By using operations with fractions, you can determine the total weight of gold found by a miner.
Gold Mining
California
**Vocabulary**

Choose the best term from the list to complete each sentence.

1. A(n) __?__ is a number that is written using the base-ten place value system.
2. An example of a(n) __?__ is \(\frac{14}{5}\).
3. A(n) __?__ is a number that represents a part of a whole.

**Simplify Fractions**

Write each fraction in simplest form.

4. \(\frac{24}{40}\)
5. \(\frac{64}{84}\)
6. \(\frac{66}{78}\)
7. \(\frac{64}{192}\)
8. \(\frac{21}{35}\)
9. \(\frac{11}{99}\)
10. \(\frac{16}{36}\)
11. \(\frac{20}{90}\)

**Write Mixed Numbers as Fractions**

Write each mixed number as an improper fraction.

12. \(\frac{7}{2}\)
13. \(\frac{25}{6}\)
14. \(\frac{14}{15}\)
15. \(\frac{32}{11}\)
16. \(\frac{37}{8}\)
17. \(\frac{84}{9}\)
18. \(\frac{41}{7}\)
19. \(\frac{59}{10}\)

**Write Fractions as Mixed Numbers**

Write each improper fraction as a mixed number.

20. \(\frac{23}{6}\)
21. \(\frac{17}{3}\)
22. \(\frac{29}{7}\)
23. \(\frac{39}{4}\)
24. \(\frac{48}{5}\)
25. \(\frac{82}{9}\)
26. \(\frac{69}{4}\)
27. \(\frac{35}{8}\)

**Add, Subtract, Multiply, or Divide Integers**

Find each sum, difference, product, or quotient.

28. \(-11 + (-24)\)
29. \(-11 - 7\)
30. \(-4 \cdot (-10)\)
31. \(-22 \div (-11)\)
32. \(23 + (-30)\)
33. \(-33 - 74\)
34. \(-62 \cdot (-34)\)
35. \(84 \div (-12)\)
36. \(-26 - 18\)
The information below “unpacks” the standards. The Academic Vocabulary is highlighted and defined to help you understand the language of the standards. Refer to the lessons listed after each standard for help with the math terms and phrases. The Chapter Concept shows how the standard is applied in this chapter.

<table>
<thead>
<tr>
<th>California Standard</th>
<th>Academic Vocabulary</th>
<th>Chapter Concept</th>
</tr>
</thead>
</table>
| **NS2.1** Solve problems involving addition, subtraction, multiplication, and division of positive fractions and explain why a particular operation was used for a given situation. (Lessons 4-2, 4-3, 4-4, 4-5, 4-6) (Labs 4-2, 4-4) | operations include addition, subtraction, multiplication, and division | You add, subtract, multiply, and divide to solve problems with fractions.  
*Example:* \( \frac{1}{5} + \frac{2}{5} \)  
Add the numerators and keep the common denominator.  
\( \frac{1}{5} + \frac{2}{5} = \frac{3}{5} \)  
*Example:* \( \frac{2}{10} + \frac{3}{10} \)  
Add the whole numbers and add the fractions.  
\( \frac{2}{10} + \frac{3}{10} = \frac{5}{10} \) |
| **NS2.2** Explain the meaning of multiplication and division of positive fractions and perform the calculations (e.g., \( \frac{3}{4} \div \frac{16}{5} = \frac{3}{4} \cdot \frac{5}{16} = \frac{3}{8} \)). (Lessons 4-4, 4-5, 4-6) (Lab 4-4) | perform do calculations the steps of doing the operations in a problem | You understand multiplying and dividing fractions.  
*Example:* \( \frac{1}{2} \times \frac{3}{4} \)  
Multiply the numerators and multiply the denominators.  
\( \frac{1}{2} \times \frac{3}{4} = \frac{3}{8} \) |
| **AF2.1** Convert one unit of measurement to another (e.g., from feet to miles, from centimeters to inches). (Lesson 4-9) | convert change from one form to another unit of measurement a quantity used for measuring  
*Examples:*  
A meter is a unit of length.  
A kilogram is a unit of mass.  
A second is a unit of time. | You change measurements from one type of unit to another.  
*Example:* 1 meter is equal to 100 centimeters, so 4 meters is equal to 400 centimeters.  
*Example:* 1 kilogram is equal to 1,000 grams, so 2,000 grams is equal to 2 kilograms. |

Standards NS2.4 and AF1.1 are also covered in this chapter. To see these standards unpacked, go to Chapter 3, p. 126 (NS2.4) and Chapter 1, p. 4 (AF1.1).
Study Strategy: Use Your Notes Effectively

Taking notes helps you understand and remember information from your textbook and lessons in class. Listed below are some steps for effectively using your notes before and after class.

Step 1: Before Class
- Read through your notes from the last class.
- Then look ahead to the next lesson. Write down any questions you have.

Step 2: During Class
- Write down main points that your teacher stresses.
- If you miss something, leave a blank space and keep taking notes.
- Use abbreviations. Make sure you will understand any abbreviations later.
- Draw pictures or diagrams.

Step 3: After Class
- Fill in any information you may have missed.
- Highlight or circle the most important ideas, such as vocabulary, formulas and rules, or steps.
- Use your notes to quiz a friend or yourself.

1/2/08 Lesson 3-1 Prime Factorization

How do I know when I have found the prime factorization of a number?

Prime number — whole number > 1 that has exactly 2 factors: 1 and itself. Ex. 2, 3, 7

Composite number — whole num. that has more than 2 factors. Ex. 4, 6, 9

The number 1 has exactly one factor.
Not prime and not composite

Prime factorization — a composite num. written as the product of its prime factors

Factor tree

36

4 9

2 2 3 3

36 is 2 3

or 2 3 2

Try This

1. Look at the next lesson in your textbook. Think about how the new information relates to previous lessons. Write down any questions you have.

2. With a classmate, compare the notes you took during the last class. Are there differences in the main points that you each recorded? Then brainstorm two ways you can improve your note-taking skills.
Sometimes, when solving problems, you may not need an exact answer. To estimate sums and differences of fractions and mixed numbers, round each fraction to 0, $\frac{1}{2}$, or 1. You can use a number line to help.

![Number Line]

$\frac{3}{10}$ is closer to $\frac{1}{2}$ than to 0.

You can also round a fraction by comparing its numerator with its denominator.

**Benchmarks for Rounding Fractions**

<table>
<thead>
<tr>
<th>Round to 0 if the numerator is much smaller than the denominator.</th>
<th>Round to $\frac{1}{2}$ if the numerator is about half the denominator.</th>
<th>Round to 1 if the numerator is nearly equal to the denominator.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: $\frac{1}{9}$, $\frac{3}{20}$, $\frac{2}{11}$</td>
<td>Examples: $\frac{2}{5}$, $\frac{5}{12}$, $\frac{7}{13}$</td>
<td>Examples: $\frac{8}{9}$, $\frac{23}{25}$, $\frac{97}{100}$</td>
</tr>
</tbody>
</table>

**Example 1**

**Measurement Application**

One of the largest lobsters ever caught weighed $44\frac{3}{8}$ lb. Estimate how much more this lobster weighed than an average 3 lb lobster.

*Think: How much more is $44\frac{3}{8}$ than 3? Use subtraction to find how much more.*

$44\frac{3}{8} - 3$

$44\frac{3}{8} \rightarrow 44\frac{1}{2}$  \hspace{1cm} *Round the mixed number.*

$44\frac{1}{2} - 3 = 41\frac{1}{2}$  \hspace{1cm} *Subtract.*

The $44\frac{3}{8}$-lb lobster weighed about $41\frac{1}{2}$ lb more than an average lobster.
**EXAMPLE 2**

**Estimating Sums and Differences**

Estimate each sum or difference.

**A**

\[
\frac{13}{16} + \frac{4}{7}
\]

\[
\frac{13}{16} \rightarrow 1 \quad \frac{4}{7} \rightarrow \frac{1}{2}
\]

Round each fraction.

\[
1 + \frac{1}{2} = 1\frac{1}{2}
\]

Add.

**B**

\[
\frac{3}{8} + \frac{3}{10}
\]

\[
\frac{3}{8} \rightarrow 3\frac{1}{2} \quad \frac{3}{10} \rightarrow 3
\]

Round each mixed number.

\[
3\frac{1}{2} + 3 = 6\frac{1}{2}
\]

Add.

**C**

\[
5\frac{7}{8} - \frac{4}{5}
\]

\[
5\frac{7}{8} \rightarrow 6 \quad \frac{4}{5} \rightarrow 1
\]

Round each number.

\[
6 - 1 = 5
\]

Subtract.

You can estimate products and quotients of mixed numbers by rounding to the nearest whole number. If the fraction in a mixed number is greater than or equal to \(\frac{1}{2}\), round the mixed number up to the next whole number. If the fraction is less than \(\frac{1}{2}\), round down to a whole number by dropping the fraction.

**EXAMPLE 3**

**Estimating Products and Quotients**

Estimate each product or quotient.

**A**

\[
4\frac{2}{7} \cdot 6\frac{9}{10}
\]

\[
4\frac{2}{7} \rightarrow 4 \quad 6\frac{9}{10} \rightarrow 7
\]

Round each mixed number to the nearest whole number.

\[
4 \cdot 7 = 28
\]

Multiply.

**B**

\[
11\frac{3}{4} \div 2\frac{1}{5}
\]

\[
11\frac{3}{4} \rightarrow 12 \quad 2\frac{1}{5} \rightarrow 2
\]

Round each mixed number to the nearest whole number.

\[
12 \div 2 = 6
\]

Divide.

**Think and Discuss**

1. **Demonstrate** how to round \(\frac{5}{12}\) and \(5\frac{1}{5}\).

2. **Explain** how you know that \(25\frac{5}{8} \cdot 5\frac{1}{10} > 125\).
1. The length of a large SUV is \(18\frac{9}{10}\) feet, and the length of a small SUV is \(15\frac{3}{8}\) feet. Estimate how much longer the large SUV is than the small SUV.

2. Estimate each sum or difference.
   \[
   2. \quad \frac{5}{6} + \frac{5}{12} \quad 3. \quad \frac{15}{16} - \frac{4}{5} \quad 4. \quad \frac{21}{6} + \frac{3}{11} \quad 5. \quad \frac{51}{7} - \frac{27}{9}
   \]

3. Estimate each product or quotient.
   \[
   6. \quad \frac{1}{25} \cdot 9\frac{6}{7} \quad 7. \quad 21\frac{2}{7} \div \frac{71}{3} \quad 8. \quad 31\frac{7}{5} \div \frac{4}{5} \quad 9. \quad 12\frac{2}{5} \cdot \frac{3}{9}
   \]

10. Measurement Sarah's bedroom is \(14\frac{5}{8}\) feet long and \(12\frac{1}{5}\) feet wide. Estimate the difference between the length and width of Sarah's bedroom.

11. Estimate each sum or difference.
   \[
   11. \quad \frac{4}{9} + \frac{3}{5} \quad 12. \quad \frac{25}{9} + \frac{17}{8} \quad 13. \quad \frac{83}{4} - 6 \quad 14. \quad \frac{61}{3} - \frac{5}{6}
   \]
   \[
   15. \quad \frac{7}{5} - \frac{2}{5} \quad 16. \quad \frac{151}{7} - \frac{108}{9} \quad 17. \quad \frac{87}{15} + \frac{27}{8} \quad 18. \quad \frac{4}{5} + \frac{71}{8}
   \]

19. Estimate each product or quotient.
   \[
   19. \quad 23\frac{5}{7} \div 3\frac{6}{9} \quad 20. \quad 10\frac{2}{5} + \frac{45}{8} \quad 21. \quad \frac{21}{8} \cdot 14\frac{5}{6} \quad 22. \quad \frac{79}{10} \cdot \frac{113}{4}
   \]
   \[
   23. \quad \frac{53}{5} \div \frac{2}{3} \quad 24. \quad \frac{124}{6} \cdot \frac{32}{7} \quad 25. \quad \frac{81}{4} + \frac{7}{8} \quad 26. \quad 15\frac{12}{15} \cdot \frac{15}{7}
   \]

27. Estimate each sum, difference, product, or quotient.
   \[
   27. \quad \frac{7}{9} - \frac{3}{8} \quad 28. \quad \frac{3}{5} + \frac{6}{7} \quad 29. \quad \frac{25}{7} \cdot \frac{83}{11} \quad 30. \quad 16\frac{7}{20} \div \frac{38}{9}
   \]
   \[
   31. \quad \frac{13}{5} \cdot \frac{46}{13} \quad 32. \quad \frac{53}{5} - \frac{41}{6} \quad 33. \quad \frac{37}{8} + \frac{2}{15} \quad 34. \quad 19\frac{5}{7} \div \frac{52}{5}
   \]
   \[
   35. \quad \frac{3}{8} + \frac{35}{7} + \frac{67}{8} \quad 36. \quad \frac{84}{5} + \frac{61}{12} + \frac{32}{5} \quad 37. \quad 14\frac{2}{3} + \frac{17}{9} - \frac{114}{29}
   \]

38. Kevin has \(3\frac{2}{3}\) pounds of pecans and \(6\frac{2}{3}\) pounds of walnuts. About how many more pounds of walnuts than pecans does Kevin have?

39. Business On October 19, 1987, the stock market fell 508 points. A company's stock began the day at \(70\frac{1}{4}\) and finished at \(56\frac{1}{4}\). Approximately how far did the company's stock price fall during the day?

40. Recreation Monica and Paul hiked \(5\frac{3}{6}\) miles on Saturday and \(4\frac{9}{10}\) miles on Sunday. Estimate the number of miles Monica and Paul hiked.

41. Critical Thinking If you round a divisor down, is the quotient going to be less than or greater than the actual quotient? Explain.
The diagram shows the wingspans of different species of birds. Use the diagram for Exercises 42 and 43.

42. Approximately how much longer is the wingspan of an albatross than the wingspan of a gull?

43. Approximately how much longer is the wingspan of a golden eagle than the wingspan of a blue jay?

44. Reasoning Using mixed numbers, write a problem in which an estimate is enough to solve the problem.

45. Write About It How is estimating fractions or mixed numbers similar to rounding whole numbers?

46. Challenge Suppose you had bought 10 shares of stock on October 16, 1987, for $73 per share and sold them at the end of the day on October 19, 1987, for $56 \frac{1}{4}$ per share. Approximately how much money would you have lost?

47. Multiple Choice For which of the following would 2 be the best estimate?

- (A) $\frac{8}{9} \cdot \frac{2}{5}$
- (B) $\frac{4}{5} + \frac{5}{9}$
- (C) $\frac{8}{9} \cdot \frac{4}{5}$
- (D) $\frac{1}{9} + \frac{2}{5}$

48. Multiple Choice The table shows the distance Maria biked each day last week.

<table>
<thead>
<tr>
<th>Day</th>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance (mi)</td>
<td>$12 \frac{3}{8}$</td>
<td>$9 \frac{11}{15}$</td>
<td>$3 \frac{1}{4}$</td>
<td>$8 \frac{1}{2}$</td>
<td>0</td>
<td>$4 \frac{3}{4}$</td>
<td>$5 \frac{2}{5}$</td>
</tr>
</tbody>
</table>

Which is the best estimate for the total distance Maria biked last week?

- (A) 40 mi
- (B) 44 mi
- (C) 48 mi
- (D) 52 mi

Solve each equation. Check your answer. (Lessons 1-8 to 1-11)

49. $x + 16 = 43$

50. $y - 32 = 14$

51. $5m = 65$

52. $\frac{n}{3} = 18$

Find each product or quotient. (Lesson 2-4)

53. $20 \cdot (-5)$

54. $-72 \div (-9)$

55. $-16 \cdot (-8)$

56. $-36 \div 3$
Fraction bars can be used to model addition and subtraction of fractions.

**Activity**

You can use fraction bars to find \( \frac{3}{8} + \frac{2}{8} \).

Use fraction bars to represent both fractions. Place the fraction bars side by side.

\[
\begin{array}{cccc}
\frac{1}{8} & \frac{1}{8} & \frac{1}{8} & \frac{1}{8} \\
\hline
\frac{3}{8} & \frac{2}{8} & = & \frac{5}{8}
\end{array}
\]

1. Use fraction bars to find each sum.
   - a. \( \frac{1}{3} + \frac{1}{3} \)
   - b. \( \frac{2}{4} + \frac{1}{4} \)
   - c. \( \frac{3}{12} + \frac{2}{12} \)
   - d. \( \frac{1}{5} + \frac{2}{5} \)

You can use fraction bars to find \( \frac{1}{3} + \frac{1}{4} \).

Use fraction bars to represent both fractions. Place the fraction bars side by side. Which kind of fraction bar placed side by side will fit below \( \frac{1}{3} \) and \( \frac{1}{4} \) (Hint: What is the LCM of 3 and 4?)

\[
\begin{array}{cc}
\frac{1}{3} & \frac{1}{4} \\
\hline
\frac{1}{12} & \frac{1}{12} \\
\frac{1}{12} & \frac{1}{12} \\
\frac{1}{12} & \frac{1}{12} \\
\frac{1}{12} & \frac{1}{12} \\
\end{array}
\]

\[
\frac{1}{3} + \frac{1}{4} = \frac{7}{12}
\]

2. Use fraction bars to find each sum.
   - a. \( \frac{1}{2} + \frac{1}{3} \)
   - b. \( \frac{1}{2} + \frac{1}{4} \)
   - c. \( \frac{1}{3} + \frac{1}{6} \)
   - d. \( \frac{1}{4} + \frac{1}{6} \)

You can use fraction bars to find \( \frac{1}{3} + \frac{5}{6} \).

