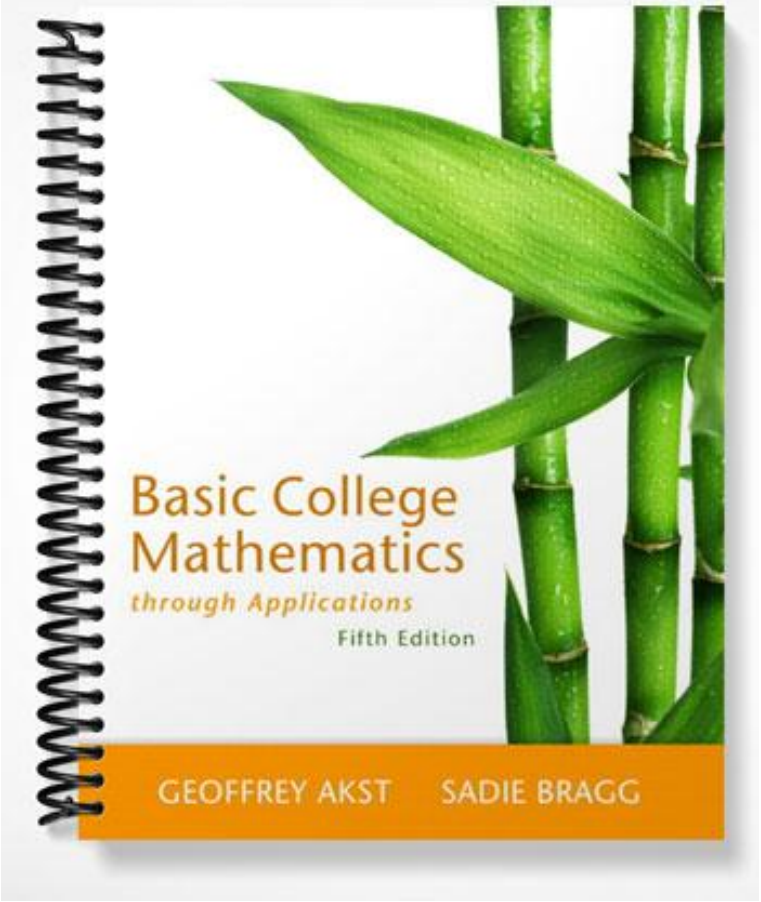
SOLUTIONS MANUAL



Basic College Mathematics

through Applications

Fifth Edition

GEOFFREY AKST SADIE BRAGG

Chapter 2

FRACTIONS

2.1 Factors and Prime Numbers

Exercises

2. A composite number is a whole number that has more than two factors.

4. The least common multiple of two or more numbers is the smallest nonzero number that is a multiple of each number.

6. The divisibility test for 10 is to check if the ones digit is 0.

8. $\frac{10}{1} = 10$ R0 $\quad \frac{10}{2} = 5$ R0
The factors of 10 are 1, 2, 5, and 10.

10. $\frac{9}{1} = 9$ R0 $\quad \frac{9}{3} = 3$ R0
The factors of 9 are 1, 3, and 9.

12. $\frac{15}{1} = 15$ R0 $\quad \frac{15}{3} = 5$ R0
The factors of 15 are 1, 3, 5, and 15.

14. $\frac{47}{1} = 47$ R0
The factors of 47 are 1 and 47.

16. $\frac{35}{1} = 35$ R0 $\quad \frac{35}{5} = 7$ R0
The factors of 35 are 1, 5, 7, and 35.

18. $\frac{73}{1} = 73$ R0
The factors of 73 are 1 and 73.

20. $\frac{98}{1} = 98$ R0 $\quad \frac{98}{2} = 49$ R0 $\quad \frac{98}{7} = 14$ R0
The factors of 98 are 1, 2, 7, 14, 49, and 98.

22. $\frac{48}{1} = 48$ R0 $\quad \frac{48}{2} = 24$ R0 $\quad \frac{48}{3} = 16$ R0
$\frac{48}{4} = 12$ R0 $\quad \frac{48}{6} = 8$ R0
The factors of 48 are 1, 2, 3, 4, 6, 8, 12, 16, 24, and 48.

24. 7 is prime.

26. 24 is composite; 2, 3, 4, 6, 8, and 12 are factors.

28. 75 is composite; 3, 5, 15, and 25 are factors.

30. 31 is prime.

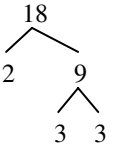
32. 45 is composite; 3, 5, 9 and 15 are factors.

34.

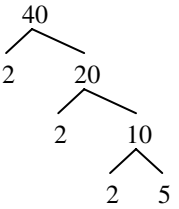

$10 = 2 \times 5$

36.

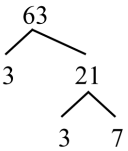

$14 = 2 \times 7$

38.


$18 = 2 \times 3 \times 3 = 2 \times 3^2$

40.


$40 = 2 \times 2 \times 2 \times 5 = 2^3 \times 5$

42.


$63 = 3 \times 3 \times 7 = 3^2 \times 7$

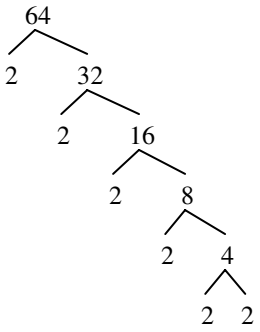
44.


$57 = 3 \times 19$

46.


$49 = 7 \times 7 = 7^2$

48.

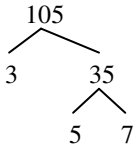


$64 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^6$

50.

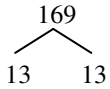
$22 = 2 \times 11$

52.



$105 = 3 \times 5 \times 7$

54.

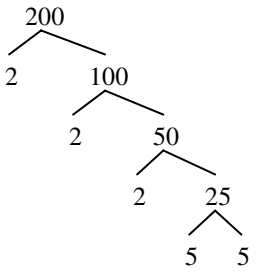


$169 = 13 \times 13 = 13^2$

56.

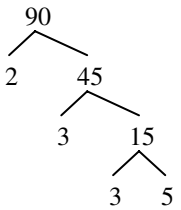
$62 = 2 \times 31$

58.



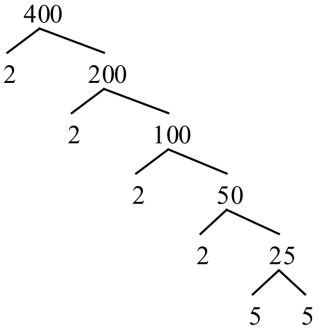
$200 = 2 \times 2 \times 2 \times 5 \times 5 = 2^3 \times 5^2$

60.



$90 = 2 \times 3 \times 3 \times 5 = 2 \times 3^2 \times 5$

62.



$400 = 2 \times 2 \times 2 \times 2 \times 5 \times 5 = 2^4 \times 5^2$

64. $9 = 3^2 \quad 12 = 2^2 \times 3$

$\text{LCM} = 2^2 \times 3^2 = 4 \times 9 = 36$

66. $4 = 2^2 \quad 6 = 2 \times 3$

$\text{LCM} = 2^2 \times 3 = 4 \times 3 = 12$

68. $20 = 2^2 \times 5 \quad 21 = 3 \times 7$

$\text{LCM} = 2^2 \times 3 \times 5 \times 7 = 4 \times 3 \times 5 \times 7 = 420$

70. $15 = 3 \times 5 \quad 60 = 2^2 \times 3 \times 5$

$\text{LCM} = 2^2 \times 3 \times 5 = 4 \times 3 \times 5 = 60$

72. $30 = 2 \times 3 \times 5 \quad 150 = 2 \times 3 \times 5^2$

$\text{LCM} = 2 \times 3 \times 5^2 = 2 \times 3 \times 25 = 150$

74. $100 = 2^2 \times 5^2 \quad 90 = 2 \times 3^2 \times 5$

$\text{LCM} = 2^2 \times 3^2 \times 5^2 = 4 \times 9 \times 25 = 900$

76. $2 = 2 \quad 8 = 2^3 \quad 10 = 2 \times 5$

$\text{LCM} = 2^3 \times 5 = 8 \times 5 = 40$

78. $2 = 2 \quad 3 = 3 \quad 5 = 5$

$\text{LCM} = 2 \times 3 \times 5 = 6 \times 5 = 30$

80. $6 = 2 \times 3 \quad 8 = 2^3 \quad 12 = 2^2 \times 3$

$\text{LCM} = 2^3 \times 3 = 8 \times 3 = 24$

82. $8 = 2^3 \quad 24 = 2^3 \times 3 \quad 56 = 2^3 \times 7$

$\text{LCM} = 2^3 \times 3 \times 7 = 8 \times 3 \times 7 = 168$

84. 63 is composite; 3, 7, 9, and 21 are factors.

