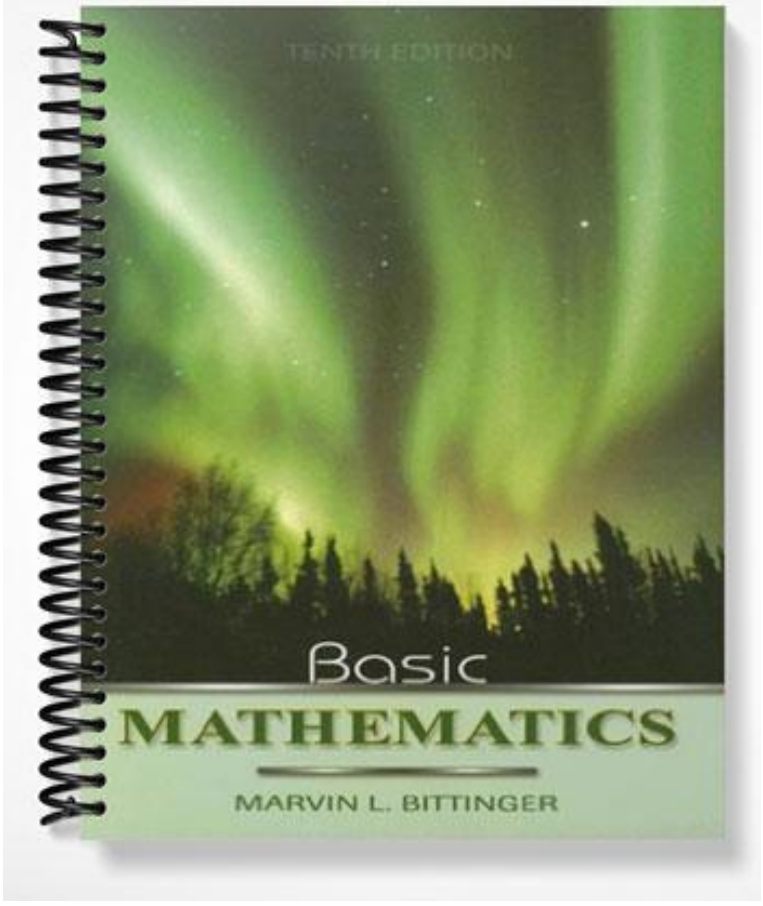
SOLUTIONS MANUAL



Chapter 2

Fraction Notation: Multiplication and Division

Exercise Set 2.1

2.
$$\begin{array}{r} 4 \\ 13\overline{)52} \\ \underline{52} \\ 0 \end{array}$$

The remainder is 0, so 13 is a factor of 52.

4.
$$\begin{array}{r} 42 \\ 16\overline{)680} \\ \underline{640} \\ 40 \\ \underline{32} \\ 8 \end{array}$$

The remainder is not 0, so 16 is not a factor of 680.

6. 1, 2, 4, 8, 16

8. 1, 2, 3, 4, 6, 8, 12, 16, 24, 48

10. 1, 3, 9

12. 1, 13

14. 1, 2, 4, 5, 10, 20, 25, 50, 100

16. 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 24, 30, 40, 60, 120

18. 11, 22, 33, 44, 55, 66, 77, 88, 99, 110

20. 50, 100, 150, 200, 250, 300, 350, 400, 450, 500

22. 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

24. 13, 26, 39, 52, 65, 78, 91, 104, 117, 130

26. 6, 12, 18, 24, 30, 36, 42, 48, 54, 60

28. 14, 28, 42, 56, 70, 84, 98, 112, 126, 140

30.
$$\begin{array}{r} 6 \\ 8\overline{)48} \\ \underline{48} \\ 0 \end{array}$$

48 is divisible by 8.

32.
$$\begin{array}{r} 1409 \\ 3\overline{)4227} \\ \underline{3000} \\ 1227 \\ \underline{1200} \\ 27 \\ \underline{27} \\ 0 \end{array}$$

4227 is divisible by 3.

34.
$$\begin{array}{r} 25 \\ 4\overline{)102} \\ \underline{80} \\ 22 \\ \underline{20} \\ 2 \end{array}$$

102 is not divisible by 4.

36.
$$\begin{array}{r} 8 \\ 25\overline{)200} \\ \underline{200} \\ 0 \end{array}$$

200 is divisible by 25.

38.
$$\begin{array}{r} 591 \\ 7\overline{)4143} \\ \underline{3500} \\ 643 \\ \underline{630} \\ 13 \\ \underline{7} \\ 6 \end{array}$$

4143 is not divisible by 7.

40. The number 2 is prime. It has only the factors 1 and 2.

42. The number 19 is prime. It has only the factors 1 and 19.

44. The number 27 has factors 1, 3, 9, and 27. It is composite.

46. The number 49 has factors 1, 7, and 49. It is composite.

48. $2 \cdot 2 \cdot 2 \cdot 2$

50. $3 \cdot 5$

52. $2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$

54. $2 \cdot 2 \cdot 2 \cdot 5$

56. $2 \cdot 31$

58. $2 \cdot 2 \cdot 5 \cdot 7$

60. $2 \cdot 5 \cdot 11$

62. $2 \cdot 5 \cdot 7$

64. $2 \cdot 43$

66. $3 \cdot 3 \cdot 11$

68. $2 \cdot 2 \cdot 11 \cdot 11$

70. $7 \cdot 13$

72. $2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \cdot 5$

74. $3 \cdot 3 \cdot 3 \cdot 5 \cdot 5$

76. $3 \cdot 3 \cdot 5 \cdot 11 \cdot 13$

77. *Discussion and Writing Exercise.* Every natural number is a multiple of 1, because every natural number is the product of 1 and the number itself.

78. *Discussion and Writing Exercise.* Find the product of two prime numbers.

80.
$$\begin{array}{r} 3\,2 \\ \times\quad 8 \\ \hline 2\,5\,6 \end{array}$$

82.
$$\begin{array}{r} 1\,6\,8 \\ \times\quad 2\,5 \\ \hline 8\,4\,0 \\ 3\,3\,6\,0 \\ \hline 4\,2\,0\,0 \end{array}$$

84. $a \div 1 = a$, so $22 \div 1 = 22$.

86.
$$\begin{array}{r} 3 \\ 2\,2\overline{)\,6\,6} \\ \underline{6\,6} \\ 0 \end{array}$$

The answer is 3.

88. Let m = the number of minutes it will take for Sandy to type 12,462 words.

Solve: $12,462 \div 62 = m$

$m = 201$ minutes, or 3 hours, 21 minutes

Exercise Set 2.2

2. The numbers for which the sum of the digits is divisible by 3 are 555, 300, 36, 45,270, 711, 13,251, and 8064. These numbers are divisible by 3.

4. The numbers for which the ones digit is 0 or 5 are 555, 300, 45,270, 85, and 254,765. These numbers are divisible by 5.

6. The numbers for which the last three digits are divisible by 8 are 224, 256, 8064, and 21,568. These numbers are divisible by 8.

8. The numbers for which the ones digit is 0 are 300 and 45,270. These numbers are divisible by 10.

10. The numbers for which the ones digit is even are 56, 324, 784, 200, 42, 812, and 402. These numbers are divisible by 2.

12. The numbers for which the last two digits are divisible by 4 are 56, 324, 784, 200, and 812. These numbers are divisible by 4.

14. The numbers that are divisible by both 2 and 3 are 324, 42, and 402. These numbers are divisible by 6.

16. The numbers for which the last three digits are divisible by 8 are 56, 784, and 200. These numbers are divisible by 8.

18. The numbers for which the sum of the digits is divisible by 3 are 1101, 313,332, 111,126, 876, 1110, 9990, and 126,111.

20. The numbers for which the ones digit is 0 or 5 are 305, 13,025, 1110, 64,000, and 9990.

22. The numbers for which the last three digits are divisible by 8 are 7624, 5128, and 64,000.

24. The numbers for which the last two digits are divisible by 4 are 313,332, 7624, 876, 5128, and 64,000.

25. *Discussion and Writing Exercise.* The divisibility tests can be used to determine if the prime numbers 2, 3, and/or 5 are factors of the given number and to determine how many factors of 2, 3, and/or 5 are in the prime factorization. In addition, the tests for divisibility by 6 and 10 can be used to find factorizations that lead to the prime factorization.

26. *Discussion and Writing Exercise.* Using the divisibility tests, it is quickly clear that none of the even-numbered years are prime numbers. In addition, the divisibility tests for 5 and 3 show that 2000, 2001, 2005, 2007, 2013, 2015, and 2019 are not prime numbers. Then the years 2003, 2009, 2011, and 2017 can be divided by prime numbers to determine if they are prime. When we do this, we find that 2011 and 2017 are prime numbers.

If the divisibility tests are not used, each of the numbers from 2000 to 2020 can be divided by prime numbers to determine if they are prime.

28.
$$\begin{aligned} y + 124 &= 263 \\ y &= 263 - 124 = 139 \end{aligned}$$

30.
$$\begin{aligned} 18 \cdot t &= 1008 \\ t &= \frac{1008}{18} = 56 \end{aligned}$$

32.
$$\begin{aligned} 338 &= a \cdot 26 \\ \frac{338}{26} &= a \\ 13 &= a \end{aligned}$$

34.
$$\begin{array}{r} 4\,0\,0\,3 \\ 4\,5\overline{)\,1\,8\,0,\,1\,3\,5} \\ \underline{1\,8\,0\,0\,0\,0} \\ 1\,3\,5 \\ \underline{1\,3\,5} \\ 0 \end{array}$$

The answer is 4003.

36. Let m = the number of minutes in 72 hours.

Solve: $60 \cdot 72 = m$

$m = 4320$ minutes.

38. 2520 is divisible by 2: $2520 = 2 \cdot 1260$; 1260 is divisible by 2: $2520 = 2 \cdot 2 \cdot 630$; 630 is divisible by 2: $2520 = 2 \cdot 2 \cdot 2 \cdot 315$; 315 is not divisible by 2, but it is divisible by 3: $2520 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 105$; 105 is divisible by 3: $2520 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 35$; 35 is not divisible by 3, but it is divisible by 5: $2520 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 5 \cdot 7$. Since 7 is a prime number, the last factorization is the prime factorization.

