7

Add and Subtract Fractions

Fractions have been a part of our lives for a long time. In ancient times, Sumerians, Babylonians, Romans, Egyptians, Greeks, Chinese, and Arabians all used fractions.

The Eye of Horus was used by ancient Egyptians to represent fractions. It was a powerful symbol that they believed protected against evil. According to an old myth, Horus' eye was torn out, broken into pieces, and then put back together.

What You Will Learn

- ❏ to find a common denominator and use it to write equivalent fractions
- ❏ to add and subtract fractions with unlike denominators
- ❏ to add and subtract mixed numbers
- ❏ to solve fraction problems

Key Words

multiple
common denominator
improper fraction
mixed number

MATH LINK

Each part of the Eye of Horus was a fraction. When all the parts were put together, it was believed that the eye was whole again. Ancient Egyptians thought that the parts had a combined value of 1. Were they correct? In this chapter, you will explore fractions through history and around the world.
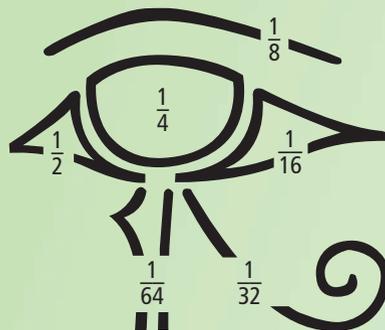
WWW Web Link

To learn more about the ancient Egyptian myth of the Eye of Horus, go to www.mathlinks7.ca and follow the links.
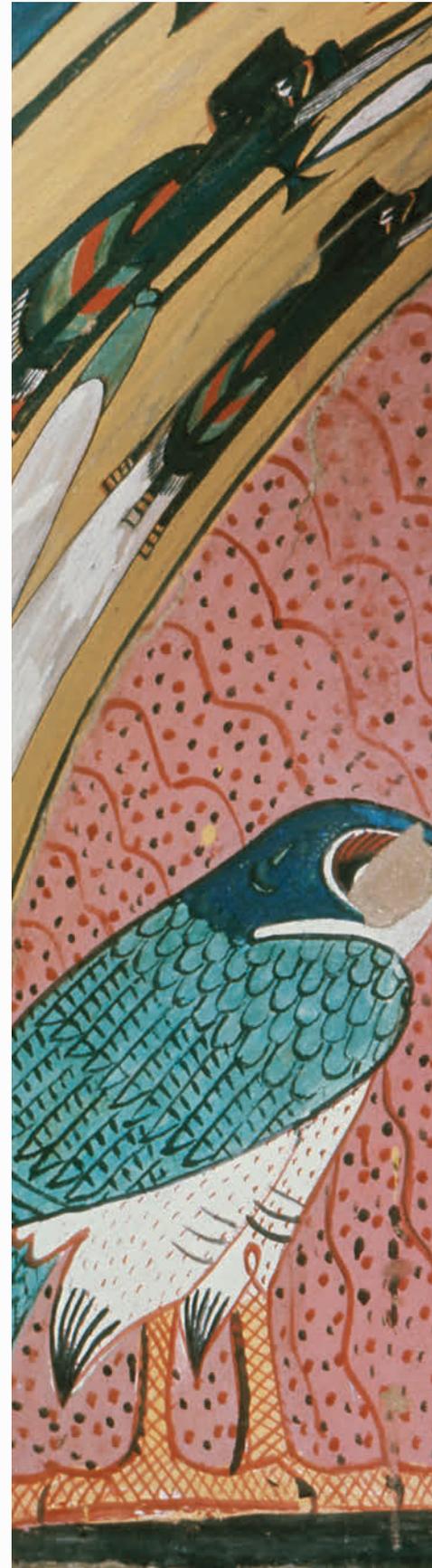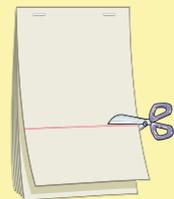
Make the following Foldable to organize what you learn in Chapter 7.

Step 1 Staple seven sheets of notebook paper together along the top edge.

Step 2 Make a line 9 cm up from the bottom of the top page. Cut across the entire page at this mark.

Step 3 Make a line 7.5 cm up from the bottom of the second page. Cut across the entire page at this mark.

Step 4 Cut across a line 6 cm up from the bottom of the third page.

Step 5 Cut across a line 4.5 cm up from the bottom of the fourth page.

Step 6 Cut across a line 3 cm up from the bottom of the fifth page.

Step 7 Cut across a line 1.5 cm up from the bottom of the sixth page.

Step 8 Label the tabs formed as shown.

Chapter 7: Add and Subtract Fractions
Key Words
7.1
7.2
7.3
7.4
What I Need to Work On
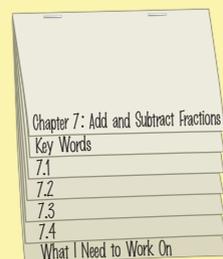
Literacy Link

As you work through Chapter 7, take notes under the appropriate tab. Include information about the key words, examples, and key ideas.

Common Denominators

Jasmin and Tyler collect trading cards. Jasmin has collected $\frac{1}{3}$ of a set. Tyler has collected $\frac{1}{4}$ of a set. They want to know who has more cards.

Jasmin and Tyler need to compare the fractions. It is easier to compare fractions when the denominators are the same. So, Jasmin and Tyler need to find a common denominator.

Explore the Math

Materials

• coloured pencils

How can you determine a common denominator?

1. Fold a piece of paper into 3 equal parts. Shade $\frac{1}{3}$ of the paper red.

2. Fold the same piece of paper into 4 equal parts the other way.

3. a) How many equal parts is the paper divided into?

b) Count how many parts you shaded red. Name an equivalent fraction for $\frac{1}{3}$ using your answer to part a) as the denominator.

4. Fold a different piece of paper into 4 equal parts. Shade $\frac{1}{4}$ of the paper blue.

5. Fold the piece of paper into 3 equal parts the other way.

6. Count how many parts you shaded blue. Name an equivalent fraction for $\frac{1}{4}$.

Reflect on Your Findings

7. a) What is the relationship between the denominators 3 and 4, and the denominator 12?

b) What is one method for determining a <mark>common denominator</mark> ?

Example: Determine a Common Denominator

a) Determine a common denominator for $\frac{2}{3}$ and $\frac{1}{2}$.

b) Determine equivalent fractions for $\frac{2}{3}$ and $\frac{1}{2}$ using the common denominator from a).
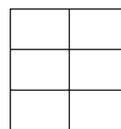
Solution

Method 1: Use Paper Folding or Diagrams

a) Divide a rectangle into 3 equal parts. Either fold a piece of paper, or draw a rectangle.
Fold the paper or divide the rectangle into 2 equal parts the other way.
There are 6 parts in the rectangle.

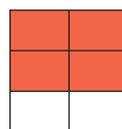A common denominator for $\frac{2}{3}$ and $\frac{1}{2}$ is 6.

b) Shade $\frac{2}{3}$ of the rectangle red.

4 of the 6 parts are red. $\frac{2}{3} = \frac{4}{6}$

Turn the paper over, or draw another rectangle and divide it as in step a).
Shade $\frac{1}{2}$ of this rectangle blue.

3 of the 6 parts are blue. $\frac{1}{2} = \frac{3}{6}$

Method 2: Use Multiples

a) The denominator of $\frac{1}{2}$ is 2.

$\boxed{\text{Multiples}}$ of 2 are 2, 4, ⑥ 8, 10, 12, …

The denominator of $\frac{2}{3}$ is 3.

Multiples of 3 are 3, ⑥ 9, 12, 15, …

The first multiple divisible by both 2 and 3 is 6.

A common denominator is 6.

> You can use divisibility rules to find multiples.
>
> 6 is divisible by both 2 and 3.
>
> So, multiples of both 2 and 3 will be multiples of 6:
> 6, 12, 18, …

> You could use any multiple of 6 as the common denominator, but the first multiple is often better to use. The denominator will be a smaller number, which is easier to work with.

b) Write equivalent fractions using 6 as the denominator.

$$\overset{\times\,3}{\frac{1}{2}} = \underset{\times\,3}{\frac{3}{6}} \qquad \overset{\times\,2}{\frac{2}{3}} = \underset{\times\,2}{\frac{4}{6}}$$
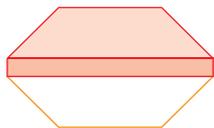
> To determine equivalent fractions, multiply the numerator and denominator by the same number. This process does not change the value of the fraction.
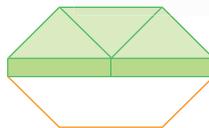>
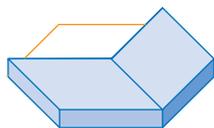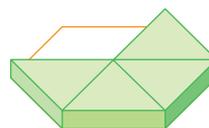> $\frac{2}{3} = \frac{4}{6}$

Check:

Use pattern blocks.

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

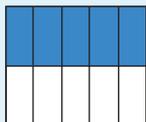$\frac{2}{3}$ = $\frac{4}{6}$

Show You Know

Determine a common denominator for each pair of fractions. Then use the common denominator to write equivalent fractions. Show two different methods.

a) $\frac{1}{3}$ and $\frac{3}{4}$ **b)** $\frac{5}{8}$ and $\frac{1}{6}$
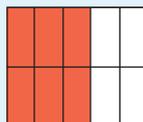
- You can use paper folding, diagrams, or multiples to determine a common denominator.

Paper Folding or Diagrams

5 of the 10 parts are blue.
$$\frac{1}{2} = \frac{5}{10}$$

6 of the 10 parts are red.
$$\frac{3}{5} = \frac{6}{10}$$

Multiples

The denominator of $\frac{1}{2}$ is 2. Multiples of 2 are 2, 4, 6, 8, (10), …

The denominator of $\frac{3}{5}$ is 5. Multiples of 5 are 5, (10), 15, 20, …

A common denominator is 10.

- To write fractions with a common denominator, determine equivalent fractions.

$$\overset{\times 5}{\overbrace{\frac{1}{2} = \frac{5}{10}}}_{\times 5}$$

$$\overset{\times 2}{\overbrace{\frac{3}{5} = \frac{6}{10}}}_{\times 2}$$

Communicate the Ideas

1. Tina wanted to find a common denominator and equivalent fractions for $\frac{3}{5}$ and $\frac{2}{3}$. This is what she did:

a) Was she correct? If not, what was her error?

b) Draw diagrams to show what she should have done.

c) Discuss your diagrams with a classmate.

2. Ian says, "A common denominator for $\frac{3}{4}$ and $\frac{5}{6}$ is 12." Meko says, "I think it is 10." Do you agree with Ian or Meko? Why?

