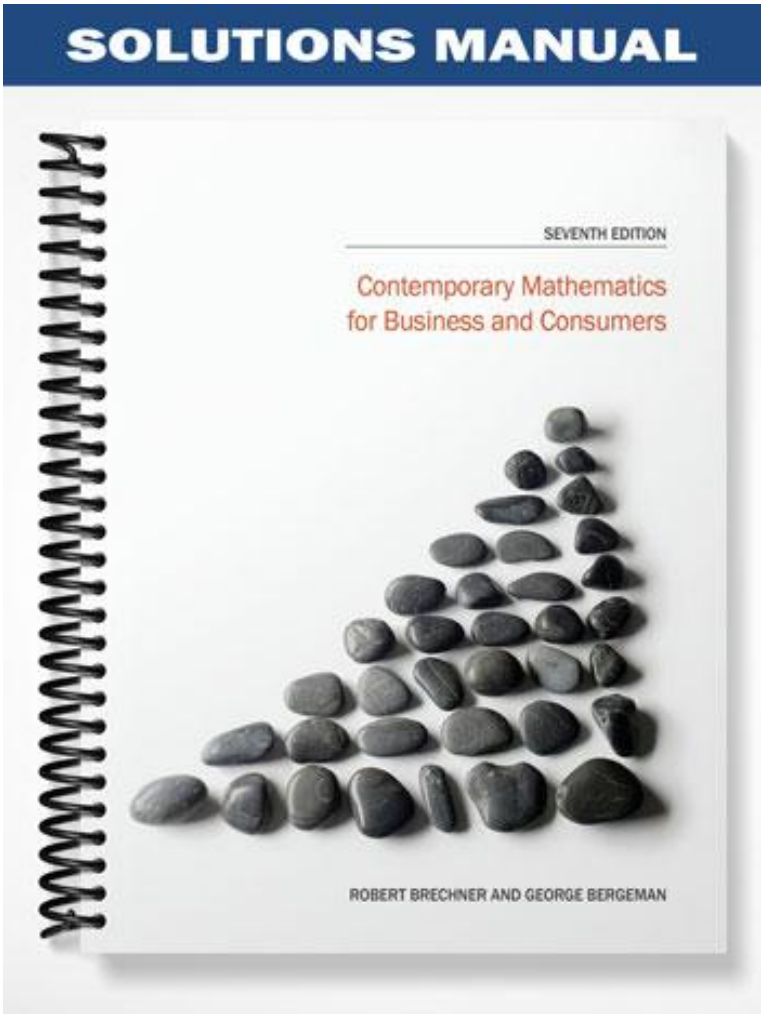
SOLUTIONS MANUAL



SECTION I 2 REVIEW EXERCISES

For each of the following, identify the type of fraction and write it in word form.

1. $23\frac{4}{5}$ — Mixed; Twenty-three and four-fifths
2. $\frac{12}{12}$ — Improper; Twelve-twelfths
3. $\frac{15}{9}$ — Improper; Fifteen-ninths
4. $\frac{7}{16}$ — Proper; Seven-sixteenths
5. $2\frac{1}{8}$ — Mixed; Two and one-eighth

Convert the following improper fractions to whole or mixed numbers.

6. $\frac{26}{8} = 3\frac{2}{8} = 3\frac{1}{4}$
7. $\frac{20}{6} = 3\frac{2}{6} = 3\frac{1}{3}$
8. $\frac{92}{16} = 5\frac{12}{16} = 5\frac{3}{4}$
9. $\frac{64}{15} = 4\frac{4}{15}$
10. $\frac{88}{11} = 8$
11. $\frac{33}{31} = 1\frac{2}{31}$

Convert the following mixed numbers to improper fractions.

12. $6\frac{1}{2} = \frac{13}{2}$ $(6 \times 2 + 1 = 13)$
13. $11\frac{4}{5} = \frac{59}{5}$ $(11 \times 5 + 4 = 59)$
14. $25\frac{2}{3} = \frac{77}{3}$ $(25 \times 3 + 2 = 77)$
15. $18\frac{5}{8} = \frac{149}{8}$ $(18 \times 8 + 5 = 149)$
16. $1\frac{5}{9} = \frac{14}{9}$ $(1 \times 9 + 5 = 14)$
17. $250\frac{1}{4} = \frac{1{,}001}{4}$ $(250 \times 4 + 1 = 1{,}001)$

use inspection or the greatest common divisor to reduce the following fractions to lowest terms.

18. $\frac{21}{35}$ $\quad \frac{21 \div 7}{35 \div 7} = \frac{3}{5}$
19. $\frac{9}{12}$ $\quad \frac{9 \div 3}{12 \div 3} = \frac{3}{4}$
20. $\frac{18}{48}$ $\quad \frac{18 \div 6}{48 \div 6} = \frac{3}{8}$
21. $\frac{216}{920}$ $\quad \frac{216 \div 8}{920 \div 8} = \frac{27}{115}$
22. $\frac{27}{36}$ $\quad \frac{27 \div 9}{36 \div 9} = \frac{3}{4}$
23. $\frac{14}{112}$ $\quad \frac{14 \div 14}{112 \div 14} = \frac{1}{8}$
24. $\frac{9}{42}$ $\quad \frac{9 \div 3}{42 \div 3} = \frac{3}{14}$
25. $\frac{95}{325}$ $\quad \frac{95 \div 5}{325 \div 5} = \frac{19}{65}$
26. $\frac{8}{23}$ $\quad \frac{8}{23}$ = Lowest terms
27. $\frac{78}{96}$ $\quad \frac{78 \div 6}{96 \div 6} = \frac{13}{16}$
28. $\frac{30}{150}$ $\quad \frac{30 \div 30}{150 \div 30} = \frac{1}{5}$
29. $\frac{85}{306}$ $\quad \frac{85 \div 17}{306 \div 17} = \frac{5}{18}$

Raise the following fractions to higher terms as indicated.