40. 1998 is divisible by 2: $1998 = 2 \cdot 999$; 999 is not divisible by 2, but it is divisible by 3: $1998 = 2 \cdot 3 \cdot 333$; 333 is divisible by 3: $1998 = 2 \cdot 3 \cdot 3 \cdot 111$; 111 is divisible by 3: $1998 = 2 \cdot 3 \cdot 3 \cdot 3 \cdot 37$. Since 37 is a prime number, the last factorization is the prime factorization.

42. The number must be a multiple of 11. We try numbers of the form $11 \cdot n$ where n is a prime number greater than 5. The smallest multiple that meets the criteria is $11 \cdot 11$, or 121. This is the number.

Exercise Set 2.3

2. Numerator: 9, denominator, 10

4. Numerator: 18, denominator, 5

6. Numerator: 1, denominator: 13

8. $\frac{2}{2}$

10. $\frac{9}{8}$

12. $\frac{7}{6}$

14. $\frac{22}{16}$

16. $\frac{13}{16}$

18. $\frac{2}{4}$

20. $\frac{9}{9}$

22. $\frac{8}{16}$

24. $\frac{6}{12}$

26. $\frac{3}{5}$

28. $\frac{6}{10}$

30. a) $\frac{5}{8}$; b) $\frac{3}{8}$

32. a) $\frac{6}{8}$; b) $\frac{2}{8}$

34. a) $\frac{8}{3}$; b) $\frac{3}{8}$; c) $\frac{8}{11}$; d) $\frac{11}{8}$

36. a) $\frac{46}{10,000}$; b) $\frac{37}{10,000}$; c) $\frac{54}{10,000}$; d) $\frac{27}{10,000}$; e) $\frac{31}{10,000}$; f) $\frac{22}{10,000}$

38. 4 orders had been delivered and $15 - 4$, or 11 orders, had not been delivered. The ratios are:
a) $\frac{4}{15}$; b) $\frac{4}{11}$; c) $\frac{11}{15}$.

40. $\frac{340}{1000}$

42. 1

44. 16

46. 20

48. $\frac{11-1}{10-9} = \frac{10}{1} = 10$

50. 238

52. 0

54. 1

56. 1

58. 0

60. $\frac{8-8}{1247} = \frac{0}{1247} = 0$

62. Not defined

64. $\frac{13}{10-10} = \frac{13}{0}$; this is not defined.

65. *Discussion and Writing Exercise.* Answers may vary.
a) If an object is divided into 8 equal parts, then 5 of the parts represent $\frac{5}{8}$ of the whole object.
b) If a set consists of 8 objects, then 5 of the objects represent $\frac{5}{8}$ of the set.
c) If a set consists of 8 objects, then $\frac{5}{8}$ represents the ratio of 5 of the objects to the total number of the objects.

66. *Discussion and Writing Exercise.* $\frac{n}{n}$ corresponds to dividing an object into n parts and taking n of them. We get the entire object, or 1 whole object.

68. 34,600

70. 30,000

72. $\frac{2784}{29} = 96$ gal

74.
$$\begin{array}{r} {\scriptstyle 1\ \ 9\ \ 12}\\ {\scriptstyle 2\ 0\ 3\ 17}\\ \not{2}\ \not{0}\ \not{3}\ \not{7}\\ -\ 1\ 1\ 8\ 9\\ \hline 8\ 4\ 8 \end{array}$$

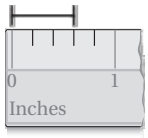
76.
$$\begin{array}{r} {\scriptstyle 1\ \ 12\ \ 12}\\ 1\ \not{2},\ \not{3}\ \not{2}\ 7\\ -\quad 4\ 7\ 6\\ \hline 1\ 1,\ 8\ 5\ 1 \end{array}$$

78. We can think of an object as being divided into 6 sections, each the size of one of the sections shaded. Since 2 sections are shaded, $\frac{2}{6}$ of the object is shaded. We could also express this as $\frac{1}{3}$.

80. We can think of the object as being divided into 16 sections, each the size of one of the sections shaded. Since a portion of the object that is the equivalent of 6 sections is shaded, $\frac{6}{16}$ of the object is shaded. We could also express this as $\frac{3}{8}$.

82. We can think of the set as containing 5 pairs of 2 objects each. Then we shade 3 pairs, or 6 of the objects.

84. Divide the inch into 5 equal parts and mark 3 of them.



Exercise Set 2.4

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

4. $\frac{4}{5}$

6. $\frac{6}{5}$

8. $\frac{45}{8}$

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

12. $\frac{12}{5}$

14. $\frac{14}{5}$

16. $\frac{120}{7}$

18. $\frac{1}{24}$

20. $\frac{1}{30}$

22. $\frac{3}{25}$

24. $\frac{9}{20}$

26. $\frac{12}{35}$

28. $\frac{12}{55}$

30. $\frac{9}{100}$

32. $\frac{16}{25}$

34. $\frac{21}{1000}$

36. $\frac{144}{169}$

38. $5 \cdot \frac{2}{3} = \frac{10}{3}$ yd

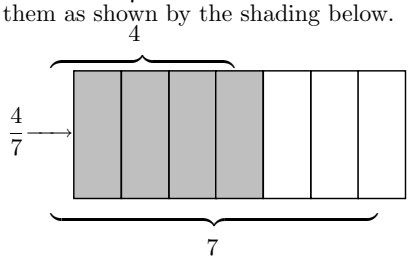
40. $\frac{1}{35} \cdot \frac{1}{75} = \frac{1}{2625}$

42. $\frac{1}{2} \cdot \frac{1}{6} = \frac{1}{12}$

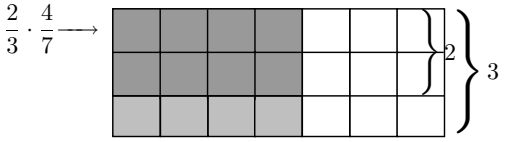
44. $\frac{3}{5} \cdot \frac{3}{4} = \frac{9}{20}$

45. *Discussion and Writing Exercise.* Answers will vary. In a literature class, $\frac{1}{2}$ of the students are women. Of the women in the class, $\frac{1}{15}$ are left-handed. What fraction of the students in the class are left-handed women?

46. *Discussion and Writing Exercise.* We first consider some object and take $\frac{4}{7}$ of it. We divide it into 7 parts and take 4 of them as shown by the shading below.



Next we take $\frac{2}{3}$ of the shaded area above. We divide it into 3 parts and take two of them as shown below



The entire object has been divided into 21 parts, 8 of which have been shaded. Thus, $\frac{2}{3} \cdot \frac{4}{7} = \frac{8}{21}$.

48.
$$\begin{array}{r} 700 \\ 46\overline{)32,200} \\ \underline{322\,00} \\ 0 \end{array}$$

The answer is 700.

50.
$$\begin{array}{r} 204 \\ 35\overline{)7148} \\ \underline{7000} \\ 148 \\ \underline{140} \\ 8 \end{array}$$

The answer is 204 R 8.

52. 8,473,901

The digit 8 means 8 millions.

54. 23,803

The digit 8 means 8 hundreds.

56. $(12-3)^2 = 9^2 = 81$

58.
$$\begin{aligned}&(10-3)^4 + 10^3 \cdot 4 - 10 \div 5\\ &= 7^4 + 10^3 \cdot 4 - 10 \div 5\\ &= 2401 + 1000 \cdot 4 - 10 \div 5\\ &= 2401 + 4000 - 2\\ &= 6401 - 2\\ &= 6399\end{aligned}$$

60. $\left(\frac{57}{61}\right)^3 = \frac{185,193}{226,981}$

62. $\left(\frac{1}{2}\right)^5\left(\frac{3}{5}\right) = \frac{1}{32}\left(\frac{3}{5}\right) = \frac{3}{160}$

Exercise Set 2.5

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

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

6. $\frac{5}{6} \cdot \frac{8}{8} = \frac{40}{48}$

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

10. $\frac{3}{8} \cdot \frac{7}{7} = \frac{21}{56}$

12. $\frac{11}{16} \cdot \frac{16}{16} = \frac{176}{256}$

14. $\frac{11}{5} \cdot \frac{6}{6} = \frac{66}{30}$

16. $\frac{10}{21} \cdot \frac{6}{6} = \frac{60}{126}$

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

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

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

24. $\frac{36}{9} = \frac{4 \cdot 9}{1 \cdot 9} = \frac{4}{1} \cdot \frac{9}{9} = 4$

26. $\frac{42}{48} = \frac{7 \cdot 6}{8 \cdot 6} = \frac{7}{8} \cdot \frac{6}{6} = \frac{7}{8}$

28. $\frac{15}{25} = \frac{3 \cdot 5}{5 \cdot 5} = \frac{3}{5} \cdot \frac{5}{5} = \frac{3}{5}$

30. $\frac{16}{14} = \frac{8 \cdot 2}{7 \cdot 2} = \frac{8}{7} \cdot \frac{2}{2} = \frac{8}{7}$

32. $\frac{100}{20} = \frac{5 \cdot 20}{1 \cdot 20} = \frac{5}{1} \cdot \frac{20}{20} = 5$

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

36. $\frac{425}{525} = \frac{17 \cdot 25}{21 \cdot 25} = \frac{17}{21} \cdot \frac{25}{25} = \frac{17}{21}$

38. $\frac{540}{810} = \frac{10 \cdot 54}{10 \cdot 81} = \frac{10}{10} \cdot \frac{54}{81} = \frac{54}{81} = \frac{2 \cdot 27}{3 \cdot 27} = \frac{2}{3} \cdot \frac{27}{27} = \frac{2}{3}$

40. $\frac{1000}{1080} = \frac{10 \cdot 100}{10 \cdot 108} = \frac{10}{10} \cdot \frac{100}{108} = \frac{100}{108} = \frac{4 \cdot 25}{4 \cdot 27} = \frac{4}{4} \cdot \frac{25}{27} = \frac{25}{27}$

42. $\frac{4}{8} \square \frac{3}{6}$

$4 \cdot 6 = 8 \cdot 3$, so $\frac{4}{8} = \frac{3}{6}$.