3. How can you use multiples to find a common denominator for the fractions $\frac{1}{2}$, $\frac{2}{5}$, and $\frac{3}{4}$?
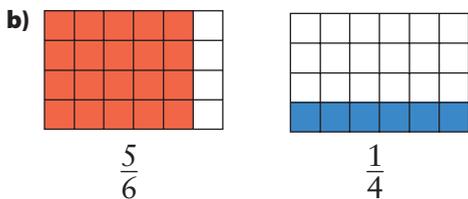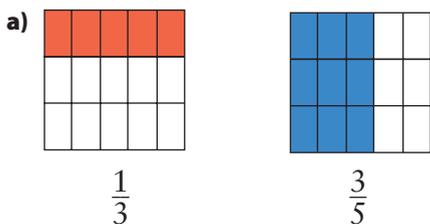
For help with #4 to #9, refer to the Example on pages 231–232.

4. Use the folded papers shown to determine a common denominator and equivalent fractions for each pair of fractions.

a)

$\frac{1}{4}$ $\frac{2}{3}$

b)

$\frac{1}{2}$ $\frac{3}{4}$
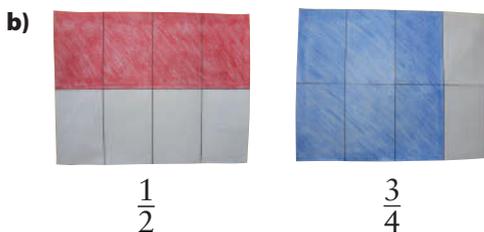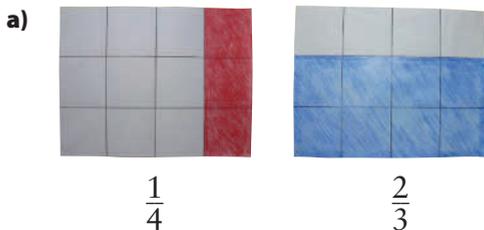
5. Look at the diagrams to determine a common denominator and equivalent fractions for each pair of fractions.

a)

$\frac{1}{3}$ $\frac{3}{5}$

b)

$\frac{5}{6}$ $\frac{1}{4}$

6. Draw a diagram to determine a common denominator for each pair of fractions. Then use the common denominator to write equivalent fractions.

a) $\frac{1}{2}$ and $\frac{1}{3}$ **b)** $\frac{2}{3}$ and $\frac{1}{5}$ **c)** $\frac{1}{6}$ and $\frac{2}{5}$

7. Use a diagram to determine a common denominator for each pair of fractions. Then write equivalent fractions using the common denominator.

a) $\frac{3}{8}$ and $\frac{1}{3}$ **b)** $\frac{5}{6}$ and $\frac{3}{4}$ **c)** $\frac{1}{5}$ and $\frac{1}{2}$

8. Use multiples to determine a common denominator for each set of fractions. Then write equivalent fractions using the common denominator.

a) $\frac{1}{2}$ and $\frac{2}{5}$ **b)** $\frac{1}{3}$ and $\frac{1}{4}$ **c)** $\frac{5}{8}, \frac{1}{6}$, and $\frac{5}{12}$

9. Using multiples, determine a common denominator for each set of fractions. Then use the common denominator to write equivalent fractions.

a) $\frac{3}{8}$ and $\frac{1}{4}$ **b)** $\frac{1}{6}$ and $\frac{1}{4}$ **c)** $\frac{1}{5}, \frac{2}{3}$, and $\frac{7}{10}$

10. Determine a common denominator for each pair of fractions. Which is the larger fraction in each pair?

a) $\frac{3}{4}, \frac{13}{16}$ **b)** $\frac{5}{7}, \frac{36}{49}$

c) $\frac{11}{30}, \frac{3}{10}$ **d)** $\frac{12}{27}, \frac{4}{9}$

11. Draw a Venn diagram like the one shown to list common denominators that are less than 50 for $\frac{1}{4}$ and $\frac{1}{6}$.

Multiples of 4   Multiples of 6
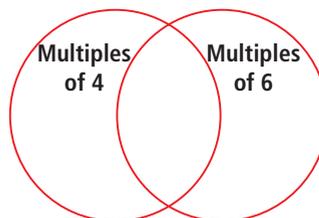
12. Fill in the blanks to make equivalent fractions.

a) $\dfrac{1}{4} = \dfrac{\blacksquare}{8} = \dfrac{\blacksquare}{12} = \dfrac{\blacksquare}{16} = \dfrac{\blacksquare}{20} = \dfrac{\blacksquare}{24} = \dfrac{\blacksquare}{28}$

b) $\dfrac{1}{5} = \dfrac{2}{\blacksquare} = \dfrac{3}{\blacksquare} = \dfrac{4}{\blacksquare} = \dfrac{5}{\blacksquare} = \dfrac{7}{\blacksquare} = \dfrac{11}{\blacksquare}$

c) $\dfrac{24}{56} = \dfrac{12}{\blacksquare} = \dfrac{6}{\blacksquare} = \dfrac{3}{\blacksquare} = \dfrac{48}{\blacksquare} = \dfrac{9}{\blacksquare}$

d) $\dfrac{30}{48} = \dfrac{15}{\blacksquare} = \dfrac{10}{\blacksquare} = \dfrac{5}{\blacksquare} = \dfrac{\blacksquare}{96} = \dfrac{\blacksquare}{32}$

13. Fill in each blank with a numerator to make the statement true. Provide as many answers as possible. Use diagrams to show how you determined your answers.

a) $\dfrac{1}{4} < \dfrac{\blacksquare}{2} < \dfrac{3}{4}$

b) $\dfrac{1}{3} < \dfrac{\blacksquare}{6} < \dfrac{5}{6}$

c) $\dfrac{2}{5} < \dfrac{\blacksquare}{10} < \dfrac{4}{5}$

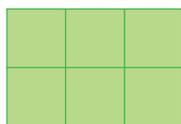**14.** Determine a common denominator for the set of fractions. Use the common denominator to write an equivalent fraction for each fraction. Then list the fractions in order from least to greatest.

$\dfrac{1}{3}, \dfrac{1}{4}, \dfrac{5}{6}, \dfrac{2}{3}, \dfrac{3}{4}, \dfrac{1}{2}$

15. The ancient Greeks thought of numbers as being represented by rectangles. They would have made a rectangle like this to represent 6:


a) How could this rectangle be used to find a common denominator for $\dfrac{1}{2}$ and $\dfrac{1}{3}$? Explain.

b) Use a rectangle to find a common denominator for $\dfrac{3}{4}$ and $\dfrac{1}{7}$.

16. $\dfrac{5}{12}$ of a schoolyard is taken up by grass.

$\dfrac{7}{18}$ is the track. The rest is pavement.

a) What common denominator could be used to compare these fractions?

b) Does the grass or the track take up more space?

**Extend**

17. a) Copy the shapes. For each shape, colour in $\dfrac{3}{8}$.
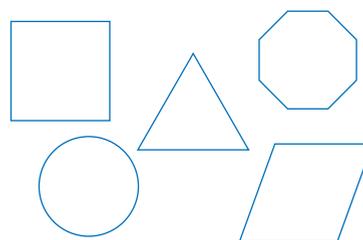
b) Which shapes were more difficult to colour in? Which were easier? Explain.

c) Imagine you are using paper folding to determine a common denominator for $\dfrac{3}{8}$ and $\dfrac{2}{5}$. Which of the shapes would it be possible for you to use? Show the work by drawing the fold lines on the shapes.

d) Compare your drawings with a classmate's.

18. Write as many different proper fractions in lowest terms as you can that have denominators from 2 to 9 and numerators that are positive numbers.

19. Which of the following fractions is closest to $\dfrac{3}{10}$?

A $\dfrac{1}{4}$ **B** $\dfrac{21}{100}$ **C** $\dfrac{9}{40}$ **D** $\dfrac{2}{5}$

20. You have three beakers that are the same size. $\frac{2}{3}$ of beaker 1 contains oil. $\frac{1}{4}$ of beaker 2 contains water. Beaker 3 is empty. When you pour the liquids into beaker 3, the level of the combined liquids corresponds exactly to one of the markings on the side of beaker 3. Which of the following beakers is beaker 3?

A

B

C

D
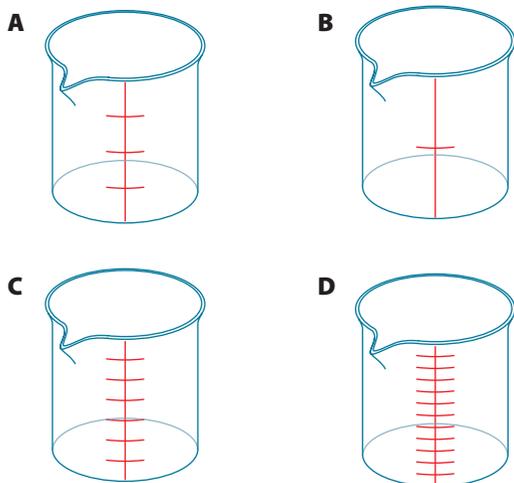
21. The table shows the fraction of the total number of students at Maple Leaf Elementary School that are in each grade.

Kindergarten	$\frac{7}{40}$
Grade 1	$\frac{3}{20}$
Grade 2	$\frac{11}{72}$
Grade 3	$\frac{5}{36}$
Grade 4	$\frac{26}{180}$
Grade 5	$\frac{17}{180}$
Grade 6	$\frac{13}{90}$

a) Which grade has the greatest number of students?

b) Which grade has the least number of students?

c) Which two grades have the same number of students?

d) If there are 54 students in grade 1, what is the total number of students in the school?

MATH LINK

a) Determine a common denominator for the fractions in the Eye of Horus. Show your work.

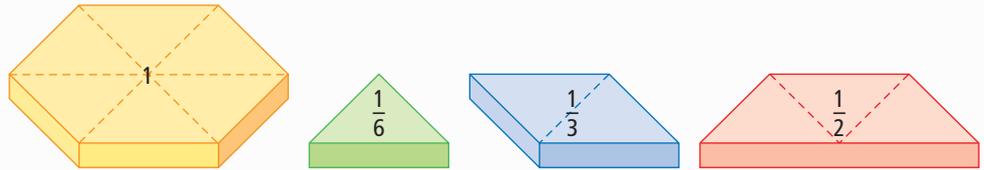**b)** Use this common denominator to determine an equivalent fraction for each part in the eye.
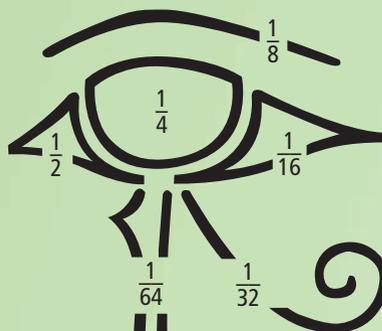
$\frac{1}{8}$

$\frac{1}{4}$

$\frac{1}{2}$

$\frac{1}{16}$

$\frac{1}{64}$

$\frac{1}{32}$

Add and Subtract Fractions With Unlike Denominators

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

How could you use pattern blocks to model addition and subtraction?

Explore the Math

How can you add and subtract fractions with unlike denominators?

