(0) = 0$

20. $30 \div 3 \cdot 2 = 10 \cdot 2 = 20$

21. **a.** $3(4 + 5) = 3 \cdot 4 + 3 \cdot 5$

b. $10(6 + 8) = 10 \cdot 6 + 10 \cdot 8$

c. $2(7 + 3) = 2 \cdot 7 + 2 \cdot 3$

22.
$$\begin{array}{r} 12 \\ \times 15 \\ \hline 60 \\ 120 \\ \hline 180 \end{array}$$

23. a.
$$9\overline{)\,0} \quad \begin{array}{r} 0 \\ \hline 0 \\ -0 \\ \hline 0 \end{array}$$

Check: $0 \cdot 9 = 0$

b. $0 \div 12 = 0$
Check: $0 \cdot 12 = 0$

c. $\dfrac{0}{5} = 0$

Check: $0 \cdot 5 = 0$

d. $\dfrac{3}{0}$ is undefined.

24. $\text{Area} = \text{length} \cdot \text{width}$
$= 7 \cdot 22$
$= 154$ square miles

The area is 154 square miles..

25.
$$9\overline{)\,1872} \quad \begin{array}{r} 208 \\ \hline -18 \\ \hline 07 \\ -0 \\ \hline 72 \\ -72 \\ \hline 0 \end{array}$$

Check:
$$\begin{array}{r} 208 \\ \times\ 9 \\ \hline 1872 \end{array}$$

26.
$$\begin{array}{r} 5000 \\ -\ 986 \\ \hline 4014 \end{array}$$

27.
$$19\overline{)\,238} \quad \begin{array}{r} 12 \\ \hline -19 \\ \hline 48 \\ -38 \\ \hline 10 \end{array}$$

Each friend will receive 12 download cards.
There will be 10 download cards left over.

28.
$$\begin{array}{r} 9 \\ \times 7 \\ \hline 63 \end{array}$$

The product of 9 and 7 is 63.

29.
$$\begin{array}{r} 30 \\ \times 20 \\ \hline 0 \\ 600 \\ \hline 600 \end{array}$$

$$15\overline{)\,600} \quad \begin{array}{r} 40 \\ \hline -60 \\ \hline 00 \\ -0 \\ \hline 0 \end{array}$$

The new length of the garden is 40 ft.

30.
$$\begin{array}{r} {\scriptstyle 1} \\ 9 \\ +\ 7 \\ \hline 16 \end{array}$$

The sum of 9 and 7 is 16.

31. $7 \cdot 7 \cdot 7 = 7^3$

32. $7 \cdot 7 \cdot 7 \cdot 7 = 7^4$

33. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 17 \cdot 17 \cdot 17 = 3^4 \cdot 17^3$

34. $2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 3 = 2^2 \cdot 3^4$

35. $2 \cdot 4 - 3 \div 3 = 8 - 3 \div 3 = 8 - 1 = 7$

36. $8 \cdot \sqrt{100} - 4^2 \cdot 5 = 8 \cdot 10 - 4^2 \cdot 5$
$= 80 - 16 \cdot 5$
$= 80 - 80$
$= 0$

37. 2 of the 5 equal parts are shaded: $\dfrac{2}{5}$

38.
$$3\overline{)\,39} \quad \begin{array}{r} 13 \\ \hline \end{array}$$
$$2\overline{)\,78}$$
$$2\overline{)\,156}$$

$156 = 2^2 \cdot 3 \cdot 13$

39. a. $4\frac{2}{9} = \frac{9 \cdot 4 + 2}{9} = \frac{38}{9}$

b. $1\frac{8}{11} = \frac{11 \cdot 1 + 8}{11} = \frac{19}{11}$

40. $7\frac{4}{5} = \frac{5 \cdot 7 + 4}{5} = \frac{39}{5}$

41. $1 \cdot 20 = 20$
$2 \cdot 10 = 20$
$4 \cdot 5 = 20$
The factors of 20 are 1, 2, 4, 5, 10, and 20.

42. Equivalent, since the cross products are equal:
$20 \cdot 14 = 280$ and $35 \cdot 8 = 280$.

43. $\frac{42}{66} = \frac{6 \cdot 7}{6 \cdot 11} = \frac{7}{11}$

44. $\frac{70}{105} = \frac{35 \cdot 2}{35 \cdot 3} = \frac{2}{3}$

45. $3\frac{1}{3} \cdot \frac{7}{8} = \frac{10}{3} \cdot \frac{7}{8}$
$= \frac{10 \cdot 7}{3 \cdot 8}$
$= \frac{2 \cdot 5 \cdot 7}{3 \cdot 2 \cdot 4}$
$= \frac{5 \cdot 7}{3 \cdot 4}$
$= \frac{35}{12}$ or $2\frac{11}{12}$

46. $\frac{2}{3} \cdot 4 = \frac{2}{3} \cdot \frac{4}{1} = \frac{2 \cdot 4}{3 \cdot 1} = \frac{8}{3}$ or $2\frac{2}{3}$

47. The reciprocal of $\frac{1}{3}$ is $\frac{3}{1}$ or 3.

48. The reciprocal of 9, or $\frac{9}{1}$, is $\frac{1}{9}$.

49. $\frac{5}{16} \div \frac{3}{4} = \frac{5}{16} \cdot \frac{4}{3} = \frac{5 \cdot 4}{16 \cdot 3} = \frac{5 \cdot 4}{4 \cdot 4 \cdot 3} = \frac{5}{4 \cdot 3} = \frac{5}{12}$

50. $1\frac{1}{10} \div 5\frac{3}{5} = \frac{11}{10} \div \frac{28}{5}$
$= \frac{11}{10} \cdot \frac{5}{28}$
$= \frac{11 \cdot 5}{10 \cdot 28}$
$= \frac{11 \cdot 5}{2 \cdot 5 \cdot 28}$
$= \frac{11}{2 \cdot 28}$
$= \frac{11}{56}$