44. $\frac{1}{4} \square \frac{2}{9}$

$1 \cdot 9 \neq 4 \cdot 2$, so $\frac{1}{4} \neq \frac{2}{9}$.

46. $\frac{2}{6} \square \frac{6}{18}$

$2 \cdot 18 = 6 \cdot 6$, so $\frac{2}{6} = \frac{6}{18}$.

48. $\frac{1}{3} \square \frac{1}{4}$

$1 \cdot 4 \neq 3 \cdot 1$, so $\frac{1}{3} \neq \frac{1}{4}$.

50. $\frac{16}{14} \square \frac{8}{7}$

$16 \cdot 7 = 14 \cdot 8$, so $\frac{16}{14} = \frac{8}{7}$.

52. $\frac{3}{10} \square \frac{7}{24}$

$3 \cdot 24 \neq 10 \cdot 7$, so $\frac{3}{10} \neq \frac{7}{24}$.

54. $\frac{700}{1000} \square \frac{70}{100}$

$700 \cdot 100 = 1000 \cdot 70$, so $\frac{700}{1000} = \frac{70}{100}$.

56. $\frac{49}{100} \square \frac{50}{1000}$

$49 \cdot 1000 \neq 100 \cdot 50$, so $\frac{49}{100} \neq \frac{50}{1000}$.

57. *Discussion and Writing Exercise.* It is possible to cancel only when identical *factors* appear in the numerator and denominator of a fraction. Situations in which it is not possible to cancel include the occurrence of identical *terms* or *digits* in the numerator and denominator.

58. *Discussion and Writing Exercise.* No; since the only factors of a prime number are the number itself and 1, two different prime numbers cannot contain a common factor (other than 1).

60.
Maple trees:	$13 \cdot \$23 = \$299$
Oak trees:	$17 \cdot \$37 = \$629$
Total cost:	$\$299 + \$629 = \$928$

62.
$$\begin{array}{r} {\scriptstyle 4\ \ 10} \\ \not{5}\ \not{0} \\ -\ 1\ 8 \\ \hline 3\ 2 \end{array}$$

64.
$$\begin{array}{r} {\scriptstyle 7\ 13\ 3\ 14} \\ \not{8}\ \not{3}\ \not{4}\ \not{4} \\ -\ 5\ 6\ 0\ 7 \\ \hline 2\ 7\ 3\ 7 \end{array}$$

66. $y = \dfrac{10,947}{123} = 89$

68. $x = 11,369 - 2368 = 9001$

70. $\dfrac{3197}{3473} = \dfrac{23 \cdot 139}{23 \cdot 151} = \dfrac{139}{151}$

72. $\dfrac{3}{20} = \dfrac{?}{460}$

$460 \div 20 = 23$, so we have $\dfrac{3}{20} \cdot \dfrac{23}{23} = \dfrac{69}{460}$. You would expect 69 people in a crowd of 460 to be left-handed.

74. $\dfrac{63}{82} \neq \dfrac{77}{100}$, because $63 \cdot 100 \neq 82 \cdot 77$. Thus, the student did not get the same portion of each test correct.

Exercise Set 2.6

2. $\dfrac{3}{8} \cdot \dfrac{1}{3} = \dfrac{3 \cdot 1}{8 \cdot 3} = \dfrac{3}{3} \cdot \dfrac{1}{8} = \dfrac{1}{8}$

4. $\dfrac{4}{9} \cdot \dfrac{1}{4} = \dfrac{4 \cdot 1}{9 \cdot 4} = \dfrac{4}{4} \cdot \dfrac{1}{9} = \dfrac{1}{9}$

6. $\dfrac{2}{5} \cdot \dfrac{1}{6} = \dfrac{2 \cdot 1}{5 \cdot 6} = \dfrac{2 \cdot 1}{5 \cdot 2 \cdot 3} = \dfrac{2}{2} \cdot \dfrac{1}{5 \cdot 3} = \dfrac{1}{15}$

8. $\dfrac{4}{6} \cdot \dfrac{1}{6} = \dfrac{4 \cdot 1}{6 \cdot 6} = \dfrac{2 \cdot 2 \cdot 1}{2 \cdot 3 \cdot 2 \cdot 3} = \dfrac{2 \cdot 2}{2 \cdot 2} \cdot \dfrac{1}{3 \cdot 3} = \dfrac{1}{9}$

10. $\dfrac{16}{15} \cdot \dfrac{5}{4} = \dfrac{16 \cdot 5}{15 \cdot 4} = \dfrac{4 \cdot 4 \cdot 5}{3 \cdot 5 \cdot 4} = \dfrac{4}{3} \cdot \dfrac{4 \cdot 5}{4 \cdot 5} = \dfrac{4}{3}$

12. $\dfrac{25}{12} \cdot \dfrac{4}{3} = \dfrac{25 \cdot 4}{12 \cdot 3} = \dfrac{25 \cdot 4}{3 \cdot 4 \cdot 3} = \dfrac{25}{3 \cdot 3} \cdot \dfrac{4}{4} = \dfrac{25}{9}$

14. $4 \cdot \dfrac{1}{4} = \dfrac{4 \cdot 1}{4} = \dfrac{4 \cdot 1}{4 \cdot 1} = 1$

16. $\dfrac{1}{6} \cdot 6 = \dfrac{1 \cdot 6}{6} = \dfrac{1 \cdot 6}{1 \cdot 6} = 1$

18. $\dfrac{8}{9} \cdot \dfrac{9}{8} = \dfrac{8 \cdot 9}{9 \cdot 8} = 1$

20. $\dfrac{2}{11} \cdot \dfrac{11}{2} = \dfrac{2 \cdot 11}{11 \cdot 2} = 1$

22. $\dfrac{1}{3} \cdot 18 = \dfrac{18}{3} = 6$

24. $16 \cdot \dfrac{1}{2} = \dfrac{16}{2} = 8$

26. $18 \cdot \dfrac{5}{6} = \dfrac{18 \cdot 5}{6} = \dfrac{3 \cdot 6 \cdot 5}{6 \cdot 1} = \dfrac{6}{6} \cdot \dfrac{3 \cdot 5}{1} = 15$

28. $\dfrac{2}{9} \cdot 36 = \dfrac{2 \cdot 36}{9} = \dfrac{2 \cdot 4 \cdot 9}{1 \cdot 9} = \dfrac{2 \cdot 4}{1} \cdot \dfrac{9}{9} = 8$

30. $15 \cdot \dfrac{1}{6} = \dfrac{15 \cdot 1}{6} = \dfrac{3 \cdot 5 \cdot 1}{2 \cdot 3} = \dfrac{3}{3} \cdot \dfrac{5 \cdot 1}{2} = \dfrac{5}{2}$

32. $\dfrac{5}{8} \cdot 34 = \dfrac{5 \cdot 34}{8} = \dfrac{5 \cdot 2 \cdot 17}{2 \cdot 4} = \dfrac{2}{2} \cdot \dfrac{5 \cdot 17}{4} = \dfrac{85}{4}$

34. $\dfrac{1}{3} \cdot 120 = \dfrac{120}{3} = 40$

36. $150 \cdot \dfrac{1}{5} = \dfrac{150}{5} = 30$

38. $\dfrac{7}{10} \cdot \dfrac{34}{150} = \dfrac{7 \cdot 34}{10 \cdot 150} = \dfrac{7 \cdot 2 \cdot 17}{2 \cdot 5 \cdot 150} = \dfrac{2}{2} \cdot \dfrac{7 \cdot 17}{5 \cdot 150} = \dfrac{119}{750}$

40. $\dfrac{3}{10} \cdot \dfrac{8}{10} = \dfrac{3 \cdot 8}{10 \cdot 10} = \dfrac{3 \cdot 2 \cdot 2 \cdot 2}{2 \cdot 5 \cdot 2 \cdot 5} = \dfrac{3 \cdot 2}{5 \cdot 5} \cdot \dfrac{2 \cdot 2}{2 \cdot 2} = \dfrac{6}{25}$

42. $\dfrac{15}{22} \cdot \dfrac{4}{7} = \dfrac{15 \cdot 4}{22 \cdot 7} = \dfrac{15 \cdot 2 \cdot 2}{2 \cdot 11 \cdot 7} = \dfrac{2}{2} \cdot \dfrac{15 \cdot 2}{11 \cdot 7} = \dfrac{30}{77}$

44. $\dfrac{17}{18} \cdot \dfrac{3}{5} = \dfrac{17 \cdot 3}{18 \cdot 5} = \dfrac{17 \cdot 3}{3 \cdot 6 \cdot 5} = \dfrac{3}{3} \cdot \dfrac{17}{6 \cdot 5} = \dfrac{17}{30}$

46. $\dfrac{3}{32} \cdot 10 = \dfrac{3 \cdot 10}{32} = \dfrac{15}{16}$ in.

48. $\dfrac{1}{5} \cdot \$75 = \dfrac{\$75}{5} = \$15$

50. $\dfrac{2}{5} \cdot 650 = \dfrac{2 \cdot 650}{5} = 260$ people

52. $\dfrac{1}{4} \cdot \dfrac{2}{5} = \dfrac{1 \cdot 2}{4 \cdot 5} = \dfrac{1}{10}$

54. $\dfrac{3}{4} \cdot \$4600 = \dfrac{3 \cdot \$4600}{4} = \$3450$

56. $\dfrac{3}{4} \cdot 120 = \dfrac{3 \cdot 120}{4} = 90$ mi

58. Food: $\dfrac{1}{4} \cdot \$29,700 = \dfrac{\$29,700}{4} = \$7425$

Housing: $\dfrac{1}{5} \cdot \$29,700 = \dfrac{\$29,700}{5} = \$5940$

Clothing: $\dfrac{1}{10} \cdot \$29,700 = \dfrac{\$29,700}{10} = \$2970$

Savings: $\dfrac{1}{9} \cdot \$29,700 = \dfrac{\$29,700}{9} = \$3300$

Taxes: $\dfrac{1}{4} \cdot \$29,700 = \dfrac{\$29,700}{4} = \$7425$

Total of the above:
$$\begin{array}{r} \$\ \ 7\ 4\ 2\ 5 \\ 5\ 9\ 4\ 0 \\ 2\ 9\ 7\ 0 \\ 3\ 3\ 0\ 0 \\ 7\ 4\ 2\ 5 \\ \hline \$2\ 7,\ 0\ 6\ 0 \end{array}$$

Amount spent on other expenses:

$\$29{,}700 - \$27{,}060 = \$2640$.