1. a) What two pattern blocks would you use to represent $\frac{1}{2}$ and $\frac{1}{3}$?

b) Can you tell what the answer to $\frac{1}{2} + \frac{1}{3}$ is using these two pattern blocks? Explain.

2. a) Use the green triangles to represent $\frac{1}{2}$ and $\frac{1}{3}$. What fraction does each green triangle represent?

b) Can you tell what the answer to $\frac{1}{2} + \frac{1}{3}$ is now? Explain.

3. a) What pattern blocks would you use to represent $\frac{1}{2}$ and $\frac{1}{6}$?

b) Can you tell what the answer to $\frac{1}{2} - \frac{1}{6}$ is using these two pattern blocks? Explain.

4. a) Use the green triangles to represent $\frac{1}{2}$.

b) Can you tell what the answer to $\frac{1}{2} - \frac{1}{6}$ is now? Explain.

c) How many green triangles are left?

Reflect on Your Findings

5. How can you use pattern blocks to help you add and subtract fractions with unlike denominators?
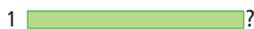
Example 1: Add Fractions With Unlike Denominators

Add. Write the answer in lowest terms.
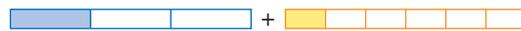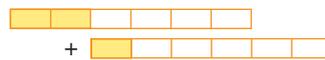
$$\frac{1}{3} + \frac{1}{6}$$

Solution

Method 1: Use Fraction Strips

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

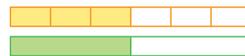To add, you need to use parts that are the same size.

Each part represents $\frac{1}{6}$. Count the parts.

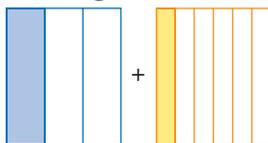$$\frac{1}{3} + \frac{1}{6} = \frac{3}{6}$$

Write the answer in lowest terms.
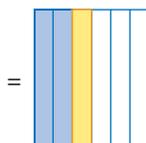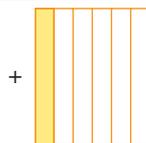
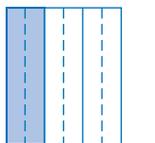$$\frac{3}{6} = \frac{1}{2}$$

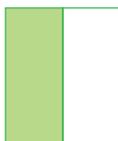*Method 2: Draw a Diagram*

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

To add, you need to use parts that are the same size.

$$\frac{1}{3} + \frac{1}{6} = \frac{3}{6}$$

Strategies

Solve a Simpler Problem
Refer to page xvii.

Write the answer in lowest terms.

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

Method 3: Use a Common Denominator

The denominator of $\frac{1}{3}$ is 3.

Multiples of 3 are 3, ⑥ 9, 12, …

The denominator of $\frac{1}{6}$ is 6.

Multiples of 6 are ⑥ 12, 18, 24, …

The first multiple divisible by both 3 and 6 is 6.

A common denominator is 6.

Write equivalent fractions with 6 as the denominator.

$$\frac{1}{3} + \frac{1}{6} = \frac{2}{6} + \frac{1}{6}$$
$$= \frac{2 + 1}{6} \quad \text{Add the numerators.}$$
$$= \frac{3}{6}$$

Write the answer in lowest terms.

$$\overset{\div\,3}{\frac{3}{6} = \frac{1}{2}}_{\div\,3}$$

Check:

Use pattern blocks.

Is [blocks] closer to [block] or [block] ?

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

It equals $\frac{1}{2}$. The answer is reasonable.

Show You Know

Add. Write each answer in lowest terms.

a) $\frac{1}{6} + \frac{2}{3}$ $\qquad$ **b)** $\frac{1}{10} + \frac{4}{5}$ $\qquad$ **c)** $\frac{1}{2} + \frac{4}{8}$

Literacy Link

When the numerator equals the denominator, the fraction is equal to 1.
$\frac{3}{3} = 1$ $\qquad$ $\frac{16}{16} = 1$

Example 2: Subtract Fractions With Unlike Denominators

Subtract.

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

Solution

M E

Is the difference closer to

0

or

$\frac{1}{2}$?

Method 1: Use Fraction Strips

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

To subtract $\frac{2}{5}$, you need parts that are the same size.
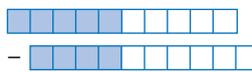
Subtract.

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

Check:

Is $\frac{1}{10}$ closer to 0 or $\frac{1}{2}$?

M E

$$0 = \frac{0}{10} \qquad \frac{1}{2} = \frac{5}{10}$$

$\frac{1}{10}$ is a little more than $\frac{0}{10}$, or 0.

> Compare this to the estimate you made before you subtracted.

Method 2: Draw a Diagram

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

To subtract $\frac{2}{5}$, you need parts that are the same size.
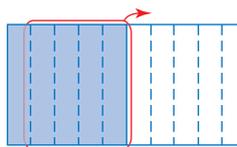
Subtract.

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

Method 3: Use a Common Denominator

The denominator of $\frac{1}{2}$ is 2.

Multiples of 2 are 2, 4, 6, 8, (10), …

The denominator of $\frac{2}{5}$ is 5.

Multiples of 5 are 5, (10), 15, 20, …

The first multiple divisible by both 2 and 5 is 10.

A common denominator is 10.
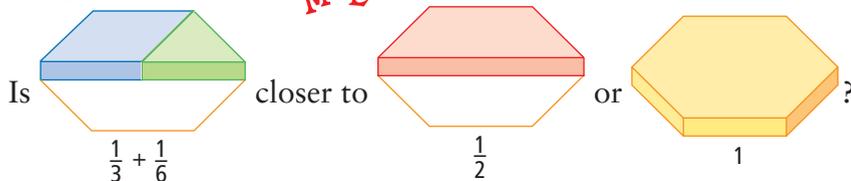
Write equivalent fractions with 10 as the denominator.

$$\frac{1}{2} - \frac{2}{5} = \frac{5}{10} - \frac{4}{10}$$
$$= \frac{5-4}{10} \qquad \text{Subtract the numerators.}$$
$$= \frac{1}{10}$$

Show You Know

Subtract. Write each answer in lowest terms.

a) $\frac{3}{4} - \frac{1}{2}$ **b)** $\frac{2}{3} - \frac{1}{4}$ **c)** $\frac{3}{4} - \frac{1}{8}$

Key Ideas

- When adding and subtracting fractions using models or diagrams, show each fraction using parts of the whole that are of equal size.

Pattern Blocks
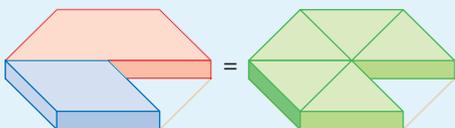
$$\frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6}$$

Diagram
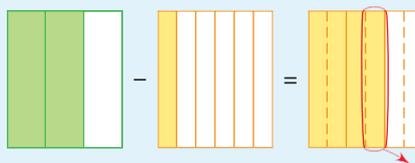
$$\frac{2}{3} - \frac{1}{6} = \frac{4}{6} - \frac{1}{6}$$

- To add or subtract fractions with unlike denominators, use a common denominator.
- You can estimate when adding or subtracting fractions by comparing fractions to 0, $\frac{1}{2}$, or 1.

Communicate the Ideas

1. How are $\frac{1}{3}$ and $\frac{2}{6}$ alike? How are they different?

2. a) How would you use diagrams to calculate $\frac{1}{4} + \frac{1}{2}$?

     b) Compare your answer with a classmate's.

3. Why is it difficult to calculate $\frac{1}{2} - \frac{1}{8}$ without changing $\frac{1}{2}$ to $\frac{4}{8}$?

For help with #4 to #7, refer to Example 1 on pages 238–239.

4. Write each addition statement shown by the fraction strips. Estimate and then add.

a) +

b) +

c) +

5. For each diagram, write an addition statement. Then add.

a)

b)

c)

6. Add. Write your answers in lowest terms.

a) $\dfrac{2}{5} + \dfrac{1}{10}$ **b)** $\dfrac{5}{8} + \dfrac{1}{4}$

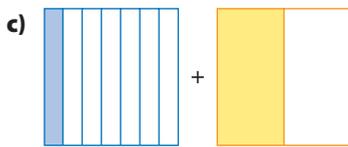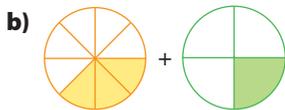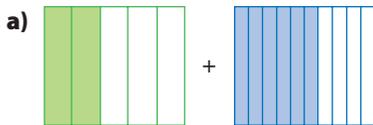**c)** $\dfrac{1}{3} + \dfrac{5}{12}$ **d)** $\dfrac{1}{4} + \dfrac{3}{5}$

e) $\dfrac{1}{2} + \dfrac{1}{5}$ **f)** $\dfrac{3}{8} + \dfrac{1}{6}$

7. Determine the sum. Write your answers in lowest terms.

a) $\dfrac{1}{2} + \dfrac{3}{8}$ **b)** $\dfrac{1}{12} + \dfrac{5}{6}$

c) $\dfrac{2}{10} + \dfrac{4}{5}$ **d)** $\dfrac{1}{3} + \dfrac{2}{9}$

e) $\dfrac{2}{5} + \dfrac{1}{2}$ **f)** $\dfrac{1}{6} + \dfrac{3}{4}$

8. Write each addition statement shown by the pattern blocks. Then add.

a) +

b) +
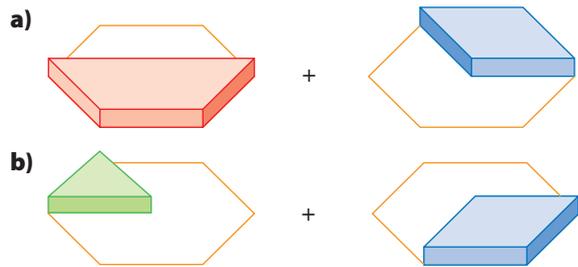
For help with #9 to #12, refer to Example 2 on pages 240–241.

9. Write each subtraction statement shown by the fraction strips. Estimate and then subtract.

a) –

b) –

c) –

10. For each diagram, write a subtraction statement. Then subtract.

a) –

b) –

c) –
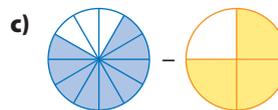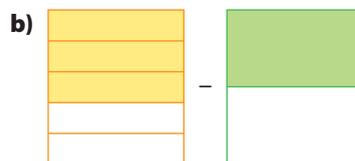
11. Subtract. Write your answers in lowest terms.

a) $\dfrac{3}{5} - \dfrac{3}{10}$ **b)** $\dfrac{5}{6} - \dfrac{1}{2}$

c) $\dfrac{1}{2} - \dfrac{1}{10}$ **d)** $\dfrac{7}{8} - \dfrac{1}{2}$

e) $\dfrac{2}{3} - \dfrac{2}{5}$ **f)** $\dfrac{5}{8} - \dfrac{5}{12}$

12. Determine the difference. Write your answers in lowest terms.

a) $\dfrac{3}{4} - \dfrac{1}{8}$ **b)** $\dfrac{11}{12} - \dfrac{5}{6}$

c) $\dfrac{2}{3} - \dfrac{1}{2}$ **d)** $\dfrac{1}{6} - \dfrac{1}{9}$

e) $\dfrac{2}{5} - \dfrac{1}{4}$ **f)** $\dfrac{5}{6} - \dfrac{11}{15}$

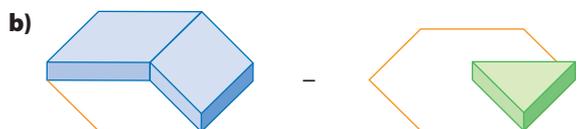**13.** Write each subtraction statement shown by the pattern blocks. Then subtract.

a)

b)

Apply

14. The students made muffins in cooking class. They get to take some muffins home. There are 12 muffins in a muffin tray.

a) John says, "I'm taking $\dfrac{1}{4}$ of a tray."