86. $5 = 5 \quad 10 = 2 \times 5 \quad 12 = 2^2 \times 3$

$\text{LCM} = 2^2 \times 3 \times 5 = 4 \times 15 = 60$

88. a. $4\overline{)196}$ $\begin{array}{r} 49 \\ \text{R0} \end{array}$

Yes, because 196 is a multiple of 4.

b. $4\overline{)198}$ R2

No, because 198 is not a multiple of 4.

90. Yes, an oil change would be recommended at 21,000 miles, because 21,000 is divisible by 3,000.

92. $\text{LCM}(4,3) = 12$. Both prizes will be given in 2006 + 12 = 2018.

94. $6 = 2 \times 3;\ 3 = 3;\ 4 = 2 \times 2$

$\text{LCM}(6,3,4) = 2^2 \times 3 = 12$, so the bills will all fall due again in 12 months.

Mindstretchers

1. a. $57 = 7 + 19 + 31$ or $57 = 3 + 17 + 37$

b. $81 = 11 + 23 + 47$ or $81 = 7 + 37 + 37$

2. $1 = 1 \quad 2 = 2 \quad 3 = 3 \quad 4 = 2^2 \quad 5 = 5$

$6 = 2 \times 3 \quad 7 = 7 \quad 8 = 2^3 \quad 9 = 3^2 \quad 10 = 2 \times 5$

$\text{LCM} = 1 \times 2^3 \times 3^2 \times 5 \times 7 = 2{,}520$

3. $715 \times 7 \times 11 \times 13 = 715{,}715$

2.2 Introduction to Fractions

Exercises

2. The improper fraction $\frac{5}{2}$ can be expressed as a mixed number.

4. Divide the numerator and denominator of a fraction by the same whole number in order to simplify it.

6. The least common denominator of two or more fractions is the least common multiple of their denominators.

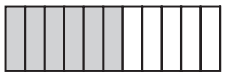
8. There are 4 equal parts of which 1 part is shaded. The fraction is $\frac{1}{4}$.

10. There are 5 equal parts of which 4 parts are shaded. The fraction is $\frac{4}{5}$.

12. There are 2 wholes and $\frac{2}{5}$ of a whole shaded. The mixed number is $2\frac{2}{5}$.

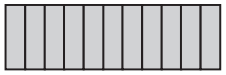
14. There is 1 whole shaded and $\frac{6}{8}$ of a whole shaded. The mixed number is $1\frac{6}{8}$.

16. $\frac{6}{11}$

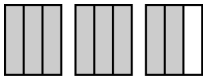


18. $\frac{4}{10}$

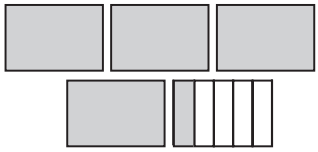
20. $\frac{11}{11}$



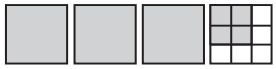
22. $\frac{8}{3}$



24. $4\frac{1}{5}$



26. $3\frac{4}{9}$



28. $\frac{7}{12}$, proper **30.** $\frac{11}{10}$, improper

32. $12\frac{1}{2}$, mixed number

34. $\frac{4}{4}$, improper **36.** $\frac{5}{6}$, proper

38. $10\frac{3}{4}$, mixed number

40. $1\frac{1}{3} = \frac{(3 \times 1) + 1}{3} = \frac{4}{3}$

42. $10\frac{2}{3} = \frac{(3\times 10)+2}{3} = \frac{32}{3}$

44. $12\frac{3}{4} = \frac{(4\times 12)+3}{4} = \frac{51}{4}$

46. $8 = \frac{8}{1}$

48. $6\frac{5}{6} = \frac{(6\times 6)+5}{6} = \frac{41}{6}$

50. $10\frac{1}{2} = \frac{(2\times 10)+1}{2} = \frac{21}{2}$

52. $20\frac{1}{8} - \frac{(8\times 20)+1}{8} = \frac{161}{8}$

54. $11\frac{5}{7} = \frac{(7\times 11)+5}{7} = \frac{82}{7}$

56. $10 = \frac{10}{1}$

58. $2\frac{7}{13} = \frac{(13\times 2)+7}{13} = \frac{33}{13}$

60. $4\frac{1}{6} = \frac{(6\times 4)+1}{6} = \frac{25}{6}$

62. $14\frac{1}{10} = \frac{(10\times 14)+1}{10} = \frac{141}{10}$

64. $\frac{6}{5} = 5\overline{)6}\ \begin{matrix}1\\ \text{R1}\end{matrix}$ $\quad \frac{6}{5} = 1\frac{1}{5}$

66. $\frac{12}{5} = 5\overline{)12}\ \begin{matrix}2\\ \text{R2}\end{matrix}$ $\quad \frac{12}{5} = 2\frac{2}{5}$

68. $\frac{12}{12} = 12\overline{)12}\ \begin{matrix}1\\ \text{R0}\end{matrix}$ $\quad \frac{12}{12} = 1$

70. $\frac{100}{100} = 100\overline{)100}\ \begin{matrix}1\\ \text{R0}\end{matrix}$ $\quad \frac{100}{100} = 1$

72. $\frac{31}{2} = 2\overline{)31}\ \begin{matrix}15\\ \text{R1}\end{matrix}$ $\quad \frac{31}{2} = 15\frac{1}{2}$

74. $\frac{62}{3} = 3\overline{)62}\ \begin{matrix}20\\ \text{R2}\end{matrix}$ $\quad \frac{62}{3} = 20\frac{2}{3}$

76. $\frac{40}{3} = 3\overline{)40}\ \begin{matrix}13\\ \text{R1}\end{matrix}$ $\quad \frac{40}{3} = 13\frac{1}{3}$

78. $\frac{41}{8} = 8\overline{)41}\ \begin{matrix}5\\ \text{R1}\end{matrix}$ $\quad \frac{41}{8} = 5\frac{1}{8}$

80. $\frac{58}{11} = 11\overline{)58}\ \begin{matrix}5\\ \text{R3}\end{matrix}$ $\quad \frac{58}{11} = 5\frac{3}{11}$

82. $\frac{38}{3} = 3\overline{)38}\ \begin{matrix}12\\ \text{R2}\end{matrix}$ $\quad \frac{38}{3} = 12\frac{2}{3}$

84. $\frac{72}{9} = 9\overline{)72}\ \begin{matrix}8\\ \text{R0}\end{matrix}$ $\quad \frac{72}{9} = 8$

86. $\frac{19}{1} = 1\overline{)19}\ \begin{matrix}19\\ \text{R0}\end{matrix}$ $\quad \frac{19}{1} = 19$

88. Possible answers:

$$\frac{3}{10} = \frac{3\cdot 2}{10\cdot 2} = \frac{6}{20}$$

$$\frac{3}{10} = \frac{3\cdot 3}{10\cdot 3} = \frac{9}{30}$$

90. Possible answers:

$$\frac{1}{10} = \frac{1\cdot 2}{10\cdot 2} = \frac{2}{20}$$

$$\frac{1}{10} = \frac{1\cdot 3}{10\cdot 3} = \frac{3}{30}$$

92. Possible answers:

$$\frac{5}{6} = \frac{5\cdot 2}{6\cdot 2} = \frac{10}{12}$$

$$\frac{5}{6} = \frac{5\cdot 3}{6\cdot 3} = \frac{15}{18}$$

94. Possible answers:

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

$$\frac{3}{5} = \frac{3\cdot 3}{5\cdot 3} = \frac{9}{15}$$

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

98. $\frac{7}{10} = \frac{7\cdot 2}{10\cdot 2} = \frac{14}{20}$

100. $5 = \frac{5}{1} = \frac{5\cdot 15}{1\cdot 15} = \frac{75}{15}$

102. $\frac{4}{9} = \frac{4\cdot 7}{9\cdot 7} = \frac{28}{63}$

104. $\frac{3}{10} = \frac{3\cdot 4}{10\cdot 4} = \frac{12}{40}$

106. $2 = \frac{2}{1} = \frac{2\cdot 21}{1\cdot 21} = \frac{42}{21}$

108. $\frac{7}{8} = \frac{7\cdot 3}{8\cdot 3} = \frac{21}{24}$

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

112. $\frac{1}{3} = \frac{1\cdot 30}{3\cdot 30} = \frac{30}{90}$

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

116. $\frac{7}{8} = \frac{7\cdot 7}{8\cdot 7} = \frac{49}{56}$

118. $\frac{5}{6} = \frac{5\cdot 24}{6\cdot 24} = \frac{120}{144}$

120. $\frac{9}{12} = \frac{\overset{1}{\cancel{3}}\cdot 3}{\underset{1}{\cancel{3}}\cdot 4} = \frac{3}{4}$

122. $\frac{21}{21} = \frac{\overset{1}{\cancel{3}}\cdot\overset{1}{\cancel{7}}}{\underset{1}{\cancel{3}}\cdot\underset{1}{\cancel{7}}} = 1$

124. $\dfrac{4}{24} = \dfrac{\overset{1}{\cancel{2}} \cdot \overset{1}{\cancel{2}}}{\underset{1}{\cancel{2}} \cdot \underset{1}{\cancel{2}} \cdot 2 \cdot 3} = \dfrac{1}{6}$ **126.** $\dfrac{25}{49} = \dfrac{5 \cdot 5}{7 \cdot 7} = \dfrac{25}{49}$