59. *Discussion and Writing Exercise.* We factor in the numerator and in the denominator in order to simplify the product. If we calculated the products before doing this, the next step would be immediately to "undo" them.

60. *Discussion and Writing Exercise.* No; in order to simplify a fraction, we must be able to remove a factor of the type $\frac{n}{n}, n \neq 0$, where n is a factor that the numerator and denominator have in common.

62. $74 \cdot x = 6290$

$$x = \frac{6290}{74} = 85$$

64. $2880 = 24 \cdot y$

$$\frac{2880}{24} = y$$

$$120 = y$$

66. $x = 9002 - 456 = 8546$

68. $m = 10,000 - 3593 = 6407$

70.
$$\begin{array}{r} 7\ \overset{7}{\not{8}}\ \overset{9}{\not{0}}\ \overset{10}{\not{\emptyset}} \\ -2\ 4\ 6\ 2 \\ \hline 5\ 3\ 3\ 8 \end{array}$$

72. $\frac{5767}{3763} \cdot \frac{159}{395} = \frac{5767 \cdot 159}{3763 \cdot 395} = \frac{73 \cdot 79 \cdot 3 \cdot 53}{53 \cdot 71 \cdot 5 \cdot 79} = \frac{79 \cdot 53}{79 \cdot 53} \cdot \frac{73 \cdot 3}{71 \cdot 5} = \frac{219}{355}$

74. Of the entering students, $\frac{1}{7}$ are left-handed, $\frac{7}{8}$ are high school graduates, and $\frac{1}{3}$ are 20 years old or younger.

Solve $n = \frac{1}{7} \cdot \frac{7}{8} \cdot \frac{1}{3} \cdot 480$.

$n = 20$ students

Exercise Set 2.7

2. $\frac{8}{7}$

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

6. 4

8. $\frac{4}{17}$

10. $\frac{2}{3} \div \frac{3}{4} = \frac{2}{3} \cdot \frac{4}{3} = \frac{8}{9}$

12. $\frac{6}{7} \div \frac{3}{5} = \frac{6}{7} \cdot \frac{5}{3} = \frac{2 \cdot 3 \cdot 5}{7 \cdot 3} = \frac{10}{7}$

14. $\frac{10}{9} \div \frac{1}{3} = \frac{10}{9} \cdot \frac{3}{1} = \frac{10 \cdot 3}{3 \cdot 3 \cdot 1} = \frac{10}{3}$

16. $\frac{1}{4} \div \frac{1}{5} = \frac{1}{4} \cdot \frac{5}{1} = \frac{5}{4}$

18. $\frac{5}{6} \div 5 = \frac{5}{6} \cdot \frac{1}{5} = \frac{5 \cdot 1}{6 \cdot 5} = \frac{1}{6}$

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

22. $24 \div \frac{3}{8} = 24 \cdot \frac{8}{3} = \frac{3 \cdot 8 \cdot 8}{3 \cdot 1} = 64$

24. $40 \div \frac{2}{3} = 40 \cdot \frac{3}{2} = \frac{2 \cdot 20 \cdot 3}{2 \cdot 1} = 60$

26. $\frac{2}{5} \div \frac{2}{5} = \frac{2}{5} \cdot \frac{5}{2} = \frac{2 \cdot 5}{2 \cdot 5} = 1$

28. $\frac{6}{13} \div \frac{3}{26} = \frac{6}{13} \cdot \frac{26}{3} = \frac{2 \cdot 3 \cdot 2 \cdot 13}{13 \cdot 3 \cdot 1} = 4$

30. $\frac{5}{12} \div \frac{25}{36} = \frac{5}{12} \cdot \frac{36}{25} = \frac{5 \cdot 2 \cdot 3 \cdot 6}{2 \cdot 6 \cdot 5 \cdot 5} = \frac{3}{5}$

32. $360 \div \frac{8}{7} = 360 \cdot \frac{7}{8} = \frac{8 \cdot 45 \cdot 7}{8 \cdot 1} = 315$

34. $t = 90 \div \frac{3}{2} = 90 \cdot \frac{2}{3} = \frac{3 \cdot 30 \cdot 2}{3 \cdot 1} = 60$

36. $m = \frac{8}{3} \div \frac{4}{9} = \frac{8}{3} \cdot \frac{9}{4} = \frac{2 \cdot 4 \cdot 3 \cdot 3}{3 \cdot 4 \cdot 1} = 6$

38. $p = \frac{8}{15} \div \frac{4}{5} = \frac{8}{15} \cdot \frac{5}{4} = \frac{2 \cdot 4 \cdot 5}{3 \cdot 5 \cdot 4} = \frac{2}{3}$

40. $y = 120 \div \frac{5}{6} = 120 \cdot \frac{6}{5} = \frac{5 \cdot 24 \cdot 6}{5 \cdot 1} = 144$

42. Let g = the number of gallons of gasoline the tanker holds when it is full.

Solve: $\frac{7}{9} \cdot g = 1400$

$g = 1800$ gal

44. $25 \div \frac{5}{6} = 25 \cdot \frac{6}{5} = \frac{5 \cdot 5 \cdot 6}{5 \cdot 1} = 30$ shirts

46. $10 \div \frac{2}{3} = 10 \cdot \frac{3}{2} = \frac{2 \cdot 5 \cdot 3}{2 \cdot 1} = 15$ bowls

48. Let p = the amount the tank could hold.

Solve: $\frac{4}{5} \cdot p = 20$

$p = 25$ L

50. $\frac{4}{5} \div 8 = \frac{4}{5} \cdot \frac{1}{8} = \frac{4 \cdot 1}{5 \cdot 2 \cdot 4} = \frac{1}{10}$ m

52. Let n = the number of complete rotations needed to drive the screw $\frac{3}{4}$ in. into a piece of pine wood.

Solve: $\frac{3}{32} \cdot n = \frac{3}{4}$

$n = 8$ rotations

53. *Discussion and Writing Exercise.* Since $\frac{1}{7}$ is a smaller number than $\frac{2}{3}$, there are more $\frac{1}{7}$'s in 5 than $\frac{2}{3}$'s. Thus, $5 \div \frac{1}{7}$ is a bigger number than $5 \div \frac{2}{3}$.

54. *Discussion and Writing Exercise.* The student is probably multiplying the divisor by the reciprocal of the dividend rather than multiplying the dividend by the reciprocal of the divisor.

56. In the product $10 \cdot \frac{3}{4}$, 10 and $\frac{3}{4}$ are called factors.

58. In the fraction $\frac{4}{17}$, we call 17 the denominator.

60. The product of 6 and $\frac{1}{6}$ is 1; we say that 6 and $\frac{1}{6}$ are reciprocals of each other.

62. A sentence with = is called an equation.

64. $\frac{8633}{7387} \div \frac{485}{581} = \frac{8633}{7387} \cdot \frac{581}{485} = \frac{8633 \cdot 581}{7387 \cdot 485} =$
$\frac{89 \cdot 97 \cdot 7 \cdot 83}{83 \cdot 89 \cdot 5 \cdot 97} = \frac{89 \cdot 97 \cdot 83}{89 \cdot 97 \cdot 83} \cdot \frac{7}{5} = \frac{7}{5}$

66.
$$\frac{\left(\frac{3}{7}\right)^2 \div \frac{12}{5}}{\left(\frac{2}{9}\right)\left(\frac{9}{2}\right)} = \frac{\frac{9}{49} \div \frac{12}{5}}{\left(\frac{2}{9}\right)\left(\frac{9}{2}\right)}$$
$$= \frac{\frac{9}{49} \cdot \frac{5}{12}}{\frac{2 \cdot 9}{9 \cdot 2}}$$
$$= \frac{\frac{3 \cdot 3 \cdot 5}{7 \cdot 7 \cdot 3 \cdot 4}}{\frac{1 \cdot 2 \cdot 9}{9 \cdot 2}}$$
$$= \frac{\frac{3 \cdot 5}{7 \cdot 7 \cdot 4}}{1}$$
$$= \frac{15}{196}$$

Chapter 2 Review Exercises

1. We find as many two-factor factorizations as we can:

$60 = 1 \cdot 60$ $\quad$ $60 = 4 \cdot 15$
$60 = 2 \cdot 30$ $\quad$ $60 = 5 \cdot 12$
$60 = 3 \cdot 20$ $\quad$ $60 = 6 \cdot 10$

Factors: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

2. We find as many two-factor factorizations as we can:

$176 = 1 \cdot 176$ $\quad$ $176 = 8 \cdot 22$
$176 = 2 \cdot 88$ $\quad$ $176 = 11 \cdot 16$
$176 = 4 \cdot 44$

Factors: 1, 2, 4, 8, 11, 16, 22, 44, 88, 176

3.
$1 \cdot 8 = 8$ $\quad$ $6 \cdot 8 = 48$
$2 \cdot 8 = 16$ $\quad$ $7 \cdot 8 = 56$
$3 \cdot 8 = 24$ $\quad$ $8 \cdot 8 = 64$
$4 \cdot 8 = 32$ $\quad$ $9 \cdot 8 = 72$
$5 \cdot 8 = 40$ $\quad$ $10 \cdot 8 = 80$

4.
$$\begin{array}{r} 8\,4 \\ 11\overline{)\,9\,2\,4} \\ \underline{8\,8\,0} \\ 4\,4 \\ \underline{4\,4} \\ 0 \end{array}$$

Since the remainder is 0, 924 is divisible by 11.

5.
$$\begin{array}{r} 1\,1\,2 \\ 16\overline{)\,1\,8\,0\,0} \\ \underline{1\,6\,0\,0} \\ 2\,0\,0 \\ \underline{1\,6\,0} \\ 4\,0 \\ \underline{3\,2} \\ 8 \end{array}$$

Since the remainder is not 0, 1800 is not divisible by 16.

6. The only factors of 37 are 1 and 37, so 37 is prime.

7. 1 is neither prime nor composite.