Katie says, "I'm taking $\dfrac{1}{3}$ of a tray."

What fraction of a tray are John and Katie taking altogether?

b) Marjoe says, "I'm taking $\dfrac{1}{6}$ of a tray."

Sandeep says, "I'm taking $\dfrac{1}{12}$ of a tray."

What fraction of a tray are Marjoe and Sandeep taking altogether?

15. Zach was leading in a swimming race by $\dfrac{5}{8}$ of a length. He won the race by $\dfrac{1}{2}$ a length. By how much did the second-place swimmer catch up by the end of the race?

16. A friend shows you the following work for an addition problem.

$$\dfrac{1}{4} + \dfrac{1}{3} = \dfrac{2}{7}$$

a) Explain the error in your friend's work.

b) Use a diagram to show the correct answer.

17. An airplane was loading in Pond Inlet for its flight to Iqaluit, Nunavut. The plane was $\dfrac{1}{6}$ full of passengers and $\dfrac{1}{3}$ full of cargo. How much space was left?

18. You can use a number line to show $\dfrac{2}{3} + \dfrac{1}{12} = \dfrac{9}{12}$.
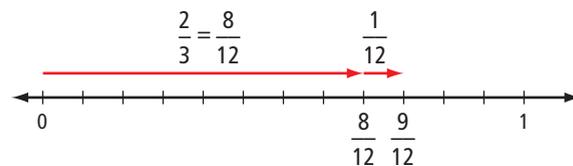
Draw number lines to add the fractions.

a) $\dfrac{1}{4} + \dfrac{1}{4}$ **b)** $\dfrac{1}{2} + \dfrac{1}{8}$ **c)** $\dfrac{3}{10} + \dfrac{3}{5}$

19. You can use a number line to show $\dfrac{2}{3} - \dfrac{1}{12} = \dfrac{7}{12}$.

Draw number lines to subtract the fractions.

a) $\dfrac{1}{2} - \dfrac{1}{8}$ **b)** $\dfrac{1}{4} - \dfrac{1}{12}$ **c)** $\dfrac{5}{6} - \dfrac{1}{4}$

20. The ancient Egyptians thought the fractions in the Eye of Horus added up to 1. Were they correct? Show your work.

$\frac{1}{8}$ $\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{16}$ $\frac{1}{64}$ $\frac{1}{32}$

21. Water is pumped into a pool. After one hour, $\frac{1}{5}$ of the pool is filled.

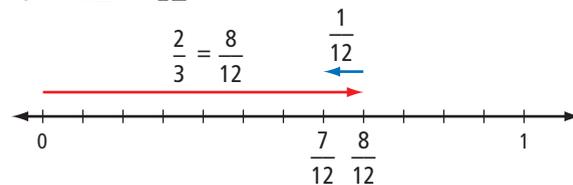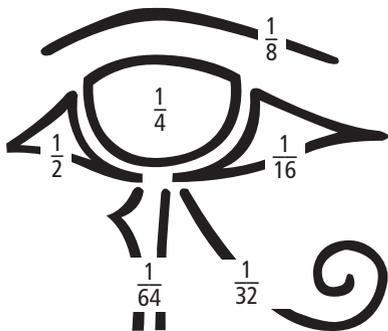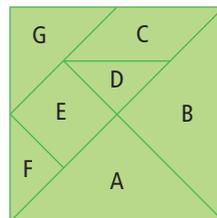**a)** After 3 h, how full is the pool?

b) How long does it take in total to fill the pool?

22. The sum of each row, column, and diagonal in this magic square must equal 1. Copy the square and fill in the blanks.

■	■	$\frac{5}{12}$
$\frac{7}{12}$	$\frac{1}{3}$	■
$\frac{1}{4}$	■	■

23. A tangram is a square puzzle that is divided into seven shapes.

a) Suppose piece A is $\frac{1}{4}$. What are the values of pieces B, C, D, E, F, and G?

b) What is the sum of A and B?

c) Subtract the value of D from the whole.

d) Which two tangram pieces add up to the value of C?

e) Make a problem of your own using tangram pieces. Have a classmate solve it.

MATH LINK

The Egyptians of 3000 B.C.E. used only unit fractions. These are fractions with a numerator of 1, such as $\frac{1}{2}, \frac{1}{3}$, and $\frac{1}{4}$. They wrote all other fractions as sums of unit fractions. For example,

$\frac{3}{4} = \frac{1}{2} + \frac{1}{4}$ $\frac{5}{6} = \frac{1}{2} + \frac{1}{3}$
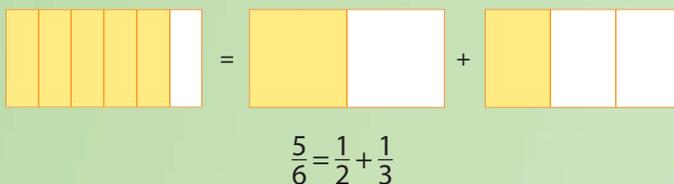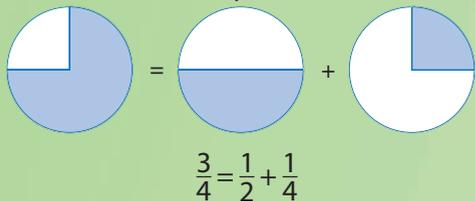
These sums are called Egyptian fractions.

a) Add the unit fractions. Use diagrams to show your work.

$\frac{1}{4} + \frac{1}{8}$ $\frac{1}{3} + \frac{1}{9}$

b) Which one of the two sums in a) is greater? By how much?

c) How would ancient Egyptians have written $\frac{5}{12}$ as the sum of two unit fractions?
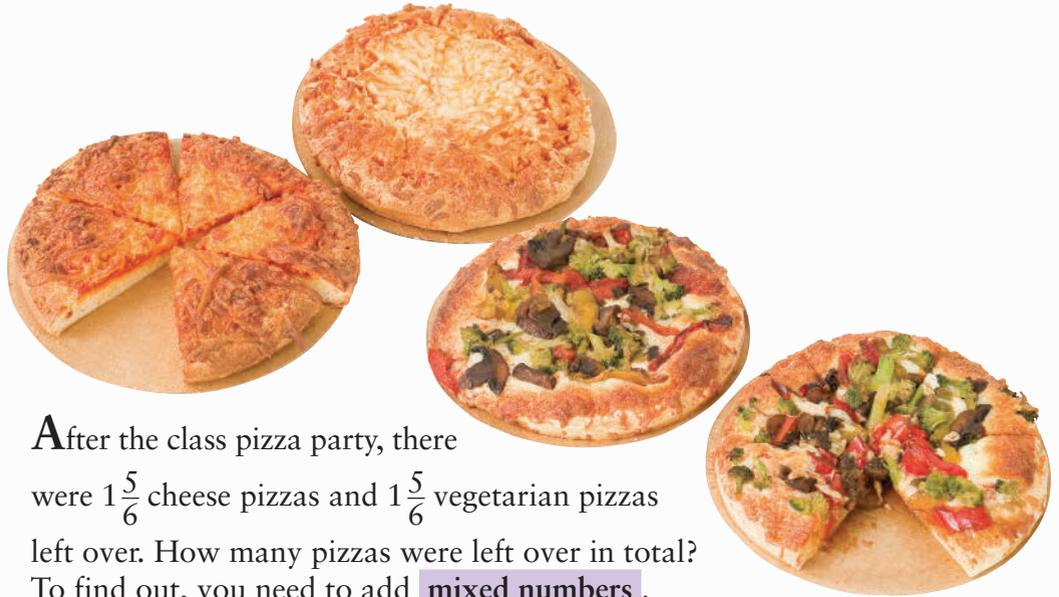
Add Mixed Numbers

After the class pizza party, there were $1\frac{5}{6}$ cheese pizzas and $1\frac{5}{6}$ vegetarian pizzas left over. How many pizzas were left over in total? To find out, you need to add **mixed numbers** .

Discuss the Math

How do you add mixed numbers?

mixed numbers

• a number made up of a whole number and a fraction, such as $2\frac{1}{3}$

Strategies

Model It
Refer to page xvi.

Example 1: Add Mixed Numbers With Like Denominators

Add. Write the answer in lowest terms.
$1\frac{5}{6} + 1\frac{5}{6}$

Solution
Method 1: Use Pattern Blocks

Add the whole yellow hexagons.
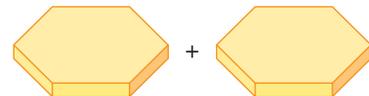
Add the green triangles.
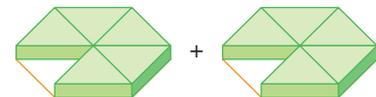
$1\frac{5}{6} + 1\frac{5}{6} = 1 + 1 + \frac{5}{6} + \frac{5}{6}$

Move 1 green triangle to the hexagon with 5 green triangles to make 1 whole hexagon.
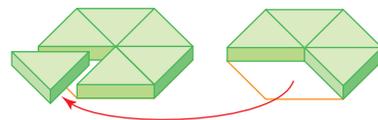
There are now 3 whole hexagons and 4 green triangles.

$$1 + 1 + 1 + \frac{4}{6} = 3\frac{4}{6}$$

Write the answer in lowest terms.

$$3\frac{4}{6} = 3\frac{2}{3}$$

improper fraction

- a fraction that has a numerator greater than the denominator, such as $\frac{9}{8}$
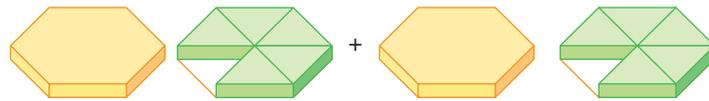
Method 2: Use an Addition Statement

$$1\frac{5}{6} + 1\frac{5}{6} = 1 + 1 + \frac{5}{6} + \frac{5}{6} \qquad \text{Add the whole numbers.}$$

$$= 2 + \frac{5+5}{6} \qquad \text{Add the fractions.}$$

$$= 2 + \frac{10}{6}$$

$$= 2 + \frac{6}{6} + \frac{4}{6} \qquad \text{Write the \textbf{improper fraction} as a mixed number.}$$

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

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

You can use diagrams.
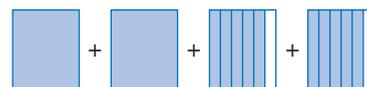
$$1 + 1 + \frac{5}{6} + \frac{5}{6} = 3\frac{4}{6}$$

Write the answer in lowest terms.

$$\div 2$$
$$3\frac{4}{6} = 3\frac{2}{3}$$
$$\div 2$$

Check:

$$1\frac{5}{6} + 1\frac{5}{6} \approx 2 + 2$$

$$2 + 2 = 4$$

$3\frac{2}{3}$ is a little less than the estimate of 4. The answer is reasonable.