Use fraction bars to represent both fractions. Place the fraction bars side by side. Which kind of fraction bar placed side by side will fit below \( \frac{1}{3} \) and \( \frac{5}{6} \) (Hint: What is the LCM of 3 and 6?)

\[
\begin{array}{ccccccc}
\frac{1}{3} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\hline
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\end{array}
\]

\[
\frac{1}{3} + \frac{5}{6} = \frac{7}{6}
\]

Chapter 4 Operations with Rational Numbers
When the sum is an improper fraction, you can use the 1 bar along with fraction bars to find the mixed-number equivalent.

\[
\begin{array}{cccccccc}
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\hline \\
\frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \\
\hline \\
1 & & & & & & \\
\hline \\
\frac{1}{6} & & & & & & \\
\hline \\
7 \div 6 = 1 \frac{1}{6}
\end{array}
\]

3 Use fraction bars to find each sum.
   a. \(\frac{3}{4} + \frac{3}{4}\)  
   b. \(\frac{2}{3} + \frac{1}{2}\)  
   c. \(\frac{5}{6} + \frac{1}{4}\)  
   d. \(\frac{3}{8} + \frac{3}{4}\)

You can use fraction bars to find \(\frac{2}{3} - \frac{1}{2}\).

Place a \(\frac{1}{2}\) bar beneath bars that show \(\frac{2}{3}\), and find which fraction fills in the remaining space.

\[
\begin{array}{cccc}
\frac{1}{3} & \frac{1}{3} & \frac{1}{6} \\
\hline \\
\frac{1}{2} & \frac{1}{6} \\
\hline \\
\frac{2}{3} - \frac{1}{2} = \frac{1}{6}
\end{array}
\]

4 Use fraction bars to find each difference.
   a. \(\frac{2}{3} - \frac{1}{3}\)  
   b. \(\frac{1}{4} - \frac{1}{6}\)  
   c. \(\frac{1}{2} - \frac{1}{3}\)  
   d. \(\frac{3}{4} - \frac{2}{3}\)

Think and Discuss
1. Model and solve \(\frac{3}{4} - \frac{1}{6}\). Explain your steps.
2. Two students solved \(\frac{1}{4} + \frac{1}{3}\) in different ways. One got \(\frac{7}{12}\) for the answer, and the other got \(\frac{5}{6}\). Use models to show which student is correct.
3. Find three different ways to model \(\frac{1}{2} + \frac{1}{4}\).

Try This

Use fraction bars to find each sum or difference.
1. \(\frac{1}{2} + \frac{1}{2}\)  
2. \(\frac{2}{3} + \frac{1}{6}\)  
3. \(\frac{1}{4} + \frac{1}{6}\)  
4. \(\frac{1}{3} + \frac{7}{12}\)  
5. \(\frac{5}{12} - \frac{1}{3}\)  
6. \(\frac{1}{2} - \frac{1}{4}\)  
7. \(\frac{3}{4} - \frac{1}{6}\)  
8. \(\frac{2}{3} - \frac{1}{4}\)

9. You ate \(\frac{1}{4}\) of a pizza for lunch and \(\frac{5}{8}\) of the pizza for dinner. How much of the pizza did you eat in all?
10. It is \(\frac{5}{6}\) mile from your home to the library. After walking \(\frac{3}{4}\) mile, you stop to visit a friend on your way to the library. How much farther must you walk to reach the library?
Why learn this? You can add fractions to determine how much of Earth’s surface is covered by oceans. (See Example 3.)

To add and subtract fractions with like denominators, add or subtract the numerators and keep the common denominator.

**Example 1**

Adding and Subtracting Fractions with Like Denominators

Add or subtract. Write each answer in simplest form.

A. 
\[ \frac{3}{10} + \frac{1}{10} = \frac{3 + 1}{10} = \frac{4}{10} = \frac{2}{5} \]

Add the numerators and keep the common denominator.

Subtract the numerators and keep the common denominator.

B. 
\[ \frac{7}{9} - \frac{4}{9} = \frac{7 - 4}{9} = \frac{3}{9} = \frac{1}{3} \]

Simplify.

Simplify.

To add or subtract fractions with different denominators, you must rewrite the fractions with a common denominator.

**Helpful Hint**

The LCM of two denominators is the least common denominator (LCD) of the fractions.

**Two Ways to Find a Common Denominator**

- **Method 1:** Multiply the denominators.
- **Method 2:** Find the LCM (least common multiple) of the denominators.
### Example 2: Adding and Subtracting Fractions with Unlike Denominators

Add or subtract. Write each answer in simplest form.

**A** \( \frac{5}{8} - \frac{1}{10} \)

\[
\frac{5}{8} - \frac{1}{10} = \frac{5 \cdot 10}{8 \cdot 10} - \frac{1 \cdot 8}{10 \cdot 8}
\]

Use Method 1: Multiply the denominators.

\[
= \frac{50}{80} - \frac{8}{80}
\]

Write equivalent fractions using a common denominator.

\[
= \frac{42}{80} = \frac{21}{40}
\]

Subtract. Then simplify.

**B** \( \frac{3}{8} + \frac{5}{12} \)

\[
\frac{3}{8} + \frac{5}{12} = \frac{3 \cdot 3}{8 \cdot 3} + \frac{5 \cdot 2}{12 \cdot 2}
\]

Use Method 2: The LCM of the denominators is 24.

\[
= \frac{9}{24} + \frac{10}{24}
\]

Write equivalent fractions using a common denominator.

\[
= \frac{19}{24}
\]

Add.

**C** \( \frac{2}{3} + \frac{5}{8} \)

\[
\frac{2}{3} + \frac{5}{8} = \frac{2 \cdot 8}{3 \cdot 8} + \frac{5 \cdot 3}{8 \cdot 3}
\]

Use Method 2: The LCM of the denominators is 24.

\[
= \frac{16}{24} + \frac{15}{24}
\]

Write equivalent fractions using a common denominator.

\[
= \frac{31}{24} = 1\frac{7}{24}
\]

Add. Then simplify.

### Example 3: Earth Science Application

The Pacific Ocean covers about \( \frac{1}{3} \) of Earth’s surface, and the Atlantic Ocean covers about \( \frac{1}{5} \) of Earth’s surface. Find the fraction of Earth’s surface covered by both oceans.

Think: How much is \( \frac{1}{3} \) combined with \( \frac{1}{5} \)? Use addition to put parts together.

\[
\frac{1}{3} + \frac{1}{5} = \frac{1 \cdot 5}{3 \cdot 5} + \frac{1 \cdot 3}{5 \cdot 3}
\]

Use Method 1: Multiply the denominators.

\[
= \frac{5}{15} + \frac{3}{15}
\]

Write equivalent fractions.

\[
= \frac{8}{15}
\]

Add.

Together, the Pacific Ocean and Atlantic Ocean cover about \( \frac{8}{15} \) of Earth’s surface.

### Think and Discuss

1. Describe the process for subtracting fractions with different denominators.
See Example 1
Add or subtract. Write each answer in simplest form.
1. \(\frac{2}{3} - \frac{1}{3}\)
2. \(\frac{1}{12} + \frac{1}{12}\)
3. \(\frac{16}{21} - \frac{7}{21}\)
4. \(\frac{4}{17} + \frac{11}{17}\)
5. \(\frac{1}{6} + \frac{1}{3}\)
6. \(\frac{9}{10} - \frac{3}{4}\)
7. \(\frac{2}{3} + \frac{1}{8}\)
8. \(\frac{5}{8} - \frac{3}{10}\)
9. Parker spends \(\frac{1}{4}\) of his earnings on rent and \(\frac{1}{6}\) on entertainment. How much more of his earnings does Parker spend on rent than on entertainment?

See Example 2

See Example 3

Add or subtract. Write each answer in simplest form.
10. \(\frac{2}{3} + \frac{1}{3}\)
11. \(\frac{3}{20} + \frac{7}{20}\)
12. \(\frac{5}{8} + \frac{7}{8}\)
13. \(\frac{6}{15} + \frac{3}{15}\)
14. \(\frac{7}{12} - \frac{5}{12}\)
15. \(\frac{5}{6} - \frac{1}{6}\)
16. \(\frac{8}{9} - \frac{5}{9}\)
17. \(\frac{9}{25} - \frac{4}{25}\)
18. \(\frac{1}{5} + \frac{2}{3}\)
19. \(\frac{1}{6} + \frac{1}{12}\)
20. \(\frac{5}{6} + \frac{3}{4}\)
21. \(\frac{1}{2} + \frac{2}{8}\)
22. \(\frac{21}{24} - \frac{1}{2}\)
23. \(\frac{11}{12} - \frac{3}{4}\)
24. \(\frac{1}{2} - \frac{2}{7}\)
25. \(\frac{7}{10} - \frac{1}{6}\)
26. Seana picked \(\frac{3}{4}\) quart of blackberries. She ate \(\frac{1}{12}\) quart. How much was left?
27. Armando lives \(\frac{2}{3}\) mi from his school. If he has walked \(\frac{1}{2}\) mi already this morning, how much farther must he walk to get to his school?

Extra Practice

Find each sum or difference. Write your answer in simplest form.
28. \(\frac{4}{5} + \frac{6}{7}\)
29. \(\frac{5}{6} - \frac{1}{9}\)
30. \(\frac{3}{4} - \frac{1}{2}\)
31. \(\frac{2}{3} + \frac{2}{15}\)
32. \(\frac{5}{7} + \frac{1}{3}\)
33. \(\frac{7}{12} - \frac{1}{2}\)
34. \(\frac{3}{4} + \frac{2}{5}\)
35. \(\frac{9}{14} - \frac{1}{7}\)
36. \(\frac{7}{8} + \frac{2}{3} + \frac{5}{6}\)
37. \(\frac{3}{5} + \frac{3}{4} - \frac{1}{10}\)
38. \(\frac{3}{10} + \frac{5}{8} + \frac{1}{5}\)
39. \(\frac{2}{5} - \frac{1}{6} + \frac{7}{10}\)
40. \(\frac{3}{8} + \frac{2}{7} - \frac{1}{2}\)
41. \(\frac{1}{3} + \frac{3}{7} - \frac{1}{9}\)
42. \(\frac{2}{9} - \frac{7}{18} + \frac{1}{6}\)
43. \(\frac{2}{15} + \frac{4}{9} + \frac{1}{3}\)
44. \(\frac{9}{35} + \frac{4}{7} - \frac{5}{14}\)
45. \(\frac{1}{3} - \frac{5}{7} + \frac{8}{21}\)
46. \(\frac{2}{9} - \frac{1}{12} + \frac{7}{18}\)
47. \(\frac{4}{5} + \frac{5}{8} - \frac{2}{3}\)
48. **Cooking** One fruit salad recipe calls for \(\frac{1}{2}\) cup of sugar. Another recipe calls for 2 tablespoons of sugar. Since 1 tablespoon is \(\frac{1}{16}\) cup, how much more sugar does the first recipe require?
49. It took Earl \(\frac{3}{4}\) hour to do his science homework and \(\frac{1}{3}\) hour to do his math homework. How long did Earl work on homework?
50. **Music** In music written in \(\frac{3}{4}\) time, a half note lasts for \(\frac{1}{2}\) measure and an eighth note lasts for \(\frac{1}{8}\) measure. In terms of a musical measure, what is the difference in the duration of the two notes?
**Fitness**  Four friends had a competition to see how far they could walk while spinning a hoop around their waists. The table shows how far each friend walked. Use the table for Exercises 51–53.

<table>
<thead>
<tr>
<th>Person</th>
<th>Distance (mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosalyn</td>
<td>1 8</td>
</tr>
<tr>
<td>Cai</td>
<td>3 4</td>
</tr>
<tr>
<td>Lauren</td>
<td>2 3</td>
</tr>
<tr>
<td>Janna</td>
<td>7 10</td>
</tr>
</tbody>
</table>

51. How much farther did Lauren walk than Rosalyn?

52. What is the combined distance that Cai and Rosalyn walked?

53. Who walked farther, Janna or Cai?

54. **Measurement**  A shrew weighs $\frac{3}{10}$ lb. A hamster weighs $\frac{1}{4}$ lb.
   a. How many more pounds does a hamster weigh than a shrew?
   b. There are 16 oz in 1 lb. How many more ounces does the hamster weigh than the shrew?

55. **Multi-Step**  To make $\frac{3}{4}$ lb of mixed nuts, how many pounds of cashews would you add to $\frac{1}{8}$ lb of almonds and $\frac{1}{4}$ lb of peanuts?

56. **Reasoning**  Use facts you find in a newspaper or magazine to write a problem that can be solved using addition or subtraction of fractions. Explain how you know whether addition or subtraction could be used to solve your problem.

57. **Write About It**  Explain the steps you use to add or subtract fractions that have different denominators.

58. **Challenge**  The sum of two fractions is 1. If one fraction is $\frac{3}{8}$ greater than the other, what are the two fractions?

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**Spiral Standards Review**

59. **Multiple Choice**  What is the value of the expression $\frac{3}{7} + \frac{1}{5}$?
   - A. $\frac{1}{3}$
   - B. $\frac{22}{35}$
   - C. $\frac{2}{3}$
   - D. $\frac{26}{35}$

60. **Gridded Response**  Grace has $\frac{1}{2}$ pound of apples. Julie has $\frac{2}{5}$ pound of apples. They want to combine their apples to use in a recipe that calls for 1 pound of apples. How many more pounds of apples do they need?

   Find the greatest common divisor (GCD).  (Lesson 3-2)
   61. 5, 9
   62. 6, 54
   63. 18, 24
   64. 12, 36, 50

   Estimate each sum or difference.  (Lesson 4-1)
   65. $\frac{4}{7} + \frac{1}{9}$
   66. $\frac{4}{3} - \frac{2}{5}$
   67. $\frac{7}{9} + \frac{3}{7}$
   68. $\frac{6}{8} + \frac{4}{7}$
A mixed number can be written as the sum of an integer and a fraction.

\[ 3\frac{4}{5} = 3 + \frac{4}{5} \]

To add mixed numbers, add the integers and then add the fractions.

**Example 1** Adding Mixed Numbers

Add. Write each answer in simplest form.

\[
A \quad 3\frac{4}{5} + 4\frac{2}{5} \\
= \frac{3}{5} + \frac{4}{5} = 7 + \frac{6}{5} \\
= 7 + 1\frac{1}{5} \\
= 8\frac{1}{5}
\]

Add the integers, and then add the fractions.

Rewrite the improper fraction as a mixed number.

Add.

\[
B \quad 1\frac{2}{15} + 7\frac{1}{6} \\
= \frac{1}{15} + \frac{1}{6} = 1\frac{4}{30} + 7\frac{5}{30} \\
= 8 + \frac{9}{30} \\
= 8\frac{9}{30} = 8\frac{3}{10}
\]

Find a common denominator.

Add the integers, and then add the fractions.

Add. Then simplify.

Sometimes, when you subtract mixed numbers, the fraction portion of the first number is less than the fraction portion of the second number. In these cases, you must regroup before subtracting.

**Regrouping Mixed Numbers**

<table>
<thead>
<tr>
<th>Words</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regroup. Rewrite 1 as a fraction with a common denominator. Add.</td>
<td>[ 7\frac{1}{8} = 6 + 1 + \frac{1}{8} = 6 + \frac{8}{8} + \frac{1}{8} = 6\frac{9}{8} ]</td>
</tr>
</tbody>
</table>
Subtracting Mixed Numbers

Subtract. Write each answer in simplest form.

A \[ \frac{10}{9} - \frac{2}{9} \]
\[ 10\frac{7}{9} - 4\frac{2}{9} = 6\frac{5}{9} \]
Subtract the integers, and then subtract the fractions.

B \[ \frac{12}{8} - \frac{17}{24} \]
\[ 12\frac{7}{8} - 5\frac{17}{24} = 12\frac{21}{24} - 5\frac{17}{24} \]
Find a common denominator.
\[ = 7\frac{4}{24} \]
Subtract the integers, and then subtract the fractions.
\[ = 7\frac{1}{6} \]
Simplify.

C \[ \frac{72}{5} - \frac{63}{5} \]
\[ 72\frac{3}{5} - 63\frac{4}{5} = 71\frac{8}{5} - 63\frac{4}{5} \]
Regroup. \( 72\frac{3}{5} = 71 + \frac{5}{5} + \frac{3}{5} \)
Subtract the integers, and then subtract the fractions.
\[ = 8\frac{4}{5} \]

Measurement Application

The giraffe beetle can grow about \( 6\frac{2}{5} \) centimeters longer than the giant green fruit beetle can. The giant green fruit beetle can grow up to \( 1\frac{1}{5} \) centimeters long. What is the maximum length of the giraffe beetle?

Think: What is \( 6\frac{2}{5} \) cm longer than \( 1\frac{1}{5} \) cm? Use addition to put two measurements together.

\[ \frac{6}{5} + 1\frac{1}{5} = 7 + \frac{3}{5} \]
Add the integers, and then add the fractions.
\[ = 7\frac{3}{5} \]
Add.

The maximum length of the giraffe beetle is \( 7\frac{3}{5} \) centimeters.

Estimate \[ 6\frac{1}{2} + 1 = 7\frac{1}{2} \]
Round \( 6\frac{2}{5} \) to \( 6\frac{1}{2} \) and \( 1\frac{1}{5} \) to 1.
\[ 7\frac{3}{5} \] is close to \( 7\frac{1}{2} \), so the answer is reasonable.