8. The number 91 has factors 1, 7, 13, and 91, so it is composite.

9.
$$\begin{array}{r} 7 \\ 5\overline{)\,3\,5} \\ 2\overline{)\,7\,0} \end{array} \quad \leftarrow \text{ 7 is prime.}$$

$70 = 2 \cdot 5 \cdot 7$

10.
$$\begin{array}{r} 5 \\ 3\overline{)\,1\,5} \\ 2\overline{)\,3\,0} \end{array} \quad \leftarrow \text{ 5 is prime.}$$

$30 = 2 \cdot 3 \cdot 5$

11.
$$\begin{array}{r} 5 \\ 3\overline{)\,1\,5} \\ 3\overline{)\,4\,5} \end{array} \quad \leftarrow \text{ 5 is prime.}$$

$45 = 3 \cdot 3 \cdot 5$

12.
$$\begin{array}{r} 5 \\ 5\overline{)\,2\,5} \\ 3\overline{)\,7\,5} \\ 2\overline{)\,1\,5\,0} \end{array} \quad \leftarrow \text{ 5 is prime.}$$

$150 = 2 \cdot 3 \cdot 5 \cdot 5$

13.
$$\begin{array}{r} 3 \\ 3\overline{)\,9} \\ 3\overline{)\,2\,7} \\ 3\overline{)\,8\,1} \\ 2\overline{)\,1\,6\,2} \\ 2\overline{)\,3\,2\,4} \\ 2\overline{)\,6\,4\,8} \end{array} \quad \leftarrow \text{ 3 is prime.}$$

$648 = 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3 \cdot 3 \cdot 3$

14.
$$\begin{array}{r} 7 \\ 5\overline{)\,3\,5} \\ 5\overline{)\,1\,7\,5} \\ 5\overline{)\,8\,7\,5} \\ 3\overline{)\,2\,6\,2\,5} \\ 2\overline{)\,5\,2\,5\,0} \end{array} \quad \leftarrow \text{ 7 is prime.}$$

$5250 = 2 \cdot 3 \cdot 5 \cdot 5 \cdot 5 \cdot 7$

15. A number is divisible by 3 if the sum of its digits is divisible by 3. The numbers whose digits add to a multiple of 3 are 4344, 600, 93, 330, 255,555, 780, 2802, and 711.

16. A number is divisible by 2 if its ones digit is even. Thus, the numbers 140, 182, 716, 2432, 4344, 600, 330, 780, and 2802 are divisible by 2.

17. A number is divisible by 4 if the number named by its last two digits is divisible by 4. Thus, the numbers 140, 716, 2432, 4344, 600, and 780 are divisible by 4.

18. A number is divisible by 8 if the number named by its last three digits is divisible by 8. Thus, the numbers 2432, 4344, and 600 are divisible by 8.

19. A number is divisible by 5 if its ones digit is 0 or 5. Thus, the numbers 140, 95, 475, 600, 330, 255,555, and 780 are divisible by 5.

20. A number is divisible by 6 if its one digit is even and the sum of the digits is divisible by 3. The numbers whose ones digits are even are given in Exercise 16 above. Of these numbers, the ones whose digits add to a multiple of 3 are 4344, 600, 330, 780, and 2802.

21. A number is divisible by 9 if the sum of its digits is divisible by 9. The numbers whose digits add to a multiple of 9 are 255,555 and 711.

22. A number is divisible by 10 if its ones digit is 0. Thus, the numbers 140, 600, 330, and 780 are divisible by 10.

23. The top number is the numerator, and the bottom number is the denominator.

$$\begin{array}{ll} 2 & \leftarrow \text{Numerator} \\ \hline 7 & \leftarrow \text{Denominator} \end{array}$$

24. The object is divided into 5 equal parts. The unit is $\frac{1}{5}$. The denominator is 5. We have 3 parts shaded. This tells us that the numerator is 3. Thus, $\frac{3}{5}$ is shaded.

25. We can regard this as 2 bars of 6 parts each and take 7 of those parts. The unit is $\frac{1}{6}$. The denominator is 6 and the numerator is 7. Thus, $\frac{7}{6}$ is shaded.

26. There are 7 objects in the set, and 2 of the objects are shaded. Thus, $\frac{2}{7}$ of the set is shaded.

27. a) The ratio is $\frac{3}{5}$.

b) The ratio is $\frac{5}{3}$.

c) There are $3 + 5$, or 8, members of the committee. The desired ratio is $\frac{3}{8}$.

28. $\frac{0}{n} = 0$, for any whole number n that is not 0.

$\frac{0}{4} = 0$

29. $\frac{n}{n} = 1$, for any whole number n that is not 0.

$\frac{23}{23} = 1$

30. $\frac{n}{1} = n$, for any whole number n.

$\frac{48}{1} = 48$

31. $\frac{48}{8} = \frac{6 \cdot 8}{1 \cdot 8} = \frac{6}{1} \cdot \frac{8}{8} = 6$

32. $\frac{10}{15} = \frac{2 \cdot 5}{3 \cdot 5} = \frac{2}{3} \cdot \frac{5}{5} = \frac{2}{3}$

33. $\frac{7}{28} = \frac{7 \cdot 1}{4 \cdot 7} = \frac{7}{7} \cdot \frac{1}{4} = \frac{1}{4}$

34. $\frac{n}{n} = 1$, for any whole number n that is not 0.

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

35. $\frac{0}{n} = 0$, for any whole number n that is not 0.

$\frac{0}{25} = 0$

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

37. $\frac{n}{1} = n$, for any whole number n.

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

38. $\frac{32}{8} = \frac{4 \cdot 8}{1 \cdot 8} = \frac{4}{1} \cdot \frac{8}{8} = 4$

39. $\frac{9}{27} = \frac{1 \cdot 9}{3 \cdot 9} = \frac{1}{3} \cdot \frac{9}{9} = \frac{1}{3}$

40. $\frac{n}{0}$ is not defined for any whole number n.

$\frac{18}{0}$ is not defined.

41. $\frac{5}{8-8} = \frac{5}{0}$ is not defined because $\frac{n}{0}$ is not defined for any whole number n.

42. $\frac{88}{184} = \frac{8 \cdot 11}{8 \cdot 23} = \frac{8}{8} \cdot \frac{11}{23} = \frac{11}{23}$

43. $\frac{140}{490} = \frac{10 \cdot 14}{10 \cdot 49} = \frac{10}{10} \cdot \frac{14}{49} = \frac{14}{49} = \frac{2 \cdot 7}{7 \cdot 7} = \frac{2}{7} \cdot \frac{7}{7} = \frac{2}{7}$

44. $\frac{1170}{1200} = \frac{10 \cdot 117}{10 \cdot 120} = \frac{10}{10} \cdot \frac{117}{120} = \frac{117}{120} = \frac{3 \cdot 39}{3 \cdot 40} =$
$\frac{3}{3} \cdot \frac{39}{40} = \frac{39}{40}$

45. $\frac{288}{2025} = \frac{9 \cdot 32}{9 \cdot 225} = \frac{9}{9} \cdot \frac{32}{225} = \frac{32}{225}$

46. 3 and 100 have no prime factors in common, so $\frac{3}{100}$ cannot be simplified.

$\frac{8}{100} = \frac{2 \cdot 4}{25 \cdot 4} = \frac{2}{25} \cdot \frac{4}{4} = \frac{2}{25}$

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

$\frac{15}{100} = \frac{3 \cdot 5}{20 \cdot 5} = \frac{3}{20} \cdot \frac{5}{5} = \frac{3}{20}$

21 and 100 have no prime factors in common, so $\frac{21}{100}$ cannot be simplified.

43 and 100 have no prime factors in common, so $\frac{43}{100}$ cannot be simplified.

47. We multiply these two numbers: $3 \cdot 6 = 18$

We multiply these two numbers: $\frac{3}{5} \quad \frac{4}{6} \quad 5 \cdot 4 = 20$

Since $18 \neq 20$, $\frac{3}{5} \neq \frac{4}{6}$.

48. We multiply these two numbers: $4 \cdot 14 = 56$

We multiply these two numbers: $\frac{4}{7} \quad \frac{8}{14} \quad 7 \cdot 8 = 56$

Since $56 = 56$, $\frac{4}{7} = \frac{8}{14}$.

49. We multiply these two numbers: $4 \cdot 6 = 24$

We multiply these two numbers: $\frac{4}{5} \quad \frac{5}{6} \quad 5 \cdot 5 = 25$

Since $24 \neq 25$, $\frac{4}{5} \neq \frac{5}{6}$.

50. We multiply these two numbers: $4 \cdot 21 = 84$

We multiply these two numbers: $\frac{4}{3} \quad \frac{28}{21} \quad 3 \cdot 28 = 84$

Since $84 = 84$, $\frac{4}{3} = \frac{28}{21}$.