Show You Know

Add. Write each answer in lowest terms.

a) $1\frac{1}{3} + 2\frac{1}{3}$ **b)** $3\frac{1}{6} + 2\frac{5}{6}$ **c)** $3\frac{2}{3} + \frac{2}{3}$

Example 2: Add Mixed Numbers With Unlike Denominators

How many pies are there in total?

$1\frac{1}{2}$ apple pies.

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

Solution

Method 1: Use Pattern Blocks
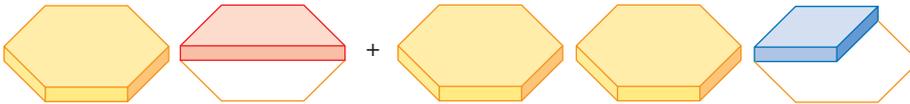
$1\frac{1}{2} + 2\frac{1}{3}$

Add the whole yellow hexagons.
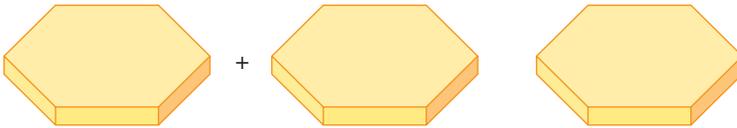
Add the red trapezoid and blue rhombus.
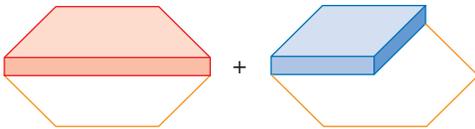
$1 + 2 + \frac{1}{2} + \frac{1}{3} = 3 + \frac{1}{2} + \frac{1}{3}$

To add $\frac{1}{2}$ and $\frac{1}{3}$, you need to use pattern blocks that are the same size.
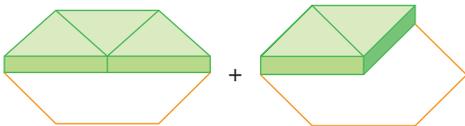
There are 5 green triangles altogether.

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

There are $3\frac{5}{6}$ pies.

Method 2: Use an Addition Statement

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

$$= 1 + 2 + \frac{3}{6} + \frac{2}{6} \quad \text{Add the whole numbers.}$$

$$= 3 + \frac{3}{6} + \frac{2}{6}$$

$$= 3 + \frac{3 + 2}{6} \quad \text{Add the numerators.}$$

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

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

Use multiples to determine a common denominator.
Multiples of 2 are 2, 4, ⑥, 8, …
Multiples of 3 are 3, ⑥, 9, 12, …
Use 6 as a common denominator.

There are $3\frac{5}{6}$ pies altogether.

Check: **M E**

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

$$2 + 2 = 4$$

$3\frac{5}{6}$ is a little less than the estimate of 4.

The answer is reasonable.

You can use diagrams.

$1 + 2 = 3$

$\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$
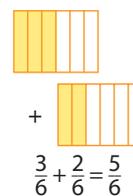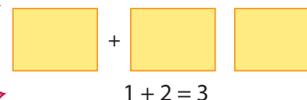
Show You Know

Add. Write each answer in lowest terms.

a) $2\frac{1}{2} + 4\frac{1}{6}$ b) $1\frac{2}{3} + 1\frac{3}{4}$ c) $3\frac{3}{5} + \frac{1}{2}$

Key Ideas

- When adding mixed numbers with like denominators, you can
  – add the whole numbers
  – add the fractions
- When adding mixed numbers with unlike denominators, you can
  – determine a common denominator for the fractions
  – add the whole numbers
  – add the fractions
- To check your answer, compare the answer to an estimate.

1. After dinner, $1\frac{1}{2}$ ham sandwiches and $2\frac{3}{4}$ egg salad sandwiches are left. Jeremy and his sister want to use 4 of the leftover sandwiches for their lunches tomorrow.

a) Are there enough sandwiches, not enough sandwiches, or more than enough sandwiches left over?

b) Describe the method you used to find your answer.

c) Solve the problem using another method.

2. Which method that you used in #1 did you prefer? Explain.

3. a) How would you use estimation to check your answer in #1?

b) Compare your estimate with a partner's.

Practise

For help with #4 to #7, refer to Example 1 on pages 245–246.

4. Write each addition statement shown.

a)

b)

c)
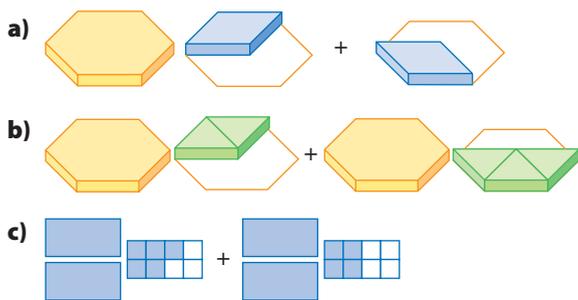
5. For each of the following, write the addition statement.

a)

b)

c)
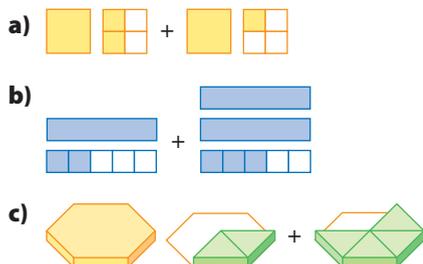
6. Add. Write your answers in lowest terms. Check your answers using estimation.

a) $1\frac{1}{3} + 1\frac{1}{3}$ **b)** $3\frac{1}{8} + 5\frac{5}{8}$ **c)** $\frac{3}{4} + 1\frac{1}{4}$

d) $2\frac{1}{10} + 3\frac{7}{10}$ **e)** $3\frac{2}{5} + 1\frac{4}{5}$ **f)** $4\frac{8}{9} + 1\frac{7}{9}$

7. Determine the sum. Write your answers in lowest terms.

a) $1\frac{2}{5} + 2\frac{1}{5}$ **b)** $3\frac{1}{8} + 1\frac{5}{8}$ **c)** $5\frac{4}{9} + \frac{2}{9}$

d) $2\frac{1}{4} + 2\frac{3}{4}$ **e)** $2\frac{3}{5} + \frac{4}{5}$ **f)** $4\frac{7}{12} + 6\frac{11}{12}$

For help with #8 to #11, refer to Example 2 on pages 247–248.

8. Write each addition statement shown.

a)

b)

c)
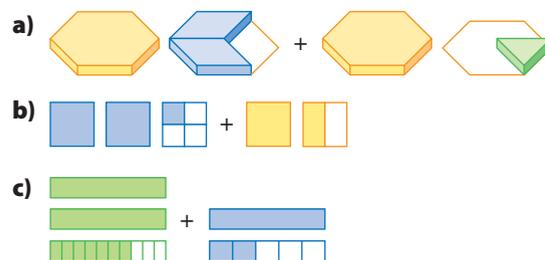
9. For each of the following, write an addition statement.

a)

b)

c)
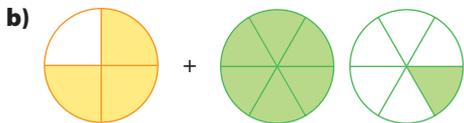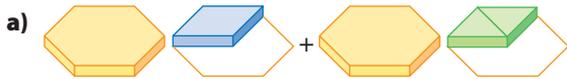
10. Add. Write your answers in lowest terms.

a) $2\frac{3}{5} + 1\frac{1}{10}$ **b)** $3\frac{1}{2} + 2\frac{1}{6}$

c) $\frac{3}{4} + 2\frac{5}{6}$ **d)** $5\frac{1}{2} + \frac{3}{10}$

e) $4\frac{1}{4} + 3\frac{5}{12}$ **f)** $2\frac{2}{3} + 7\frac{5}{7}$

11. Determine the sum. Write your answers in lowest terms.

a) $4\frac{1}{3} + 2\frac{1}{6}$ **b)** $3\frac{1}{2} + 3\frac{2}{5}$

c) $1\frac{1}{5} + 5\frac{1}{4}$ **d)** $4\frac{4}{15} + 5\frac{1}{10}$

e) $1\frac{3}{4} + \frac{5}{6}$ **f)** $6\frac{1}{2} + \frac{9}{10}$

Apply

12. Susie ran for $1\frac{3}{4}$ h and then walked for $2\frac{1}{4}$ h. For how long did she travel?

13. Kathleen did $1\frac{3}{4}$ pages of homework before dinner. After dinner, she did another $\frac{7}{8}$ of a page. In total, how many pages of homework did Kathleen do?

14. The camp cook uses $1\frac{1}{2}$ dozen eggs to make pancakes. She uses another $3\frac{1}{3}$ dozen for scrambled eggs. How many dozen eggs does she use altogether? Check your answer using estimation.

15. Chef Dimitri finished cutting $1\frac{1}{4}$ trays of spinach pie before his break. After his break he cut another $2\frac{2}{3}$ trays. How many trays of pie in total did he cut? Include diagrams with your answer.

16. Jenny studied $1\frac{1}{3}$ h for her math test and $\frac{3}{4}$ h for her science test. For how long did she study in total? Check your answer using estimation.

17. Jonas and Amy collect comic books. Jonas has $\frac{21}{10}$ boxes of Granite Guy comics and $2\frac{2}{3}$ boxes of Quest of Koko comics. Amy has $2\frac{5}{6}$ boxes of Alpha Woman comics and $1\frac{3}{5}$ boxes of Quest of Koko comics.

a) Who has the larger collection?

b) How many boxes of Quest of Koko comics do Jonas and Amy own altogether?

c) Jonas trades $\frac{7}{10}$ of a box of comics to Amy for her *Granite Guy* DVD. How many boxes of comics does she have now?

18. Melissa is in training for a rowing competition. She keeps track of the hours she practises. At the end of the week, she totals her hours.

Hours Practised

Sun	Mon	Tues	Wed	Thurs	Fri	Sat
2	$\frac{3}{4}$	$2\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{1}{2}$

a) This week she had a goal to practise for a total of at least 10 h. Estimate whether she met her goal.

b) How many hours did she practise?

c) Was your estimate reasonable? Explain.

19. At the school's spring fair they sold $5\frac{1}{3}$ vegetarian pizzas, $6\frac{3}{4}$ pepperoni pizzas, and $4\frac{5}{6}$ cheese pizzas.

a) Draw diagrams to show how much of each pizza was sold.

b) Estimate, then calculate how much pizza was sold altogether.