Think and Discuss

1. Describe the process for subtracting mixed numbers.
2. Explain whether \( 2\frac{3}{5} + 1\frac{3}{5} = 3\frac{8}{5} \) is correct. Is there another way to write the answer?
3. Demonstrate how to regroup to simplify \( 6\frac{2}{5} - 4\frac{3}{5} \).
Exercises

1. 3\(\frac{2}{5}\) + 4\(\frac{1}{5}\)
2. 2\(\frac{7}{8}\) + 3\(\frac{3}{4}\)
3. 1\(\frac{8}{9}\) + 4\(\frac{4}{9}\)
4. 5\(\frac{1}{2}\) + 2\(\frac{1}{4}\)

Subtract.

5. 6\(\frac{2}{3}\) - 5\(\frac{1}{3}\)
6. 8\(\frac{1}{6}\) - 2\(\frac{5}{6}\)
7. 3\(\frac{2}{3}\) - 2\(\frac{3}{4}\)
8. 7\(\frac{5}{8}\) - 3\(\frac{2}{5}\)

9. Measurement
   Chrystelle’s mother is 1\(\frac{2}{3}\) ft taller than Chrystelle. If Chrystelle is 3\(\frac{1}{2}\) ft tall, how tall is her mother?

Add.

10. 6\(\frac{1}{4}\) + 8\(\frac{3}{4}\)
11. 3\(\frac{3}{5}\) + 7\(\frac{4}{5}\)
12. 3\(\frac{5}{6}\) + 1\(\frac{5}{6}\)
13. 2\(\frac{3}{5}\) + 4\(\frac{1}{3}\)
14. 2\(\frac{3}{10}\) + 4\(\frac{1}{2}\)
15. 6\(\frac{1}{6}\) + 8\(\frac{9}{10}\)
16. 6\(\frac{1}{6}\) + 5\(\frac{3}{10}\)
17. 1\(\frac{2}{5}\) + 9\(\frac{1}{4}\)

Subtract.

18. 2\(\frac{1}{4}\) - 1\(\frac{3}{14}\)
19. 4\(\frac{5}{12}\) - 1\(\frac{7}{12}\)
20. 8 - 2\(\frac{3}{4}\)
21. 7\(\frac{3}{4}\) - 5\(\frac{2}{3}\)
22. 8\(\frac{3}{4}\) - 6\(\frac{2}{5}\)
23. 3\(\frac{1}{3}\) - 2\(\frac{5}{8}\)
24. 4\(\frac{2}{5}\) - 3\(\frac{1}{2}\)
25. 11 - 6\(\frac{5}{9}\)

Sports
The track at Daytona International Speedway is \(\frac{24}{25}\) mi longer than the track at Atlanta Motor Speedway. If the track at Atlanta is 1\(\frac{27}{50}\) mi long, how long is the track at Daytona?

Add or subtract.

27. 7\(\frac{1}{3}\) + 8\(\frac{1}{5}\)
28. 14\(\frac{3}{5}\) - 8\(\frac{1}{2}\)
29. 9\(\frac{1}{6}\) + 4\(\frac{6}{9}\)
30. 21\(\frac{8}{12}\) - 3\(\frac{1}{2}\)
31. 3\(\frac{5}{8}\) + 2\(\frac{7}{12}\)
32. 25\(\frac{1}{3}\) + 3\(\frac{5}{6}\)
33. 1\(\frac{7}{9}\) - 1\(\frac{7}{18}\)
34. 3\(\frac{1}{2}\) + 5\(\frac{1}{4}\)
35. 1\(\frac{7}{15}\) + 2\(\frac{7}{10}\)
36. 12\(\frac{4}{5}\) - 2\(\frac{3}{5}\)
37. 4\(\frac{2}{3}\) + 1\(\frac{7}{8}\) + 3\(\frac{1}{2}\)
38. 5\(\frac{1}{6}\) + 8\(\frac{2}{3}\) - 9\(\frac{1}{2}\)

Compare.

39. 12\(\frac{1}{4}\) - 10\(\frac{3}{4}\)
40. 4\(\frac{1}{2}\) + 3\(\frac{4}{5}\)
41. 13\(\frac{3}{4}\) - 2\(\frac{3}{8}\)
42. 4\(\frac{1}{3}\) - 2\(\frac{1}{4}\)

History During the California Gold Rush, a miner discovers 4 nuggets that separately weigh \(\frac{1}{4}\) ounce, 1\(\frac{1}{4}\) ounces, 1\(\frac{1}{2}\) ounces, and 3\(\frac{3}{4}\) ounce. What is the total weight of the nuggets?
Travel  The table shows the distances in miles between four cities. To find the distance between two cities, locate the square where the row for one city and the column for the other city intersect.

44. How much farther is it from Charleston to Dixon than from Atherton to Baily?

45. If you drove from Charleston to Atherton and then from Atherton to Dixon, how far would you drive?

46. Agriculture  In 2003, the United States imported \(\frac{97}{100}\) of its tulip bulbs from the Netherlands and \(\frac{1}{50}\) of its tulip bulbs from New Zealand. What fraction more of tulip imports came from the Netherlands?

47. Recreation  Kathy wants to hike to Candle Lake. The waterfall trail is \(1\frac{2}{3}\) miles long, and the meadow trail is \(1\frac{5}{6}\) miles long. Which route is shorter and by how much? Explain how you decided which operation to use to solve this problem.

48. Choose a Strategy  Spiro needs to draw a 6-inch-long line. He does not have a ruler, but he has sheets of notebook paper that are \(8\frac{1}{2}\) in. wide and 11 in. long. Describe how Spiro can use the notebook paper to measure 6 in.

49. Write About It  Explain why it is sometimes necessary to regroup a mixed number when subtracting.

50. Challenge  Todd had \(d\) pounds of nails. He sold \(3\frac{1}{2}\) pounds on Monday and \(5\frac{2}{3}\) pounds on Tuesday. Write an expression to show how many pounds he had left and then simplify it.

### Spiral Standards Review

**NS2.1, NS2.3, NS2.4**

51. **Multiple Choice** Which expression is NOT equal to \(2\frac{7}{8}\)?
   - \(A\) \(\frac{1}{2} + 1\frac{3}{8}\)
   - \(B\) \(\frac{515}{16} - 3\frac{1}{16}\)
   - \(C\) \(6 - 3\frac{1}{8}\)
   - \(D\) \(\frac{1}{8} + 1\frac{1}{4}\)

52. **Short Response** Where Maddie lives, there is a \(5\frac{1}{2}\)-cent state sales tax, a \(1\frac{3}{4}\)-cent county sales tax, and a \(3\frac{3}{4}\)-cent city sales tax. The total sales tax is the sum of the state, county, and city sales taxes. What is the total sales tax where Maddie lives? Show your work.

Find each sum.  **(Lesson 2-2)**

53. \(-3 + 9\)
54. \(6 + (-15)\)
55. \(-4 + (-8)\)
56. \(-11 + 5\)

Find each sum or difference. Write your answer in simplest form.  **(Lesson 4-2)**

57. \(\frac{2}{5} + \frac{7}{20}\)
58. \(\frac{3}{7} - \frac{1}{3}\)
59. \(\frac{3}{4} + \frac{7}{18}\)
60. \(\frac{4}{5} - \frac{1}{3}\)
Quiz for Lessons 4-1 Through 4-3

4-1 Estimating with Fractions

1. Stacy’s new mug is \(4\frac{3}{4}\) inches tall, and her old mug is \(3\frac{1}{8}\) inches tall. About how much taller is her new mug?

Estimate each sum or difference.

2. \(\frac{3}{4} - \frac{2}{9}\)  
3. \(\frac{7}{8} + 5\frac{6}{11}\)
4. \(\frac{7}{15} - \frac{3}{5}\)  
5. \(\frac{4}{9} + 4\frac{1}{7}\)

Estimate each product or quotient.

6. \(4\frac{9}{15} \cdot 3\frac{1}{4}\)  
7. \(\frac{7}{9} + 4\frac{3}{5}\)
8. \(\frac{2}{3} \cdot 3\frac{3}{7}\)  
9. \(15\frac{1}{2} + 3\frac{5}{9}\)

4-2 Adding and Subtracting Fractions

Add or subtract. Write each answer in simplest form.

10. \(\frac{5}{8} + \frac{1}{8}\)  
11. \(\frac{14}{15} - \frac{11}{15}\)  
12. \(\frac{6}{9} - \frac{1}{3}\)  
13. \(\frac{2}{3} - \frac{5}{8}\)
14. \(\frac{1}{4} + \frac{1}{6}\)  
15. \(\frac{5}{8} - \frac{1}{2}\)  
16. \(\frac{7}{8} + \frac{5}{6}\)  
17. \(\frac{5}{12} - \frac{1}{3}\)

18. Inés added \(\frac{3}{5}\) cup of dried apples and \(\frac{1}{2}\) cup of dried blueberries to a container of yogurt. How many cups of dried fruit did Inés add to the yogurt?

19. The distance from Gabriel’s house to his school is \(\frac{7}{10}\) mile. The distance from his house to the library is \(\frac{1}{4}\) mile. How much closer is Gabriel’s house to the library than to his school?

4-3 Adding and Subtracting Mixed Numbers

Add or subtract. Write each answer in simplest form.

20. \(6\frac{1}{9} + 2\frac{2}{9}\)  
21. \(\frac{3}{6} + 7\frac{2}{3}\)  
22. \(\frac{5\frac{5}{8} - 3\frac{1}{8}}{4}\)  
23. \(8\frac{1}{12} - 3\frac{3}{4}\)
24. \(4\frac{2}{5} - 2\frac{4}{5}\)  
25. \(9\frac{1}{12} - 6\frac{1}{2}\)  
26. \(3\frac{1}{5} + 7\frac{1}{3}\)  
27. \(11\frac{1}{2} + 8\frac{7}{8}\)

28. A stone carving in a museum weighs \(35\frac{1}{2}\) pounds. A wood carving in the museum weighs \(26\frac{3}{4}\) pounds less than the stone carving. How much does the wood carving weigh?

29. A mother giraffe is \(13\frac{7}{16}\) ft tall. She is \(5\frac{1}{2}\) ft taller than her young giraffe. How tall is the young giraffe?

30. Rachel ran \(\frac{7}{6}\) mile on Monday, \(1\frac{1}{4}\) miles on Tuesday, and \(2\frac{1}{2}\) miles on Wednesday. How many miles did Rachel run in all?
Focus on Problem Solving

Understand the Problem

- Sequence and prioritize information

When you are reading a math problem, putting events in order, or in sequence, can help you understand the problem better. It helps to prioritize the information when you put it in order. To prioritize, you decide which of the information in your list is most important. The most important information has highest priority.

Use the information in the list or table to answer each question.

1. The list shows everything that Roderick has to do on Saturday. He starts the day without any money.
   a. Which two activities on Roderick’s list must be done before any of the other activities? Do these two activities have higher or lower priority?
   b. Is there more than one way that he can order his activities? Explain.
   c. List the order in which Roderick’s activities could occur on Saturday.

2. Tara and her family will visit Ocean World Park from 9:30 to 4:00. They want to see the waterskiing show at 10:00. Each show in the park is 50 minutes long. The time they choose to eat lunch will depend on the schedule they choose for seeing the shows.
   a. Which of the information given in the paragraph above has the highest priority? Which has the lowest priority?
   b. List the order in which they can see all of the shows, including the time they will see each.
   c. When should they plan to have lunch? Explain your reasoning.

<table>
<thead>
<tr>
<th>Show Times at Ocean World Park</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00, 12:00</td>
</tr>
<tr>
<td>9:00, 3:00</td>
</tr>
<tr>
<td>10:00, 2:00</td>
</tr>
<tr>
<td>10:00, 1:00</td>
</tr>
<tr>
<td>11:00, 4:00</td>
</tr>
</tbody>
</table>
You can use grids to model fraction multiplication and division.

**Activity 1**

Use a grid to model \(\frac{3}{4} \times \frac{1}{2}\).

*Think of \(\frac{3}{4} \times \frac{1}{2}\) as \(\frac{3}{4}\) of \(\frac{1}{2}\).*

1. Model \(\frac{1}{2}\) by shading half of a grid.

   \[
   \begin{array}{c}
   \text{Divide the grid into 2 columns.}
   \\
   \text{Shade 1 column to show } \frac{1}{2}.
   \end{array}
   \]

2. Use a different color to shade \(\frac{3}{4}\) of the same grid.

   \[
   \begin{array}{c}
   \text{Divide the grid into 4 rows. Shade 3 rows to show } \frac{3}{4}.
   \end{array}
   \]

3. Determine what fraction of the grid is shaded with both colors.

   \[
   \begin{array}{c}
   \text{There are 8 equal parts, and 3 of the parts are shaded with both colors. The fraction shaded with both colors is } \frac{3}{8}.
   \end{array}
   \]

   \[
   \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}
   \]

   The section of the grid shaded with both colors shows 3 parts of \(\frac{1}{2}\) when \(\frac{1}{2}\) is divided into 4 equal parts. In other words, the grid shows \(\frac{3}{4}\) of \(\frac{1}{2}\), or \(\frac{3}{4} \times \frac{1}{2}\).

**Think and Discuss**

1. Are \(\frac{2}{3} \times \frac{1}{3}\) and \(\frac{1}{5} \times \frac{2}{3}\) modeled the same way? Explain.

2. When you multiply a positive fraction by a positive fraction, the product is less than either factor. Why?
Try This

Use a grid to find each product. Explain how your grid shows the product.

1. \( \frac{1}{2} \cdot \frac{1}{2} \)
2. \( \frac{3}{4} \cdot \frac{2}{3} \)
3. \( \frac{5}{8} \cdot \frac{1}{3} \)
4. \( \frac{2}{5} \cdot \frac{5}{6} \)

Activity 2

Use grids to model \( 4\frac{1}{3} \div \frac{2}{3} \).

Divide 5 grids into thirds. Shade 4 grids and \( \frac{1}{3} \) of a fifth grid to represent \( 4\frac{1}{3} \).

Think: How many groups of \( \frac{2}{3} \) are in \( 4\frac{1}{3} \)?

Divide the shaded grids into equal groups of 2.

There are 6 groups of \( \frac{2}{3} \), with \( \frac{1}{3} \) left over. This piece is \( \frac{1}{2} \) of a group of \( \frac{2}{3} \).

Thus there are \( 6 + \frac{1}{2} \) groups of \( \frac{2}{3} \) in \( 4\frac{1}{3} \).

\( 4\frac{1}{3} \div \frac{2}{3} = 6\frac{1}{2} \)

Think and Discuss

1. Are \( \frac{3}{4} \div \frac{1}{6} \) and \( \frac{1}{6} \div \frac{3}{4} \) modeled the same way? Explain.

2. When you divide positive fractions less than 1, is the quotient greater than or less than the dividend? Explain.

Try This

Use grids to find each quotient. Explain how your grid shows the quotient.

1. \( \frac{7}{12} \div \frac{1}{6} \)
2. \( \frac{4}{5} \div \frac{3}{10} \)
3. \( \frac{2}{3} \div \frac{4}{9} \)
4. \( \frac{3}{5} \div \frac{3}{5} \)
Recall that multiplication can be written as repeated addition. For example, \( 3 \times 5 = 5 + 5 + 5 = 15 \). You can use repeated addition to multiply a whole number by a fraction.

### Transportation Application

In 2005, the San Francisco–Oakland Bay Bridge toll for a car was $3.00. In 1939, the toll was \( \frac{2}{15} \) of the toll in 2005. What was the toll in 1939?

Think: How much is \( \frac{2}{15} \) of 3? Use multiplication to find a fraction of a number.

\[
3 \times \frac{2}{15} = \frac{2}{15} + \frac{2}{15} + \frac{2}{15} = \frac{6}{15} = \frac{2}{5} = 0.40
\]

The Bay Bridge toll for a car was $0.40 in 1939.

### Multiplying Fractions

**Words**

Multiply the numerators to find the product's numerator. Multiply the denominators to find the product's denominator.

**Numbers**

\[
\frac{1}{3} \times \frac{2}{5} = \frac{1 \times 2}{3 \times 5} = \frac{2}{15}
\]

**Algebra**

\[
\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}
\]

where \( b \neq 0 \) and \( d \neq 0 \)

### Example 2

**Multiplying Fractions**

Multiply. Write each answer in simplest form.

**A** \( \frac{15}{1} \times \frac{2}{3} \)

\[
\frac{15}{1} \times \frac{2}{3} = 15 \times \frac{2}{3} = \frac{15 \times 2}{3} = \frac{30}{3} = 10
\]

Write 15 as a fraction. Divide a numerator and denominator by their GCD, 3. Multiply numerators. Multiply denominators.

**Helpful Hint**

Use the GCD of a numerator and denominator to simplify before multiplying.
Think and Discuss

1. Describe how to multiply a mixed number and a fraction.

2. Explain why \( \frac{1}{2} \cdot \frac{1}{3} \cdot \frac{1}{4} = \frac{1}{24} \) is or is not correct.

3. Explain why \( 3 \cdot \frac{2}{15} \) can be written as \( \frac{2}{15} + \frac{2}{15} + \frac{2}{15} \).
**Guided Practice**

See Example 1

1. On average, people spend \( \frac{1}{3} \) of the time they sleep in a dream state. If Maxwell slept 10 hours last night, how much time did he spend dreaming? Write your answer in simplest form.