30. $\frac{2}{3}$ to twenty-sevenths $\quad \frac{2}{3} = \frac{18}{27}$ $\begin{pmatrix} 27 \div 3 = 9 \\ 9 \times 2 = 18 \end{pmatrix}$
31. $\frac{3}{4}$ to forty-eighths $\quad \frac{3}{4} = \frac{36}{48}$ $\begin{pmatrix} 48 \div 4 = 12 \\ 12 \times 3 = 36 \end{pmatrix}$
32. $\frac{7}{8}$ to eightieths $\quad \frac{7}{8} = \frac{70}{80}$ $\begin{pmatrix} 80 \div 8 = 10 \\ 10 \times 7 = 70 \end{pmatrix}$
33. $\frac{11}{16}$ to sixty-fourths $\quad \frac{11}{16} = \frac{44}{64}$ $\begin{pmatrix} 64 \div 16 = 4 \\ 4 \times 11 = 44 \end{pmatrix}$
34. $\frac{1}{5}$ to hundredths $\quad \frac{1}{5} = \frac{20}{100}$ $\begin{pmatrix} 100 \div 5 = 20 \\ 20 \times 1 = 20 \end{pmatrix}$
35. $\frac{3}{7}$ to ninety-eighths $\quad \frac{3}{7} = \frac{42}{98}$ $\begin{pmatrix} 98 \div 7 = 14 \\ 14 \times 3 = 42 \end{pmatrix}$
36. $\frac{3}{5} = \frac{\quad}{25}$ $\quad \frac{3}{5} = \frac{15}{25}$ $\begin{pmatrix} 25 \div 5 = 5 \\ 5 \times 3 = 15 \end{pmatrix}$
37. $\frac{5}{8} = \frac{\quad}{64}$ $\quad \frac{5}{8} = \frac{40}{64}$ $\begin{pmatrix} 64 \div 8 = 8 \\ 8 \times 5 = 40 \end{pmatrix}$
38. $\frac{5}{6} = \frac{\quad}{360}$ $\quad \frac{5}{6} = \frac{300}{360}$ $\begin{pmatrix} 360 \div 6 = 60 \\ 60 \times 5 = 300 \end{pmatrix}$
39. $\frac{9}{13} = \frac{\quad}{182}$ $\quad \frac{9}{13} = \frac{126}{182}$ $\begin{pmatrix} 182 \div 13 = 14 \\ 14 \times 9 = 126 \end{pmatrix}$

40. What fraction represents the laptops in this group of computers?

$\frac{3}{8}$

41. What fraction represents the screwdrivers in this group of tools?

$\frac{5}{11}$

42. A wedding cake was cut into 40 slices. If 24 of the slices were eaten, what fraction represents the eaten portion of the cake? Reduce your answer to lowest terms.

$\frac{24}{40} = \underline{\underline{\frac{3}{5}}}$ Was eaten

43. Jasmine Marley's swimming pool holds 16,000 gallons of water, and her spa holds 2,000 gallons of water. Of all the water in the pool and spa,

a. What fraction is the spa water?

$$\frac{2{,}000}{2{,}000 + 16{,}000} = \frac{2}{18} = \underline{\underline{\frac{1}{9}}}$$

b. What fraction is the pool water?

$$\frac{16{,}000}{2{,}000 + 16{,}000} = \frac{16}{18} = \underline{\underline{\frac{8}{9}}}$$

44. You work in the tool department at The Home Depot. Your manager asks you to set up a point-of-purchase display for a set of 10 wrenches that are on sale this week. He asks you to arrange them in order from smallest to largest on the display board. When you open the box, you find the following sizes in inches: $\frac{9}{32}, \frac{5}{8}, \frac{5}{16}, \frac{1}{2}, \frac{3}{16}, \frac{3}{4}, \frac{7}{8}, \frac{5}{32}, \frac{1}{4}, \frac{3}{8}$.

a. Rearrange the wrenches by size from smallest to largest.

To solve, raise all fractions to the LCD, 32; then arrange and reduce.

$$\frac{5}{32}, \frac{3}{16}, \frac{1}{4}, \frac{9}{32}, \frac{5}{16}, \frac{3}{8}, \frac{1}{2}, \frac{5}{8}, \frac{3}{4}, \frac{7}{8}$$

b. Next your manager tells you that the sale will be "1/3 off" the regular price of $57 and has asked you to calculate the sale price to be printed on the sign.

$\frac{2}{3} \times 57 = \underline{\underline{\$38}}$

c. After the sale is over, your manager asks you for the sales figures on the wrench promotion. If 150 sets were sold that week, what amount of revenue will you report?

$$\begin{array}{r} 150 \\ \times\ 38 \\ \hline \underline{\underline{\$5{,}700}} \end{array}$$

d. If $6,000 in sales was expected, what reduced fraction represents sales attained?

$\frac{5{,}700}{6{,}000} = \underline{\underline{\frac{19}{20}}}$

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The Home Depot is the largest home improvement chain in the world with approximately 2,250 stores in the United States, Puerto Rico, Canada, Mexico, and China.

Lowe's is number two with about 1,650 stores.

BUSINESS DECISION: EVALUATING THE QUESTION

45. You are on an academic committee tasked to evaluate state employment math test questions. The following question has come to the attention of the committee:

> "Each of the four digits 2, 4, 6, and 9 is placed in one of the boxes to form a fraction. The numerator and the denominator are two-digit whole numbers. What is the smallest value of all the common fractions that can be formed? Express your answer as a reduced fraction."

Adapted from the NCTM Calendar, November 2004.

Some committee members contend this is not a valid question. Solve the problem and explain the solution to prove (or disprove) the question's validity.

$\frac{1}{4}$ To make a fraction as small as possible, make the numerator as small as possible and the denominator as large as possible. With the given digits, 2, 4, 6, and 9, the smallest two-digit number that can be formed is 24 and the largest two-digit number that can be formed is 96. The fraction is $\frac{24}{96}$, which reduces to $\frac{1}{4}$. The test question is valid.