128. $\dfrac{75}{100} = \dfrac{3 \cdot \overset{1}{\cancel{25}}}{4 \cdot \underset{1}{\cancel{25}}} = \dfrac{3}{4}$

130. $\dfrac{875}{1,000} = \dfrac{\overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}} \cdot \overset{1}{\cancel{5}} \cdot 7}{\underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}} \cdot \underset{1}{\cancel{5}} \cdot 8} = \dfrac{7}{8}$

132. $\dfrac{15}{9} = \dfrac{\overset{1}{\cancel{3}} \cdot 5}{\underset{1}{\cancel{3}} \cdot 3} = \dfrac{5}{3} = 1\dfrac{2}{3}$

134. $\dfrac{30}{18} = \dfrac{5 \cdot \overset{1}{\cancel{6}}}{3 \cdot \underset{1}{\cancel{6}}} = \dfrac{5}{3} = 1\dfrac{2}{3}$

136. $\dfrac{36}{45} - \dfrac{\overset{1}{\cancel{9}} \cdot 4}{\underset{1}{\cancel{9}} \cdot 5} = \dfrac{4}{5}$ **138.** $\dfrac{19}{51} = \dfrac{19}{51}$

140. $\dfrac{36}{144} = \dfrac{\overset{1}{\cancel{9}} \cdot \overset{1}{\cancel{4}}}{\underset{1}{\cancel{9}} \cdot \underset{1}{\cancel{4}} \cdot 4} = \dfrac{1}{4}$

142. $\dfrac{21}{36} = \dfrac{\overset{1}{\cancel{3}} \cdot 7}{\underset{1}{\cancel{3}} \cdot 12} = \dfrac{7}{12}$

144. $11\dfrac{51}{102} = 11\dfrac{1 \cdot \overset{1}{\cancel{51}}}{2 \cdot \underset{1}{\cancel{51}}} = 11\dfrac{1}{2}$

146. $1\dfrac{144}{144} = 1 + 1 = 2$

148. $\dfrac{5}{10} > \dfrac{3}{10}$ because $5 > 3$

150. $\dfrac{5}{6} < \dfrac{7}{8}$ because $\dfrac{20}{24} < \dfrac{21}{24}$

152. $\dfrac{9}{12} = \dfrac{3}{4}$ because $9 \cdot 4 = 12 \cdot 3, 36 = 36$

154. $2\dfrac{3}{7} > 1\dfrac{1}{2}$ because $\dfrac{17}{7} > \dfrac{3}{2}$ since $\dfrac{34}{14} > \dfrac{21}{14}$

156. $2 = 2 \quad 3 = 3 \quad 4 = 2^2$

$\text{LCM} = 2^2 \cdot 3 = 4 \cdot 3 = 12$

$\dfrac{3}{2} = \dfrac{3 \cdot 6}{2 \cdot 6} = \dfrac{18}{12}$

$\dfrac{3}{3} = \dfrac{3 \cdot 4}{3 \cdot 4} = \dfrac{12}{12}$

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

In increasing order, the fractions are $\dfrac{3}{4}, \dfrac{3}{3}, \dfrac{3}{2}$.

158. $4 = 2^2 \quad 6 = 2 \cdot 3 \quad 8 = 2^3$

$\text{LCM} = 2^3 \cdot 3 = 8 \cdot 3 = 24$

$\dfrac{3}{4} = \dfrac{3 \cdot 6}{4 \cdot 6} = \dfrac{18}{24}$

$\dfrac{5}{6} = \dfrac{5 \cdot 4}{6 \cdot 4} = \dfrac{20}{24}$

$\dfrac{7}{8} = \dfrac{7 \cdot 3}{8 \cdot 3} = \dfrac{21}{24}$

In increasing order, the fractions are $\dfrac{3}{4}, \dfrac{5}{6}, \dfrac{7}{8}$.

160. $8 = 2^3 \quad 2 = 2 \quad 11 = 11$

$\text{LCM} = 2^3 \cdot 11 = 8 \cdot 11 = 88$

$\dfrac{5}{8} = \dfrac{5 \cdot 11}{8 \cdot 11} = \dfrac{55}{88}$

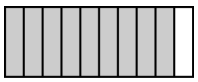
$\dfrac{1}{2} = \dfrac{1 \cdot 44}{2 \cdot 44} = \dfrac{44}{88}$

$\dfrac{4}{11} = \dfrac{4 \cdot 8}{11 \cdot 8} = \dfrac{32}{88}$

In increasing order, the fractions are $\dfrac{4}{11}, \dfrac{1}{2}, \dfrac{5}{8}$.

162. $6\overline{)32}$ $\begin{matrix}5 \\ \text{R2}\end{matrix}$ $\dfrac{32}{6} = 5\dfrac{2}{6} = 5\dfrac{1}{3}$

164. $\dfrac{9}{10}$



166. $2\dfrac{3}{8} = \dfrac{19}{8}$

168. $4\overline{)6}$ $\begin{matrix}1 \\ \text{R2}\end{matrix}$ $\dfrac{6}{4} = 1\dfrac{2}{4} = 1\dfrac{1}{2}$

There are $1\dfrac{1}{2}$ cloves per serving.

170. a. The total number of therapists is 182,000 + 94,000 = 276,000. The fraction of therapists who are physical therapists is $\frac{182,000}{276,000} = \frac{182}{276} = \frac{91}{138}$.

b. The fraction of therapists who are respiratory therapists is $\frac{94,000}{276,000} = \frac{94}{276} = \frac{47}{138}$.

172. The Lakers did not win 82 − 65 = 17 games. This is $\frac{17}{82}$ of the games played.

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

$\frac{5}{36} = \frac{5}{36}$

There is a greater probability of getting a 6 because $\frac{5}{36} > \frac{1}{9}$.

176. The LCM of 2, 8, and 16 is 16.

$\frac{1}{16} = \frac{1}{16} \quad \frac{1}{8} = \frac{1 \cdot 2}{8 \cdot 2} = \frac{2}{16} \quad \frac{1}{2} = \frac{1 \cdot 8}{2 \cdot 8} = \frac{8}{16}$

a. Newark Airport had the best visibility at $\frac{1}{2}$ mi.

b. Kennedy Airport had the worst visibility at $\frac{1}{16}$ mi.

178. average age $= \frac{57 + 61 + 57 + 57 + 58 + 57}{6}$

$= \frac{347}{6}$ yr $= 57\frac{5}{6}$ yr

Mindstretchers

1. The shaded center triangle is equivalent to 4 of the smaller shaded triangles, so there are 7 shaded triangles. There are 9 unshaded triangles, so there are 16 triangles in total. $\frac{7}{16}$ of the triangle is shaded.

2. There are an infinite number of fractions, such as

$\frac{3}{2} = 1\frac{1}{2}, \frac{4}{3} = 1\frac{1}{3}, \frac{5}{4} = 1\frac{1}{4}$, and so on.

3. a. 42 = 42; 174 = 174; 406 = 406

b. $\frac{2}{4} = \frac{3}{6} = \frac{79}{158}$

2.3 Adding and Subtracting Fractions

Exercises

2. To subtract unlike fractions, rewrite them as equivalent fractions with the same denominator.

4. Fractions with equal numerators and denominators are equivalent to 1.

6. $\frac{7}{10} + \frac{9}{10} = \frac{16}{10} = 1\frac{6}{10}$ or $1\frac{3}{5}$

8. $\frac{71}{100} + \frac{79}{100} = \frac{150}{100} = 1\frac{50}{100}$ or $1\frac{1}{2}$

10. $\frac{1}{7} + \frac{3}{7} + \frac{2}{7} = \frac{6}{7}$

12. $\frac{1}{10} + \frac{3}{10} + \frac{1}{10} = \frac{5}{10} = \frac{1}{2}$

14.
$$\begin{array}{r} \frac{1}{4} = \frac{5}{20} \\ +\frac{2}{5} = +\frac{8}{20} \\ \hline \frac{13}{20} \end{array}$$

16.
$$\begin{array}{r} \frac{1}{6} = \frac{1}{6} \\ +\frac{2}{3} = +\frac{4}{6} \\ \hline \frac{5}{6} \end{array}$$

18.
$$\begin{array}{r} \frac{5}{6} = \frac{10}{12} \\ +\frac{1}{12} = +\frac{1}{12} \\ \hline \frac{11}{12} \end{array}$$

20.
$$\begin{array}{r} \frac{3}{4} = \frac{21}{28} \\ +\frac{3}{7} = +\frac{12}{28} \\ \hline \frac{33}{28} = 1\frac{5}{28} \end{array}$$

22.
$$\begin{array}{r} \frac{9}{10} = \frac{9}{10} \\ +\frac{4}{5} = +\frac{8}{10} \\ \hline \frac{17}{10} = 1\frac{7}{10} \end{array}$$