20. The movie started 2 h 12 min ago. The movie will end in $1\frac{5}{6}$ h.

a) What is the total length of the movie in hours written as a fraction?

b) If the movie started at 2:15 p.m., when did the movie end? Write the time as a fraction.

MATH LINK

Egyptian fractions can be useful today. Suppose you have 13 sacks of rice to divide among 8 people. That means each person would get $1\frac{5}{8}$ sacks.

How can you give each person $1\frac{5}{8}$ sacks of rice if you do not have a calculator or scale?

First, give each person 1 whole sack. Then, use Egyptian fractions to determine how to give each person $\frac{5}{8}$ sack:

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

The Egyptian fraction shows that you should give each person $\frac{1}{2}$ sack, plus $\frac{1}{8}$ sack.

After you give $\frac{1}{2}$ sack to each person, there will be 1 sack left.

You then divide this sack into 8 and give each person $\frac{1}{8}$.

The diagram shows that each person gets

1 whole sack, plus $\frac{1}{2}$ sack and $\frac{1}{8}$ sack.

How would you divide the following?

a) 7 sacks of potatoes among 4 people

b) 7 bags of flour among 5 people

c) 9 loaves of bread among 5 people
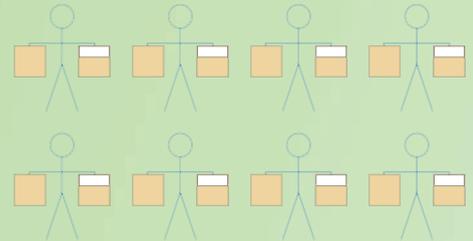
Strategies

Solve a Simpler Problem
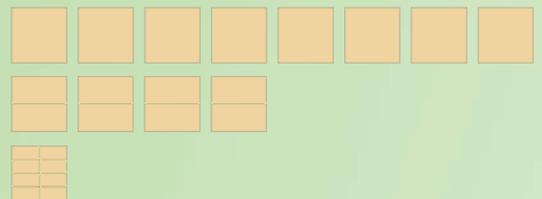
Refer to page xvii.

Subtract Mixed Numbers

After Lucy worked on her art project, she had $2\frac{3}{4}$ jars of paint left. Later, she used $1\frac{1}{4}$ jars of paint to finish her painting. How much paint is left now?

Discuss the Math

How do you subtract mixed numbers?

Example 1: Subtract Mixed Numbers With Like Denominators

Subtract. Write the answer in lowest terms.

$2\frac{3}{4} - 1\frac{1}{4}$

Solution

Method 1: Use Fraction Strips

$2\frac{3}{4} - 1\frac{1}{4}$

Subtract.

There are now $1\frac{2}{4}$ fraction strips.

Write the answer in lowest terms.

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

Method 2: Use a Subtraction Statement

Subtract the whole numbers.

$2 - 1 = 1$

Subtract the fractions.

$\frac{3}{4} - \frac{1}{4} = \frac{2}{4}$

$2\frac{3}{4} - 1\frac{1}{4} = 1\frac{2}{4}$

You can use diagrams.

$2 - 1 = 1$

$\frac{3}{4} - \frac{1}{4} = \frac{2}{4}$

Write the answer in lowest terms.

$\div 2$

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

$\div 2$

Check: **M E**

$2\frac{3}{4} - 1\frac{1}{4} \approx 3 - 1$

$3 - 1 = 2$

$1\frac{1}{2}$ is close to the estimate of 2.

The answer is reasonable.
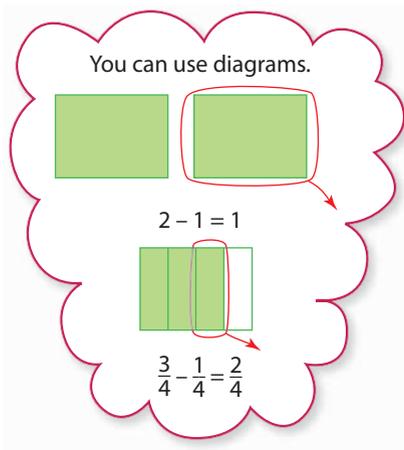
Show You Know

Subtract. Write each answer in lowest terms.

a) $2\frac{2}{3} - 1\frac{1}{3}$ b) $3\frac{7}{8} - 1\frac{3}{8}$ c) $4\frac{3}{4} - \frac{1}{4}$

Example 2: Subtract Mixed Numbers With Unlike Denominators

Subtract.

$$3\frac{3}{8} - 1\frac{1}{2}$$

Solution

Method 1: Use Fraction Strips
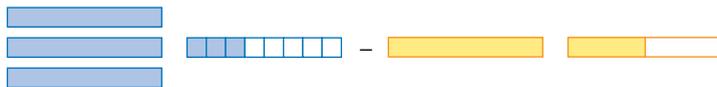
$$3\frac{3}{8} - 1\frac{1}{2}$$

To subtract $\frac{3}{8}$ and $\frac{1}{2}$, you need to use parts that are the same size.

You cannot subtract $\frac{4}{8}$ from $\frac{3}{8}$.

Take 1 whole strip from $3\frac{3}{8}$ and make it the equivalent fraction $\frac{8}{8}$.

Subtract.

There are $1\frac{7}{8}$ strips left.

$$3\frac{3}{8} - 1\frac{1}{2} = 1\frac{7}{8}$$

Method 2: Use a Subtraction Statement and Regroup

Use multiples to determine a common denominator.

Multiples of 2 are 2, 4, 6, ⑧,…

Multiples of 8 are ⑧, 16, …

Use 8 as a common denominator.

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

You cannot subtract $\frac{4}{8}$ from $\frac{3}{8}$. You need to regroup.

Regroup 1 whole from $3\frac{3}{8}$.

$$3\frac{3}{8} = 2 + \frac{8}{8} + \frac{3}{8}$$
$$= 2\frac{11}{8}$$

$$3\frac{3}{8} - 1\frac{4}{8} = 2\frac{11}{8} - 1\frac{4}{8}$$
$$= 1\frac{7}{8}$$

Subtract the whole numbers and subtract the fractions.

You can use diagrams.

$$2\frac{11}{8} - 1\frac{4}{8} = 1\frac{7}{8}$$
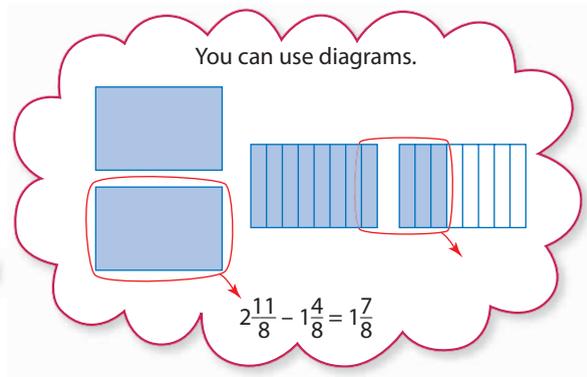
Method 3: Use a Subtraction Statement and Improper Fractions

Determine a common denominator.

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

You cannot subtract $\frac{4}{8}$ from $\frac{3}{8}$.

You can change to improper fractions.

$$3\frac{3}{8} - 1\frac{4}{8} = \frac{27}{8} - \frac{12}{8}$$ Subtract.
$$= \frac{15}{8}$$
$$= 1\frac{7}{8}$$

You can use diagrams.

$$\frac{27}{8} - \frac{12}{8} = \frac{15}{8}$$
$$= 1\frac{7}{8}$$

Check: **M E**

$$3\frac{3}{8} - 1\frac{1}{2} \approx 3\frac{1}{2} - 1\frac{1}{2}$$

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

$1\frac{7}{8}$ is a little less than the estimate of 2. The answer is reasonable.

Show You Know

Subtract. Write each answer in lowest terms.

a) $3\frac{3}{8} - 1\frac{1}{2}$ **b)** $4\frac{1}{4} - 3\frac{2}{5}$ **c)** $4\frac{1}{4} - \frac{7}{8}$

Did You Know?

Chinese fractions do not have a fraction bar. A symbol is used that represents the words "part of" or "parts of." $\frac{1}{2}$ is written or spoken as "1 part of 2."

Key Ideas

- When subtracting mixed numbers with like denominators, you can
  - subtract the whole numbers
  - subtract the fractions
- When subtracting mixed numbers with unlike denominators, you can
  - determine a common denominator for the fractions
  - subtract the whole numbers
  - subtract the fractions
- Sometimes, mixed numbers need to be regrouped or changed to improper fractions before subtracting.

Regroup

$$4\frac{3}{8} - 1\frac{5}{8} = 3\frac{11}{8} - 1\frac{5}{8}$$
$$= 2\frac{6}{8}$$
$$= 2\frac{3}{4}$$

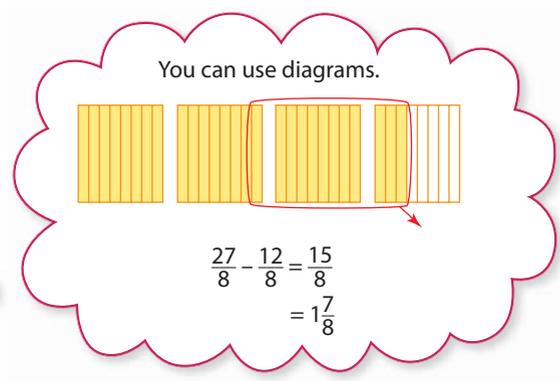*Change to Improper Fractions*

$$4\frac{3}{8} - 1\frac{5}{8} = \frac{35}{8} - \frac{13}{8}$$
$$= \frac{22}{8}$$
$$= 2\frac{6}{8}$$
$$= 2\frac{3}{4}$$

- To check your answer, compare to an estimate.

Communicate the Ideas

1. After Jack's party, $2\frac{3}{4}$ bottles of pop were left. The next day, Jack's family drank $2\frac{1}{4}$ bottles. How much pop is left now? Discuss with a partner how you would solve this problem.

2. a) What do you need to do before you can calculate $2\frac{1}{6} - 1\frac{5}{12}$?

   b) Determine the answer to $2\frac{1}{6} - 1\frac{5}{12}$.

   c) Use estimation to check your answer. What method did you use?

   d) With a partner, compare how you calculated the answer to $2\frac{1}{6} - 1\frac{5}{12}$. Then compare the method you used to check your answer.

For help with #3 to #6, refer to Example 1 on pages 252–253.