SECTION II 2 Addition and Subtraction of Fractions

Adding and subtracting fractions occurs frequently in business. Quite often we must combine or subtract quantities expressed as fractions. To add or subtract fractions, the denominators must be the same. If they are not, we must find a common multiple, or **common denominator**, of all the denominators in the problem. The most efficient common denominator to use is the least common denominator, or LCD. By using the LCD, you avoid raising fractions to terms higher than necessary.

common denominator A common multiple of all the denominators in an addition or subtraction of fractions problem. A common denominator of the fractions $\frac{1}{4}+\frac{3}{5}$ is 40.

2-6 Determining the Least Common Denominator (LCD) of Two or More Fractions

least common denominator (LCD) The smallest and, therefore, most efficient common denominator in addition or subtraction of fractions. The least common denominator of the fractions $\frac{1}{4}+\frac{3}{5}$ is 20.

The **least common denominator (LCD)** is the smallest number that is a multiple of each of the given denominators. We can often find the LCD by inspection (i.e., mentally) just by using the definition. For example, if we want to find the LCD of $\frac{1}{4}$ and $\frac{1}{6}$, we think (or write out, if we wish):

Multiples of 4 are 4, 8, 12, 16, 20, 24, etc.

Multiples of 6 are 6, 12, 18, 24, 30, etc.

By looking at these two lists, we see that 12 is the smallest multiple of both 4 and 6. Thus, 12 is the LCD.

Sometimes, especially when we have several denominators or the denominators are relatively large numbers, it is easier to use prime numbers to find the LCD. A **prime number** is a whole number greater than 1 that is evenly divisible only by itself and 1. Following are prime numbers:

prime number A whole number greater than 1 that is divisible only by itself and 1. For example, 2, 3, 5, 7, and 11 are prime numbers.

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, and so on

STEPS For Determining the Least Common Denominator of Two or More Fractions Using Prime Numbers

STEP 1. Write all the denominators in a row.

STEP 2. Find a prime number that divides evenly into any of the denominators. Write that prime number to the left of the row and divide. Place all quotients and undivided numbers in the next row down.

STEP 3. Repeat this process until the new row contains all ones.

STEP 4. Multiply all the prime numbers on the left to get the LCD of the fractions.

SECTION II 2 REVIEW EXERCISES

Find the least common denominator for the following groups of fractions. For problems 1–3, try finding the LCD by inspection (i.e., mentally) first, then use the prime-number method.

1. $\frac{4}{5}, \frac{2}{3}, \frac{8}{15}$

3	5	3	15
5	5	1	5
	1	1	1

$3 \times 5 = \underline{\underline{15}}$ LCD

2. $\frac{1}{3}, \frac{4}{9}, \frac{3}{4}$

2	3	9	4
2	3	9	2
3	3	9	1
3	1	3	1
	1	1	1

$2 \times 2 \times 3 \times 3 = \underline{\underline{36}}$ LCD

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

2	6	12	4	2
2	3	6	2	1
3	3	3	1	1
	1	1	1	1

$2 \times 2 \times 3 = \underline{\underline{12}}$ LCD

4. $\frac{1}{6}, \frac{19}{24}, \frac{2}{3}, \frac{3}{5}$

2	6	24	3	5
2	3	12	3	5
2	3	6	3	5
3	3	3	3	5
5	1	1	1	5
	1	1	1	1

$2 \times 2 \times 2 \times 3 \times 5 = \underline{\underline{120}}$ LCD

5. $\frac{21}{25}, \frac{9}{60}, \frac{7}{20}, \frac{1}{3}$

2	25	60	20	3
2	25	30	10	3
3	25	15	5	3
5	25	5	5	1
5	5	1	1	1
	1	1	1	1

$2 \times 2 \times 3 \times 5 \times 5 = \underline{\underline{300}}$ LCD

6. $\frac{5}{12}, \frac{9}{14}, \frac{2}{3}, \frac{7}{10}$

2	12	14	3	10
2	6	7	3	5
3	3	7	3	5
5	1	7	1	5
7	1	7	1	1
	1	1	1	1

$2 \times 2 \times 3 \times 5 \times 7 = \underline{\underline{420}}$ LCD

Add the following fractions and reduce to lowest terms.

7. $\frac{5}{6} + \frac{1}{2}$

$$\frac{5}{6} + \frac{3}{6} = \frac{8}{6} = 1\frac{2}{6} = \underline{\underline{1\frac{1}{3}}}$$

8. $\frac{2}{3} + \frac{3}{4}$

$$\frac{8}{12} + \frac{9}{12} = \frac{17}{12} = \underline{\underline{1\frac{5}{12}}}$$

9. $\frac{5}{8} + \frac{13}{16}$

$$\frac{10}{16} + \frac{13}{16} = \frac{23}{16} = \underline{\underline{1\frac{7}{16}}}$$

10. $\frac{9}{32} + \frac{29}{32}$

$$\frac{9+29}{32} = \frac{38}{32} = 1\frac{6}{32} = \underline{\underline{1\frac{3}{16}}}$$

11. $\frac{1}{2} + \frac{4}{5} + \frac{7}{20}$

$$\frac{10}{20} + \frac{16}{20} + \frac{7}{20} = \frac{33}{20} = \underline{\underline{1\frac{13}{20}}}$$

12. $\frac{3}{4} + \frac{7}{8} + \frac{5}{16}$

$$\frac{12}{16} + \frac{14}{16} + \frac{5}{16} = \frac{31}{16} = \underline{\underline{1\frac{15}{16}}}$$

13. $\frac{11}{12} + \frac{3}{5} + \frac{19}{30}$

$$\frac{55}{60} + \frac{36}{60} + \frac{38}{60} = \frac{129}{60} = 2\frac{9}{60} = \underline{\underline{2\frac{3}{20}}}$$

14. $5\frac{4}{7} + \frac{2}{3}$

$$5\frac{12}{21} + \frac{14}{21} = 5\frac{26}{21} = 5 + 1\frac{5}{21} = \underline{\underline{6\frac{5}{21}}}$$