24.
$$\begin{array}{r} \frac{7}{20} = \frac{7}{20} \\ +\frac{3}{4} = +\frac{15}{20} \\ \hline \frac{22}{20} = 1\frac{2}{20} = 1\frac{1}{10} \end{array}$$

26. $\frac{1}{5} + \frac{1}{6} + \frac{1}{3} = \frac{6}{30} + \frac{5}{30} + \frac{10}{30} = \frac{21}{30} = \frac{7}{10}$

28. $\frac{3}{10}+\frac{1}{3}+\frac{1}{9}=\frac{27}{90}+\frac{30}{90}+\frac{10}{90}=\frac{67}{90}$

30.
$$\begin{array}{r} \frac{1}{2} = \frac{6}{12} \\ \frac{1}{3} = \frac{4}{12} \\ +\frac{1}{4} = +\frac{3}{12} \\ \hline \frac{13}{12} = 1\frac{1}{12} \end{array}$$

32.
$$\begin{array}{r} \frac{1}{10} = \frac{3}{30} \\ \frac{2}{5} = \frac{12}{30} \\ +\frac{5}{6} = +\frac{25}{30} \\ \hline \frac{40}{30} = 1\frac{10}{30} = 1\frac{1}{3} \end{array}$$

34.
$$\begin{array}{r} 4\frac{1}{5} \\ +2 \\ \hline 6\frac{1}{5} \end{array}$$
Check: $4\frac{1}{5}+2$
$\downarrow \quad \downarrow$
$4 \quad +2=6$

36.
$$\begin{array}{r} 6\frac{1}{12} \\ +4\frac{1}{12} \\ \hline 10\frac{2}{12}=10\frac{1}{6} \end{array}$$
Check: $6\frac{1}{12}+4\frac{1}{12}$
$\downarrow \quad \downarrow$
$6 \quad + \quad 4=10$

38.
$$\begin{array}{r} 8\frac{2}{3} \\ +6\frac{2}{3} \\ \hline 14\frac{4}{3}=15\frac{1}{3} \end{array}$$
Check: $8\frac{2}{3}+6\frac{2}{3}$
$\downarrow \quad \downarrow$
$9 \quad + \quad 7=16$

40.
$$\begin{array}{r} 2\frac{3}{10} \\ +7\frac{9}{10} \\ \hline 9\frac{12}{10}=10\frac{2}{10}=10\frac{1}{5} \end{array}$$
Check: $2\frac{3}{10}+7\frac{9}{10}$
$\downarrow \quad \downarrow$
$2 \quad + \quad 8=10$

42.
$$\begin{array}{r} 17\frac{3}{8} = 17\frac{15}{40} \\ +20\frac{1}{5} = +20\frac{8}{40} \\ \hline 37\frac{23}{40} \end{array}$$
Check: $17\frac{3}{8}+20\frac{1}{5}$
$\downarrow \quad \downarrow$
$17 \quad + \quad 20=37$

44.
$$\begin{array}{r} 4\frac{7}{10} = 4\frac{14}{20} \\ +\frac{7}{20} = +\frac{7}{20} \\ \hline 4\frac{21}{20}=5\frac{1}{20} \end{array}$$
Check: $4\frac{7}{10}+\frac{7}{20}$
$\downarrow \quad \downarrow$
$5 \quad + \quad 0=5$

46.
$$\begin{array}{r} 4\frac{1}{9} = 4\frac{10}{90} \\ +20\frac{7}{10} = +20\frac{63}{90} \\ \hline 24\frac{73}{90} \end{array}$$
Check: $4\frac{1}{9}+20\frac{7}{10}$
$\downarrow \quad \downarrow$
$4 \quad + \quad 21=25$

48.
$$\begin{array}{r} \frac{1}{6} = \frac{5}{30} \\ +3\frac{2}{5} = +3\frac{12}{30} \\ \hline 3\frac{17}{30} \end{array}$$
Check: $\frac{1}{6}+3\frac{2}{5}$
$\downarrow \quad \downarrow$
$0 \quad + \quad 3=3$

50.
$$\begin{array}{r} 20\frac{3}{5} = 20\frac{6}{10} \\ +4\frac{1}{2} = +4\frac{5}{10} \\ \hline 24\frac{11}{10}=25\frac{1}{10} \end{array}$$
Check: $20\frac{3}{5}+4\frac{1}{2}$
$\downarrow \quad \downarrow$
$21 \quad + \quad 5=26$

52.
$$\begin{array}{r} 4\frac{8}{9} = 4\frac{8}{9} \\ +5\frac{1}{3} = +5\frac{3}{9} \\ \hline 9\frac{11}{9}=10\frac{2}{9} \end{array}$$
Check: $4\frac{8}{9}+5\frac{1}{3}$
$\downarrow \quad \downarrow$
$5 \quad + \quad 5=10$

54.
$$\begin{array}{r} 10\frac{5}{6} = 10\frac{10}{12} \\ +\ 8\frac{1}{4} = +\ 8\frac{3}{12} \\ \hline 18\frac{13}{12} \text{ or } 19\frac{1}{12} \end{array}$$
Check: $10\frac{5}{6}+8\frac{1}{4}$
$\downarrow \quad \downarrow$
$11 \quad + \quad 8=19$

56.
$$\begin{array}{r} 8\frac{3}{10} = 8\frac{300}{1,000} \\ +2\frac{321}{1,000} = +2\frac{321}{1,000} \\ \hline 10\frac{621}{1,000} \end{array}$$

Check: $8\frac{3}{10} + 2\frac{321}{1,000}$

$\downarrow \quad \downarrow$

$8 + 2 = 10$

58.
$$\begin{array}{r} \frac{1}{3} = \frac{8}{24} \\ 25\frac{7}{24} = 25\frac{7}{24} \\ +100\frac{1}{2} = +100\frac{12}{24} \\ \hline 125\frac{27}{24} = 126\frac{3}{24} \text{ or } 126\frac{1}{8} \end{array}$$

Check: $\frac{1}{3} + 25\frac{7}{24} + 100\frac{1}{2}$

$\downarrow \quad \downarrow \quad \downarrow$

$0 + 25 + 101 = 126$

60.
$$\begin{array}{r} 4\frac{1}{8} = 4\frac{2}{16} \\ 4\frac{3}{16} = 4\frac{3}{16} \\ +\frac{5}{4} = +\frac{20}{16} \\ \hline 8\frac{25}{16} = 9\frac{9}{16} \end{array}$$

Check: $4\frac{1}{8} + 4\frac{3}{16} + \frac{5}{4}$

$\downarrow \quad \downarrow \quad \downarrow$

$4 + 4 + 1 = 9$

62.
$$\begin{array}{r} 1\frac{2}{3} = 1\frac{8}{12} \\ 5\frac{5}{6} = 5\frac{10}{12} \\ +3\frac{1}{4} = +3\frac{3}{12} \\ \hline 9\frac{21}{12} = 10\frac{9}{12} = 10\frac{3}{4} \end{array}$$

Check: $1\frac{2}{3} + 5\frac{5}{6} + 3\frac{1}{4}$

$\downarrow \quad \downarrow \quad \downarrow$

$2 + 6 + 3 = 11$

64.
$$\begin{array}{r} 4\frac{2}{3} = 4\frac{24}{36} \\ 2\frac{11}{36} = 2\frac{11}{36} \\ +1\frac{1}{2} = +1\frac{18}{36} \\ \hline 7\frac{53}{36} = 8\frac{17}{36} \end{array}$$

Check: $4\frac{2}{3} + 2\frac{11}{36} + 1\frac{1}{2}$

$\downarrow \quad \downarrow \quad \downarrow$

$5 + 2 + 2 = 9$

66. $\frac{7}{9} - \frac{5}{9} = \frac{2}{9}$

68. $\frac{11}{12} - \frac{5}{12} = \frac{6}{12} = \frac{1}{2}$

70. $\frac{3}{2} - \frac{1}{2} = \frac{2}{2} = 1$

72. $\frac{7}{9} - \frac{4}{9} = \frac{3}{9} = \frac{1}{3}$

74. $\frac{1}{8} - \frac{1}{8} = 0$

76.
$$\begin{array}{r} \frac{2}{5} = \frac{12}{30} \\ -\frac{1}{6} = -\frac{5}{30} \\ \hline \frac{7}{30} \end{array}$$

78.
$$\begin{array}{r} \frac{9}{10} = \frac{90}{100} \\ -\frac{3}{100} = -\frac{3}{100} \\ \hline \frac{87}{100} \end{array}$$

80.
$$\begin{array}{r} \frac{5}{6} = \frac{20}{24} \\ -\frac{1}{8} = -\frac{3}{24} \\ \hline \frac{17}{24} \end{array}$$

82.
$$\begin{array}{r} \frac{2}{5} = \frac{18}{45} \\ -\frac{2}{9} = -\frac{10}{45} \\ \hline \frac{8}{45} \end{array}$$

84.
$$\begin{array}{r} \frac{11}{12} = \frac{11}{12} \\ -\frac{1}{3} = -\frac{4}{12} \\ \hline \frac{7}{12} \end{array}$$