51. $4 \cdot \frac{3}{8} = \frac{4 \cdot 3}{8} = \frac{4 \cdot 3}{2 \cdot 4} = \frac{4}{4} \cdot \frac{3}{2} = \frac{3}{2}$

52. $\frac{7}{3} \cdot 24 = \frac{7 \cdot 24}{3} = \frac{7 \cdot 3 \cdot 8}{3 \cdot 1} = \frac{3}{3} = \frac{7 \cdot 8}{1} = \frac{7 \cdot 8}{1} = 56$

53. $9 \cdot \frac{5}{18} = \frac{9 \cdot 5}{18} = \frac{9 \cdot 5}{2 \cdot 9} = \frac{9}{9} \cdot \frac{5}{2} = \frac{5}{2}$

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

55. $\frac{3}{4} \cdot \frac{8}{9} = \frac{3 \cdot 8}{4 \cdot 9} = \frac{3 \cdot 2 \cdot 4}{4 \cdot 3 \cdot 3} = \frac{3 \cdot 4}{3 \cdot 4} \cdot \frac{2}{3} = \frac{2}{3}$

56. $\frac{5}{7} \cdot \frac{1}{10} = \frac{5 \cdot 1}{7 \cdot 10} = \frac{5 \cdot 1}{7 \cdot 2 \cdot 5} = \frac{5}{5} \cdot \frac{1}{7 \cdot 2} = \frac{1}{7 \cdot 2} = \frac{1}{14}$

57. $\frac{3}{7} \cdot \frac{14}{9} = \frac{3 \cdot 14}{7 \cdot 9} = \frac{3 \cdot 2 \cdot 7}{7 \cdot 3 \cdot 3} = \frac{3 \cdot 7}{3 \cdot 7} \cdot \frac{2}{3} = \frac{2}{3}$

58. $\frac{1}{4} \cdot \frac{2}{11} = \frac{1 \cdot 2}{4 \cdot 11} = \frac{1 \cdot 2}{2 \cdot 2 \cdot 11} = \frac{2}{2} \cdot \frac{1}{2 \cdot 11} = \frac{1}{2 \cdot 11} = \frac{1}{22}$

59. $\frac{4}{25} \cdot \frac{15}{16} = \frac{4 \cdot 15}{25 \cdot 16} = \frac{4 \cdot 3 \cdot 5}{5 \cdot 5 \cdot 4 \cdot 4} = \frac{4 \cdot 5}{4 \cdot 5} \cdot \frac{3}{5 \cdot 4} = \frac{3}{5 \cdot 4} = \frac{3}{20}$

60. $\frac{11}{3} \cdot \frac{30}{77} = \frac{11 \cdot 30}{3 \cdot 77} = \frac{11 \cdot 3 \cdot 10}{3 \cdot 11 \cdot 7} = \frac{3 \cdot 11}{3 \cdot 11} \cdot \frac{10}{7} = \frac{10}{7}$

61. Interchange the numerator and the denominator. The reciprocal of $\frac{4}{5}$ is $\frac{5}{4}$.

62. Think of 3 as $\frac{3}{1}$ and interchange the numerator and the denominator. The reciprocal of 3 is $\frac{1}{3}$.

63. Interchange the numerator and the denominator. The reciprocal of $\frac{1}{9}$ is $\frac{9}{1}$, or 9.

64. Interchange the numerator and the denominator. The reciprocal of $\frac{47}{36}$ is $\frac{36}{47}$.

65. $6 \div \frac{4}{3} = 6 \cdot \frac{3}{4} = \frac{6 \cdot 3}{4} = \frac{2 \cdot 3 \cdot 3}{2 \cdot 2} = \frac{2}{2} \cdot \frac{3 \cdot 3}{2} = \frac{3 \cdot 3}{2} = \frac{9}{2}$

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

67. $\frac{1}{6} \div \frac{1}{11} = \frac{1}{6} \cdot \frac{11}{1} = \frac{1 \cdot 11}{6 \cdot 1} = \frac{11}{6}$

68. $\frac{3}{14} \div \frac{6}{7} = \frac{3}{14} \cdot \frac{7}{6} = \frac{3 \cdot 7}{14 \cdot 6} = \frac{3 \cdot 7 \cdot 1}{2 \cdot 7 \cdot 2 \cdot 3} = \frac{3 \cdot 7}{3 \cdot 7} \cdot \frac{1}{2 \cdot 2} = \frac{1}{2 \cdot 2} = \frac{1}{4}$

69. $\frac{1}{4} \div \frac{1}{9} = \frac{1}{4} \cdot \frac{9}{1} = \frac{1 \cdot 9}{4 \cdot 1} = \frac{9}{4}$

70. $180 \div \frac{3}{5} = 180 \cdot \frac{5}{3} = \frac{180 \cdot 5}{3} = \frac{3 \cdot 60 \cdot 5}{3 \cdot 1} = \frac{3}{3} \cdot \frac{60 \cdot 5}{1} = \frac{60 \cdot 5}{1} = 300$

71. $\frac{23}{25} \div \frac{23}{25} = \frac{23}{25} \cdot \frac{25}{23} = \frac{23 \cdot 25}{25 \cdot 23} = 1$

72. $\frac{2}{3} \div \frac{3}{2} = \frac{2}{3} \cdot \frac{2}{3} = \frac{2 \cdot 2}{3 \cdot 3} = \frac{4}{9}$

73. $\frac{5}{4} \cdot t = \frac{3}{8}$

$t = \frac{3}{8} \div \frac{5}{4}$ Dividing by $\frac{5}{4}$ on both sides

$t = \frac{3}{8} \cdot \frac{4}{5}$

$= \frac{3 \cdot 4}{8 \cdot 5} = \frac{3 \cdot 4}{2 \cdot 4 \cdot 5} = \frac{4}{4} \cdot \frac{3}{2 \cdot 5} = \frac{3}{2 \cdot 5} = \frac{3}{10}$

74. $x \cdot \frac{2}{3} = 160$

$x = 160 \div \frac{2}{3}$ Dividing by $\frac{2}{3}$ on both sides

$x = 160 \cdot \frac{3}{2}$

$= \frac{160 \cdot 3}{2} = \frac{2 \cdot 80 \cdot 3}{2 \cdot 1} = \frac{2}{2} \cdot \frac{80 \cdot 3}{1} = \frac{80 \cdot 3}{1} = 240$

75. ***Familiarize***. Let d = the number of days it will take to repave the road.

Translate.

$$\underbrace{\text{Number of miles repaved each day}}_{\frac{1}{12}} \text{ times } \underbrace{\text{Number of days}}_{d} \text{ is } \underbrace{\text{Total number of miles repaved}}_{\frac{3}{4}}$$

$$\frac{1}{12} \cdot d = \frac{3}{4}$$

Solve. We divide by $\frac{1}{12}$ on both sides of the equation.

$$d = \frac{3}{4} \div \frac{1}{12}$$

$$d = \frac{3}{4} \cdot \frac{12}{1} = \frac{3 \cdot 12}{4 \cdot 1} = \frac{3 \cdot 3 \cdot 4}{4 \cdot 1}$$

$$= \frac{4}{4} \cdot \frac{3 \cdot 3}{1} = \frac{3 \cdot 3}{1} = 9$$

Check. We repeat the calculation. The answer checks.

State. It will take 9 days to repave the road.

76. ***Familiarize***. Let t = the total length of the trip, in km.

Translate.

$$\underbrace{\text{Distance driven}}_{600} \text{ is } \frac{3}{5} \text{ of } \underbrace{\text{Total distance}}_{t}$$

$$600 = \frac{3}{5} \cdot t$$

Solve. We divide by $\frac{3}{5}$ on both sides of the equation.

$$t = 600 \div \frac{3}{5}$$

$$t = 600 \cdot \frac{5}{3} = \frac{600 \cdot 5}{3} = \frac{3 \cdot 200 \cdot 5}{3 \cdot 1}$$

$$= \frac{3}{3} \cdot \frac{200 \cdot 5}{1} = \frac{200 \cdot 5}{1} = 1000$$

Check. We repeat the calculation. The answer checks.

State. The trip is 1000 km long.

77. ***Familiarize***. Let x = the number of cups of peppers needed for $\frac{1}{2}$ recipe and y = the amount needed for 3 recipes.

Translate. For $\frac{1}{2}$ recipe we want to find $\frac{1}{2}$ of $\frac{2}{3}$ cup, so we have the multiplication sentence $x = \frac{1}{2} \cdot \frac{2}{3}$. For 3 recipes we want to find 3 times $\frac{2}{3}$, so we have $y = 3 \cdot \frac{2}{3}$.

Solve. We carry out the multiplication.

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

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

Check. We repeat the calculations. The answer checks.

State. For $\frac{1}{2}$ recipe, $\frac{1}{3}$ cup of peppers are needed; 2 cups are needed for 3 recipes.

78. ***Familiarize***. Let w = the amount Bernardo earns for working $\frac{1}{7}$ of a day.

Translate. We want to find $\frac{1}{7}$ of \$105, so we have $w = \frac{1}{7} \cdot 105$.

Solve. We carry out the multiplication.

$$w = \frac{1}{7} \cdot 105 = \frac{1 \cdot 105}{7} = \frac{1 \cdot 7 \cdot 15}{7 \cdot 1} = \frac{7}{7} \cdot \frac{1 \cdot 15}{1} = \frac{1 \cdot 15}{1} = 15$$

Check. We repeat the calculation. The answer checks.

State. Bernardo earns \$15 for working $\frac{1}{7}$ of a day.

79. ***Familiarize***. Let b = the number of bags that can be made from 48 yd of fabric.

Translate.

$$\underbrace{\text{Fabric for one bag}}_{\frac{4}{5}} \text{ times } \underbrace{\text{Number of bags}}_{b} \text{ is } \underbrace{\text{Total amount of fabric}}_{48}$$

$$\frac{4}{5} \cdot b = 48$$

Solve. We divide by $\frac{4}{5}$ on both sides of the equation.

$$b = 48 \div \frac{4}{5}$$

$$b = 48 \cdot \frac{5}{4} = \frac{48 \cdot 5}{4} = \frac{4 \cdot 12 \cdot 5}{4 \cdot 1}$$

$$= \frac{4}{4} \cdot \frac{12 \cdot 5}{1} = \frac{12 \cdot 5}{1} = 60$$

Check. Since $\frac{4}{5} \cdot 60 = \frac{4 \cdot 60}{5} = \frac{4 \cdot 5 \cdot 12}{5 \cdot 1} = \frac{5}{5} \cdot \frac{4 \cdot 12}{1} = 48$, the answer checks.

State. 60 book bags can be made from 48 yd of fabric.

80. ***Familiarize***. Let c = the number of metric tons of corn produced in the U.S. in 2003.

Translate.

$$\underbrace{\text{U.S. corn production}}_{c} \text{ is } \frac{2}{5} \text{ of } \underbrace{\text{Total world corn production}}_{640,000,000}$$

$$c = \frac{2}{5} \cdot 640,000,000$$

Solve. We carry out the multiplication.

$$c = \frac{2}{5} \cdot 640,00,000 = \frac{2 \cdot 640,000,000}{5}$$

$$= \frac{2 \cdot 5 \cdot 128,000,000}{5 \cdot 1} = \frac{5}{5} \cdot \frac{2 \cdot 128,000,000}{1}$$

$$= \frac{2 \cdot 128,000,000}{1} = 256,000,000$$

Check. We repeat the calculation. The answer checks.

State. The U.S. produced 256,000,000 metric tons of corn in 2003.