See Example 2

Multiply. Write each answer in simplest form.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>8 ( \cdot \frac{3}{4} )</td>
<td>3.</td>
<td>( \frac{2}{3} \cdot \frac{3}{5} )</td>
</tr>
<tr>
<td>4.</td>
<td>( \frac{1}{4} \cdot \frac{2}{3} )</td>
<td>5.</td>
<td>( \frac{3}{5} \cdot 15 )</td>
</tr>
</tbody>
</table>

See Example 3

6. | 4 \( \cdot \frac{3}{2} \) |
7. | \( \frac{4}{9} \cdot \frac{5}{2} \) |
8. | \( 1\frac{1}{2} \cdot 1\frac{5}{9} \) |
9. | \( 2\frac{6}{7} \cdot 7 \) |

**Independent Practice**

See Example 1

10. Sherry spent 4 hours exercising last week. If \( \frac{3}{5} \) of the time was spent jogging, how much time did she spend jogging? Write your answer in simplest form.

11. **Measurement** A bread recipe calls for \( \frac{1}{3} \) teaspoon of salt for 1 batch. Doreen wants to bake 5 batches of bread. How much salt does she need? Write your answer in simplest form.

See Example 2

Multiply. Write each answer in simplest form.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>12.</td>
<td>5 ( \cdot \frac{1}{8} )</td>
<td>13.</td>
<td>( 4 \cdot \frac{1}{8} )</td>
</tr>
<tr>
<td>14.</td>
<td>( 3 \cdot \frac{5}{8} )</td>
<td>15.</td>
<td>( 6 \cdot \frac{2}{3} )</td>
</tr>
<tr>
<td>16.</td>
<td>( \frac{2}{5} \cdot \frac{5}{7} )</td>
<td>17.</td>
<td>( \frac{3}{8} \cdot \frac{2}{3} )</td>
</tr>
<tr>
<td>18.</td>
<td>( \frac{1}{2} \cdot \frac{4}{9} )</td>
<td>19.</td>
<td>( \frac{5}{6} \cdot \frac{2}{3} )</td>
</tr>
</tbody>
</table>

See Example 3

20. | \( 7\frac{1}{2} \cdot 2\frac{2}{5} \) |
21. | \( 6 \cdot 7\frac{2}{5} \) |
22. | \( 2\frac{4}{7} \cdot \frac{1}{6} \) |
23. | \( 2\frac{5}{8} \cdot 6\frac{2}{3} \) |

24. | \( \frac{2}{3} \cdot \frac{2}{4} \) |
25. | \( 1\frac{1}{2} \cdot 1\frac{5}{9} \) |
26. | \( 7 \cdot 5\frac{1}{8} \) |
27. | \( 3\frac{3}{4} \cdot 2\frac{1}{5} \) |

**Practice and Problem Solving**

Multiply. Write each answer in simplest form.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>28.</td>
<td>( \frac{5}{8} \cdot \frac{4}{5} )</td>
<td>29.</td>
<td>( \frac{3}{7} \cdot \frac{5}{6} )</td>
</tr>
<tr>
<td>30.</td>
<td>( \frac{2}{3} \cdot 6 )</td>
<td>31.</td>
<td>( 2 \cdot \frac{1}{6} )</td>
</tr>
<tr>
<td>32.</td>
<td>( \frac{1}{8} \cdot 5 )</td>
<td>33.</td>
<td>( \frac{3}{4} \cdot \frac{2}{9} )</td>
</tr>
<tr>
<td>34.</td>
<td>( 4\frac{2}{3} \cdot 2\frac{4}{7} )</td>
<td>35.</td>
<td>( \frac{4}{9} \cdot \frac{3}{16} )</td>
</tr>
<tr>
<td>36.</td>
<td>( 3\frac{1}{2} \cdot 5 )</td>
<td>37.</td>
<td>( \frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{5} )</td>
</tr>
<tr>
<td>38.</td>
<td>( 6 \cdot 5 )</td>
<td>39.</td>
<td>( 1\frac{1}{2} \cdot \frac{3}{5} \cdot \frac{7}{9} )</td>
</tr>
<tr>
<td>40.</td>
<td>( \frac{2}{3} \cdot 1\frac{1}{2} \cdot \frac{2}{3} )</td>
<td>41.</td>
<td>( \frac{8}{9} \cdot \frac{3}{11} \cdot \frac{33}{40} )</td>
</tr>
<tr>
<td>42.</td>
<td>( \frac{1}{6} \cdot 6 \cdot 8\frac{2}{3} )</td>
<td>43.</td>
<td>( \frac{8}{9} \cdot 1\frac{1}{8} )</td>
</tr>
</tbody>
</table>

**Reasoning** Complete each multiplication sentence.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>44.</td>
<td>( \frac{1}{2} \cdot \frac{3}{8} = \frac{3}{16} )</td>
<td>45.</td>
<td>( \frac{2}{3} \cdot \frac{3}{4} = \frac{1}{2} )</td>
</tr>
<tr>
<td>46.</td>
<td>( \frac{5}{3} \cdot \frac{5}{8} = \frac{5}{12} )</td>
<td>47.</td>
<td>( \frac{3}{5} \cdot \frac{5}{7} = \frac{3}{7} )</td>
</tr>
<tr>
<td>48.</td>
<td>( \frac{5}{6} \cdot \frac{3}{4} = \frac{1}{4} )</td>
<td>49.</td>
<td>( \frac{4}{5} \cdot \frac{4}{5} = \frac{8}{15} )</td>
</tr>
<tr>
<td>50.</td>
<td>( \frac{2}{3} \cdot \frac{9}{11} = \frac{3}{11} )</td>
<td>51.</td>
<td>( \frac{15}{15} \cdot \frac{3}{5} = \frac{1}{25} )</td>
</tr>
</tbody>
</table>

52. **Measurement** A standard paper clip is \( 1\frac{1}{4} \) in. long. If you laid 75 paper clips end to end, how long would the line of paper clips be?
53. **Science** The weight of an object on the moon is \(\frac{1}{6}\) its weight on Earth. If a bowling ball weighs \(12\frac{1}{2}\) pounds on Earth, how much would it weigh on the moon? Explain how you decided which operation to use to solve this problem.

54. In a survey, 200 students were asked what most influenced them to buy their latest CD. The results are shown in the circle graph.

a. How many students said radio most influenced them?

b. How many more students were influenced by radio than by a music video channel?

c. How many said a friend or relative influenced them or they heard the CD in a store?

55. The Mississippi River flows at a rate of 2 miles per hour. If Eduardo floats down the river in a boat for \(5\frac{1}{2}\) hours, how far will he travel?

56. **Choose a Strategy** What is the product of \(\frac{1}{2} \cdot \frac{2}{3} \cdot \frac{3}{4} \cdot \frac{4}{5}\)?

57. **Write About It** Explain what it means to multiply \(\frac{1}{4}\) by \(\frac{2}{3}\). Use a model in your explanation.

58. **Challenge** Write three multiplication problems to show that the product of two fractions can be less than, equal to, or greater than 1.
Reciprocals can help you divide by fractions. Two numbers are reciprocals or multiplicative inverses if their product is 1. The reciprocal of \( \frac{1}{3} \) is 3 because 
\[
\frac{1}{3} \cdot 3 = \frac{1}{3} \cdot \frac{3}{1} = \frac{3}{3} = 1.
\]
Dividing by a number is the same as multiplying by its reciprocal.

\[
6 \div \frac{1}{3} = 2 \quad 6 \cdot 3 = 2
\]

You can use this rule to divide by fractions.

### DIVIDING FRACTIONS

<table>
<thead>
<tr>
<th>Words</th>
<th>Numbers</th>
<th>Algebra</th>
</tr>
</thead>
<tbody>
<tr>
<td>To divide by a fraction, find its reciprocal and then multiply.</td>
<td>( \frac{1}{2} \div \frac{3}{5} = \frac{1}{2} \cdot \frac{5}{3} = \frac{5}{6} )</td>
<td>( \frac{a}{b} \div \frac{c}{d} = \frac{a \cdot d}{b \cdot c} ) where ( b, c, d \neq 0 )</td>
</tr>
</tbody>
</table>

### EXAMPLE 1

**Dividing Fractions**

Divide. Write each answer in simplest form.

**A** \( \frac{2}{3} \div \frac{1}{5} \)

\[
\frac{2}{3} \div \frac{1}{5} = \frac{2}{3} \cdot \frac{5}{1} = \frac{2 \cdot 5}{3 \cdot 1} = \frac{10}{3} \text{ or } 3\frac{1}{3}
\]

*Multiply by the reciprocal of \( \frac{1}{5} \).*

**B** \( \frac{3}{5} \div 6 \)

\[
\frac{3}{5} \div 6 = \frac{3}{5} \cdot \frac{1}{6} = \frac{1 \cdot 3}{5 \cdot 6} = \frac{1}{10}
\]

*Multiply by the reciprocal of 6.*

*Simplify.*
**EXAMPLE 2**

**Dividing Mixed Numbers**

Divide. Write each answer in simplest form.

**A** \[4 \frac{1}{3} \div 2 \frac{1}{2} = \frac{13}{3} \div \frac{5}{2} \]

Write mixed numbers as improper fractions.

\[= \frac{13}{3} \cdot \frac{2}{5} \]

Multiply by the reciprocal of \(\frac{5}{2}\).

\[= \frac{26}{15} \text{ or } 1 \frac{11}{15} \]

**B** \[\frac{5}{6} \div 7 \frac{1}{7} = \frac{5}{6} \div \frac{50}{7} \]

Write \(7 \frac{1}{7}\) as an improper fraction.

\[= \frac{5}{6} \cdot \frac{7}{50} \]

Multiply by the reciprocal of \(\frac{50}{7}\).

\[= \frac{1}{6} \cdot \frac{7}{10} \]

Simplify.

\[= \frac{7}{60} \]

**EXAMPLE 3**

**Social Studies Application**

Use the bar graph to determine how many times longer a $100 bill is expected to stay in circulation than a $1 bill.

The life span of a $1 bill is \(1 \frac{1}{2}\) years. The life span of a $100 bill is 9 years.

Think: How many \(1 \frac{1}{2}\)’s are there in 9? Use division.

\[9 \div 1 \frac{1}{2} = \frac{9}{1} \div \frac{3}{2} \]

Write both numbers as improper fractions.

\[= \frac{9}{1} \cdot \frac{2}{3} \]

Multiply by the reciprocal of \(\frac{3}{2}\).

\[= \frac{3}{1} \cdot \frac{2}{1} \]

Simplify.

\[= \frac{6}{1} \text{ or } 6 \]

A $100 bill is expected to stay in circulation 6 times longer than a $1 bill.

**Think and Discuss**

1. Explain whether finding half of a number is the same as dividing a number by \(\frac{1}{2}\).
### GUIDED PRACTICE

See Example 1 Divide. Write each answer in simplest form.

1. \(6 ÷ \frac{1}{3}\)
2. \(\frac{3}{5} ÷ \frac{3}{4}\)
3. \(\frac{3}{4} ÷ 8\)
4. \(\frac{5}{9} ÷ \frac{2}{5}\)

See Example 2

5. \(\frac{5}{6} ÷ 3\frac{1}{3}\)
6. \(\frac{5}{8} ÷ 4\frac{1}{2}\)
7. \(10\frac{4}{5} ÷ 5\frac{2}{5}\)
8. \(2\frac{1}{10} ÷ \frac{3}{5}\)

See Example 3

9. Kareem has 12\(4\frac{1}{2}\) yards of material. A cape for a play takes 3\(\frac{5}{8}\) yards. How many capes can Kareem make with the material?

### INDEPENDENT PRACTICE

See Example 1 Divide. Write each answer in simplest form.

10. \(2 ÷ \frac{7}{8}\)
11. \(10 ÷ \frac{5}{9}\)
12. \(\frac{3}{4} ÷ 6\)
13. \(\frac{7}{8} ÷ \frac{1}{5}\)

14. \(\frac{8}{9} ÷ \frac{1}{4}\)
15. \(\frac{4}{9} ÷ 12\)
16. \(\frac{9}{10} ÷ 6\)
17. \(16 ÷ \frac{2}{5}\)

See Example 2

18. \(\frac{7}{11} ÷ \frac{4\frac{1}{2}}{5}\)
19. \(\frac{3}{4} ÷ 2\frac{1}{10}\)
20. \(22\frac{1}{2} ÷ \frac{4\frac{7}{7}}{7}\)
21. \(10\frac{1}{2} ÷ \frac{3\frac{2}{4}}{5}\)

22. \(3\frac{5}{7} ÷ 9\frac{1}{7}\)
23. \(14\frac{2}{3} ÷ 1\frac{1}{6}\)
24. \(\frac{7\frac{7}{10}}{2\frac{2}{5}}\)
25. \(\frac{8\frac{2}{5}}{7\frac{8}}\)

See Example 3

26. A juicer holds 43\(\frac{3}{4}\) pints of juice. How many 2\(\frac{1}{2}\)-pint bottles can be filled with that much juice?

27. **Measurement** How many 24\(\frac{1}{2}\) in. pieces of ribbon can be cut from a roll of ribbon that is 147 in. long?

### PRACTICE AND PROBLEM SOLVING

Evaluate. Write each answer in simplest form.

28. \(6\frac{2}{3} ÷ \frac{7}{9}\)
29. \(9 ÷ 1\frac{2}{3}\)
30. \(\frac{2}{3} ÷ \frac{8}{9}\)
31. \(1\frac{7}{11} ÷ \frac{9}{11}\)

32. \(\frac{1}{2} ÷ 4\frac{3}{4}\)
33. \(\frac{4}{21} ÷ 3\frac{1}{2}\)
34. \(4\frac{1}{2} ÷ 3\frac{1}{2}\)
35. \(1\frac{3}{5} ÷ 2\frac{1}{2}\)

36. \(\frac{7}{8} ÷ 2\frac{1}{10}\)
37. \(1\frac{3}{5} ÷ \left(\frac{2\frac{3}{5}}{9}\right)\)
38. \(\left(\frac{1}{2} + \frac{2}{5}\right) ÷ 1\frac{1}{2}\)
39. \(\left(\frac{3\frac{3}{4}}{4} + \frac{3\frac{2}{3}}{5}\right) ÷ \frac{11}{18}\)

40. \(2\frac{2}{3} ÷ \left(\frac{1\frac{2}{3}}{5}\right)\)
41. \(\frac{4}{5} ÷ \frac{3\frac{3}{8} ÷ 9\frac{1}{10}}{12}\)
42. \(\frac{12\frac{2}{13} ÷ 13\frac{18}{} ÷ 1\frac{2}{12}}{3\frac{7}{15} ÷ 18\frac{2}{4}}\)

44. Three friends will be driving to an amusement park that is 226\(\frac{3}{4}\) mi from their town. If each friend drives the same distance, how far will each drive? Explain how you decided which operation to use to solve this problem.

45. **Multi-Step** How many 4\(\frac{1}{4}\) lb hamburger patties can be made from a 10\(\frac{1}{4}\) lb package and an 11\(\frac{1}{2}\) lb package of ground meat?

46. **Write About It** Explain what it means to divide \(\frac{5}{3}\) by \(\frac{1}{3}\). Use a model in your explanation.
47. **Multi-Step** The students in Mr. Park's woodworking class are making birdhouses. The plans call for the side pieces of the birdhouses to be \(7\frac{1}{4}\) inches long. If Mr. Park has 6 boards that are \(50\frac{3}{4}\) inches long, how many side pieces can be cut?

48. For his drafting class, Manuel is drawing plans for a bookcase. He wants his drawing to be \(\frac{1}{4}\) the actual size of the bookcase. If the bookcase will be \(3\frac{2}{3}\) feet wide, how wide will Manuel's drawing be?

49. The table shows the total number of hours that the students in each of Mrs. Anwar's 5 industrial arts classes took to complete their final projects. If the third-period class has 17 students, how many hours did each student in that class work on average?

<table>
<thead>
<tr>
<th>Period</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>200(\frac{1}{2})</td>
</tr>
<tr>
<td>2nd</td>
<td>179(\frac{2}{5})</td>
</tr>
<tr>
<td>3rd</td>
<td>199(\frac{3}{4})</td>
</tr>
<tr>
<td>5th</td>
<td>190(\frac{3}{4})</td>
</tr>
<tr>
<td>6th</td>
<td>180(\frac{1}{4})</td>
</tr>
</tbody>
</table>

50. **Critical Thinking** Brandy is stamping circles from a strip of aluminum. If each circle is \(1\frac{1}{4}\) inches in diameter, how many circles can she get from an \(8\frac{3}{4}\)-inch by \(1\frac{1}{4}\)-inch strip of aluminum?

51. **Challenge** Alexandra is cutting wood stencils to spell her first name with capital letters. Her first step is to cut a square of wood that is \(3\frac{1}{2}\)-in. long on a side for each letter in her name. Will Alexandra be able to make all of the letters of her name from a single piece of wood that is \(7\frac{1}{2}\) in. wide and 18 in. long? Explain your answer.

52. **Multiple Choice** Which expression is NOT equivalent to \(2\frac{2}{3} \div 1\frac{5}{8}\)?

   - A) \(\frac{8}{3} \div \frac{8}{13}\)
   - B) \(2\frac{2}{3} \div \frac{13}{8}\)
   - C) \(\frac{8}{3} \div \frac{13}{8}\)
   - D) \(\frac{8}{3} \cdot 1\frac{5}{8}\)

53. **Multiple Choice** What is the value of the expression \(\frac{3}{5} \cdot \frac{1}{6} \div \frac{2}{5}\)?