86.
$$\begin{array}{r} \frac{5}{6} = \frac{5}{6} \\ -\frac{2}{3} = -\frac{4}{6} \\ \hline \frac{1}{6} \end{array}$$

88.
$$\begin{array}{r} 6\frac{2}{3} \\ -1\frac{1}{3} \\ \hline 5\frac{1}{3} \end{array}$$

Check:
$$\begin{array}{r} 5\frac{1}{3} \\ +1\frac{1}{3} \\ \hline 6\frac{2}{3} \end{array}$$

90.
$$\begin{array}{r} 10\frac{5}{6} \\ -2\frac{5}{6} \\ \hline 8 \end{array}$$

Check:
$$\begin{array}{r} 8 \\ +2\frac{5}{6} \\ \hline 10\frac{5}{6} \end{array}$$

92. $7\frac{3}{4}$

$$\underline{-\frac{1}{4}}$$

$$7\frac{2}{4} = 7\frac{1}{2}$$

Check: $7\frac{1}{2} = 7\frac{2}{4}$

$$\underline{+\frac{1}{4}} = \underline{+\frac{1}{4}}$$

$$7\frac{3}{4}$$

94. $2\frac{1}{3}$

$$\underline{-2}$$

$$\frac{1}{3}$$

Check: $\frac{1}{3}$

$$\underline{+2}$$

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

96. $4 = 3\frac{5}{5}$

$$\underline{-1\frac{1}{5}} = \underline{-1\frac{1}{5}}$$

$$2\frac{4}{5}$$

Check: $2\frac{4}{5}$

$$\underline{+1\frac{1}{5}}$$

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

98. $2 = 1\frac{2}{2}$

$$\underline{-1\frac{1}{2}} = \underline{-1\frac{1}{2}}$$

$$\frac{1}{2}$$

Check: $\frac{1}{2}$

$$\underline{+1\frac{1}{2}}$$

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

100. $5 = 4\frac{10}{10}$

$$\underline{-4\frac{9}{10}} = \underline{-4\frac{9}{10}}$$

$$\frac{1}{10}$$

Check: $\frac{1}{10}$

$$\underline{+4\frac{9}{10}}$$

$$4\frac{10}{10} = 5$$

102. $9 = 8\frac{4}{4}$

$$\underline{-\frac{3}{4}} = \underline{-\frac{3}{4}}$$

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

Check: $8\frac{1}{4}$

$$\underline{+\frac{3}{4}}$$

$$8\frac{4}{4} = 9$$

104. $5\frac{1}{10} = 4\frac{11}{10}$

$$\underline{-2\frac{3}{10}} = \underline{-2\frac{3}{10}}$$

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

Check: $2\frac{4}{5} = 2\frac{8}{10}$

$$\underline{+2\frac{3}{10}} = \underline{+2\frac{3}{10}}$$

$$4\frac{11}{10} = 5\frac{1}{10}$$

106. $3\frac{1}{5} = 2\frac{6}{5}$

$$\underline{-1\frac{4}{5}} = \underline{-1\frac{4}{5}}$$

$$1\frac{2}{5}$$

Check: $1\frac{2}{5}$

$$\underline{+1\frac{4}{5}}$$

$$2\frac{6}{5} = 3\frac{1}{5}$$

108. $3\frac{7}{10} = 2\frac{17}{10}$

$$\underline{-\frac{9}{10}} = \underline{-\frac{9}{10}}$$

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

Check: $2\frac{4}{5} = 2\frac{8}{10}$

$$\underline{+\frac{9}{10}} = \underline{+\frac{9}{10}}$$

$$2\frac{17}{10} = 3\frac{7}{10}$$

110. $2\frac{1}{5} = 1\frac{6}{5}$

$$\underline{-\frac{4}{5}} = \underline{-\frac{4}{5}}$$

$$1\frac{2}{5}$$

Check: $1\frac{2}{5}$

$$\underline{+\frac{4}{5}}$$

$$1\frac{6}{5} = 2\frac{1}{5}$$

112. $7\frac{1}{10} = 7\frac{7}{70} = 6\frac{77}{70}$

$$\underline{-2\frac{1}{7}} = \underline{-2\frac{10}{70}} = \underline{-2\frac{10}{70}}$$

$$4\frac{67}{70}$$

Check:

$$7\frac{1}{10} - 2\frac{1}{7}$$

$$\downarrow \quad \downarrow$$

$$7 - 2 = 5$$

114. $2\frac{1}{10} = 2\frac{10}{100} = 1\frac{110}{100}$

$$\underline{-1\frac{27}{100}} = \underline{-1\frac{27}{100}} = \underline{-1\frac{27}{100}}$$

$$\frac{83}{100}$$

Check:

$$2\frac{1}{10} - 1\frac{27}{1000}$$

$$\downarrow \quad \downarrow$$

$$2 - 1 = 1$$

116. $9\frac{13}{100} = 9\frac{13}{100} = 8\frac{113}{100}$

$\underline{-6\frac{7}{10}} = \underline{-6\frac{70}{100}} = \underline{-6\frac{70}{100}}$

$2\frac{43}{100}$

Check:

$9\frac{13}{100} - 6\frac{7}{10}$

$\downarrow \quad \downarrow$

$9 \quad - \quad 7 = 2$

118. $1\frac{2}{8} = 1\frac{3}{12} = \frac{15}{12}$

$\underline{-\frac{2}{6}} = \underline{-\frac{4}{12}} = \underline{-\frac{4}{12}}$

$\frac{11}{12}$

Check: $\frac{11}{12} = \frac{11}{12}$

$\underline{+\frac{2}{6}} = \underline{+\frac{4}{12}}$

$\frac{15}{12} = 1\frac{3}{12} = 1\frac{1}{4} = 1\frac{2}{8}$

120. $2\frac{1}{2} = 2\frac{2}{4} = 1\frac{6}{4}$

$\underline{-1\frac{3}{4}} = \underline{-1\frac{3}{4}} = \underline{-1\frac{3}{4}}$

$\frac{3}{4}$

Check: $\frac{3}{4}$

$\underline{+1\frac{3}{4}}$

$1\frac{6}{4} = 2\frac{2}{4} = 2\frac{1}{2}$

122. $7\frac{1}{4} = 7\frac{4}{16} = 6\frac{20}{16}$

$\underline{-1\frac{5}{16}} = \underline{-1\frac{5}{16}} = \underline{-1\frac{5}{16}}$

$5\frac{15}{16}$

Check: $5\frac{15}{16}$

$\underline{+1\frac{5}{16}}$

$6\frac{20}{16} = 7\frac{4}{16} = 7\frac{1}{4}$

124. $9\frac{1}{10} = 9\frac{1}{10} = 8\frac{11}{10}$

$\underline{-3\frac{1}{2}} = \underline{-3\frac{5}{10}} = \underline{-3\frac{5}{10}}$

$5\frac{6}{10} = 5\frac{3}{5}$

Check: $5\frac{3}{5} = 5\frac{6}{10}$

$\underline{+3\frac{1}{2}} = \underline{+3\frac{5}{10}}$

$8\frac{11}{10} = 9\frac{1}{10}$

126. $3\frac{1}{4} = 3\frac{4}{16} = 2\frac{20}{16}$

$\underline{-2\frac{5}{16}} = \underline{-2\frac{5}{16}} = \underline{-2\frac{5}{16}}$

$\frac{15}{16}$

Check: $\frac{15}{16}$

$\underline{+2\frac{5}{16}}$

$2\frac{20}{16} = 3\frac{4}{16} = 3\frac{1}{4}$

128. $\frac{2}{3} - \frac{1}{5} + \frac{1}{2} = \frac{20}{30} - \frac{6}{30} + \frac{15}{30} = \frac{29}{30}$

130. $7\frac{1}{3} = 7\frac{5}{15} = 6\frac{20}{15}$ $\quad 4\frac{8}{15} = 4\frac{8}{15}$

$\underline{-2\frac{4}{5}} = \underline{-2\frac{12}{15}} = \underline{-2\frac{12}{15}}$ $\quad \underline{-1\frac{1}{3}} = \underline{-1\frac{5}{15}}$

$4\frac{8}{15}$ $\quad 3\frac{3}{15} = 3\frac{1}{5}$

132. $4\frac{1}{10} \quad 7 = 6\frac{4}{4}$

$\underline{+2\frac{9}{10}} \quad \underline{-3\frac{3}{4}} = \underline{-3\frac{3}{4}}$

$6\frac{10}{10} = 7 \quad 3\frac{1}{4}$

134. $8\frac{9}{10} = 8\frac{9}{10}$

$\underline{-\frac{1}{5}} = \underline{-\frac{2}{10}}$

$8\frac{7}{10}$

$19\frac{1}{6} = 19\frac{5}{30} = 18\frac{35}{30}$

$\underline{-8\frac{7}{10}} = \underline{-8\frac{21}{30}} = \underline{-8\frac{21}{30}}$

$10\frac{14}{30} = 10\frac{7}{15}$

136.
$$\begin{array}{r} 6\frac{1}{10} = 6\frac{3}{30} \\ +\,3\frac{7}{15} = +\,3\frac{14}{30} \\ \hline 9\frac{17}{30} \end{array}$$

138.
$$\begin{array}{r} \frac{3}{8} = \frac{9}{24} \\ \frac{1}{2} = \frac{12}{24} \\ +\,\frac{1}{3} = +\,\frac{8}{24} \\ \hline \frac{29}{24} = 1\frac{5}{24} \end{array}$$

140.
$$\begin{array}{r} \frac{9}{10} = \frac{18}{20} \\ -\,\frac{1}{4} = -\,\frac{5}{20} \\ \hline \frac{13}{20} \end{array}$$

142.
$$\begin{array}{r} \frac{7}{8}\text{ acre} = \frac{7}{8}\text{ acre} \\ -\,\frac{1}{4}\text{ acre} = -\,\frac{2}{8}\text{ acre} \\ \hline \frac{5}{8}\text{ acre} \end{array}$$

The area of the land not occupied by the building is $\frac{5}{8}$ acre.