81. *Discussion and Writing Exercise.* To simplify fraction notation, first factor the numerator and the denominator

into prime numbers. Examine the factorizations for factors common to both the numerator and the denominator. Factor the fraction, with each pair of like factors forming a factor of 1. Remove the factors of 1, and multiply the remaining factors in the numerator and in the denominator, if necessary.

82. *Discussion and Writing Exercise.* Taking $\frac{1}{2}$ of a number is equivalent to multiplying the number by $\frac{1}{2}$. Dividing by $\frac{1}{2}$ is equivalent to multiplying by the reciprocal of $\frac{1}{2}$, or 2. Thus taking $\frac{1}{2}$ of a number is not the same as dividing by $\frac{1}{2}$.

83. *Discussion and Writing Exercise.* $9732 = 9\cdot1000+7\cdot100+3\cdot10+2\cdot1 = 9(999+1)+7(99+1)+3(9+1)+2\cdot1 = 9\cdot999+9\cdot1+7\cdot99+7\cdot1+3\cdot9+3\cdot1+2\cdot1$. Since 999, 99, and 9 are each a multiple of 9, $9\cdot999$, $7\cdot99$, and $3\cdot9$ are multiples of 9. This leaves $9\cdot1+7\cdot1+3\cdot1+2\cdot1$, or $9+7+3+2$. If $9+7+3+2$, the sum of the digits, is divisible by 9, then 9732 is divisible by 9.

84. $\frac{19}{24}\div\frac{a}{b}=\frac{19}{24}\cdot\frac{b}{a}=\frac{19\cdot b}{24\cdot a}=\frac{187,853}{268,224}$

Then, assuming the quotient has not been simplified, we have

$$19\cdot b = 187,853 \quad \text{and} \quad 24\cdot a = 268,224$$
$$b = \frac{187,853}{19} \quad \text{and} \quad a = \frac{268,224}{24}$$
$$b = 9887 \quad \text{and} \quad a = 11,176.$$

85. 13 and 31 are both prime numbers, so 13 is a palindrome prime.

19 is prime but 91 is not ($91 = 7\cdot13$), so 19 is not a palindrome prime.

16 is not prime ($16 = 2\cdot8 = 4\cdot4$), so it is not a palindrome prime.

11 is prime and when its digits are reversed we have 11 again, so 11 is a palindrome prime.

15 is not prime ($15 = 3\cdot5$), so it is not a palindrome prime.

24 is not prime ($24 = 2\cdot12 = 3\cdot8 = 4\cdot6$), so it is not a palindrome prime.

29 is prime but 92 is not ($92 = 2\cdot46 = 4\cdot23$), so 29 is not a palindrome prime.

101 is prime and when its digits are reversed we get 101 again, so 101 is a palindrome prime.

201 is not prime ($201 = 3\cdot67$), so it is not a palindrome prime.

37 and 73 are both prime numbers, so 37 is a palindrome prime.

Chapter 2 Test

1. We find as many "two-factor" factorizations of 300 as we can.

$1\cdot300$
$2\cdot150$
$3\cdot100$
$4\cdot75$
$5\cdot60$
$6\cdot50$
$10\cdot30$
$12\cdot25$
$15\cdot20$

If there are additional factors, they must be between 15 and 20. Since 16, 17, 18, and 19 are not factors of 300, we are finished. The factors of 300 are 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 25, 30, 50, 60, 75, 100, 150, and 300.

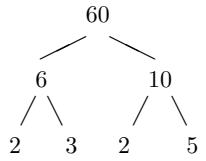
2. The number 41 is prime. It has only the factors 41 and 1.

3. The number 14 is composite. It has the factors 1, 2, 7, and 14.

4.
$$\begin{array}{r|l} & 3 \quad \leftarrow \text{ 3 is prime.} \\ 3 & 9 \\ 2 & 18 \end{array}$$

$18 = 2\cdot3\cdot3$

5. We use a factor tree.



$60 = 2\cdot3\cdot2\cdot5$, or $2\cdot2\cdot3\cdot5$

6. 1<u>784</u> is divisible by 8 because <u>784</u> is divisible by 8.

7. $7+8+4=19$; since 19 is not divisible by 9, 784 is not divisible by 9.

8. 555<u>2</u> is not divisible by 5 because the ones digit (2) is not 0 or 5.

9. The ones digit (2) is even; the sum of the digits 2+3+2+2, or 9 is divisible by 3. Thus, 2322 is divisible by 6.

10. $\frac{4}{5}$ ← Numerator
← Denominator

11. The figure is divided into 4 equal parts, so the unit is $\frac{1}{4}$ and the denominator is 4. Three of the units are shaded, so the numerator is 3. Thus, $\frac{3}{4}$ is shaded.

12. There are 7 objects in the set, so the denominator is 7. Three of the objects are shaded, so the numerator is 3. Thus, $\frac{3}{7}$ of the set is shaded.

13. a) The ratio of pass completions to attempts is $\frac{336}{497}$.

b) The number of incomplete passes is $497 - 336$, or 161. Then the ratio of incomplete passes to attempts is $\frac{161}{497}$.

14. $\frac{n}{1} = n$ for any whole number n. Then $\frac{26}{1} = 26$.

15. $\frac{n}{n} = 1$ for any whole number n that is not 0. Then $\frac{12}{12} = 1$.

16. $\frac{0}{n} = 0$ for any whole number n that is not 0. Then $\frac{0}{16} = 0$.

17. $\frac{12}{24} = \frac{1 \cdot 12}{2 \cdot 12} = \frac{1}{2} \cdot \frac{12}{12} = \frac{1}{2}$

18. $\frac{42}{7} = \frac{6 \cdot 7}{1 \cdot 7} = \frac{6}{1} \cdot \frac{7}{7} = \frac{6}{1} = 6$

19. $\frac{2}{28} = \frac{2 \cdot 1}{2 \cdot 14} = \frac{2}{2} \cdot \frac{1}{14} = \frac{1}{14}$

20. $\frac{n}{0}$ is not defined for any whole number n. Then $\frac{9}{0}$ is not defined.

21. $\frac{7}{2-2} = \frac{7}{0}$

$\frac{n}{0}$ is not defined for any whole number n. Then $\frac{7}{2-2}$ is not defined.

22. $\frac{35}{140} = \frac{1 \cdot 35}{4 \cdot 35} = \frac{1}{4} \cdot \frac{35}{35} = \frac{1}{4}$

23. $\frac{72}{108} = \frac{2 \cdot 36}{3 \cdot 36} = \frac{2}{3} \cdot \frac{36}{36} = \frac{2}{3}$

24. We multiply these two numbers: We multiply these two numbers:

$$3 \cdot 8 = 24 \quad \frac{3}{4} \quad \frac{6}{8} \quad 4 \cdot 6 = 24$$

Since $24 = 24$, $\frac{3}{4} = \frac{6}{8}$.

25. We multiply these two numbers: We multiply these two numbers:

$$5 \cdot 7 = 35 \quad \frac{5}{4} \quad \frac{9}{7} \quad 4 \cdot 9 = 36$$

Since $35 \neq 36$, $\frac{5}{4} \neq \frac{9}{7}$.

26. $\frac{4}{3} \cdot 24 = \frac{4 \cdot 24}{3} = \frac{4 \cdot 3 \cdot 8}{3 \cdot 1} = \frac{3}{3} \cdot \frac{4 \cdot 8}{1} = 1 \cdot \frac{4 \cdot 8}{1} = \frac{4 \cdot 8}{1} = 32$

27. $5 \cdot \frac{3}{10} = \frac{5 \cdot 3}{10} = \frac{5 \cdot 3}{2 \cdot 5} = \frac{5}{5} \cdot \frac{3}{2} = 1 \cdot \frac{3}{2} = \frac{3}{2}$

28. $\frac{2}{3} \cdot \frac{15}{4} = \frac{2 \cdot 15}{3 \cdot 4} = \frac{2 \cdot 3 \cdot 5}{3 \cdot 2 \cdot 2} = \frac{2 \cdot 3}{2 \cdot 3} \cdot \frac{5}{2} = 1 \cdot \frac{5}{2} = \frac{5}{2}$

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

30. $\frac{22}{15} \cdot \frac{5}{33} = \frac{22 \cdot 5}{15 \cdot 33} = \frac{2 \cdot 11 \cdot 5}{3 \cdot 5 \cdot 3 \cdot 11} = \frac{5 \cdot 11}{5 \cdot 11} \cdot \frac{2}{3 \cdot 3} = 1 \cdot \frac{2}{3 \cdot 3} = \frac{2}{3 \cdot 3} = \frac{2}{9}$

31. $\frac{5}{8}$ Interchange the numerator and denominator.

The reciprocal of $\frac{5}{8}$ is $\frac{8}{5}$. $\left(\frac{5}{8} \cdot \frac{8}{5} = \frac{40}{40} = 1\right)$

32. $\frac{1}{4}$ Interchange the numerator and denominator.

The reciprocal of $\frac{1}{4}$ is 4. $\left(\frac{4}{1} = 4;\ \frac{1}{4} \cdot \frac{4}{1} = \frac{4}{4} = 1\right)$

33. Think of 18 as $\frac{18}{1}$.

$\frac{18}{1}$ Interchange the numerator and denominator.