15. $7\frac{1}{2} + 2\frac{7}{8} + 1\frac{1}{6}$

$$7\frac{12}{24} + 2\frac{21}{24} + 1\frac{4}{24} = 10\frac{37}{24} = 10 + 1\frac{13}{24} = \underline{\underline{11\frac{13}{24}}}$$

16. $13\frac{5}{9} + 45\frac{1}{3} + 9\frac{7}{27}$

$$13\frac{15}{27} + 45\frac{9}{27} + 9\frac{7}{27} = 67\frac{31}{27} = 67 + 1\frac{4}{27} = \underline{\underline{68\frac{4}{27}}}$$

17. Chet Murray ran $3\frac{1}{2}$ miles on Monday, $2\frac{4}{5}$ miles on Tuesday, and $4\frac{1}{8}$ miles on Wednesday. What was Chet's total mileage for the 3 days?

$$\begin{aligned} \text{Monday} \quad & 3\tfrac{1}{2} = 3\tfrac{20}{40} \\ \text{Tuesday} \quad & 2\tfrac{4}{5} = 2\tfrac{32}{40} \\ \text{Wednesday} \quad & \underline{4\tfrac{1}{8} = +\,4\tfrac{5}{40}} \\ & 9\tfrac{57}{40} = 9 + 1\tfrac{17}{40} = \underline{\underline{10\tfrac{17}{40}}} \quad \text{Total miles} \end{aligned}$$

18. Crate and Barrel shipped three packages to New York weighing $45\frac{1}{5}$, $126\frac{3}{4}$, and $88\frac{3}{8}$ pounds. What was the total weight of the shipment?

$$45\frac{1}{5} = 45\frac{8}{40}$$
$$126\frac{3}{4} = 126\frac{30}{40}$$
$$+\ 88\frac{3}{8} = +\ 88\frac{15}{40}$$
$$259\frac{53}{40} = 259 + 1\frac{13}{40} = 260\frac{13}{40} \text{ Pounds}$$

EXCEL 3

19. At the Fresh Market, you buy $6\frac{3}{10}$ pounds of yams and $4\frac{1}{3}$ pounds of corn. What is the total weight of the purchase?

$$6\frac{3}{10} = 6\frac{9}{30}$$
$$+\ 4\frac{1}{3} = +4\frac{10}{30}$$
$$10\frac{19}{30}$$

20. BrewMasters Coffee Co. purchased $12\frac{1}{2}$ tons of coffee beans in January, $15\frac{4}{5}$ tons in February, and $34\frac{7}{10}$ tons in March. What was the total weight of the purchases?

$$\text{January} \quad 12\frac{1}{2} = 12\frac{5}{10}$$
$$\text{February} \quad 15\frac{4}{5} = 15\frac{8}{10}$$
$$\text{March} \quad +\ 34\frac{7}{10} = +34\frac{7}{10}$$
$$61\frac{20}{10} = 61 + 2 = 63 \text{ Tons}$$

Subtract the following fractions and reduce to lowest terms.

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

22. $\frac{4}{7} - \frac{1}{8}$
$= \frac{32}{56} - \frac{7}{56} = \frac{25}{56}$

23. $\frac{2}{3} - \frac{1}{18}$
$= \frac{12}{18} - \frac{1}{18} = \frac{11}{18}$

24. $\frac{3}{4} - \frac{9}{16}$
$= \frac{12}{16} - \frac{9}{16} = \frac{3}{16}$

25. $12\frac{3}{5} - 4\frac{1}{3}$
$= 12\frac{9}{15} - 4\frac{5}{15}$
$= 8\frac{4}{15}$

26. $8\frac{1}{4} - 5\frac{2}{3}$
$= 8\frac{3}{12} - 5\frac{8}{12}$
$= 7\frac{15}{12} - 5\frac{8}{12} = 2\frac{7}{12}$

27. $28\frac{4}{9} - 1\frac{4}{5}$
$= 28\frac{20}{45} - 1\frac{36}{45}$
$= 27\frac{65}{45} - 1\frac{36}{45} = 26\frac{29}{45}$

28. $8\frac{11}{12} - 8\frac{3}{8}$
$= 8\frac{22}{24} - 8\frac{9}{24} = \frac{13}{24}$

EXCEL 2

29. Casey McKee sold $18\frac{4}{5}$ of his $54\frac{2}{3}$ acres of land. How many acres does Casey have left?

$$54\frac{2}{3} = 54\frac{10}{15} = 53\frac{25}{15}$$
$$-18\frac{4}{5} = -18\frac{12}{15} = -18\frac{12}{15}$$
$$35\frac{13}{15} \text{ Acres left}$$

30. A particular dress requires $3\frac{1}{4}$ yards of fabric for manufacturing. If the matching jacket requires $\frac{5}{6}$ yard less fabric, how much fabric is needed for both pieces?

$$3\frac{1}{4} = \frac{13}{4} = \frac{39}{12}$$
$$-\frac{5}{6} = -\frac{5}{6} = -\frac{10}{12}$$
$$\frac{29}{12} = 2\frac{5}{12} \text{ Yards for jacket}$$

$$3\frac{1}{4} = 3\frac{3}{12}$$
$$+2\frac{5}{12} = +2\frac{5}{12}$$
$$5\frac{8}{12} = 5\frac{2}{3} \text{ Total yards for both pieces}$$

Richard Levine/Alamy

gobble, gobble According to www.eatturkey.com, turkey is one of the most popular protein foods in the United States, with annual sales of over $3.6 billion.

Over 270 million turkeys are consumed in a typical year. This amounts to more than 17 pounds per person. The top turkey processor in the United States in a recent year was Butterball, LLC, with 1.45 million pounds. Other major U.S. processors include Jennie-O Turkey Store and Cargill Meat Solutions.

31. Robert Burkart bought a frozen, factory-processed turkey that included the giblets and neck. The package weighed $22\frac{3}{4}$ pounds. Robert thawed the bird and then removed and weighed the giblets and neck, which totaled $1\frac{1}{8}$ pounds. The liquid that he drained from the package weighed $\frac{1}{2}$ pound. How much did the turkey weigh going into the oven?