144. a.
$$\begin{array}{r} \frac{1}{32} = \frac{1}{32} \\ +\,\frac{1}{8} = +\,\frac{4}{32} \\ \hline \frac{5}{32} \end{array}$$

The combined amount of electricity generated by liquid fuels and nuclear power is $\frac{5}{32}$ of the total world electricity.

b.
$$\begin{array}{r} \frac{7}{16} = \frac{14}{32} \\ -\,\frac{5}{32} = -\,\frac{5}{32} \\ \hline \frac{9}{32} \end{array}$$

The amount of electricity generated by coal is $\frac{9}{32}$ greater than the combined amount generated by liquid fuel and nuclear power.

146. The sum of the fractions of the votes would equal 1 whole, or $\frac{8}{8}$.

$$\frac{5}{8}+\frac{1}{4}=\frac{5}{8}+\frac{2}{8}=\frac{7}{8}$$
$$\frac{8}{8}-\frac{7}{8}=\frac{1}{8}$$

The third candidate got $\frac{1}{8}$ of the votes.

148.
$$\begin{array}{r} 20\frac{5}{8} = 20\frac{5}{8} \\ +10\frac{1}{2} = +10\frac{4}{8} \\ \hline 30\frac{9}{8} = 31\frac{1}{8} \end{array}$$

The total weight of the boxes is $31\frac{1}{8}$ oz.

150. The difference in foot length when comparing sizes 4 and 7 is

$$6\frac{1}{2}-5\frac{3}{4}=6\frac{2}{4}-5\frac{3}{4}=5\frac{6}{4}-5\frac{3}{4}=\frac{3}{4}\text{ in.}$$

The difference in foot length when comparing sizes 7 and 10 is

$$7\frac{1}{4}-6\frac{1}{2}=7\frac{1}{4}-6\frac{2}{4}=6\frac{5}{4}-6\frac{2}{4}=\frac{3}{4}\text{ in.}$$

Both differences are the same.

152. The total weight of the packages on the right side of the scale is:

$$\begin{array}{r} 1\frac{1}{2}\text{ lb} = 1\frac{2}{4}\text{ lb} \\ +3\frac{1}{4}\text{ lb} = +3\frac{1}{4}\text{ lb} \\ \hline 4\frac{3}{4}\text{ lb} \end{array}$$

The total weight of the packages on the left side of the scale must also equal $4\frac{3}{4}$ lb.

$$\begin{array}{r} 4\frac{3}{4}\text{ lb} \\ -2\frac{3}{4}\text{ lb} \\ \hline 2\text{ lb} \end{array}$$

The small package on the left weighs 2 lb.

Mindstretchers

1.

$1\frac{1}{4}$	$\frac{2}{3}$	$1\frac{1}{12}$
$\frac{5}{6}$	1	$1\frac{1}{6}$
$\frac{11}{12}$	$1\frac{1}{3}$	$\frac{3}{4}$

2. $\frac{3}{7}=\frac{1}{28}+\frac{1}{7}+\frac{1}{4}$

3. a. In Method 1 we "borrow" from the whole number in the minuend so that the fraction in the minuend is big enough to subtract the fraction in the subtrahend. In Method 2 we add a fraction to the subtrahend, making it a whole number. We add the same fraction to the minuend and then subtract.

b. Answers may vary.

c. Answers may vary.

2.4 Multiplying and Dividing Fractions

Exercises

2. To multiply mixed numbers, change each mixed number to its equivalent improper fraction.

4. To divide fractions, change the divisor to its reciprocal, and multiply the resulting fractions.

6. When multiplying fractions, we can divide any numerator and any denominator by a common factor.

8. $\frac{7}{8}\times\frac{1}{2}=\frac{7}{16}$

10. $\left(\frac{3}{10}\right)\left(\frac{1}{4}\right)=\frac{3}{40}$

12. $\left(\frac{1}{8}\right)^2=\left(\frac{1}{8}\right)\left(\frac{1}{8}\right)=\frac{1}{64}$

14. $\frac{1}{2}\times\frac{3}{2}=\frac{3}{4}$

16. $\frac{20}{3}\times\frac{2}{7}=\frac{40}{21}=1\frac{19}{21}$

18. $\frac{11}{10}\cdot\frac{9}{5}=\frac{99}{50}=1\frac{49}{50}$

20. $\left(\frac{4}{5}\right)\left(\frac{1}{4}\right)=\left(\frac{\overset{1}{\cancel{4}}}{5}\right)\left(\frac{1}{\underset{1}{\cancel{4}}}\right)=\frac{1}{5}$

22. $\frac{4}{5}\times\frac{1}{2}=\frac{\overset{2}{\cancel{4}}}{5}\times\frac{1}{\underset{1}{\cancel{2}}}=\frac{2}{5}$

24. $\left(\frac{4}{6}\right)\left(\frac{3}{8}\right)=\left(\frac{\overset{1}{\cancel{4}}}{\underset{2}{6}}\right)\left(\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{8}}}\right)=\frac{1}{4}$

26. $\frac{12}{5}\times\frac{15}{4}=\frac{\overset{3}{\cancel{12}}}{\underset{1}{\cancel{5}}}\times\frac{\overset{3}{\cancel{15}}}{\underset{1}{\cancel{4}}}=9$

28. $\frac{5}{6}\times 5=\frac{5}{6}\times\frac{5}{1}=\frac{25}{6}=4\frac{1}{6}$

30. $\frac{5}{3}\times 7=\frac{5}{3}\times\frac{7}{1}=\frac{35}{3}=11\frac{2}{3}$

32. $\frac{3}{4}\times 12=\frac{3}{\underset{1}{\cancel{4}}}\times\frac{\overset{3}{\cancel{12}}}{1}=9$

34. $100\cdot\frac{2}{5}=\frac{\overset{20}{\cancel{100}}}{1}\cdot\frac{2}{\underset{1}{\cancel{5}}}=40$

36. $20\cdot\frac{4}{5}=\frac{\overset{4}{\cancel{20}}}{1}\cdot\frac{4}{\underset{1}{\cancel{5}}}=16$

38. $\frac{5}{8}\times 12=\frac{5}{\underset{2}{\cancel{8}}}\times\frac{\overset{3}{\cancel{12}}}{1}=\frac{15}{2}=7\frac{1}{2}$

40. $\left(4\frac{1}{3}\right)\left(\frac{1}{5}\right)=\left(\frac{13}{3}\right)\left(\frac{1}{5}\right)=\frac{13}{15}$

42. $\frac{1}{3}\times 2\frac{1}{5}=\frac{1}{3}\times\frac{11}{5}=\frac{11}{15}$

44. $\left(\frac{9}{10}\right)\left(2\frac{1}{7}\right)=\left(\frac{9}{\underset{2}{\cancel{10}}}\right)\left(\frac{\overset{3}{\cancel{15}}}{7}\right)=\frac{27}{14}=1\frac{13}{14}$

46. $4\frac{1}{2}\times\frac{2}{3}=\frac{\overset{3}{\cancel{9}}}{\underset{1}{\cancel{2}}}\times\frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}}}=3$

48. $\frac{3}{8}\cdot 5\frac{1}{3}=\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{8}}}\cdot\frac{\overset{2}{\cancel{16}}}{\underset{1}{\cancel{3}}}=2$

50. $\left(\frac{7}{9}\right)\left(2\frac{1}{4}\right)=\left(\frac{7}{\underset{1}{\cancel{9}}}\right)\left(\frac{\overset{1}{\cancel{9}}}{4}\right)=\frac{7}{4}=1\frac{3}{4}$

52. $2\frac{1}{3}\times 1\frac{1}{2}=\frac{7}{\underset{1}{\cancel{3}}}\times\frac{\overset{1}{\cancel{3}}}{2}=\frac{7}{2}=3\frac{1}{2}$