   - A) \(\frac{1}{25}\)
   - B) \(\frac{1}{4}\)
   - C) \(\frac{15}{22}\)
   - D) 25

54. **Gridded Response** Each cat at the animal shelter gets \(\frac{3}{4}\) c of food every day. If Alysse has \(16\frac{1}{2}\) c of cat food, how many cats can she feed?

Find the least common multiple (LCM). (**Lesson 3-3**)  
55. 2, 15  
56. 6, 8  
57. 4, 6, 18  
58. 3, 4, 8

Multiply. Write each answer in simplest form. (**Lesson 4-4**)  
59. \(\frac{2}{15} \cdot \frac{5}{8}\)  
60. \(1\frac{7}{20} \cdot 6\)  
61. \(1\frac{2}{7} \cdot 2\frac{3}{4}\)  
62. \(\frac{1}{8} \cdot 6 \cdot 2\frac{5}{9}\)
The goal when solving equations that contain fractions is the same as when working with other kinds of numbers—to get the variable by itself on one side of the equation.

**EXAMPLE 1**

**Solving Equations by Adding or Subtracting**

Solve. Write each answer in simplest form.

**A**

\[ x - \frac{1}{5} = \frac{3}{5} \]

\[ x - \frac{1}{5} = \frac{3}{5} \]

\[ x - \frac{1}{5} + \frac{1}{5} = \frac{3}{5} + \frac{1}{5} \]

\[ x = \frac{4}{5} \]

Since \( \frac{1}{5} \) is subtracted from \( x \), add \( \frac{1}{5} \) to both sides.

Simplify.

**B**

\[ \frac{5}{12} + y = \frac{2}{3} \]

\[ \frac{5}{12} + y = \frac{2}{3} \]

\[ \frac{5}{12} + y - \frac{5}{12} = \frac{2}{3} - \frac{5}{12} \]

\[ y = \frac{8}{12} - \frac{5}{12} \]

\[ y = \frac{3}{12} = \frac{1}{4} \]

Since \( \frac{5}{12} \) is added to \( y \), subtract \( \frac{5}{12} \) from both sides.

Find a common denominator.

Subtract. Then simplify.

**C**

\[ \frac{7}{18} + u = \frac{14}{27} \]

\[ \frac{7}{18} + u = \frac{14}{27} \]

\[ \frac{7}{18} + u - \frac{7}{18} = \frac{14}{27} - \frac{7}{18} \]

\[ u = \frac{28}{54} - \frac{21}{54} \]

\[ u = \frac{7}{54} \]

Since \( \frac{7}{18} \) is added to \( u \), subtract \( \frac{7}{18} \) from both sides.

Find a common denominator.

Subtract.

**Check**

\[ \frac{7}{18} + u = \frac{14}{27} \]

\[ \frac{7}{18} + \frac{7}{54} = \frac{14}{27} \]

\[ \frac{21}{54} + \frac{7}{54} = \frac{28}{54} \]

\[ \frac{28}{54} = \frac{28}{54} \]

Substitute \( \frac{7}{54} \) for \( u \).

Find a common denominator.

Add.
Solving Equations by Multiplying

Solve. Write each answer in simplest form.

A \( \frac{2}{3}x = \frac{4}{5} \)
\[
\begin{align*}
\frac{2}{3}x &= \frac{4}{5} \\
\frac{2}{3}x \cdot \frac{2}{2} &= \frac{4}{5} \cdot \frac{2}{2} \\
x &= \frac{6}{5} \\
&= 1 \frac{1}{5}
\end{align*}
\]

Multiply by the reciprocal of \( \frac{2}{3} \). Then simplify.

B \( 3y = \frac{6}{7} \)
\[
\begin{align*}
3y &= \frac{6}{7} \\
3y \cdot \frac{1}{3} &= \frac{6}{7} \cdot \frac{1}{3} \\
y &= \frac{2}{7}
\end{align*}
\]

Multiply by the reciprocal of 3. Then simplify.

Science Application

Pink gold is made of pure gold, silver, and copper. There is \( \frac{11}{20} \) more pure gold than copper in pink gold. If pink gold is \( \frac{3}{4} \) pure gold, what portion of pink gold is copper?

Let \( c \) represent the amount of copper in pink gold.
\[
\begin{align*}
c + \frac{11}{20} &= \frac{3}{4} & \text{Write an equation.} \\
c &= \frac{3}{4} - \frac{11}{20} & \text{Since} \ \frac{11}{20} \ \text{is added to} \ \ c, \\
&= \frac{15}{20} - \frac{11}{20} & \text{Find a common denominator.} \\
&= \frac{4}{20} & \text{Subtract.} \\
&= \frac{1}{5} & \text{Simplify.}
\end{align*}
\]

Pink gold is \( \frac{1}{5} \) copper.

Think and Discuss

1. Show the first step you would use to solve \( m + \frac{3}{8} = 12 \frac{1}{2} \).
2. Describe how to decide whether \( \frac{2}{3} \) is a solution of \( \frac{7}{8}y = \frac{3}{5} \).
3. Explain why solving \( \frac{2}{3}c = \frac{3}{5} \) by multiplying both sides by \( \frac{5}{2} \) is the same as solving it by dividing both sides by \( \frac{2}{5} \).
GUIDED PRACTICE

See Example 1
Solve. Write each answer in simplest form.

1. \( a - \frac{1}{2} = \frac{1}{4} \)
2. \( m + \frac{1}{6} = \frac{5}{6} \)
3. \( p - \frac{2}{3} = \frac{5}{6} \)

See Example 2
4. \( \frac{1}{5}x = 8 \)
5. \( \frac{2}{3}r = \frac{3}{5} \)
6. \( 3w = \frac{3}{7} \)

See Example 3
7. Kara has \( \frac{3}{8} \) cup less oatmeal than she needs for a cookie recipe. If she has \( \frac{3}{4} \) cup of oatmeal, how much oatmeal does she need?

INDEPENDENT PRACTICE

See Example 1
Solve. Write each answer in simplest form.

8. \( n - \frac{1}{5} = \frac{3}{5} \)
9. \( t - \frac{3}{8} = \frac{1}{4} \)
10. \( s - \frac{7}{24} = \frac{1}{3} \)

11. \( x + \frac{2}{3} = \frac{27}{8} \)
12. \( h + \frac{7}{10} = \frac{7}{10} \)
13. \( y + \frac{5}{6} = \frac{19}{20} \)

See Example 2
14. \( \frac{1}{5}x = 4 \)
15. \( \frac{1}{4}w = \frac{1}{8} \)
16. \( 5y = \frac{3}{10} \)

17. \( 6z = \frac{1}{2} \)
18. \( \frac{5}{8}x = \frac{2}{5} \)
19. \( \frac{5}{8}r = \frac{11}{5} \)

See Example 3
20. **Earth Science** Carbon-14 has a half-life of 5,730 years. After 17,190 years, \( \frac{1}{8} \) of the carbon-14 in a sample will be left. If 5 grams of carbon-14 are left after 17,190 years, how much was in the original sample?

PRACTICE AND PROBLEM SOLVING

Solve. Write each answer in simplest form.

21. \( \frac{4}{5}t = \frac{1}{5} \)
22. \( m - \frac{1}{2} = \frac{2}{3} \)
23. \( \frac{1}{8}w = \frac{3}{4} \)
24. \( \frac{8}{9} + t = \frac{17}{18} \)
25. \( \frac{5}{3}x = 1 \)
26. \( j + \frac{5}{8} = \frac{11}{16} \)
27. \( \frac{4}{3}n = \frac{3}{5} \)
28. \( z + \frac{1}{6} = \frac{3}{15} \)
29. \( \frac{3}{4}v = \frac{3}{8} \)
30. \( \frac{5}{26} + m = \frac{7}{13} \)
31. \( \frac{1}{11} + r = \frac{8}{77} \)
32. \( y - \frac{3}{4} = \frac{9}{20} \)
33. \( h - \frac{3}{8} = \frac{11}{24} \)
34. \( \frac{5}{36}t = \frac{5}{16} \)
35. \( \frac{8}{13}v = \frac{6}{13} \)
36. \( 4\frac{6}{7} + p = 5\frac{1}{4} \)
37. \( d - 5\frac{1}{8} = 9\frac{3}{10} \)
38. \( 6\frac{8}{21}k = 13\frac{1}{3} \)

39. **Food** Each person in Finland drinks an average of \( 24\frac{1}{4} \) lb of coffee per year. This is \( 13\frac{7}{10} \) lb more than the average person in Italy consumes. On average, how much coffee does an Italian drink each year?

40. **Weather** Yuma, Arizona, receives \( 102\frac{1}{100} \) fewer inches of rain each year than Quillayute, Washington, which receives \( 105\frac{9}{50} \) inches per year. *(Source: National Weather Service).* How much rain does Yuma get in one year?
41. **Science** Scientists have discovered $1\frac{1}{2}$ million species of animals. This is estimated to be $\frac{1}{10}$ the total number of species thought to exist. About how many species do scientists think exist?

42. **History** The circle graph shows the birthplaces of the United States’ presidents who were in office between 1789 and 1845.

   a. If six of the presidents represented in the graph were born in Virginia, how many presidents are represented in the graph?

   b. Based on your answer to a, how many of the presidents were born in Massachusetts?

43. **Architecture** An office building has $\frac{2}{3}$ as many stories as a bank building. If the office building has 32 stories, how many stories does the bank building have?

44. **Multi-Step** This week, Jennifer had $\frac{1}{15}$ of her allowance left over after she put $\frac{1}{5}$ of it into her savings account and used part of it to buy her lunch each day. What fraction of her allowance did she spend on lunches?

45. **What’s the Error?** A student solved $\frac{3}{5}x = \frac{2}{3}$ and got $x = \frac{2}{5}$. Find the error.

46. **Write About It** Solve $3\frac{1}{2}z = 1\frac{1}{2}$. Explain why you need to write mixed numbers as improper fractions when multiplying and dividing.

47. **Challenge** Solve $\frac{3}{5}w = 0.9$. Write your answer as a fraction and as a decimal.

**Spiral Standards Review**

48. **Multiple Choice** Which value of $y$ is the solution to the equation $y - \frac{7}{8} = \frac{3}{5}$?
   
   A. $y = \frac{11}{40}$  
   B. $y = \frac{10}{13}$  
   C. $y = \frac{19}{40}$  
   D. $y = 2$

49. **Multiple Choice** Which equation has the solution $x = \frac{2}{5}$?
   
   A. $\frac{2}{5}x = 1$  
   B. $\frac{3}{4}x = \frac{6}{20}$  
   C. $\frac{4}{7} + x = \frac{2}{3}$  
   D. $x - \frac{5}{7} = \frac{3}{2}$

Order the numbers from least to greatest. (Lesson 3-6)

50. $-0.61, -\frac{3}{5}, -\frac{4}{3}, -1.25$  
51. $3.25, 3\frac{2}{10}, 3, 3.02$  
52. $\frac{1}{2}, -0.2, -\frac{7}{10}, 0.04$

Divide. Write each answer in simplest form. (Lesson 4-5)

53. $\frac{2}{5} \div \frac{7}{12}$  
54. $5 \div \frac{3}{4}$  
55. $3\frac{1}{2} \div 2\frac{5}{8}$
Quiz for Lessons 4-4 Through 4-6

4-4 Multiplying Fractions and Mixed Numbers

Multiply. Write each answer in simplest form.

1. $12 \cdot \frac{5}{6}$
2. $\frac{5}{14} \cdot \frac{7}{10}$
3. $8\frac{4}{5} \cdot \frac{10}{11}$
4. $10\frac{5}{12} \cdot 1\frac{3}{5}$
5. $\frac{52}{5} \cdot 3$
6. $4\frac{2}{7} \cdot \frac{4}{15}$
7. $1\frac{1}{17} \cdot \frac{52}{3}$
8. $3\frac{1}{11} \cdot 10\frac{1}{2}$

9. During the first day of a recycle drive, the seventh grade collected $23\frac{1}{2}$ pounds of aluminum cans. The sixth grade collected $\frac{3}{4}$ as many pounds as the seventh grade. How many pounds of aluminum cans did the sixth grade collect?

10. A recipe calls for $1\frac{1}{3}$ cups flour. Tom is making $2\frac{1}{2}$ times the recipe for his family reunion. How much flour does he need? Write your answer in simplest form.

4-5 Dividing Fractions and Mixed Numbers

Divide. Write each answer in simplest form.

11. $\frac{1}{6} \div \frac{5}{6}$
12. $\frac{2}{3} \div 4$
13. $5\frac{3}{5} \div \frac{4}{5}$
14. $4\frac{2}{7} \div 1\frac{1}{5}$
15. $2\frac{3}{4} \div 6$
16. $9 \div \frac{2}{3}$
17. $5\frac{4}{5} \div \frac{1}{10}$
18. $5 \div 2\frac{1}{7}$

19. Marcus feeds his dog $1\frac{3}{4}$ pounds of food each day. How many days can he feed his dog if he has a 42-pound bag of dog food?

20. Nina has $9\frac{3}{4}$ yards of material. She needs $1\frac{1}{2}$ yards to make a pillow case. How many pillow cases can Nina make with the material?

4-6 Solving Equations Containing Fractions

Solve. Write each answer in simplest form.

21. $x - \frac{2}{3} = \frac{2}{15}$
22. $\frac{4}{9} = 2q$
23. $\frac{1}{6}m = \frac{1}{9}$
24. $\frac{1}{6} + p = \frac{5}{8}$
25. $x - 2\frac{1}{2} = 8\frac{3}{8}$
26. $\frac{3}{5}n = \frac{4}{5}$
27. $\frac{1}{7}m = \frac{2}{3}$
28. $5\frac{4}{5} + x = 19$

29. Adrian used $\frac{4}{5}$ of his supply of clay to make a statue. If the statue weighed 68 pounds, how much did Adrian’s original supply of clay weigh?

30. A recipe for Uncle Frank’s homemade hush puppies calls for $\frac{1}{8}$ teaspoon of cayenne pepper. The recipe calls for 6 times as much salt as it does cayenne pepper. How much salt does Uncle Frank’s recipe require?
Understand the Problem

• Write the problem in your own words

One way to understand a problem better is to write it in your own words. Before you do this, you may need to read it over several times, perhaps aloud so that you can hear yourself say the words. When you write a problem in your own words, try to make the problem simpler. Use smaller words and shorter sentences. Leave out any extra information, but make sure to include all the information you need to answer the question.

Write each problem in your own words. Check that you have included all the information you need to answer the question.

1. Martin is making muffins for his class bake sale. The recipe calls for \(2\frac{1}{3}\) cups of flour, but Martin's only measuring cup holds \(\frac{1}{3}\) cup. How many times should he fill his measuring cups?

2. Mariko sold an old book to a used bookstore. She had hoped to sell it for $0.80, but the store gave her \(\frac{3}{4}\) of a dollar. What is the difference between the two amounts?

3. Koalas of eastern Australia feed mostly on eucalyptus leaves. They select certain trees over others to find the \(1\frac{1}{4}\) pounds of food they need each day. Suppose a koala has eaten \(1\frac{3}{8}\) pounds of food. Has the koala eaten enough food for the day?

4. The first day of the Tour de France is called the prologue. Each of the days after that is called a stage, and each stage covers a different distance. The total distance covered in the race is about 3,600 km. If a cyclist has completed \(\frac{1}{3}\) of the race, how many kilometers has he ridden?
One of the coolest summers on record in the Midwest was in 1992. The average summertime temperature that year was 66.8°F. Normally, the average temperature is 4°F higher than it was in 1992.

To find the normal average summertime temperature in the Midwest, you can add 66.8°F and 4°F.

$$\begin{align*}
66.8 \\
+ 4.0 \\
\hline
70.8
\end{align*}$$

The normal average summertime temperature in the Midwest is 70.8°F.

**Example 1**

**Adding and Subtracting Decimals**

Add or subtract. Estimate to check whether each answer is reasonable.

**A**

3.62 + 18.57

- Line up the decimal points.
- Add.

<table>
<thead>
<tr>
<th>3.62</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 18.57</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>22.19</td>
</tr>
</tbody>
</table>

**Estimate**

Round 3.62 to 4, and round 18.57 to 19.

4 + 19 = 23

22.19 is a reasonable answer.

**B**

14.00 − 7.32

- Use zeros as placeholders.
- Line up the decimal points.
- Subtract.

<table>
<thead>
<tr>
<th>14.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>− 7.32</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>6.68</td>
</tr>
</tbody>
</table>

**Estimate**

Round 7.32 to 7.

14 − 7 = 7

6.68 is a reasonable answer.
To multiply decimals, multiply as you would with integers, and then place the decimal point. The product should have the same number of decimal places as the sum of the decimal places in the factors.

**EXAMPLE 2**

**Reasoning**

**Multiplying Decimals**

Multiply. Estimate to check whether each answer is reasonable.

**A**

\[0.04 \times 2\]

\[
\begin{array}{c}
0.04 \\
\times 2 \\
0.08
\end{array}
\]

**Estimate**

\[0 \times 2 = 0\]

**0.08 is a reasonable answer.**

**B**

\[-2.78 \times 0.8\]

\[
\begin{array}{c}
-2.78 \\
\times 0.8 \\
-2.224
\end{array}
\]

**Estimate**

\[-3 \times 1 = -3\]

**-2.224 is a reasonable answer.**

**EXAMPLE 3**

**Earth Science Application**

On average, 0.36 kg of carbon dioxide is added to the atmosphere for each mile a single car is driven. How many kilograms of carbon dioxide are added for each mile the 132 million cars in the United States are driven?

\[
\begin{array}{c}
132 \\
\times 0.36 \\
792 \\
3960 \\
47.52
\end{array}
\]

**0 + 2 = 2 decimal places**

Approximately 47.52 million (47,520,000) kilograms of carbon dioxide are added to the atmosphere for each mile driven.