$1\frac{1}{8}$ Pounds—giblets and neck

$+\frac{1}{2}$ Pounds—juice

$1\frac{5}{8}$ Pounds—weight lost after thawing and removing giblets and necks

$22\frac{3}{4} = 22\frac{6}{8}$

$-\ 1\frac{5}{8} = -\ 1\frac{5}{8}$

$21\frac{1}{8}$ Pounds

32. Brady White weighed $196\frac{1}{2}$ pounds when he decided to join a gym to lose some weight. At the end of the first month, he weighed $191\frac{3}{8}$ pounds.

a. How much did he lose that month?

$196\frac{1}{2} = 196\frac{4}{8}$

$-191\frac{3}{8} = -191\frac{3}{8}$

$5\frac{1}{8}$ Pounds

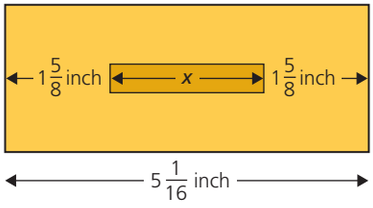
b. If his goal is $183\frac{3}{4}$ pounds, how much more does he have to lose?

$191\frac{3}{8} = 191\frac{3}{8} = 190\frac{11}{8}$

$-183\frac{3}{4} = -183\frac{6}{8} = -183\frac{6}{8}$

$7\frac{5}{8}$ Pounds

EXCEL 2



33. Hot Shot Industries manufactures metal heat shields for light fixture assemblies. What is the length, x, on the heat shield?

$1\frac{5}{8}$

$+1\frac{5}{8}$

$2\frac{10}{8} = 3\frac{2}{8} = 3\frac{1}{4}$

$5\frac{1}{16} = 4\frac{17}{16}$

$-3\frac{1}{4} = -3\frac{4}{16}$

$1\frac{13}{16}$ Inch

EXCEL 3

34. Tim Kenney, a painter, used $6\frac{4}{5}$ gallons of paint on the exterior of a house and $9\frac{3}{4}$ gallons on the interior.

a. What is the total amount of paint used on the house?

$6\frac{4}{5} = 6\frac{16}{20}$

$+9\frac{3}{4} = +9\frac{15}{20}$

$15\frac{31}{20} = 16\frac{11}{20}$

b. If an additional $8\frac{3}{5}$ gallons was used on the garage, what is the total amount of paint used on the house and garage?

$16\frac{11}{20} = 16\frac{11}{20}$

$+\ 8\frac{3}{5} = +\ 8\frac{12}{20}$

$24\frac{23}{20} = 25\frac{3}{20}$

c. Rounding your answer from part b up to the next whole gallon, calculate the total cost of the paint if you paid $23 for each gallon.

26

$\times\ 23$

$\$\ 598$ Total cost of paint

BUSINESS DECISION: THE RED-EYE EXPRESS

35. You are an executive with the Varsity Corporation in Atlanta, Georgia. The company president was scheduled to make an important sales presentation tomorrow afternoon in Seattle, Washington, but has now asked you to take his place.

    The trip consists of a $2\frac{1}{2}$-hour flight from Atlanta to Dallas, a $1\frac{1}{4}$-hour layover in Dallas, and then a $3\frac{3}{4}$-hour flight to Portland. There is a $1\frac{1}{2}$-hour layover in Portland and then a $\frac{3}{4}$-hour flight to Seattle. Seattle is on Pacific Time, which is 3 hours earlier than Eastern Time in Atlanta.

    a. If you depart Atlanta tonight at 11:30 P.M. and all flights are on schedule, what time will you arrive in Seattle?

    $2\frac{1}{2} + 1\frac{1}{4} + 3\frac{3}{4} + 1\frac{1}{2} + \frac{3}{4} = 9\frac{3}{4}$ Hours

    11:30 P.M. $+ 9\frac{3}{4}$ hours $-$ 3-hour time difference $=$ 6:15 A.M.

    b. If your return flight is scheduled to leave Seattle at 10:10 P.M. tomorrow night, with the same flight times and layovers in reverse, what time are you scheduled to arrive in Atlanta?

    10:10 P.M. $+ 9\frac{3}{4}$ hours $+$ 3-hour time difference $=$ 10:55 A.M.

    c. If the leg from Dallas back to Atlanta is $\frac{2}{3}$ of an hour longer than scheduled due to headwinds, what time will you actually arrive?

    $\frac{2}{3}$ hour $= 40$ minutes

    10:55 A.M. $+ 40$ minutes $=$ 11:35 A.M.

2 MULTIPLICATION AND DIVISION OF FRACTIONS

SECTION III

In addition and subtraction, we were concerned with common denominators; however, in multiplication and division, common denominators are not required. This simplifies the process considerably.

2-9 MULTIPLYING FRACTIONS AND MIXED NUMBERS

STEPS FOR MULTIPLYING FRACTIONS

STEP 1. Multiply all the numerators to form the new numerator.

STEP 2. Multiply all the denominators to form the new denominator.

STEP 3. Reduce the answer to lowest terms if necessary.

A procedure known as **cancellation** can serve as a useful shortcut when multiplying fractions. Cancellation simplifies the numbers with which we are dealing and often leaves the answer in lowest terms.

cancellation When multiplying fractions, cancellation is the process of finding a common factor that divides evenly into at least one numerator and one denominator. The common factor 2 can be used to cancel

$$\frac{1}{\cancel{4}_{2}} \times \frac{\cancel{6}^{3}}{7} \text{ to } \frac{1}{2} \times \frac{3}{7}.$$

EXAMPLE 16 DIVIDING FRACTIONS

Divide the following fractions.

a. $\frac{4}{5} \div \frac{2}{3}$ b. $6\frac{3}{8} \div 2\frac{1}{2}$ c. $12\frac{1}{6} \div 3$

Solution Strategy

a. $\frac{4}{5} \div \frac{2}{3} = \frac{4}{5} \times \frac{3}{2}$

In this example, invert the divisor, $\frac{2}{3}$, to form its reciprocal, $\frac{3}{2}$, and change the sign from "÷" to "×."