54. $\left(1\frac{1}{2}\right)^2=\left(\frac{3}{2}\right)\left(\frac{3}{2}\right)=\frac{9}{4}=2\frac{1}{4}$

56. $5\cdot 1\frac{1}{2}=\frac{5}{1}\times\frac{3}{2}=\frac{15}{2}=7\frac{1}{2}$

58. $1\frac{5}{6}\times 20=\frac{11}{\underset{3}{\cancel{6}}}\times\frac{\overset{10}{\cancel{20}}}{1}=\frac{110}{3}=36\frac{2}{3}$

60. $5\frac{1}{4}\times 1\frac{1}{9}=\frac{\overset{7}{\cancel{21}}}{\underset{2}{\cancel{4}}}\times\frac{\overset{5}{\cancel{10}}}{\underset{3}{\cancel{9}}}=\frac{35}{6}=5\frac{5}{6}$

62. $\left(1\frac{3}{10}\right)\left(2\frac{4}{9}\right)=\left(\frac{13}{\underset{5}{\cancel{10}}}\right)\left(\frac{\overset{11}{\cancel{22}}}{9}\right)=\frac{143}{45}=3\frac{8}{45}$

64. $5\frac{1}{10}\cdot 1\frac{2}{3}=\frac{\overset{17}{\cancel{51}}}{\underset{2}{\cancel{10}}}\cdot\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{3}}}=\frac{17}{2}=8\frac{1}{2}$

66. $37\frac{1}{2}\cdot 1\frac{3}{5}=\frac{\overset{15}{\cancel{75}}}{\underset{1}{\cancel{2}}}\cdot\frac{\overset{4}{\cancel{8}}}{\underset{1}{\cancel{5}}}=60$

68. $\frac{1}{8}\times 2\frac{1}{4}\times 6=\frac{1}{8}\times\frac{9}{\underset{2}{\cancel{4}}}\times\frac{\overset{3}{\cancel{6}}}{1}=\frac{27}{16}=1\frac{11}{16}$

70. $\left(1\frac{1}{4}\right)^2\left(\frac{1}{5}\right)=\left(\frac{5}{4}\right)\left(\frac{\overset{1}{\cancel{5}}}{4}\right)\left(\frac{1}{\underset{1}{\cancel{5}}}\right)=\frac{5}{16}$

72. $8\frac{1}{3}\times\frac{3}{10}\times\frac{5}{6}=\frac{\overset{5}{\cancel{25}}}{3}\times\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{10}}}\times\frac{5}{\underset{2}{\cancel{6}}}=\frac{25}{12}=2\frac{1}{12}$

74. $\left(2\frac{1}{2}\right)^3=\left(\frac{5}{2}\right)\left(\frac{5}{2}\right)\left(\frac{5}{2}\right)=\frac{125}{8}=15\frac{5}{8}$

76. $\frac{2}{3}\div\frac{3}{5}=\frac{2}{3}\times\frac{5}{3}=\frac{10}{9}=1\frac{1}{9}$

78. $\frac{7}{8}\div\frac{4}{5}=\frac{7}{8}\times\frac{5}{4}=\frac{35}{32}=1\frac{3}{32}$

80. $\frac{1}{7}\div\frac{1}{2}=\frac{1}{7}\times\frac{2}{1}=\frac{2}{7}$

82. $\frac{1}{8}\div\frac{5}{9}=\frac{1}{8}\times\frac{9}{5}=\frac{9}{40}$

84. $\frac{3}{10}\div\frac{6}{5}=\frac{\overset{1}{\cancel{3}}}{\underset{2}{\cancel{10}}}\times\frac{\overset{1}{\cancel{5}}}{\underset{2}{\cancel{6}}}=\frac{1}{4}$

86. $\frac{10}{3}\div\frac{5}{6}=\frac{\overset{2}{\cancel{10}}}{\underset{1}{\cancel{3}}}\times\frac{\overset{2}{\cancel{6}}}{\underset{1}{\cancel{5}}}=4$

88. $\frac{5}{6}\div\frac{1}{3}=\frac{5}{\underset{2}{\cancel{6}}}\times\frac{\overset{1}{\cancel{3}}}{1}=\frac{5}{2}=2\frac{1}{2}$

90. $\frac{3}{4}\div\frac{6}{5}=\frac{\overset{1}{\cancel{3}}}{4}\times\frac{5}{\underset{2}{\cancel{6}}}=\frac{5}{8}$

92. $\frac{7}{10}\div 10=\frac{7}{10}\div\frac{10}{1}=\frac{7}{10}\times\frac{1}{10}=\frac{7}{100}$

94. $\frac{1}{20}\div 2=\frac{1}{20}\div\frac{2}{1}=\frac{1}{20}\times\frac{1}{2}=\frac{1}{40}$

96. $8\div\frac{2}{9}=\frac{8}{1}\div\frac{2}{9}=\frac{\overset{4}{\cancel{8}}}{1}\times\frac{9}{\underset{1}{\cancel{2}}}=36$

98. $10\div\frac{2}{5}=\frac{10}{1}\div\frac{2}{5}=\frac{\overset{5}{\cancel{10}}}{1}\times\frac{5}{\underset{1}{\cancel{2}}}=25$

100. $10\div\frac{2}{3}=\frac{10}{1}\div\frac{2}{3}=\frac{\overset{5}{\cancel{10}}}{1}\times\frac{3}{\underset{1}{\cancel{2}}}=15$

102. $3\div\frac{1}{8}=\frac{3}{1}\div\frac{1}{8}=\frac{3}{1}\times\frac{8}{1}=24$

104. $5\frac{1}{9}\div\frac{2}{3}=\frac{46}{9}\div\frac{2}{3}=\frac{\overset{23}{\cancel{46}}}{\underset{3}{\cancel{9}}}\times\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{2}}}=\frac{23}{3}=7\frac{2}{3}$

106. $7\frac{1}{10}\div\frac{1}{2}=\frac{71}{10}\div\frac{1}{2}=\frac{71}{\underset{5}{\cancel{10}}}\times\frac{\overset{1}{\cancel{2}}}{1}=\frac{71}{5}=14\frac{1}{5}$

108. $6\frac{1}{2}\div\frac{1}{2}=\frac{13}{2}\div\frac{1}{2}=\frac{13}{\underset{1}{\cancel{2}}}\times\frac{\overset{1}{\cancel{2}}}{1}=13$

110. $15\frac{2}{3}\div\frac{5}{6}=\frac{47}{3}\div\frac{5}{6}=\frac{47}{\underset{1}{\cancel{3}}}\times\frac{\overset{2}{\cancel{6}}}{5}=\frac{94}{5}=18\frac{4}{5}$

112. $\frac{2}{7}\div 1\frac{1}{3}=\frac{2}{7}\div\frac{4}{3}=\frac{\overset{1}{\cancel{2}}}{7}\times\frac{3}{\underset{2}{\cancel{4}}}=\frac{3}{14}$

114. $\frac{3}{4}\div 3\frac{1}{9}=\frac{3}{4}\div\frac{28}{9}=\frac{3}{4}\times\frac{9}{28}=\frac{27}{112}$

116. $7 \div 1\frac{9}{10} = \frac{7}{1} \div \frac{19}{10} = \frac{7}{1} \times \frac{10}{19} = \frac{70}{19} = 3\frac{13}{19}$

118. $5\frac{6}{7} \div 14 = \frac{41}{7} \div \frac{14}{1} = \frac{41}{7} \times \frac{1}{14} = \frac{41}{98}$

120. $3\frac{1}{7} \div 2\frac{1}{2} = \frac{22}{7} \div \frac{5}{2} = \frac{22}{7} \times \frac{2}{5} = \frac{44}{35} = 1\frac{9}{35}$

122. $1\frac{7}{10} \div 5\frac{1}{8} = \frac{17}{10} \div \frac{41}{8} = \frac{17}{\cancel{10}_{5}} \times \frac{\overset{4}{\cancel{8}}}{41} = \frac{68}{205}$

124. $8\frac{1}{6} \div 2\frac{1}{2} = \frac{49}{6} \div \frac{5}{2} = \frac{49}{\cancel{6}_{3}} \times \frac{\overset{1}{\cancel{2}}}{5} = \frac{49}{15} = 3\frac{4}{15}$

126. $1\frac{2}{3} \div 1\frac{2}{5} = \frac{5}{3} \div \frac{7}{5} = \frac{5}{3} \times \frac{5}{7} = \frac{25}{21} = 1\frac{4}{21}$

128.
$$\frac{9}{10} + \frac{4}{5} \cdot 8 = \frac{9}{10} + \left(\frac{4}{5} \cdot \frac{8}{1}\right)$$
$$= \frac{9}{10} + \frac{32}{5}$$
$$= \frac{9}{10} + \frac{64}{10}$$
$$= \frac{73}{10} = 7\frac{3}{10}$$