**Think and Discuss**

1. **Describe** how you can check an answer when adding and subtracting decimals.

2. **Explain** whether the multiplication \(2.1 \times 3.3 = 69.3\) is correct.
### GUIDED PRACTICE

Add or subtract. Estimate to check whether each answer is reasonable.

1. $5.37 + 16.45$  
2. $7 + 5.826$  
3. $7.89 - 5.91$  
4. $4.97 - 3.2$

Multiply. Estimate to check whether each answer is reasonable.

5. $3 \cdot 0.2$  
6. $2.6 \cdot 0.4$  
7. $1.5 \cdot (-0.21)$  
8. $-0.4 \cdot 1.17$

9. If Carla is able to drive her car 24.03 miles on one gallon of gas, how far could she drive on 13.93 gallons of gas?

### INDEPENDENT PRACTICE

Add or subtract. Estimate to check whether each answer is reasonable.

10. $7.82 + 31.23$  
11. $5.98 + 12.99$  
12. $4.917 + 12$  
13. $10.022 + 0.11$

14. $5.45 - 3.21$  
15. $15.39 - 2.6$  
16. $21.04 - 4.99$  
17. $5 - 0.53$

Multiply. Estimate to check whether each answer is reasonable.

18. $2.4 \cdot 3.2$  
19. $2.8 \cdot 1.6$  
20. $5.3 \cdot 4.6$  
21. $4.02 \cdot 0.7$

22. $-5.14 \cdot 0.03$  
23. $1.04 \cdot (-8.9)$  
24. $4.31 \cdot (-9.5)$  
25. $-6.1 \cdot (-1.01)$

26. Nicholas bicycled 15.8 kilometers each day for 18 days last month. How many kilometers did he bicycle last month?

27. While walking, Lara averaged 3.63 miles per hour. How far did she walk in 1.5 hours?

### PRACTICE AND PROBLEM SOLVING

Add or subtract. Estimate to check whether each answer is reasonable.

28. $7.238 - 6.9$  
29. $9.043 - 4.16$  
30. $2.09 + 15.271$

31. $5.23 + 9.1$  
32. $123 + 2.55$  
33. $5.29 - 3.37$

Multiply. Estimate to check whether each answer is reasonable.

34. $-325.9 \cdot 1.5$  
35. $14.7 \cdot 0.13$  
36. $-28.5 \cdot (-1.07)$

37. $-7.02 \cdot (-0.05)$  
38. $1.104 \cdot (-0.7)$  
39. $0.072 \cdot 0.12$

40. **Multi-Step** Students at Hill Middle School plan to run a total of 2,462 mi, which is the distance from Los Angeles to New York City. So far, the sixth grade has run 273.5 mi, the seventh grade has run 275.8 mi, and the eighth grade has run 270.2 mi. How many more miles must the students run to reach their goal?

41. **Critical Thinking** Why must you line up the decimal points when adding and subtracting decimals?
42. **Reasoning** The graph shows the results of a survey about river recreation activities.


43. **Science** To float in water, an object must have a density of less than 1 gram per milliliter. The density of a fresh egg is about 1.2 grams per milliliter. If the density of a spoiled egg is about 0.3 grams per milliliter less than that of a fresh egg, what is the density of a spoiled egg? How can you use water to tell whether an egg is spoiled?

44. **What’s the Question?** In a collection, each rock sample has a mass of 4.35 kilograms. There are a dozen rocks in the collection. If the answer is 52.2 kilograms, what is the question?

45. **Write About It** How do the products 4.3 \( \div \) 0.56 and 0.43 \( \div \) 5.6 compare? Explain.

46. **Challenge** Find the missing number. \( 5.11 \div 6.9 \div 15.3 \div \square = 20 \)

---

**Spiral Standards Review**

47. **Multiple Choice** In the 1900 Olympic Games, the 200-meter dash was won in 22.20 seconds. In 2000, the 200-meter dash was won in 20.09 seconds. How many seconds faster was the winning time in the 2000 Olympics?

   - A) 1.10 seconds
   - B) 2.11 seconds
   - C) 2.29 seconds
   - D) 4.83 seconds

48. **Gridded Response** Julia walked 1.8 mi each day from Monday through Friday. On Saturday, she walked 2.3 mi. How many miles did she walk in all?

49. Solve each equation. Check your answer. (Lesson 2-5)

   - 49. \( x - 8 = -22 \)
   - 50. \( -3y = -45 \)
   - 51. \( \frac{z}{2} = -8 \)
   - 52. \( 29 = -10 + p \)

50. Solve. Write each answer in simplest form. (Lesson 4-6)

   - 53. \( n - \frac{2}{7} = \frac{1}{2} \)
   - 54. \( x + \frac{2}{3} = \frac{3}{4} \)
   - 55. \( \frac{1}{4}m = \frac{1}{2} \)
   - 56. \( \frac{5}{8}x = 1 \)
Dividing Decimals

Why learn this?  You can divide decimals to determine how far a car can travel per gallon of gasoline. (See Example 3.)

You can use a grid to model 0.6 ÷ 0.3. Circle groups of 0.3 and count the number of groups. There are 2 groups of 0.3 in 0.6, so 0.6 ÷ 0.3 = 2.

When you divide two numbers, you can multiply both numbers by the same power of ten without changing the final answer.

Multiply both 0.6 and 0.3 by 10:

\[
0.6 \times 10 = 6 \quad \text{and} \quad 0.3 \times 10 = 3
\]

\[
0.6 \div 0.3 = 2 \quad \text{and} \quad 6 \div 3 = 2
\]

By multiplying both numbers by the same power of ten, you can make the divisor an integer. Dividing by an integer is much easier than dividing by a decimal.

EXAMPLE 1 Dividing Decimals by Decimals

Divide.

A \[\begin{array}{c}
4.32 \div 3.6 \\
3.6 \overline{)4.32} \\
\underline{-3.6} \\
0.72 \\
\underline{-0.72} \\
0
\end{array}\]

Multiply both numbers by 10 to make the divisor an integer.

Divide as with whole numbers.

B \[\begin{array}{c}
12.95 \div (-1.25) \\
1.25 \overline{)12.95} \\
\underline{-10.50} \\
2.45 \\
\underline{-2.50} \\
7.50 \\
\underline{-7.50} \\
0
\end{array}\]

Multiply both numbers by 100 to make the divisor an integer.

Use zeros as placeholders.

Divide as with whole numbers.

\[12.95 \div (-1.25) = -10.36\]

The signs are different.
Dividing Integers by Decimals
Divide. Estimate to check whether each answer is reasonable.

**A** 9 ÷ 1.25

\[
\begin{array}{c|c}
1.25 & 9.00 \\
\hline
7.2 & \\
125 & 900.0 \\
-875 & \\
\hline
250 & \\
-250 & \\
\hline
0 & \\
\end{array}
\]

*Estimate* 9 ÷ 1 = 9

**B** −12 ÷ (−1.6)

\[
\begin{array}{c|c}
1.6 & 12.0 \\
\hline
7.5 & \\
16 & 120.0 \\
-112 & \\
\hline
80 & \\
-80 & \\
\hline
0 & \\
\end{array}
\]

−12 ÷ (−1.6) = 7.5

*Estimate* −12 ÷ (−2) = 6

Transportation Application

If Sandy used 15.45 gallons of gas to drive her car 370.8 miles, how many miles per gallon did she get?

\[
\begin{array}{c|c}
15.45 & 370.80 \\
\hline
24 & \\
1,545 & 37,080 \\
-3090 & \\
\hline
6180 & \\
-6180 & \\
\hline
0 & \\
\end{array}
\]

Sandy got 24 miles per gallon.

Think and Discuss

1. **Explain** whether 4.27 ÷ 0.7 is the same as 427 ÷ 7.
2. **Explain** how to divide an integer by a decimal.
### 4-8 Exercises

**GUIDED PRACTICE**

See Example 1

Divide.

1. $3.78 \div 4.2$
2. $13.3 \div (-0.38)$
3. $14.49 \div 3.15$
4. $1.06 \div 0.2$
5. $-9.76 \div 3.05$
6. $263.16 \div (-21.5)$

See Example 2

Divide. Estimate to check whether each answer is reasonable.

7. $3 \div 1.2$
8. $84 \div 2.4$
9. $36 \div (-2.25)$
10. $24 \div (-1.2)$
11. $-18 \div 3.75$
12. $189 \div 8.4$

See Example 3

13. **Transportation** Samuel used 14.35 gallons of gas to drive his car 401.8 miles. How many miles per gallon did he get?

**INDEPENDENT PRACTICE**

See Example 1

Divide.

14. $81.27 \div 0.03$
15. $-0.408 \div 3.4$
16. $38.5 \div (-5.5)$
17. $-1.12 \div 0.08$
18. $27.82 \div 2.6$
19. $14.7 \div 3.5$

See Example 2

Divide. Estimate to check whether each answer is reasonable.

20. $35 \div (-2.5)$
21. $361 \div 7.6$
22. $63 \div (-4.2)$
23. $5 \div 1.25$
24. $14 \div 2.5$
25. $-78 \div 1.6$

See Example 3

26. **Transportation** Lonnie used 26.75 gallons of gas to drive his truck 508.25 miles. How many miles per gallon did he get?

27. Mitchell walked 8.5 laps in 20.4 minutes. If he walked each lap at the same pace, how long did it take him to walk one full lap?

**PRACTICE AND PROBLEM SOLVING**

Divide. Estimate to check whether each answer is reasonable.

28. $-24 \div 0.32$
29. $153 \div 6.8$
30. $-2.58 \div (-4.3)$
31. $4.12 \div (-10.3)$
32. $-17.85 \div 17$
33. $64 \div 2.56$

Simplify each expression.

34. $4.2 + (11.5 \div 4.6) + 5.8$
35. $2 \cdot (6.8 \div 3.4) \cdot 5$
36. $(6.4 \div 2.56) - 1.2 + 2.5$
37. $11.7 \div (0.7 + 0.6) \cdot 2$
38. $4 \cdot (0.6 + 0.78) \cdot 0.25$
39. $(1.6 \div 3.2) \cdot (4.2 + 8.6)$

40. **Reasoning** A car loan totaling $13,456.44 is to be paid off in 36 equal monthly payments. Lin Yao can afford no more than $350 per month. Can she afford the loan? Explain.
41. Glaciers form when snow accumulates faster than it melts and thus becomes compacted into ice under the weight of more snow. Once the ice reaches a thickness of about 18 m, it begins to flow. If ice were to accumulate at a rate of 0.0072 m per year, how long would it take to start flowing?

42. An alpine glacier is estimated to be flowing at a rate of 4.75 m per day. At this rate, how long will it take for a marker placed on the glacier by a researcher to move 1,140 m?

43. If the Muir Glacier in Glacier Bay, Alaska, retreats at an average speed of 0.73 m per year, how long will it take to retreat a total of 7.9 m? Round your answer to the nearest year.

44. Multi-Step The table shows the thickness of a glacier as measured at five different points using radar. What is the average thickness of the glacier?

<table>
<thead>
<tr>
<th>Location</th>
<th>Thickness (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>180.23</td>
</tr>
<tr>
<td>B</td>
<td>160.5</td>
</tr>
<tr>
<td>C</td>
<td>210.19</td>
</tr>
<tr>
<td>D</td>
<td>260</td>
</tr>
<tr>
<td>E</td>
<td>200.22</td>
</tr>
</tbody>
</table>

45. The Harvard Glacier in Alaska is advancing at a rate of about 0.055 m per day. At this rate, how long will it take the glacier to advance 20 m? Round your answer to the nearest hundredth.

46. Challenge Hinman Glacier, on Mount Hinman, in Washington State, had an area of 1.3 km² in 1958. The glacier has lost an average of 0.06875 km² of area each year. Based on this rate, in what year was the total area 0.2 km²?

47. Multiple Choice Simplify $4.42 \div 2.6 + 4.6$.

- A 6.3
- B 2.9
- C 1.4
- D 0.6

48. Multiple Choice A deli is selling 5 sandwiches for $5.55, including tax. A school spent $83.25 on roast beef sandwiches for its 25 football players. How many sandwiches did each player get?

- A 1
- B 2
- C 3
- D 5

Simplify each expression. (Lesson 1-3)

49. $2 + 6 \cdot 2$

50. $3^2 - 8 \cdot 0$

51. $(2 - 1)^5 + 3 \cdot 2^2$

52. A monarch butterfly has a wingspan of $3\frac{3}{8}$ in., and a common blue butterfly has a wingspan of $1\frac{3}{16}$ in. How much greater is the wingspan of the monarch butterfly than that of the common blue butterfly? (Lesson 4-3)
Choosing the Most Appropriate Metric Unit

Choose the most appropriate metric unit for each measurement. Justify your answer.

A. The length of a car
   Meters—the length of a car is similar to the width of several doorways.

B. The mass of a skateboard
   Kilograms—the mass of a skateboard is similar to the mass of several textbooks.

C. The recommended dose of a cough syrup
   Milliliters—one dose of cough syrup is similar to the amount of liquid in several eyedroppers.
The prefixes of metric units correlate to place values in the base-10 number system. The table shows how metric units are based on powers of 10.

<table>
<thead>
<tr>
<th></th>
<th>1,000</th>
<th>100</th>
<th>10</th>
<th>1</th>
<th>0.1</th>
<th>0.01</th>
<th>0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thousands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hundreds</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tens</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ones</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Tenths</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Hundredths</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Thousandths</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Kilo- Hecto- Deca- Base unit Deci- Centi- Milli-

You can convert units within the metric system by multiplying or dividing by powers of 10. To convert to a smaller unit, you must multiply. To convert to a larger unit, you must divide.

**EXAMPLE 2** Converting Metric Units

Convert each measure.

A 510 cm to meters

\[ 510 \text{ cm} = (510 \div 100) \text{ m} = 5.1 \text{ m} \]

Move the decimal point 2 places left: 510.

B 2.3 L to milliliters

\[ 2.3 \text{ L} = (2.3 \times 1,000) \text{ mL} = 2,300 \text{ mL} \]

Move the decimal point 3 places right: 2.300.

**EXAMPLE 3** Using Unit Conversion to Make Comparisons

Mai and Brian are measuring the mass of rocks in their Earth Science class. Mai’s rock has a mass of 480 g. Brian’s rock has a mass of 0.05 kg. Whose rock has the greater mass?

You can convert the mass of Mai’s rock to kilograms.

\[ 480 \text{ g} = (480 \div 1,000) \text{ kg} = 0.48 \text{ kg} \]

Move the decimal point 3 places left: 480.

Since 0.48 kg > 0.05 kg, Mai’s rock has the greater mass.

**Check**

Use number sense. There are 1,000 grams in a kilogram, so the mass of Mai’s rock is about half a kilogram, or 0.5 kg. This is much greater than 0.05 kg, the mass of Brian’s rock, so the answer is reasonable.

**Think and Discuss**

1. **Tell** how the metric system relates to the base-10 number system.
2. **Explain** why it makes sense to multiply by a whole number when you convert to a smaller unit.
4-9 Exercises

GUIDED PRACTICE

See Example 1
Choose the most appropriate metric unit for each measurement.

Justify your answer.

1. The mass of a pumpkin
2. The amount of water in a pond
3. The length of an eagle’s beak
4. The mass of a penny

See Example 2
Convert each measure.

5. 12 kg to grams
6. 4.3 m to centimeters
7. 0.7 mm to centimeters
8. 3,200 mL to liters

See Example 3
9. On Sunday, Li ran 0.8 km. On Monday, she ran 7,200 m. On which day did Li run farther? Use estimation to explain why your answer makes sense.

INDEPENDENT PRACTICE

See Example 1
Choose the most appropriate metric unit for each measurement.

Justify your answer.

10. The capacity of a teacup
11. The mass of 10 grains of salt
12. The height of a palm tree
13. The distance between your eyes

See Example 2
Convert each measure.

14. 0.067 L to milliliters
15. 1.4 m to kilometers
16. 900 mg to grams
17. 355 cm to millimeters

See Example 3
18. Carmen pours 75 mL of water into a beaker. Nick pours 0.75 L of water into a different beaker. Who has the greater amount of water? Use estimation to explain why your answer makes sense.

PRACTICE AND PROBLEM SOLVING

Convert each measure.

19. 1.995 m = cm
20. 0.00004 kg = g
21. 2,050 kL = L
22. 0.002 mL = L
23. 3.7 mm = cm
24. 61.8 g = mg

Compare. Write <, >, or =.

25. 0.1 cm 1 mm
26. 25 g 3,000 mg
27. 340 mg 0.4 g
28. 0.05 kL 5 L
29. 0.3 mL 0.005 L
30. 1.3 kg 1,300 g

31. Art  The Mona Lisa by Leonardo da Vinci is 77 cm tall. Starry Night by Vincent Van Gogh is 0.73 m tall. Which is the taller painting? How much taller is it?
Write each set of measures in order from least to greatest.

32. 0.005 kL; 4.1 L; 6,300 mL  
33. 1.5 m; 1,200 mm; 130 cm  
34. 4,000 mg; 50 kg; 70 g  
35. 9.03 g; 0.0008 kg; 1,000 mg

36. **Measurement** Use a ruler to measure the line segment at right in centimeters. Then give the length of the segment in millimeters and meters.