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

Now multiply in the usual manner. Note that the 4 in the numerator and the 2 in the denominator can be reduced by the common factor 2. The answer, $\frac{6}{5}$, is an improper fraction and must be converted to the mixed number $1\frac{1}{5}$.

b. $6\frac{3}{8} \div 2\frac{1}{2} = \frac{51}{8} \div \frac{5}{2}$

First, convert the mixed numbers to the improper fractions $\frac{51}{8}$ and $\frac{5}{2}$; then state them again as division.

$\frac{51}{8} \times \frac{2}{5}$

Next, invert the divisor, $\frac{5}{2}$, to its reciprocal, $\frac{2}{5}$, and change the sign from "÷" to "×."

$\frac{51}{\underset{4}{\cancel{8}}} \times \frac{\overset{1}{\cancel{2}}}{5} = \frac{51}{20} = 2\frac{11}{20}$

Now multiply in the usual way. Note that the 2 in the numerator and the 8 in the denominator can be reduced by the common factor 2. The answer, $\frac{51}{20}$, is an improper fraction and must be converted to the mixed number $2\frac{11}{20}$.

c. $12\frac{1}{6} \div 3 = \frac{73}{6} \div \frac{3}{1}$

In this example, we have a mixed number that must be converted to the improper fraction $\frac{73}{6}$ and the whole number 3, which converts to $\frac{3}{1}$.

$\frac{73}{6} \times \frac{1}{3}$

The fraction $\frac{3}{1}$ is the divisor and must be inverted to its reciprocal, $\frac{1}{3}$. The sign is changed from "÷" to "×."

$\frac{73}{6} \times \frac{1}{3} = \frac{73}{18} = 4\frac{1}{18}$

The answer is the improper fraction $\frac{73}{18}$, which converts to the mixed number $4\frac{1}{18}$.

try it exercise 16

Divide the following fractions and mixed numbers.

a. $\frac{14}{25} \div \frac{4}{5}$ b. $11\frac{3}{16} \div 8\frac{2}{3}$ c. $18 \div 5\frac{3}{5}$

CHECK YOUR ANSWERS WITH THE SOLUTIONS ON PAGE 59.

IN THE Business World

According to *The Wall Street Journal*, the problem below was a question on the Jersey City High School admissions exam in June 1885! Try this for practice:

Divide the difference between 37 hundredths and 95 thousandths by 25 hundred-thousandths and express the result in words.

Answer: one thousand, one hundred

SECTION III 2 REVIEW EXERCISES

Multiply the following fractions and reduce to lowest terms. use cancellation whenever possible.

1. $\frac{2}{3} \times \frac{4}{5} = \frac{8}{15}$
2. $\frac{5}{6} \times \frac{1}{4} = \frac{5}{24}$
3. $\frac{1}{\underset{1}{2}} \times \frac{\overset{2}{\cancel{4}}}{9} = \frac{2}{9}$
4. $\frac{\overset{1}{\cancel{7}}}{\underset{2}{\cancel{8}}} \times \frac{1}{3} \times \frac{\overset{1}{\cancel{4}}}{\underset{1}{\cancel{7}}} = \frac{1}{6}$
5. $\frac{\overset{2}{\cancel{16}}}{19} \times \frac{5}{\underset{1}{\cancel{8}}} = \frac{10}{19}$
6. $\frac{\overset{5}{\cancel{25}}}{51} \times \frac{2}{\underset{1}{\cancel{5}}} = \frac{10}{51}$
7. $\frac{\overset{1}{\cancel{8}}}{\underset{1}{\cancel{11}}} \times \frac{\overset{3}{\cancel{33}}}{\underset{5}{\cancel{40}}} \times \frac{4}{1} = \frac{12}{5} = 2\frac{2}{5}$
8. $\frac{2}{3} \times \frac{2}{\underset{1}{\cancel{3}}} \times \frac{\overset{2}{\cancel{6}}}{1} = \frac{8}{3} = 2\frac{2}{3}$
9. $8\frac{1}{5} \times 2\frac{2}{3}$ $\frac{41}{5} \times \frac{8}{3} = \frac{328}{15} = 21\frac{13}{15}$
10. $\frac{1}{\underset{1}{2}} \times \frac{\overset{1}{\cancel{2}}}{\underset{1}{\cancel{3}}} \times \frac{\overset{1}{\cancel{4}}}{\underset{1}{\cancel{5}}} \times \frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{1}{\cancel{5}}}{1} = \frac{1}{1} = 1$
11. $\frac{1}{5} \times \frac{1}{5} \times \frac{1}{5} = \frac{1}{125}$
12. $\frac{2}{3} \times 5\frac{4}{5} \times 9$ $\frac{2}{\underset{1}{\cancel{3}}} \times \frac{29}{5} \times \frac{\overset{3}{\cancel{9}}}{1} = \frac{174}{5} = 34\frac{4}{5}$

13. A recent market research survey showed that $\frac{3}{8}$ of the people interviewed preferred decaffeinated coffee over regular.

    a. What fraction of the people preferred regular coffee?

    $\frac{8}{8} - \frac{3}{8} = \frac{5}{8}$ Preferred regular

    b. If 4,400 people were interviewed, how many preferred regular coffee?

    $\frac{\overset{550}{\cancel{4{,}400}}}{1} \times \frac{5}{\underset{1}{\cancel{8}}} = \frac{2{,}750}{1} = 2{,}750$ People preferred regular

14. Wendy Wilson planned to bake a triple recipe of chocolate chip cookies for her office party. If the recipe calls for $1\frac{3}{4}$ cups of flour, how many cups will she need?