The reciprocal of $\frac{18}{1}$ is $\frac{1}{18}$. $\left(\frac{18}{1} \cdot \frac{1}{18} = \frac{18}{18} = 1\right)$

34. $\frac{3}{8} \div \frac{5}{4} = \frac{3}{8} \cdot \frac{4}{5} = \frac{3 \cdot 4}{8 \cdot 5} = \frac{3 \cdot 4}{2 \cdot 4 \cdot 5} = \frac{4}{4} \cdot \frac{3}{2 \cdot 5} = \frac{3}{2 \cdot 5} = \frac{3}{10}$

35. $\frac{1}{5} \div \frac{1}{8} = \frac{1}{5} \cdot \frac{8}{1} = \frac{1 \cdot 8}{5 \cdot 1} = \frac{8}{5}$

36. $12 \div \frac{2}{3} = 12 \cdot \frac{3}{2} = \frac{12 \cdot 3}{2} = \frac{2 \cdot 6 \cdot 3}{2 \cdot 1} = \frac{2}{2} \cdot \frac{6 \cdot 3}{1} = \frac{6 \cdot 3}{1} = 18$

37. $\frac{24}{5} \div \frac{28}{15} = \frac{24}{5} \cdot \frac{15}{28} = \frac{24 \cdot 15}{5 \cdot 28} = \frac{4 \cdot 6 \cdot 3 \cdot 5}{5 \cdot 4 \cdot 7} = \frac{4 \cdot 5}{4 \cdot 5} \cdot \frac{6 \cdot 3}{7} = \frac{6 \cdot 3}{7} = \frac{18}{7}$

38. $\frac{7}{8} \cdot x = 56$

$x = 56 \div \frac{7}{8}$ Dividing by $\frac{7}{8}$ on both sides

$x = 56 \cdot \frac{8}{7}$

$= \frac{56 \cdot 8}{7} = \frac{7 \cdot 8 \cdot 8}{7 \cdot 1} = \frac{7}{7} \cdot \frac{8 \cdot 8}{1} = \frac{8 \cdot 8}{1} = 64$

The solution is 64.

39. $t \cdot \frac{2}{5} = \frac{7}{10}$

$t = \frac{7}{10} \div \frac{2}{5}$ Dividing by $\frac{2}{5}$ on both sides

$t = \frac{7}{10} \cdot \frac{5}{2}$

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

The solution is $\frac{7}{4}$.

40. ***Familiarize***. Let d = the number of students who live in dorms.

Translate. We translate to an equation.

$$\underbrace{\text{How many students}}_{\downarrow} \ \underbrace{\text{is}}_{\downarrow} \ \underbrace{\frac{5}{8}}_{\downarrow} \ \underbrace{\text{of}}_{\downarrow} \ \underbrace{\text{7000 students?}}_{\downarrow}$$

$$d \quad = \quad \frac{5}{8} \quad \cdot \quad 7000$$

Solve. We carry out the multiplication.

$$d = \frac{5}{8} \cdot 7000 = \frac{5 \cdot 7000}{8} = \frac{5 \cdot 8 \cdot 875}{8 \cdot 1} = \frac{8}{8} \cdot \frac{5 \cdot 875}{1} = 4375$$

Check. We can check by repeating the calculation. The answer checks.

State. 4375 students live in dorms.

41. ***Familiarize***. Let l = the length of each piece of taffy, in meters.

Translate. We are dividing $\frac{9}{10}$ m into 12 equal pieces of length l. An equation that corresponds to the situation is $l = \frac{9}{10} \div 12$.

Solve. We carry out the division.

$$l = \frac{9}{10} \div 12 = \frac{9}{10} \cdot \frac{1}{12} = \frac{9 \cdot 1}{10 \cdot 12} = \frac{3 \cdot 3 \cdot 1}{10 \cdot 3 \cdot 4} = \frac{3}{3} \cdot \frac{3 \cdot 1}{10 \cdot 4} = \frac{3}{40}$$

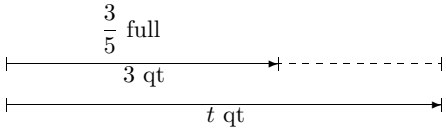
Check. The total length of 12 pieces of taffy, each of length $\frac{3}{40}$ m, is

$$12 \cdot \frac{3}{40} = \frac{12 \cdot 3}{40} = \frac{3 \cdot 4 \cdot 3}{4 \cdot 10} = \frac{4}{4} \cdot \frac{3 \cdot 3}{10} = \frac{9}{10} \text{ m.}$$

The answer checks.

State. The length of each piece of taffy will be $\frac{3}{40}$ m.

42. ***Familiarize***. Let t = the number of quarts of tea the thermos holds when it is full.



Translate. We translate to an equation.

$$\underbrace{\text{Fraction filled}}_{\downarrow} \ \underbrace{\text{of}}_{\downarrow} \ \underbrace{\text{Total capacity of thermos}}_{\downarrow} \ \underbrace{\text{is}}_{\downarrow} \ \underbrace{\text{Amount in thermos}}_{\downarrow}$$

$$\frac{3}{5} \quad \cdot \quad t \quad = \quad 3$$

Solve. We divide by $\frac{3}{5}$ on both sides and carry out the division.

$$t = 3 \div \frac{3}{5} = 3 \cdot \frac{5}{3} = \frac{3 \cdot 5}{3} = \frac{3}{3} \cdot \frac{5}{1} = 5$$

Check. Since $\frac{3}{5} \cdot 5 = \frac{3 \cdot 5}{5} = \frac{5}{5} \cdot \frac{3}{1} = 3$, the answer checks.

State. The thermos holds 5 qt of tea when it is full.

43. ***Familiarize***. Let s = the number of inches the screw will go into the piece of walnut when it is turned 6 complete revolutions.

Translate. We translate to an equation.

$$\underbrace{\text{Pitch of screw}}_{\downarrow} \ \underbrace{\text{times}}_{\downarrow} \ \underbrace{\text{Number of revolutions}}_{\downarrow} \ \underbrace{\text{is}}_{\downarrow} \ \underbrace{\text{Distance traveled}}_{\downarrow}$$

$$\frac{1}{8} \quad \cdot \quad 6 \quad = \quad s$$

Solve. We carry out the multiplication.

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

Check. We repeat the calculation. The answer checks.

State. The screw will go $\frac{3}{4}$ in. into the piece of walnut.

44. ***Familiarize***. This is a multistep problem. First we will find half the amount of salt for one batch of pancakes. Then we will find 5 times this amount. Let s = half the amount of salt in a single batch, in teaspoons.

Translate. We translate to an equation.

$$s = \frac{1}{2} \cdot \frac{3}{4}$$

Solve. We carry out the multiplication.

$$s = \frac{1}{2} \cdot \frac{3}{4} = \frac{1 \cdot 3}{2 \cdot 4} = \frac{3}{8}$$

Half the amount of salt in a single batch of pancakes is $\frac{3}{8}$ tsp. Let p = the number of teaspoons of salt in 5 batches. The equation that corresponds to this situation is

$$p = 5 \cdot \frac{3}{8}.$$

We solve the equation by carrying out the multiplication.

$$p = 5 \cdot \frac{3}{8} = \frac{5 \cdot 3}{8} = \frac{15}{8}$$

Check. We repeat the calculations. The answer checks.

State. Jacqueline will need $\frac{15}{8}$ tsp of salt.

45. ***Familiarize***. This is a multistep problem. First we will find the number of acres Karl received. Then we will find how much of that land Eileen received. Let k = the number of acres of land Karl received.

Translate. We translate to an equation.

$$k = \frac{7}{8} \cdot \frac{2}{3}$$

Solve. We carry out the multiplication.

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

Karl received $\frac{7}{12}$ acre of land. Let a = the number of acres Eileen received. An equation that corresponds to this situation is

$$a = \frac{1}{4} \cdot \frac{7}{12}.$$

We solve the equation by carrying out the multiplication.

$$a = \frac{1}{4} \cdot \frac{7}{12} = \frac{1 \cdot 7}{4 \cdot 12} = \frac{7}{48}$$

Check. We repeat the calculations. The answer checks.

State. Eileen received $\frac{7}{48}$ acre of land.

46. First we will evaluate the exponential expression; then we will multiply and divide in order from left to right.

$$\begin{aligned}
\left(\frac{3}{8}\right)^2 \div \frac{6}{7} \cdot \frac{2}{9} \div 5 &= \frac{9}{64} \div \frac{6}{7} \cdot \frac{2}{9} \div 5 \\
&= \frac{9}{64} \cdot \frac{7}{6} \cdot \frac{2}{9} \div 5 \\
&= \frac{9 \cdot 7}{64 \cdot 6} \cdot \frac{2}{9} \div 5 \\
&= \frac{9 \cdot 7 \cdot 2}{64 \cdot 6 \cdot 9} \div 5 \\
&= \frac{9 \cdot 7 \cdot 2}{64 \cdot 6 \cdot 9} \cdot \frac{1}{5} \\
&= \frac{9 \cdot 7 \cdot 2 \cdot 1}{64 \cdot 6 \cdot 9 \cdot 5} \\
&= \frac{9 \cdot 7 \cdot 2 \cdot 1}{64 \cdot 2 \cdot 3 \cdot 9 \cdot 5} \\
&= \frac{9 \cdot 2}{9 \cdot 2} \cdot \frac{7 \cdot 1}{64 \cdot 3 \cdot 5} \\
&= \frac{7}{960}
\end{aligned}$$

47.

$$\begin{aligned}
\frac{33}{38} \cdot \frac{34}{55} &= \frac{17}{35} \cdot \frac{15}{19} x \\
\frac{33 \cdot 34}{38 \cdot 55} &= \frac{17 \cdot 15}{35 \cdot 19} x \\
\frac{3 \cdot 11 \cdot 2 \cdot 17}{2 \cdot 19 \cdot 5 \cdot 11} &= \frac{17 \cdot 3 \cdot 5}{5 \cdot 7 \cdot 19} x \\
\frac{2 \cdot 11}{2 \cdot 11} \cdot \frac{3 \cdot 17}{19 \cdot 5} &= \frac{5}{5} \cdot \frac{17 \cdot 3}{7 \cdot 19} x \\
\frac{3 \cdot 17}{19 \cdot 5} &= \frac{17 \cdot 3}{7 \cdot 19} x \\
\frac{3 \cdot 17}{19 \cdot 5} \div \frac{17 \cdot 3}{7 \cdot 19} &= x \quad \text{Dividing by } \frac{17 \cdot 3}{7 \cdot 19} \text{ on both sides} \\
\frac{3 \cdot 17}{19 \cdot 5} \cdot \frac{7 \cdot 19}{17 \cdot 3} &= x \\
\frac{3 \cdot 17 \cdot 7 \cdot 19}{19 \cdot 5 \cdot 17 \cdot 3} &= x \\
\frac{3 \cdot 17 \cdot 19}{3 \cdot 17 \cdot 19} \cdot \frac{7}{5} &= x \\
\frac{7}{5} &= x
\end{aligned}$$

The solution is $\frac{7}{5}$.