**Science** The table gives information about several species of Vesper, or Evening, bats. Use the table for Exercises 37 and 38.

37. Which bat has the greatest mass?

38. Which bat has a longer wingspread, the Red Bat or the Big Brown Bat? How much longer is its wingspread?

39. **Critical Thinking** One milliliter of water has a mass of 1 gram. What is the mass of a liter of water?

40. **What’s the Error?** A student converted 45 grams to milligrams as shown below. Explain the student’s error.

\[ 45 \text{ g} = (45 \div 1,000) \text{ mg} = 0.045 \text{ mg} \]

41. **Write About It** Explain how to decide whether milligrams, grams, or kilograms are the most appropriate unit for measuring the mass of an object.

42. **Challenge** A decimeter is \( \frac{1}{10} \) of a meter. Explain how to convert millimeters to decimeters.

---

**Spiral Standards Review**

43. **Multiple Choice** Which of these is the same as 0.4 grams?

A. 0.0004 mg  
B. 0.004 mg  
C. 400 mg  
D. 4,000 mg

44. **Short Response** Which has a greater capacity, a measuring cup that holds 250 mL or a measuring cup that holds 0.5 L? Justify your answer.

Complete each equation. Then tell which property is represented. (Lesson 1-4)

45. \( 2(10 + 4) = 2 \cdot 10 + 2 \cdot \underline{\hspace{2cm}} \)  
46. \( 2 + 7 + 8 = 2 + 8 + \underline{\hspace{2cm}} \)  
47. \( (3 \cdot 6) \cdot 18 = \underline{\hspace{2cm}} \cdot (6 \cdot 18) \)  
48. \( 9 \cdot 22 \cdot 6 = 22 \cdot \underline{\hspace{2cm}} \cdot 6 \)

Add or subtract. Write each answer in simplest form. (Lesson 4-2)

49. \( \frac{9}{13} - \frac{5}{26} \)  
50. \( \frac{1}{4} + \frac{5}{8} \)  
51. \( \frac{5}{6} - \frac{2}{3} \)  
52. \( \frac{3}{8} + \frac{1}{6} \)

---

4-9 Metric Measurements 213
The slowest time in a 40-yard dash was 3.84 seconds slower than the fastest time of 7.2 seconds. You can write an equation to represent this situation. The slowest time \( s \) minus 3.84 is equal to the fastest time of 7.2 seconds.

\[ s - 3.84 = 7.2 \]

**Example 1:** Solving Equations by Adding or Subtracting

**A**

\[ s - 3.84 = 7.2 \]

\[ s - 3.84 = \boxed{7.20} \]

\[ + 3.84 + 3.84 \]

\[ s = \boxed{11.04} \]

*Since 3.84 is subtracted from \( s \), add 3.84 to both sides.*

**B**

\[ y + 20.51 = 26 \]

\[ y + 20.51 = \boxed{26.00} \]

\[ - 20.51 - 20.51 \]

\[ y = \boxed{5.49} \]

*Since 20.51 is added to \( y \), subtract 20.51 from both sides.*

**Example 2:** Solving Equations by Multiplying or Dividing

**A**

\[ \frac{w}{3.9} = 1.2 \]

\[ \frac{w}{3.9} = \boxed{1.2} \]

\[ \times 3.9 \times 3.9 \]

\[ w = \boxed{4.68} \]

*Since \( w \) is divided by 3.9, multiply both sides by 3.9.*

**B**

\[ 4 = 1.6c \]

\[ 4 = \boxed{1.6c} \]

\[ \div 1.6 \div 1.6 \]

\[ \frac{4}{1.6} = \boxed{c} \]

Think: \( 4 \div 1.6 = 40 \div 16 \).
Yancey wants to buy a new snowboard that costs $396.00. If she earns $8.25 per hour at work, how many hours must she work to earn enough money to buy the snowboard?

1. Understand the Problem
Rewrite the question as a statement.
• Find the number of hours Yancey must work to earn $396.00.
List the important information:
• Yancey earns $8.25 per hour.
• Yancey needs $396.00 to buy a snowboard.

2. Make a Plan
Yancey’s pay is equal to her hourly pay times the number of hours she works. Since you know how much money she needs to earn, you can write an equation with $h$ being the number of hours.

$$8.25h = 396$$

3. Solve

$$8.25h = 396$$

$$\frac{8.25h}{8.25} = \frac{396}{8.25}$$  
Since $h$ is multiplied by 8.25, divide both sides by 8.25.

$$h = 48$$

Yancey must work 48 hours.

4. Look Back
You can round 8.25 to 8 and 396 to 400 to estimate how many hours Yancey needs to work.

$$400 \div 8 = 50$$

So 48 hours is a reasonable answer.

Think and Discuss
1. Describe how to solve the equation $-1.25 + x = 1.25$. Then solve.
2. Explain how you can tell if 1.01 is a solution of $10s = -10.1$ without solving the equation.
GUIDED PRACTICE

See Example 1

1. \( w - 5.8 = 1.2 \)
2. \( x + 9.15 = 17 \)
3. \( k + 3.91 = 28 \)
4. \( n - 1.35 = 19.9 \)

See Example 2

5. \( \frac{b}{1.4} = 3.6 \)
6. \( \frac{x}{0.8} = 7.2 \)
7. \( 3.1t = 27.9 \)

See Example 3

9. **Consumer Math** Jeff bought a sandwich and a salad for lunch. His total bill was $7.10. The salad cost $2.85. How much did the sandwich cost?

INDEPENDENT PRACTICE

See Example 1

10. \( v + 0.84 = 6 \)
11. \( c - 32.56 = 12 \)
12. \( d - 14.25 = 23.9 \)
13. \( 3.52 + a = 8.6 \)
14. \( w - 9.01 = 12.6 \)
15. \( p - 30.34 = 22.87 \)

See Example 2

16. \( 3.2c = 8 \)
17. \( 72 = 4.5z \)
18. \( 21.8x = -124.26 \)
19. \( \frac{w}{2.8} = 4.2 \)
20. \( \frac{m}{0.19} = 12 \)
21. \( \frac{a}{21.23} = -3.5 \)

See Example 3

22. At the fair, 25 food tickets cost $31.25. What is the cost of each ticket?
23. To climb the rock wall at the fair, you must have 5 ride tickets. If each ticket costs $1.50, how much does it cost to climb the rock wall?

PRACTICE AND PROBLEM SOLVING

Solve.

24. \( 1.2y = -1.44 \)
25. \( \frac{n}{8.2} = -0.6 \)
26. \( w - 4.1 = 5 \)
27. \( r + 0.48 = 1.2 \)
28. \( x - 5.2 = 7.3 \)
29. \( 1.05 = -7m \)
30. \( a + 0.81 = 6.3 \)
31. \( 60k = 54 \)
32. \( \frac{h}{-7.1} = 0.62 \)
33. \( \frac{t}{-0.18} = -5.2 \)
34. \( 7.9 = d - 12.7 \)
35. \( v - 1.8 = 3.8 \)
36. \( -k = 287.658 \)
37. \( -n = -12.254 \)
38. \( 0.64f = 12.8 \)
39. \( 15.217 = 4.11 + j \)
40. \( 2.1 = p - 9.3 \)
41. \( 27.3 = 54.6g \)

42. The Drama Club at Smith Valley Middle School is selling mugs in order to raise money for costumes. If each mug costs $4.75, how many mugs must members sell to make $570.00?

43. **Consumer Math** Gregory bought a computer desk at a thrift store for $38. The regular price of a similar desk at a furniture store is 4.5 times as much. What is the regular price of the desk at the furniture store?
44. **Science** Pennies minted, or created, before 1982 are made mostly of copper and have a density of 8.85 grams per cubic centimeter. The density of pennies made after 1982 is 1.71 grams per cubic centimeter less. What is the density of pennies minted today?

45. **Social Studies** The table shows the most common European ancestral origins of Americans (in millions), according to a Census 2000 supplementary survey. In addition, 19.6 million people stated that their ancestry was “American.”

<table>
<thead>
<tr>
<th>European Ancestry</th>
<th>Number (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>28.3</td>
</tr>
<tr>
<td>French</td>
<td>9.8</td>
</tr>
<tr>
<td>German</td>
<td>46.5</td>
</tr>
<tr>
<td>Irish</td>
<td>33.1</td>
</tr>
<tr>
<td>Italian</td>
<td>15.9</td>
</tr>
<tr>
<td>Polish</td>
<td>9.1</td>
</tr>
<tr>
<td>Scottish</td>
<td>5.4</td>
</tr>
</tbody>
</table>

- **a.** How many people claimed ancestry from the countries listed, according to the survey?
- **b.** If the data were placed in order from greatest to least, between which two nationalities would “American” ancestry be placed?

46. **What’s the Error?** A student’s solution to the equation \( m + 0.63 = 5 \) was \( m = 5.63 \). What is the error? What is the correct solution?

47. **Write About It** Compare the process of solving equations containing integers with the process of solving equations containing decimals.

48. **Challenge** Solve the equation \(-2.8 + (b - 1.7) = -0.6 \cdot 9.4\).

50. **Multiple Choice** The pep squad is selling tickets for a raffle. The tickets are $0.25 each or 5 for $1.00. Julie bought a pack of 5 tickets. Which equation can be used to find how much Julie paid per ticket?

- **A.** \( 5x = 0.25 \)
- **B.** \( 0.25x = 1.00 \)
- **C.** \( 5x = 1.00 \)
- **D.** \( 1.00x = 0.25 \)

51. **Extended Response** Write a word problem that the equation \( 6.25x = 125 \) can be used to solve. Solve the problem and explain what the solution means.

Evaluate each expression for the given value of the variable. (Lesson 1-5)

- **52.** \( 2x - 4x \) for \( x = 5 \)
- **53.** \( n^2 + 6n \) for \( n = 7 \)
- **54.** \( \frac{p}{4} + 3p \) for \( p = 8 \)

Simplify each expression. (Lesson 4-8)

- **55.** \( 6.3 \div 2.1 - 1.5 \)
- **56.** \( 4 \cdot 5.1 \div 2 + 3.6 \)
- **57.** \( (1.6 + 3.8) \div 1.8 \)
- **58.** \( (5.4 + 3.6) \div 0.9 \)
- **59.** \( 4.5 \div 0.6 \cdot 1.2 \)
- **60.** \( 5.8 + 3.2 \div 6.4 \)
Quiz for Lessons 4-7 Through 4-10

4-7 Adding, Subtracting, and Multiplying Decimals

Add or subtract.

1. $4.73 + 29.68$  
2. $6.89 + 29.4$  
3. $23.58 - 8.36$  
4. $15 - 9.44$
5. $17 + 8.37$  
6. $6.2 - 0.45$  
7. $0.35 + 10.4$  
8. $17.8 - 6.92$

Multiply.

9. $3.4 \cdot 9.6$  
10. $-2.66 \cdot 0.9$  
11. $-7 \cdot (-0.06)$  
12. $6.94 \cdot (-24)$
13. $12.67 \cdot 15$  
14. $15.2 \cdot 2.4$  
15. $-5.4 \cdot 0.03$  
16. $-265 \cdot (-0.04)$

17. Cami can run 7.02 miles per hour. How many miles can she run in 1.75 hours? Round your answer to the nearest hundredth.

4-8 Dividing Decimals

Divide.

18. $10.8 \div (-4)$  
19. $6.5 \div 2$  
20. $-45.6 \div 12$  
21. $-99.36 \div (-4)$
22. $10.4 \div (-0.8)$  
23. $18 \div 2.4$  
24. $-3.3 \div 0.11$  
25. $-36 \div (-0.9)$

26. Cynthia ran 17.5 laps in 38.5 minutes. If she ran each lap at the same pace, how long did it take her to run one full lap?

4-9 Metric Measurements

Convert each measure.

27. $17.3 \text{ kg to grams}$  
28. $540 \text{ mL to liters}$  
29. $0.46 \text{ cm to millimeters}$

30. Cat ran in the 400-meter dash and the 800-meter run. Hilo ran in the 2-kilometer cross-country race. All together, who ran the farthest, Cat or Hilo?

4-10 Solving Equations Containing Decimals

Solve.

31. $3.4 + n = 8$  
32. $x - 1.75 = 19$  
33. $-3.5 = -5x$  
34. $10.1 = \frac{s}{8}$
35. Pablo earns $5.50 per hour. His friend Raymond earns 1.2 times as much. How much does Raymond earn per hour?

36. Emma bought a scrapbook and a pair of scissors for a total of $22.15. If the scissors cost $3.24, how much did the scrapbook cost?
Something’s Fishy!  Maria and Victor are setting up a 20-gallon aquarium. They want to choose fish for the aquarium using the rule “1 inch of fish per gallon of water.” This means that the total length of the fish in their tank should be no more than 20 inches.

1. Maria considers getting one of each fish shown in the table. Estimate the total length of the fish. Could she add more fish? Explain.

2. Victor would like to have a neon tetra and a guppy in the tank. What is the total length of the two fish?

3. What is the total length of the remaining fish that Victor could add to the tank? Explain.

4. Is there enough room left for Victor to add 4 clown barbs to the tank? Why or why not?

5. Maria and Victor decide to fill the tank with neon tetras only. Write and solve an equation to find out how many neon tetras they can put in the tank.

<table>
<thead>
<tr>
<th>Common Aquarium Fish</th>
<th>Name</th>
<th>Length (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zebra danio</td>
<td>2½</td>
<td></td>
</tr>
<tr>
<td>Neon tetra</td>
<td>1¼</td>
<td></td>
</tr>
<tr>
<td>Clown barb</td>
<td>4 7/16</td>
<td></td>
</tr>
<tr>
<td>Platy</td>
<td>1 3/4</td>
<td></td>
</tr>
<tr>
<td>Guppy</td>
<td>2 3/8</td>
<td></td>
</tr>
</tbody>
</table>
Fraction Riddles

1. What is the value of one-half of two-thirds of three-fourths of four-fifths of five-sixths of six-sevenths of seven-eighths of eight-ninths of nine-tenths of one thousand?

2. What could be the next fraction in the pattern below?
\[ \frac{1}{12}, \frac{1}{6}, \frac{1}{4}, \frac{1}{3}, \ldots \]

3. I am a three-digit number. My hundreds digit is one-third of my tens digit. My tens digit is one-third of my ones digit. What number am I?

4. A splorg costs three-fourths of a dollar plus three-fourths of a splorg. How much does a splorg cost?

5. How many cubic inches of dirt are in a hole that measures \( \frac{3}{4} \) feet by \( \frac{1}{4} \) feet by \( \frac{3}{2} \) feet?

Fraction Bingo

The object is to be the first player to cover five squares in a row horizontally, vertically, or diagonally.

One person is the caller. On each of the caller’s cards, there is an expression containing fractions. When the caller draws a card, he or she reads the expression aloud for the players.

The players must find the value of the expression. If a square on the player’s card has that value or a fraction equivalent to that value, they cover the square.

The first player to cover five squares in a row is the winner. Take turns being the caller. A variation can be played in which the winner is the first person to cover all their squares.

A complete copy of the rules and game pieces are available online.
**PROJECT**

**Operation Slide Through**

Slide notes through the frame to review key concepts about operations with rational numbers.

**Directions**

1. Keep the file folder closed throughout the project. Cut off a $3\frac{1}{2}$-inch strip from the bottom of the folder. Trim the remaining folder so that it has no tabs and measures 8 inches by 8 inches. **Figure A**

2. Cut out a thin notch about 4 inches long along the middle of the folded edge. **Figure B**

3. Cut a $3\frac{3}{4}$-inch slit about 2 inches to the right of the notch. Make another slit, also $3\frac{3}{4}$ inches long, about 3 inches to the right of the first slit. **Figure C**

4. Weave the $3\frac{1}{2}$-inch strip of the folder into the notch, through the first slit, and into the second slit. **Figure D**

**Taking Note of the Math**

As you pull the strip through the frame, divide the strip into several sections. Use each section to record vocabulary and practice problems from the chapter.
**Vocabulary**

- multiplicative inverse ........................................... 192
- reciprocal .......................................................... 192

### 4-1 Estimating with Fractions (pp. 170–173)

#### Example

**Estimate.**

\[ \frac{7}{4} - \frac{4}{3} \]

\[ \frac{7}{4} \rightarrow 8 \quad \frac{4}{3} \rightarrow \frac{4}{2} \]

\[ 8 - \frac{4}{2} = 3\frac{1}{2} \]

\[ 11\frac{7}{12} \div 3\frac{2}{5} \]

\[ 11\frac{7}{12} \rightarrow 12 \quad 3\frac{2}{5} \rightarrow 3 \]

\[ 12 \div 3 = 4 \]

#### Exercises

Estimate each sum, difference, product, or quotient.

1. \[ 11\frac{1}{7} + 12\frac{3}{4} \]
2. \[ 13\frac{10}{17} - 5\frac{5}{7} \]
3. \[ 9\frac{7}{8} - 7\frac{1}{3} \]
4. \[ 11\frac{8}{9} - 11\frac{1}{20} \]
5. \[ 5\frac{13}{20} \cdot 4\frac{1}{2} \]
6. \[ 6\frac{1}{4} + 1\frac{5}{8} \]
7. Sara ran \( 2\frac{1}{3} \) laps on Monday and \( 7\frac{3}{4} \) laps on Friday. About how many more laps did Sara run on Friday?