    $1\frac{3}{4} \times 3 = 5\frac{1}{4}$ Cups

15. A driveway requires $9\frac{1}{2}$ truckloads of gravel. If the truck holds $4\frac{5}{8}$ cubic yards of gravel, how many total cubic yards of gravel are used for the driveway?

    $9\frac{1}{2} \times 4\frac{5}{8} = \frac{19}{2} \times \frac{37}{8} = \frac{703}{16} = 43\frac{15}{16}$ Cubic yards of gravel

16. Melissa Silva borrowed \$4,200 from the bank. If she has already repaid $\frac{3}{7}$ of the loan, what is the remaining balance owed to the bank?

    $\frac{\overset{600}{\cancel{4{,}200}}}{1} \times \frac{3}{\underset{1}{\cancel{7}}} = \frac{1{,}800}{1} = \$1{,}800$ Already paid

    4,200 Total
    −1,800
    \$2,400 Still owed

17. Amy Richards' movie collection occupies $\frac{5}{8}$ of her computer's hard drive. Her photography takes up $\frac{1}{6}$ of the drive. The operating system, application software, and miscellaneous files take up another $\frac{1}{12}$ of the drive. If her hard drive's capacity is 120 gigabytes, how many gigabytes of free space remain on the hard drive?

    $\frac{5}{8} + \frac{1}{6} + \frac{1}{12} = \frac{15 + 4 + 2}{24} = \frac{21}{24} = \frac{7}{8}$ Capacity used

    $\frac{1}{8} \times 120 = 15$ Gigabytes

Angela Hampton/Bubbles Photolibrary/Alamy

Marketing Research Market and survey researchers gather information about what people think. They help companies understand what types of products and services people want and at what price. By gathering statistical data on competitors and examining prices, sales, and methods of marketing and distribution, they advise companies on the most efficient ways of marketing their products.

According to the U.S. Bureau of Labor Statistics, overall employment of market and survey researchers is projected to grow 28 percent from 2008 to 2018. Median annual salaries for market research analysts in 2012 was \$56,000.

EXCEL 2

18. Three partners share a business. Max owns $\frac{3}{8}$, Sherry owns $\frac{2}{5}$, and Duane owns the rest. If the profits this year are \$150,000, how much does each partner receive?

    Max $150{,}000 \times \frac{3}{8} = \frac{\overset{18{,}750}{\cancel{150{,}000}}}{1} \times \frac{3}{\underset{1}{\cancel{8}}} = \frac{56{,}250}{1} = \$56{,}250$

    Sherry $150{,}000 \times \frac{2}{5} = \frac{\overset{30{,}000}{\cancel{150{,}000}}}{1} \times \frac{2}{\underset{1}{\cancel{5}}} = \frac{60{,}000}{1} = \$60{,}000$

    Duane
    56,250 + 60,000 = 116,250
    150,000 − 116,250 = \$33,750

JUMP START WWW

Divide the following fractions and reduce to lowest terms.

19. $\frac{5}{6} \div \frac{3}{8}$

    $\frac{5}{\underset{3}{\cancel{6}}} \times \frac{\overset{4}{\cancel{8}}}{3} = \frac{20}{9} = 2\frac{2}{9}$

20. $\frac{7}{10} \div \frac{1}{5}$

    $\frac{7}{\underset{2}{\cancel{10}}} \times \frac{\overset{1}{\cancel{5}}}{1} = \frac{7}{2} = 3\frac{1}{2}$

21. $\frac{2}{3} \div \frac{5}{8}$

    $\frac{2}{3} \times \frac{8}{5} = \frac{16}{15} = 1\frac{1}{15}$

22. $7 \div \frac{4}{5}$

    $\frac{7}{1} \times \frac{5}{4} = \frac{35}{4} = 8\frac{3}{4}$

23. $\frac{1}{3} \div \frac{5}{6}$

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

24. $\frac{9}{16} \div \frac{9}{16}$

    $\frac{\overset{1}{\cancel{9}}}{\underset{1}{\cancel{16}}} \times \frac{\overset{1}{\cancel{16}}}{\underset{1}{\cancel{9}}} = \frac{1}{1} = 1$

EXCEL 1

25. $4\frac{4}{5} \div \frac{7}{8}$

    $\frac{24}{5} \times \frac{8}{7} = \frac{192}{35} = 5\frac{17}{35}$

26. $21\frac{1}{2} \div 5\frac{2}{3}$

    $\frac{43}{2} \times \frac{3}{17} = \frac{129}{34} = 3\frac{27}{34}$

27. $18 \div \frac{18}{19}$

    $\frac{\overset{1}{\cancel{18}}}{1} \times \frac{19}{\underset{1}{\cancel{18}}} = \frac{19}{1} = 19$

28. $12 \div 1\frac{3}{5}$

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

29. $\frac{15}{60} \div \frac{7}{10}$

    $\frac{15}{\underset{6}{\cancel{60}}} \times \frac{\overset{1}{\cancel{10}}}{7} = \frac{15}{42} = \frac{5}{14}$

30. $1\frac{1}{5} \div 10$

    $\frac{\overset{3}{\cancel{6}}}{5} \times \frac{1}{\underset{5}{\cancel{10}}} = \frac{3}{25}$

D. Hurst/Alamy

The U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) produce the *Fuel Economy Guide* to help car buyers choose the most fuel-efficient vehicle that meets their needs. The EPA compiles the fuel economy data, and the DOE publishes them in print and on the Web at www.fueleconomy.gov.