3. For each set of fraction strips, write the subtraction statement.

a)

b)

c)

4. Write a subtraction statement to represent each diagram.

a)

b)

c)
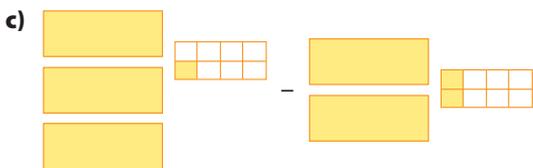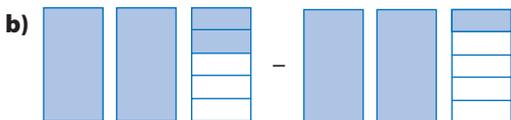
5. Subtract. Write your answers in lowest terms. Check your answers using estimation.

a) $1\frac{2}{5} - 1\frac{1}{5}$　　　　b) $6\frac{7}{8} - 5\frac{5}{8}$

c) $3\frac{1}{4} - 1\frac{1}{4}$　　　　d) $3\frac{1}{12} - 1\frac{7}{12}$

e) $2\frac{1}{6} - \frac{5}{6}$　　　　f) $4 - 1\frac{1}{7}$

6. Determine the difference. Write your answers in lowest terms.

a) $4\frac{5}{9} - 3\frac{1}{9}$　　　　b) $2\frac{1}{3} - 2\frac{1}{3}$

c) $5\frac{2}{5} - 1\frac{4}{5}$　　　　d) $4\frac{3}{10} - 2\frac{9}{10}$

e) $5 - 4\frac{7}{12}$　　　　f) $3\frac{5}{8} - 2\frac{7}{8}$

For help with #7 to #10, refer to Example 2 on pages 254–255.

7. Write a subtraction statement for each set of fraction strips.

a)

b)

c)
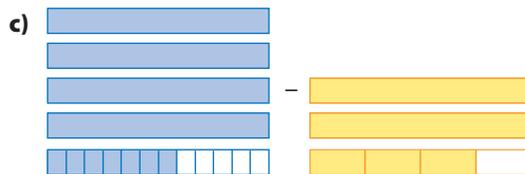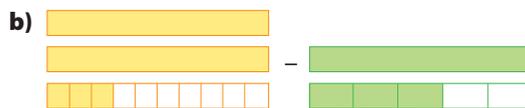
8. For each diagram, write a subtraction statement.

a)

b)

c)
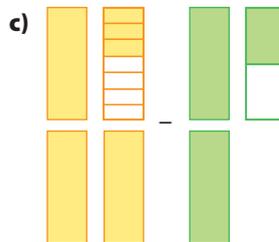
9. Subtract. Write your answers in lowest terms. Check your answers using estimation.

a) $6\frac{7}{10} - 3\frac{2}{5}$　　　　b) $4\frac{1}{2} - \frac{1}{5}$

c) $7\frac{7}{15} - 3\frac{1}{6}$　　　　d) $5\frac{5}{9} - 2\frac{2}{3}$

e) $1\frac{4}{5} - 1\frac{2}{3}$　　　　f) $2\frac{3}{14} - \frac{6}{7}$

10. Determine the difference. Write your answers in lowest terms.

a) $3\frac{2}{5} - 1\frac{3}{10}$ **b)** $1\frac{1}{3} - 1\frac{1}{4}$

c) $7\frac{5}{9} - 5\frac{1}{6}$ **d)** $4\frac{1}{4} - 2\frac{5}{12}$

e) $3\frac{1}{6} - \frac{3}{4}$ **f)** $2\frac{3}{4} - 1\frac{4}{5}$

Apply

11. Karen goes to swimming practice for $1\frac{1}{3}$ h each day. In the morning she has $\frac{2}{3}$ h of practice. How many hours of practice does she have in the afternoon?
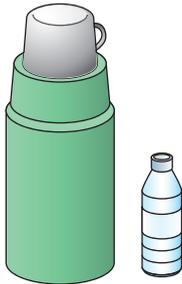
12. A large Thermos™ has enough water to fill $9\frac{3}{4}$ water bottles for a team of soccer players. Halfway through practice, the players drink $4\frac{1}{2}$ bottles of water. How much water is left for the rest of the practice?

13. It takes Ria $3\frac{3}{4}$ h to complete the marathon. The race started $1\frac{1}{2}$ h ago.
a) How much longer will Ria be running?
b) Check your answer using estimation.

14. A pie recipe calls for $3\frac{1}{2}$ packages of Saskatoon berries. Julia has $1\frac{1}{3}$ packages. How much more does she need? Include diagrams with your answer.

15. Mark and Lin race to see who can collect the most hockey cards. Mark has collected $5\frac{1}{3}$ sets. Lin has collected $4\frac{3}{4}$ sets. Who has collected more sets? How much more?

16. Alex has just completed $2\frac{3}{4}$ h of a babysitting course. He must complete $13\frac{1}{2}$ h to get his certificate.
a) How many more hours does he need?
b) Check your answer using estimation.

17. For gym class Ben ran $1\frac{5}{12}$ laps. Mei ran $\frac{18}{12}$ laps. Who ran farther and by how much?

18. You can subtract a mixed number and an improper fraction. Determine each difference.

a) $3\frac{3}{4} - \frac{3}{2}$ **b)** $2\frac{7}{10} - \frac{6}{5}$ **c)** $5\frac{1}{3} - \frac{7}{4}$

19. $1\frac{3}{4}$ trays of dinner rolls are for sale in the bakery window. A customer comes and buys $\frac{5}{6}$ of a tray. How much is left? Include diagrams with your answer.

Extend

20. Daniel spends $9\frac{1}{2}$ h sleeping. He spends $6\frac{1}{4}$ h at school.
a) How much more time does he spend sleeping than at school?
b) How much time does he spend at school and sleeping altogether?
c) How much time is left in the day to do other things?

21. Diana is allowed to use the computer for 3 h each weekend. She used it for $\frac{1}{2}$ h on Saturday morning, $1\frac{1}{4}$ h on Saturday night, and $\frac{3}{4}$ h on Sunday morning.

  a) For how much time can Diana use the computer on Sunday night?

  b) Show how you would check your answer using estimation.

22. Bella uses 4.1 pieces of construction paper to make an art project. Shelly uses $3\frac{1}{4}$ pieces of the following questions, calculate your answer using only fractions. Then calculate using only decimals. Compare the answers.

a) How much more paper does Bella use?

b) How much paper do Bella and Shelly use in total?

23. There are 12 golf balls in a package. The Takeda family has $2\frac{2}{3}$ packages. Cindy takes $\frac{1}{2}$ package, her dad takes 1 package, and her brother takes 4 golf balls.

  a) What fraction of a package is left?

  b) How many golf balls is this?

MATH LINK

The Babylonian system of numbers was based on 60, not 10.

Babylonian fractions were expressed as numbers out of 60, e.g., $\frac{2}{60}, \frac{3}{60}, \frac{5}{60}, \frac{12}{60}$.

Many things we use today come from the Babylonian times. Our clock is based on the number 60.

The time can be written as a fraction out of 60 min. For example, 9:10 a.m. $= 9\frac{10}{60}$.

For a) to e) write your answers as fractions.

a) Write each time as a fraction out of 60.
   8:10 p.m.   9:20 a.m.   7:48 a.m.   12:12 p.m.

b) The time now is 2:15 p.m. What was the time 1 h and 12 min ago?

c) The time now is 4:30 p.m. What will be the time 2 h and 36 min from now?

d) Amanda studied for $\frac{1}{3}$ of an hour. She started studying at 9:15 a.m. At what time did she finish studying?

e) How much time passed between 1:07 p.m. and 3:42 p.m.? between 5:45 p.m. and 9:20 p.m.?

f) Sam started reading the newspaper at 9:45 a.m. and finished reading it in $\frac{7}{12}$ h. Mila took $\frac{1}{4}$ h more to read the paper than Sam did. She started at 10:30 a.m. At what time did she finish reading the paper?

Key Words

For #1 to #4, unscramble each set of letters. Use the meanings to help you.

1. L T P L M U I E

the product of a given number and a natural number

2. E P R P O R M I C N O A R T I F

a fraction that has a numerator greater than the denominator

3. X D E M I M N E R U B

a number that is made up of a whole number and a fraction

4. M O O M N C R O D E M I N A N O T

a number that is a common multiple of the denominators of two or more fractions

7.1 Common Denominators, pages 230–236

5. Draw Venn diagrams like the ones shown to determine the first three common multiples of each set of numbers.

a)

Multiples of 2   Multiples of 5

b)

Multiples of 3   Multiples of 6
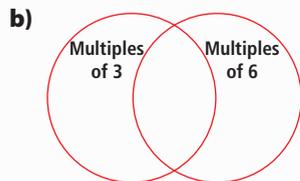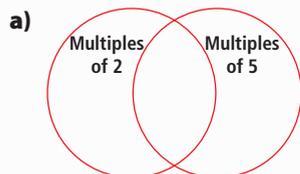
6. Determine a common denominator for each pair of fractions.

a) $\frac{1}{4}$ and $\frac{1}{8}$ **b)** $\frac{1}{3}$ and $\frac{1}{5}$

c) $\frac{1}{3}$ and $\frac{1}{4}$ **d)** $\frac{1}{4}$ and $\frac{1}{10}$

7. Determine a common denominator for the set of fractions below. Use it to make equivalent fractions. Then list the fractions in order from greatest to least.

$\frac{1}{2}, \frac{1}{6}, \frac{2}{3}, \frac{3}{4}, \frac{7}{12}$

7.2 Add and Subtract Fractions With Unlike Denominators, pages 237–244

8. Write an addition statement to represent each diagram. Then add.

a) +

b) +

9. Write a subtraction statement to represent each diagram. Then subtract.

a) –

b) –
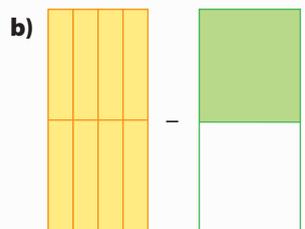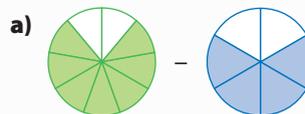
10. Add. Write each answer in lowest terms.

a) $\frac{1}{6} + \frac{1}{3}$ **b)** $\frac{2}{5} + \frac{1}{10}$ **c)** $\frac{3}{4} + \frac{3}{5}$

d) $\frac{1}{4} + \frac{1}{3}$ **e)** $\frac{5}{6} + \frac{3}{4}$ **f)** $\frac{1}{10} + \frac{2}{3}$

11. Subtract. Write each answer in lowest terms.

a) $\frac{3}{4} - \frac{1}{2}$ **b)** $\frac{1}{2} - \frac{1}{6}$ **c)** $\frac{7}{12} - \frac{1}{4}$

d) $\frac{3}{5} - \frac{1}{3}$ **e)** $\frac{1}{3} - \frac{3}{9}$ **f)** $\frac{7}{8} - \frac{7}{12}$

12. The recycling bin was $\frac{1}{4}$ full yesterday. Today the bin was filled another $\frac{1}{8}$. How full is the bin now? Include diagrams with your answer.

**13.** June-el ran for $\frac{5}{6}$ h yesterday. Today she ran for $\frac{2}{3}$ h. On which day did she run more, and by how much? Check your answer.