### 4-2 Adding and Subtracting Fractions (pp. 176–179)

#### Example

**Add.**

\[ \frac{1}{3} + \frac{2}{5} = \frac{5}{15} + \frac{6}{15} \]

\[ = \frac{11}{15} \]

*Write equivalent fractions using a common denominator.*

#### Exercises

Add or subtract. Write each answer in simplest form.

8. \[ \frac{3}{4} - \frac{1}{3} \]
9. \[ \frac{1}{4} + \frac{3}{5} \]
10. \[ \frac{4}{11} + \frac{4}{44} \]
11. \[ \frac{4}{9} - \frac{1}{3} \]
12. \[ \frac{5}{8} + \frac{7}{12} \]
13. \[ \frac{9}{16} - \frac{2}{5} \]

### 4-3 Adding and Subtracting Mixed Numbers (pp. 180–183)

#### Example

**Add.**

\[ 1\frac{1}{3} + 2\frac{1}{2} = \frac{1}{6} + \frac{2}{3} \]

\[ = 3 + \frac{5}{6} \]

\[ = 3\frac{5}{6} \]

*Add the integers, and then add the fractions.*

#### Exercises

Add or subtract. Write each answer in simplest form.

14. \[ 3\frac{7}{8} + 2\frac{1}{3} \]
15. \[ 2\frac{1}{4} + 1\frac{1}{12} \]
16. \[ 8\frac{1}{2} - 2\frac{1}{4} \]
17. \[ 11\frac{3}{4} - 10\frac{1}{3} \]
18. \[ 4\frac{3}{10} + 6\frac{11}{12} \]
19. \[ 7 - 5\frac{1}{3} \]
4-4  Multiplying Fractions and Mixed Numbers  (pp. 196–199)  

**EXAMPLE**

Multiply. Write the answer in simplest form.

- \( \frac{2}{9} \cdot \frac{3}{4} = \frac{1}{3} \cdot \frac{1}{2} \)  
  Multiply numerators.  
  \( = \frac{1}{6} \)
- \( 4 \frac{1}{2} \cdot 5 \frac{3}{4} = \frac{9}{2} \cdot \frac{23}{4} \)  
  Multiply denominators.  
  \( = \frac{207}{8} \) or \( 25 \frac{7}{8} \)

**EXERCISES**

Multiply. Write each answer in simplest form.

- 20. \( \frac{1}{8} \cdot \frac{2}{9} \)
- 21. \( \frac{5}{12} \cdot \frac{4}{7} \)
- 22. \( \frac{11}{24} \cdot \frac{6}{11} \)
- 23. \( \frac{3}{25} \cdot \frac{5}{18} \)
- 24. \( \frac{1}{3} \cdot \frac{4}{1} \)
- 25. \( \frac{4}{5} \cdot \frac{2}{3} \cdot \frac{3}{10} \)
- 26. \( \frac{4}{7} \cdot \frac{5}{9} \)
- 27. \( \frac{3}{7} \cdot \frac{3}{4} \)

4-5  Dividing Fractions and Mixed Numbers  (pp. 192–195)  

**EXAMPLE**

Divide.

- \( \frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \cdot \frac{5}{2} \)  
  Multiply by the reciprocal of \( \frac{2}{5} \).  
  \( = \frac{15}{8} \) or \( 1 \frac{7}{8} \)
- \( 2 \frac{1}{3} \div 1 \frac{4}{9} = \frac{7}{3} \div \frac{13}{9} \)  
  \( = \frac{21}{13} \) or \( 1 \frac{8}{13} \)

**EXERCISES**

Divide. Write each answer in simplest form.

- 28. \( \frac{2}{3} \div \frac{3}{8} \)
- 29. \( \frac{4}{5} \div \frac{8}{15} \)
- 30. \( \frac{1}{8} \div \frac{1}{4} \)
- 31. \( \frac{5}{7} \div \frac{10}{21} \)
- 32. \( \frac{1}{3} \div 6 \frac{1}{4} \)
- 33. \( \frac{1}{2} \div 3 \frac{3}{4} \)
- 34. \( \frac{11}{13} \div \frac{11}{13} \)
- 35. \( \frac{2}{7} \div \frac{1}{2} \)

36. A loaf of bread is 21 inches long. If it is cut into \( \frac{3}{4} \)-inch slices, how many slices will there be?

4-6  Solving Equations Containing Fractions  (pp. 196–199)  

**EXAMPLE**

Solve. Write the answer in simplest form.

- \( t + \frac{2}{3} = \frac{3}{4} \)  
  Subtract \( \frac{2}{3} \) from both sides.  
  \( t = \frac{9}{12} - \frac{8}{12} \)  
  \( t = \frac{1}{12} \)
- \( \frac{1}{4} x = \frac{1}{6} \)  
  Multiply by the reciprocal of \( \frac{1}{4} \).  
  \( x = \frac{4}{6} = \frac{2}{3} \)

**EXERCISES**

Solve. Write each answer in simplest form.

- 37. \( \frac{1}{5} x = \frac{1}{3} \)
- 38. \( \frac{1}{3} + y = \frac{2}{5} \)
- 39. \( \frac{1}{6} x = \frac{2}{7} \)
- 40. \( \frac{2}{7} + x = \frac{3}{4} \)
- 41. \( m - \frac{1}{3} = \frac{4}{5} \)
- 42. \( p + \frac{1}{12} = \frac{1}{10} \)
- 43. \( y - \frac{3}{4} = \frac{2}{7} \)
- 44. \( \frac{2}{15} c = \frac{2}{5} \)

45. A chef had \( 2 \frac{1}{2} \) cups of olive oil and used \( \frac{3}{4} \) cup for a recipe. How many cups of olive oil are left?
**4-7 Adding, Subtracting, and Multiplying Decimals** (pp. 202–205)

**Example**

Add.

\[ 5.67 + 22.44 \]

\[ 5.67 \]

\[ \underline{\ + \ 22.44} \]

\[ 28.11 \]

*Line up the decimal points.*

Multiply.

\[ 1.44 \times 0.6 \]

\[ 1.44 \]

\[ \underline{\times \ 0.6} \]

\[ 0.864 \]

2 decimal places

1 decimal place

2 + 1 = 3 decimal places

**Exercises**

Add or subtract.

46. \( 4.99 + 22.89 \)

47. \( 18.09 - 11.87 \)

48. \( 4.7 \times 5.902 \)

49. \( 6.7 + 44.5 \)

50. \( 23 - 8.905 \)

51. \( 4.68 + 31.2 \)

**4-8 Dividing Decimals** (pp. 206–209)

**Example**

Divide.

\[ 0.96 \div 1.6 \]

\[ 0.96 \]

\[ \underline{\div \ 1.6} \]

\[ 0.6 \]

16)\[ 9.6 \]

\[ -9.6 \]

\[ 0 \]

*Multiply both numbers by 10 to make the divisor an integer.*

**Exercises**

Divide.

58. \( 7.65 \div 1.7 \)

59. \( 9.483 \div (-8.7) \)

60. \( 126.28 \div (-8.2) \)

61. \( 2.5 \div (-0.005) \)

62. \( 9 \div 4.5 \)

63. \( 13 \div 3.25 \)

**4-9 Metric Measurements** (pp. 210–213)

**Example**

Convert 63 m to centimeters.

\[ 63 \text{ m} = (63 \times 100) \text{ cm} \]

\[ 100 \text{ cm} = 1 \text{ m} \]

\[ 6,300 \text{ cm} \]

**Exercises**

Convert each measure.

64. 18 L to mL

65. 720 mg to g

66. 5.3 km to m

67. 0.6 cm to mm

**4-10 Solving Equations Containing Decimals** (pp. 214–217)

**Example**

Solve.

\[ n - 4.77 = 8.60 \]

\[ + 4.77 \]

\[ + 4.77 \]

\[ n \]

\[ = 13.37 \]

*Add to isolate n.*

**Exercises**

Solve.

68. \( x + 30 = 40.44 \)

69. \( \frac{s}{1.07} = 100 \)

70. \( 0.8n = 0.0056 \)

71. \( k - 8 = 0.64 \)

72. \( 3.65 = e - 1.4 \)

73. \( \frac{w}{0.2} = 15.4 \)
Estimate each sum, difference, product, or quotient.

1. \(\frac{3}{4} + \frac{3}{8}\)  
2. \(5\frac{7}{8} - 3\frac{1}{4}\)  
3. \(6\frac{5}{7} \cdot 2\frac{2}{9}\)  
4. \(8\frac{1}{5} \div 3\frac{9}{10}\)

Add or subtract. Write each answer in simplest form.

5. \(\frac{3}{10} + \frac{2}{5}\)  
6. \(\frac{7}{8} - \frac{11}{16}\)  
7. \(\frac{71}{3} + 5\frac{11}{12}\)  
8. \(9 - 3\frac{2}{5}\)

Multiply or divide. Write each answer in simplest form.

9. \(5 \cdot 4\frac{1}{3}\)  
10. \(2\frac{7}{10} \cdot 2\frac{2}{3}\)  
11. \(\frac{3}{10} \div \frac{4}{5}\)  
12. \(2\frac{1}{5} \div 1\frac{5}{6}\)

13. A recipe calls for \(4\frac{1}{5}\) tbsp of butter. Nasim is making \(3\frac{1}{3}\) times the recipe for his soccer team. How much butter does he need? Write your answer in simplest form.

14. Brianna has \(11\frac{2}{3}\) cups of milk. She needs \(1\frac{1}{6}\) cups of milk to make a pot of hot cocoa. How many pots of hot cocoa can Brianna make?

Solve. Write each answer in simplest form.

15. \(\frac{1}{5}a = \frac{1}{8}\)  
16. \(\frac{1}{4}c = 980\)  
17. \(w - \frac{7}{9} = \frac{2}{3}\)  
18. \(z - \frac{5}{13} = \frac{6}{7}\)

19. Alan finished his homework in \(1\frac{1}{2}\) hours. It took Jimmy \(3\frac{3}{4}\) of an hour longer than Alan to finish his homework. How long did it take Jimmy to finish his homework?

20. Mya played in two softball games one afternoon. The first game lasted 42 min. The second game lasted \(1\frac{3}{5}\) times longer than the first game. How long did Mya’s second game last?

Add or subtract.

21. \(3.086 + 6.152\)  
22. \(5.91 + 12.8\)  
23. \(3.1 - 2.076\)  
24. \(14.75 - 6.926\)

Multiply or divide.

25. \(3.25 \cdot 24\)  
26. \(−3.79 \cdot 0.9\)  
27. \(3.2 ÷ 16\)  
28. \(3.57 ÷ (−0.7)\)

Convert each measure.

29. \(180\) mL to liters  
30. \(7.8\) m to centimeters  
31. \(23.4\) kg to grams

32. Jesse is 1,460 millimeters tall. Her sister is 168 centimeters tall, and her brother is 1.56 meters tall. Who is the tallest?

Solve.

33. \(w - 5.3 = 7.6\)  
34. \(4.9 = c + 3.7\)  
35. \(b ÷ 1.8 = 2.1\)  
36. \(4.3h = 81.7\)

37. All sweaters in a store are on sale for the same price. The total cost of 3 sweaters is \($63.12\). How much does each sweater cost?
Cumulative Assessment, Chapters 1–4

Multiple Choice

1. A cell phone company charges $0.05 per text message. Which expression represents the cost of \( t \) text messages?
   \( \text{A} \) 0.05\( t \)  \( \text{C} \) 0.05 \(- t \)
   \( \text{B} \) 0.05 \(+ t \)  \( \text{D} \) 0.05 \( \div t \)

2. Ahmed had $75 in his bank account on Sunday. The table shows his account activity for each day last week. What was the balance in Ahmed’s account on Friday?

<table>
<thead>
<tr>
<th>Day</th>
<th>Deposit</th>
<th>Withdrawal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>$25</td>
<td>none</td>
</tr>
<tr>
<td>Tuesday</td>
<td>none</td>
<td>$-108</td>
</tr>
<tr>
<td>Wednesday</td>
<td>$65</td>
<td>none</td>
</tr>
<tr>
<td>Thursday</td>
<td>$32</td>
<td>none</td>
</tr>
<tr>
<td>Friday</td>
<td>none</td>
<td>$-101</td>
</tr>
</tbody>
</table>

   \( \text{A} \) $86  \( \text{C} \) $0
   \( \text{B} \) $12  \( \text{D} \) $96

3. Natasha is designing a doghouse. She wants the front of the doghouse to be 3\(\frac{1}{2} \) feet wide, and she wants the side of the doghouse to be 2\(\frac{3}{4} \) feet wider than the front. Which expression can be used to find the length of the side of the doghouse?
   \( \text{A} \) 3\(\frac{1}{2} \) \(+ 2\frac{3}{4} \)
   \( \text{C} \) 3\(\frac{1}{2} \) \( \cdot 2\frac{3}{4} \)
   \( \text{B} \) 3\(\frac{1}{2} \) \(- 2\frac{3}{4} \)
   \( \text{D} \) 3\(\frac{1}{2} \) \( \div 2\frac{3}{4} \)

4. What is the value of 5\(\frac{2}{3} \) \( \div \) \(\frac{3}{9} \)?
   \( \text{A} \) 17
   \( \text{B} \) 17\(\frac{1}{9} \)
   \( \text{C} \) 10
   \( \text{D} \) 5\(\frac{1}{3} \)

5. Mrs. Herold has 5\(\frac{1}{4} \) yards of material to make two dresses. The larger dress requires 3\(\frac{3}{4} \) yards of material. Which equation can be used to find \( t \), the number of yards of material remaining to make the smaller dress?
   \( \text{A} \) 3\(\frac{3}{4} \) \(- t \) = 5\(\frac{1}{4} \)
   \( \text{B} \) 3\(\frac{3}{4} \) \( \cdot t \) = 5\(\frac{1}{4} \)
   \( \text{C} \) 3\(\frac{3}{4} \) \( \div t \) = 5\(\frac{1}{4} \)
   \( \text{D} \) 3\(\frac{3}{4} \) \( + t \) = 5\(\frac{1}{4} \)

6. On a quiz show, a player receives 10 points for each correct answer and loses 5 points for each incorrect answer. What is Janice’s total score if she has 16 correct answers and 9 incorrect answers?
   \( \text{A} \) 94  \( \text{C} \) 151
   \( \text{B} \) 115  \( \text{D} \) 205

7. Daisy the bulldog weighs 45\(\frac{13}{16} \) pounds. Henry the beagle weighs 21\(\frac{3}{4} \) pounds. How many more pounds does Daisy weigh than Henry?
   \( \text{A} \) 23\(\frac{15}{16} \) pounds
   \( \text{B} \) 24\(\frac{5}{6} \) pounds
   \( \text{C} \) 24\(\frac{1}{16} \) pounds
   \( \text{D} \) 67\(\frac{9}{16} \) pounds

8. What is the value of the expression \( 6x - y \) for \( x = -2 \) and \( y = 10 \)?
   \( \text{A} \) -22  \( \text{C} \) 2
   \( \text{B} \) -2  \( \text{D} \) 22

9. Joel threw a shot put 24\(\frac{2}{5} \) yards. Jamil threw the shot put 33\(\frac{10}{11} \) yards. Estimate how much farther Jamil threw the shot put than Joel did.
   \( \text{A} \) 8 yards
   \( \text{B} \) 10 yards
   \( \text{C} \) 12 yards
   \( \text{D} \) 15 yards
10. Which model best represents the expression $\frac{3}{4} \times \frac{1}{2}$?

(A) 

(B) 

(C) 

(D) 

11. The table shows the different types of pets owned by the 15 students in Mrs. Sizer’s Spanish class. What fraction of the students listed own a dog?

<table>
<thead>
<tr>
<th>Type of Pet</th>
<th>Number of Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cat</td>
<td>5</td>
</tr>
<tr>
<td>Dog</td>
<td>9</td>
</tr>
<tr>
<td>Hamster</td>
<td>1</td>
</tr>
</tbody>
</table>

Gridded Response

12. In 2004, the expression 5.85x could be used to determine the amount in dollars a worker earned for working x hours at minimum wage. How many dollars would a worker have earned in 2004 for working 2.4 hours at minimum wage?

13. Solve the equation $\frac{5}{12}x = \frac{1}{4}$ for x.

14. What is the value of the expression $2(3) + (-4) - 8 + 3^2$?

15. Louise is staying on the 22nd floor of a hotel. Her mother is staying on the 43rd floor. Louise wants to visit her mother, but the elevator is temporarily out of service. Write and solve an equation to find the number of floors that Louise must climb if she takes the stairs.

16. Mari bought 3 packages of colored paper. She used $\frac{3}{4}$ of a package to make greeting cards and used $\frac{1}{6}$ packages for an art project. She gave $\frac{1}{3}$ of a package to her brother. How much colored paper does Mari have left? Show the steps you used to find the answer.

17. A building proposal calls for 6 acres of land to be divided into $\frac{3}{4}$-acre lots. How many lots can be made? Explain your answer.

Extended Response

18. A high school is hosting a triple-jump competition. In this event, athletes make three leaps in a row to try to cover the greatest distance.

a. Tony’s first two jumps were $11\frac{2}{3}$ ft and $11\frac{1}{2}$ ft. His total distance was 44 ft. Write and solve an equation to find the length of his final jump.

b. Candice’s three jumps were all the same length. Her total distance was 38 ft. What was the length of each of her jumps?

c. The lengths of Davis’s jumps were 11.6 ft, $11\frac{1}{4}$ ft, and $11\frac{2}{3}$ ft. Plot these lengths on a number line. What was the farthest distance he jumped? How much farther was this distance than the shortest distance Davis jumped?