130.
$$3 \div \frac{2}{5} - 2\frac{1}{3} = \left(\frac{3}{1} \div \frac{2}{5}\right) - 2\frac{1}{3}$$
$$= \left(\frac{3}{1} \times \frac{5}{2}\right) - 2\frac{1}{3}$$
$$= \frac{15}{2} - 2\frac{1}{3} = 7\frac{1}{2} - 2\frac{1}{3}$$
$$= 7\frac{3}{6} - 2\frac{2}{6} = 5\frac{1}{6}$$

132.
$$\frac{3}{8} \cdot \frac{1}{2} - \frac{1}{10} = \left(\frac{3}{8} \cdot \frac{1}{2}\right) - \frac{1}{10}$$
$$= \frac{3}{16} - \frac{1}{10} = \frac{15}{80} - \frac{8}{80} = \frac{7}{80}$$

134. $6 \div 5 \times \frac{1}{4} = \frac{\overset{3}{\cancel{6}}}{5} \times \frac{1}{\cancel{4}_{2}} = \frac{3}{5} \times \frac{1}{2} = \frac{3}{10}$

136.
$$4 \cdot \frac{2}{3} - 1\frac{1}{8} = \left(\frac{4}{1} \cdot \frac{2}{3}\right) - 1\frac{1}{8}$$
$$= \frac{8}{3} - 1\frac{1}{8} = 2\frac{2}{3} - 1\frac{1}{8}$$
$$= 2\frac{16}{24} - 1\frac{3}{24} = 1\frac{13}{24}$$

138.
$$\frac{1}{3} \div \frac{1}{6} \times \frac{2}{3} = \left(\frac{1}{3} \div \frac{1}{6}\right) \times \frac{2}{3}$$
$$= \left(\frac{1}{\cancel{3}_{1}} \times \frac{\overset{2}{\cancel{6}}}{1}\right) \times \frac{2}{3}$$
$$= \frac{2}{1} \times \frac{2}{3}$$
$$= \frac{4}{3} = 1\frac{1}{3}$$

140.
$$3\frac{1}{8} \div 5 + 4 \div 2\frac{1}{2} = \left(\frac{25}{8} \div \frac{5}{1}\right) + \left(\frac{4}{1} \div \frac{5}{2}\right)$$
$$= \left(\frac{\overset{5}{\cancel{25}}}{8} \cdot \frac{1}{\cancel{5}_{1}}\right) + \left(\frac{4}{1} \cdot \frac{2}{5}\right)$$
$$= \frac{5}{8} + \frac{8}{5} = \frac{25}{40} + \frac{64}{40}$$
$$= \frac{89}{40} = 2\frac{9}{40}$$

142.
$$\frac{6}{11} \div \frac{18}{55} - \frac{7}{26} \cdot \frac{13}{14} = \left(\frac{6}{11} \div \frac{18}{55}\right) - \left(\frac{7}{26} \cdot \frac{13}{14}\right)$$
$$= \left(\frac{\overset{1}{\cancel{6}}}{\underset{1}{\cancel{11}}} \cdot \frac{\overset{5}{\cancel{55}}}{\underset{3}{\cancel{18}}}\right) - \left(\frac{\overset{1}{\cancel{7}}}{\underset{2}{\cancel{26}}} \cdot \frac{\overset{1}{\cancel{13}}}{\underset{2}{\cancel{14}}}\right)$$
$$= \frac{5}{3} - \frac{1}{4} = \frac{20}{12} - \frac{3}{12}$$
$$= \frac{17}{12} = 1\frac{5}{12}$$

144.
$$\left(1 - \frac{2}{5}\right)^2 \div \left(1\frac{1}{2}\right)^2 = \left(\frac{5}{5} - \frac{2}{5}\right)^2 \div \left(\frac{3}{2}\right)^2$$
$$= \left(\frac{3}{5}\right)^2 \div \left(\frac{3}{2}\right)^2 = \frac{9}{25} \div \frac{9}{4}$$
$$= \frac{9}{25} \cdot \frac{4}{9} = \frac{4}{25}$$

146.
$$\left(3\frac{1}{2}\right)^2 + 2\left(1\frac{1}{2} - 1\frac{1}{3}\right) = \left(\frac{7}{2}\right)^2 + 2\left(1\frac{3}{6} - 1\frac{2}{6}\right)$$
$$= \frac{49}{4} + 2\left(\frac{1}{6}\right)$$
$$= \frac{49}{4} + \left(\frac{\overset{1}{\cancel{2}}}{1} \cdot \frac{1}{\cancel{6}_{3}}\right) = \frac{49}{4} + \frac{1}{3}$$
$$= \frac{147}{12} + \frac{4}{12} = \frac{151}{12} = 12\frac{7}{12}$$

148. $14-3\div\left(\frac{4}{5}\right)^2=14-\left(3\div\frac{16}{25}\right)$

$=14-\left(\frac{3}{1}\cdot\frac{25}{16}\right)=14-\frac{75}{16}$

$=14-4\frac{11}{16}=13\frac{16}{16}-4\frac{11}{16}=9\frac{5}{16}$

150. $\frac{9}{10}\div\frac{2}{5}=\frac{9}{\cancel{10}_{2}}\cdot\frac{\overset{1}{\cancel{5}}}{2}=\frac{9}{4}=2\frac{1}{4}$

152. $\left(4\frac{1}{2}\right)\left(6\frac{2}{3}\right)=\frac{\overset{3}{\cancel{9}}}{\cancel{2}_{1}}\cdot\frac{\overset{10}{\cancel{20}}}{\cancel{3}_{1}}=30$

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

$\frac{1}{20}$ of the emergency room visits were due to motor vehicle accidents.

156. $\$24,000\div 12=\$2,000$

Their monthly income is \$2,000.

$\frac{1}{4}\times 2,000=\frac{1}{\cancel{4}_{1}}\times\frac{\overset{500}{\cancel{2,000}}}{1}=500$

They should spend no more than \$500 per month on rent.

158. $16\times 11\frac{1}{2}=\frac{16}{1}\times\frac{23}{2}=\frac{368}{2}=184$

$15\frac{1}{2}\times 12=\frac{31}{2}\times\frac{12}{1}=\frac{372}{2}=186$

The area of the $15\frac{1}{2}$ ft $\times 12$ ft room is larger since its area is 186 sq ft and the area of the 16 ft $\times 11\frac{1}{2}$ ft room is 184 sq ft.

160. $\frac{9}{10}\times 10\frac{1}{2}=\frac{9}{10}\times\frac{21}{2}=\frac{189}{20}=9\frac{9}{20}$

There are $9\frac{9}{20}$ gallons of gasoline in $10\frac{1}{2}$ gallons of gasohol. So there are $10\frac{1}{2}-9\frac{9}{20}=10\frac{10}{20}-9\frac{9}{20}=1\frac{1}{20}$ gallons of ethyl alcohol in gasohol. There are $9\frac{9}{20}-1\frac{1}{20}=8\frac{8}{20}=8\frac{2}{5}$ more gallons of gasoline than ethyl alcohol in gasohol.

162. $6\text{ min}\div 2\text{ min}=3$

The temperature drops by $\frac{1}{10}°$ F three times.

$70-\left(3\times\frac{1}{10}\right)=70-\frac{3}{10}=69\frac{10}{10}-\frac{3}{10}=69\frac{7}{10}$

The temperature after 6 min is $69\frac{7}{10}°$F.

164. $9\div\frac{3}{4}=\frac{\overset{3}{\cancel{9}}}{1}\times\frac{4}{\cancel{3}_{1}}=12$

He can administer 12 doses.

166. a. $3\div 1\frac{1}{2}=\frac{3}{1}\div\frac{3}{2}=\frac{\overset{1}{\cancel{3}}}{1}\times\frac{2}{\cancel{3}_{1}}=2$

The average amount collected per year is \$2 million.

b. If an additional \$1 million were collected, then the total collected is \$4 million.

$4\div 1\frac{1}{2}=\frac{4}{1}\div\frac{3}{2}=\frac{4}{1}\times\frac{2}{3}=\frac{8}{3}=2\frac{2}{3}$

$2\frac{2}{3}-2=\frac{2}{3}$

The average would increase by $\$\frac{2}{3}$ million.

Mindstretchers

1. The reciprocal of 0 would have to be $\frac{1}{0}$, which is impossible because the product of any number and its reciprocal is 1, but 0 times any number is 0.

2.

3	$\frac{1}{6}$	2
$\frac{2}{3}$	1	$1\frac{1}{2}$
$\frac{1}{2}$	6	$\frac{1}{3}$

3. $1\frac{1}{2}\cdot 1\frac{1}{3}\cdot 1\frac{1}{4}\cdot\cdots\cdot 1\frac{1}{99}\cdot 1\frac{1}{100}$

$=\frac{\overset{1}{\cancel{3}}}{2}\cdot\frac{\overset{1}{\cancel{4}}}{\cancel{3}_{1}}\cdot\frac{\overset{1}{\cancel{5}}}{\cancel{4}_{1}}\cdot\cdots\cdot\frac{\overset{1}{\cancel{100}}}{\cancel{99}_{1}}\cdot\frac{101}{\cancel{100}_{1}}$

$=\frac{101}{2}=50\frac{1}{2}$