14. Michael and Hari bought a bag of pretzels to share.
   a) Michael ate $\frac{1}{4}$ of the bag. Hari ate $\frac{1}{6}$ of the bag. How much of the bag did they eat altogether?
   b) If Michael's brother ate $\frac{1}{3}$ of the bag, what fraction of the bag is left?

7.3 Add Mixed Numbers, pages 245–251

15. Write an addition statement to represent each diagram.

a)

b)
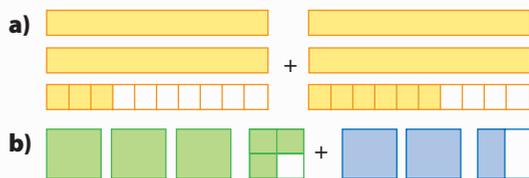
16. Draw a diagram for each addition statement. What is each sum?
   a) $1\frac{1}{5} + 3\frac{3}{5}$ **b)** $\frac{1}{3} + 6\frac{2}{5}$ **c)** $3\frac{1}{4} + 1\frac{5}{6}$
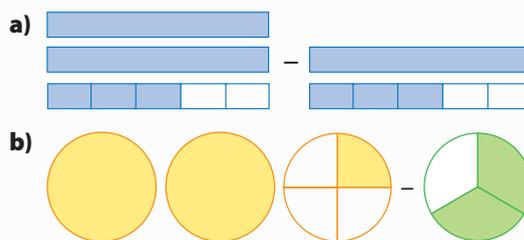
17. Add. Write each answer in lowest terms.
   a) $2\frac{1}{8} + 2\frac{3}{8}$ **b)** $3\frac{7}{10} + 1\frac{1}{5}$
   c) $2\frac{1}{2} + 1\frac{5}{6}$ **d)** $4\frac{4}{7} + 5\frac{3}{7}$
   e) $5\frac{5}{6} + \frac{11}{12}$ **f)** $7\frac{7}{8} + 2\frac{5}{6}$

18. The painters finished painting $2\frac{5}{12}$ rooms before lunch. After lunch, they finished another $5\frac{3}{4}$ rooms. How many rooms in total did they paint? Check your answer.

7.4 Subtract Mixed Numbers, pages 252–259

19. Write a subtraction statement to represent each diagram.

a)

b)

20. Draw a diagram for each subtraction statement.
   a) $4\frac{1}{6} - 2\frac{1}{6}$ **b)** $2\frac{2}{3} - 1\frac{1}{4}$ **c)** $3\frac{7}{12} - 1\frac{5}{6}$

21. Subtract. Write each answer in lowest terms.
   a) $2\frac{3}{4} - 2\frac{1}{4}$ **b)** $2\frac{1}{2} - 1\frac{3}{10}$
   c) $5\frac{3}{4} - 3\frac{1}{3}$ **d)** $3\frac{1}{5} - 1\frac{7}{10}$
   e) $2\frac{5}{14} - \frac{6}{7}$ **f)** $2\frac{4}{7} - 1\frac{2}{3}$

22. Stuart is making cookies. He has $2\frac{1}{4}$ bags of chocolate chips. He adds $1\frac{2}{3}$ bags to the cookie dough.
   **a)** What fraction of the total amount of chocolate chips is left?
   b) He decides to add $1\frac{5}{6}$ bags of butterscotch chips to the dough. How many bags of chips does he use in total?

For #1 to #4, select the best answer.

1. What is a common denominator for 6 and 12?

   A 12   **B** 6   **C** 3   **D** 2

2. What is $\frac{1}{3} + \frac{1}{4}$ written in lowest terms?

   A $\frac{2}{7}$ **B** $\frac{1}{6}$ **C** $\frac{2}{12}$ **D** $\frac{7}{12}$

3. What is $1\frac{1}{6} + 2\frac{1}{2}$ written in lowest terms?

   A $3\frac{2}{12}$ **B** $3\frac{2}{8}$ **C** $3\frac{1}{4}$ **D** $3\frac{2}{3}$

4. Yuri had $4\frac{1}{3}$ cans of tennis balls. He gave $1\frac{2}{3}$ cans to Bonnie. How many cans of tennis balls did he have left?

   A $3\frac{2}{3}$ **B** $2\frac{2}{3}$ **C** $3\frac{1}{3}$ **D** $2\frac{1}{3}$

Short Answer

5. Write an addition statement for each diagram. Then add.

a)

b)

c)

d)
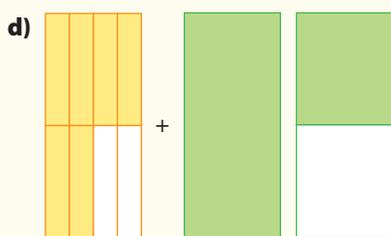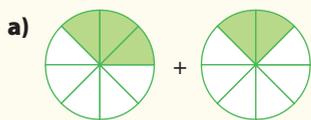
6. Write a subtraction statement for each diagram. Then subtract.

a)

b)

c)

d)
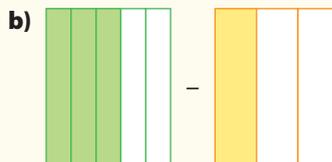
7. Add. Write each answer in lowest terms.

   a) $\frac{2}{5} + \frac{1}{10}$ **b)** $\frac{2}{3} + \frac{3}{4}$

   c) $3\frac{1}{6} + 2\frac{5}{6}$ **d)** $6\frac{1}{3} + \frac{4}{5}$

8. Subtract. Write each answer in lowest terms.

   a) $\frac{5}{6} - \frac{1}{6}$ **b)** $\frac{5}{6} - \frac{3}{4}$

   c) $3\frac{1}{2} - 1\frac{1}{3}$ **d)** $1\frac{7}{12} - \frac{2}{3}$

9. At the end of the day, the bakery had $3\frac{1}{2}$ trays of whole wheat bread and $2\frac{1}{5}$ trays of rye bread left. How many trays of bread were left altogether?

10. George spent $3\frac{3}{4}$ h helping his mom.

He spent $2\frac{1}{2}$ h on the computer.

   a) How much more time did he spend helping his mom than on the computer?

   b) How much time did he spend helping and on the computer in total?

11. It snowed for $2\frac{3}{4}$ h yesterday.

Then it rained for another $1\frac{1}{6}$ h.

a) How many more hours did it snow than rain?

b) How long did it snow and rain altogether?

12. Brenda cooks for $2\frac{2}{3}$ h on Saturday.

On Sunday she cooks for $1\frac{3}{4}$ h.

a) How many more hours does she cook on Saturday than on Sunday?

b) Check your answer.

Extended Response

13. Explain why it is important to have common denominators when adding or subtracting fractions.

14. Which diagram shows a larger fraction? Explain.
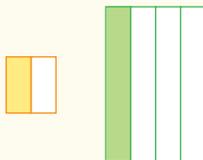
15. To subtract $3\frac{1}{5} - \frac{3}{5}$, Rowena starts by writing: $3\frac{1}{5} - \frac{3}{5} = 2\frac{6}{5} - \frac{3}{5}$

a) Is she correct? Explain.

b) Show another subtraction method.

16. The diagram shows the two rooms of the Prairietown Museum. Each room is the same size. $\frac{3}{8}$ of the two rooms is used for the town's history.

Room 1: Photos   Room 2: Artifacts

- ☐ Town's history
- ☐ Settlement in Canada
- ☐ Canadian Aboriginal peoples
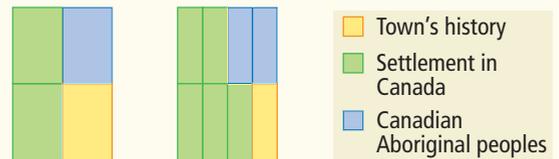
a) What fraction of the two rooms is used for Aboriginal peoples?

b) What fraction of the two rooms is used for settlement in Canada?

c) Is a greater fraction used for Aboriginal peoples or for the town's history? How much greater?

d) Is a greater fraction used for the town's history or for settlement in Canada? How much greater?

WRAP IT UP!

Create a board game about fractions around the world and through history.
- Use information from this chapter.
- Research to find interesting facts about the use of fractions in different cultures, past and present.
- Use all of this information to make questions for your board game.
- Include questions to do with addition and subtraction of fractions with unlike denominators and mixed numbers.
- Do not forget to include answers to the questions.

WWW Web Link

For more information about fractions and mathematics in different cultures and different times, go to www.mathlinks7.ca and follow the links.

Math Games

Fraction Race

You will play three versions of the same game. In a race to reach a given total, you will add fractions. Here are the rules:

- Play the game with a partner.
- Roll one die each to decide who will play first. If there is a tie, roll again.
- In one turn, spin two spinners of different colours. Use the result from the red spinner as the numerator of a fraction. Use the result from the blue spinner as the denominator of this fraction.
- Take turns spinning fractions. Each time you spin a new fraction, add it to your previous total.
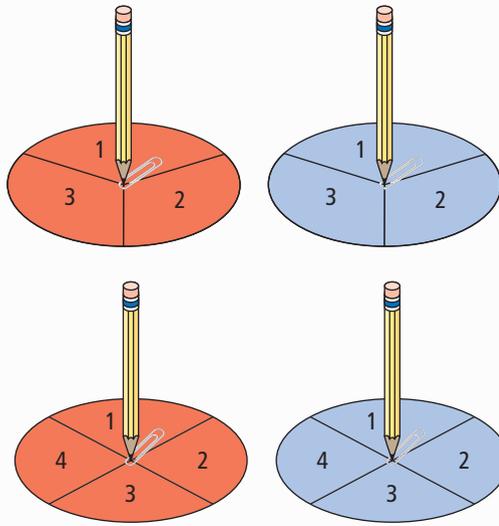
> I spun 3 on a red spinner and 2 on a blue spinner. My score for this turn is $\frac{3}{2}$ points.

1. Play the game using the red and blue spinners that are divided into thirds. The winner is the first player with at least 10 points.

2. Play the game using the red and blue spinners that are divided into fourths. The winner is the first player with at least 15 points.

3. As a challenge, play the game using the red and blue dice instead of the spinners. The winner is the first player with at least 20 points.

Magazine Design

The job of magazine designers is to create eye-catching page spreads, like the one shown.

You be the magazine designer! Design two or more magazine spreads.

Digital rights not available.

a) First decide where to place the ads. Here is the advertising information:
  • Three advertisers have two ads each.
  • The advertisers want their two ads to be different sizes and appear on different spreads.
  • The table shows the sizes and costs of ads.

b) Fill the rest of the space with articles and pictures.

c) Make a table that shows the following information for each advertiser:
  • the fraction of a page covered by each ad
  • the cost of each ad
  • the total cost of the two ads
  Show your work.

Portion of Page	Cost
full page	$299
$\frac{3}{4}$ page	$244
$\frac{1}{2}$ page	$154
$\frac{1}{4}$ page	$99
$\frac{1}{8}$ page	$79

d) Make another table that shows the fraction of space on each page covered by articles, the fraction covered by pictures, and the total space covered by both articles and pictures. Show your work.