31. Frontier Homes, Inc., a builder of custom homes, owns $126\frac{1}{2}$ acres of undeveloped land. If the property is divided into $2\frac{3}{4}$-acre pieces, how many homesites can be developed?

$$126\frac{1}{2} \div 2\frac{3}{4} = \frac{253}{2} \div \frac{11}{4} = \frac{\overset{23}{\cancel{253}}}{2} \times \frac{4}{\cancel{11}} = \frac{46}{1} = 46 \text{ Homesites}$$

32. An automobile travels 365 miles on $16\frac{2}{3}$ gallons of gasoline.

a. How many miles per gallon does the car get on the trip?

$$365 \div 16\frac{2}{3} = \frac{365}{1} \div \frac{50}{3} = \frac{\overset{73}{\cancel{365}}}{1} \times \frac{3}{\underset{10}{\cancel{50}}} = \frac{219}{10} = 21\frac{9}{10} \text{ Miles per gallon}$$

b. How many gallons would be required for the car to travel 876 miles?

$$876 \div 21\frac{9}{10} = \frac{876}{1} \div \frac{219}{10} = \frac{\overset{4}{\cancel{876}}}{1} \times \frac{10}{\underset{1}{\cancel{219}}} = \frac{40}{1} = 40 \text{ Gallons}$$

33. Pier 1 Imports purchased 600 straw baskets from a wholesaler.

a. In the first week, $\frac{2}{5}$ of the baskets are sold. How many are sold?

$$\frac{\overset{120}{\cancel{600}}}{1} \times \frac{2}{\underset{1}{\cancel{5}}} = \frac{240}{1} = 240 \text{ Baskets sold first week}$$

b. By the third week, only $\frac{3}{20}$ of the baskets remain. How many baskets are left?

$$\frac{\overset{30}{\cancel{600}}}{1} \times \frac{3}{\underset{1}{\cancel{20}}} = \frac{90}{1} = 90 \text{ Baskets left third week}$$

EXCEL 2

34. At the Cattleman's Market, $3\frac{1}{2}$ pounds of hamburger meat are to be divided into 7 equal packages. How many pounds of meat will each package contain?

$$3\frac{1}{2} \div 7 = \frac{7}{2} \times \frac{1}{7} = \frac{1}{2} \text{ Pound}$$

35. Super Value Hardware Supply buys nails in bulk from the manufacturer and packs them into $2\frac{4}{5}$-pound boxes. How many boxes can be filled from 518 pounds of nails?

$$518 \div 2\frac{4}{5} = \frac{518}{1} \div \frac{14}{5} = \frac{\overset{37}{\cancel{518}}}{1} \times \frac{5}{\underset{1}{\cancel{14}}} = \frac{185}{1} = 185 \text{ Boxes}$$

EXCEL 3

36. The chef at the Sizzling Steakhouse has 140 pounds of sirloin steak on hand for Saturday night. If each portion is $10\frac{1}{2}$ ounces, how many sirloin steak dinners can be served? Round to the nearest whole dinner. (There are 16 ounces in a pound.)

$$\begin{array}{r} 140 \text{ lb} \\ \times\ 16 \text{ oz} \\ \hline 2{,}240 \text{ Total ounces} \end{array}$$

$$2{,}240 \div 10\frac{1}{2} = \frac{2{,}240}{1} \div \frac{21}{2} = \frac{\overset{320}{\cancel{2{,}240}}}{1} \times \frac{2}{\underset{3}{\cancel{21}}} = \frac{640}{3} = 213\frac{1}{3} = 213 \text{ Dinners}$$

37. Regal Reflective Signs makes speed limit signs for the state department of transportation. By law, these signs must be displayed every $\frac{5}{8}$ of a mile. How many signs will be required on a new highway that is $34\frac{3}{8}$ miles long?

$$34\frac{3}{8} \div \frac{5}{8} = \frac{275}{8} \div \frac{5}{8} = \frac{\overset{55}{\cancel{275}}}{\underset{1}{\cancel{8}}} \times \frac{\overset{1}{\cancel{8}}}{\underset{1}{\cancel{5}}} = 55 \text{ Signs}$$

38. Engineers at Triangle Electronics use special silver wire to manufacture fuzzy logic circuit boards. The wire comes in 840-foot rolls that cost $1,200 each. Each board requires $4\frac{1}{5}$ feet of wire.

a. How many circuit boards can be made from each roll?

$$840 \div 4\frac{1}{5} = \frac{840}{1} \div \frac{21}{5} = \frac{\overset{40}{\cancel{840}}}{1} \times \frac{5}{\underset{1}{\cancel{21}}} = \frac{200}{1} = 200 \text{ Circuit boards}$$

b. What is the cost of wire per circuit board?

$$1{,}200 \div 200 = \$6 \text{ Each}$$

39. At Celtex Manufacturing, a chemical etching process reduces $2\frac{13}{16}$-inch copper plates by $\frac{35}{64}$ of an inch.

a. What is the thickness of each copper plate after the etching process?

$$\begin{array}{r} 2\frac{13}{16} \\ -\frac{35}{64} \\ \hline \end{array} \quad \begin{array}{r} 2\frac{52}{64} \\ -\frac{35}{64} \\ \hline 2\frac{17}{64} \end{array} \text{ Inches}$$

b. How many etched copper plates can fit in a box 25 inches high?

$$25 \div 2\frac{17}{64} = \frac{25}{1} \div \frac{145}{64} = \frac{\cancel{25}^{5}}{1} \times \frac{64}{\cancel{145}_{29}} = \frac{320}{29} = 11\frac{1}{29} = 11 \text{ Plates}$$

BUSINESS DECISION: DINNER SPECIAL

40. You are the owner of The Gourmet Diner. On Wednesday nights, you offer a special of "Buy one dinner, get one free dinner—of equal or lesser value." Michael and Wayne come in for the special. Michael chooses chicken Parmesan for $15, and Wayne chooses a $10 barbecue-combo platter.

a. Excluding tax and tip, how much should each pay for his proportional share of the check?

Michael $\frac{15}{25} = \frac{3}{5}$ $\quad \frac{3}{5} \times 15 = \$9$

Wayne $\frac{10}{25} = \frac{2}{5}$ $\quad \frac{2}{5} \times 15 = \$6$

b. If sales tax and tip amount to $\frac{1}{5}$ of the total of the two dinners, how much is that?

$$\frac{1}{5} \times \frac{25}{1} = \$5$$

c. If they decide to split the tax and tip in the same ratio as the dinners, how much more does each owe?

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

$\frac{2}{5} \times 5 = \$2$