RELATING DECIMALS AND FRACTIONS

A **fraction** represents a part of a whole. Decimals are a kind of fraction because they show parts of a whole. For example, fifty cents ($.50) is a fraction of one dollar ($\frac{1}{2}$ dollar).

Decimals use place value to show the value of a digit. The decimal 0.7 means *seven tenths* because the digit 7 is in the tenths place. You can also write *seven tenths* as $\frac{7}{10}$.

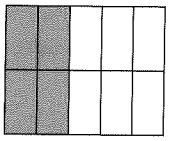
The shaded portion of this figure can be written 0.7 or $\frac{7}{10}$. Both are read "seven tenths."

In the fraction $\frac{7}{10}$, the top number, or numerator, tells how many parts are shaded. The bottom number, the denominator, tells how many total parts there are in the figure.

$\frac{7}{10}$ numerator / denominator

Write a decimal and a fraction to represent the shaded portion of each figure.

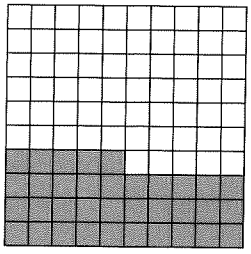
1.



Decimal _____

Fraction _____

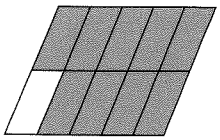
2.



Decimal _____

Fraction _____

3.



Decimal _____

Fraction _____

When the denominator of a fraction is 10, 100, 1,000, or another multiple of 10, you can easily change the fraction to a decimal.

CHANGING FRACTIONS TO DECIMALS BY USING PLACE VALUE

Example Write $\frac{75}{1,000}$ as a decimal.

Step 1

Think: How many decimal places does a fraction with a denominator of 1,000 need?

It needs 3 decimal places.

0. ___ ___ ___ ← thousandths place

Step 2

The numerator should fill the place value named by the denominator. Use placeholder zeros if necessary.

0.075 means "seventy-five thousandths"

↑ placeholder zero

Write these fractions as decimals.

4. $\frac{69}{100}$ $\frac{5}{10}$ $\frac{482}{1000}$ $\frac{3}{100}$

5. $\frac{2}{10}$ $\frac{25}{100}$ $\frac{1}{10}$ $\frac{9}{1000}$

Use your knowledge of decimals and fractions to compare each pair of numbers.
Write = (is equal to), > (is greater than), or < (is less than) in each blank.

6. $\frac{5}{100}$ _____ 0.48 0.6 _____ $\frac{6}{10}$ 0.035 _____ $\frac{350}{1000}$

7. $\frac{5}{1000}$ _____ 0.005 $\frac{16}{100}$ _____ 0.20 0.9 _____ $\frac{8}{10}$

Choose the best answer for each problem below.

8. In a race, a speed skater shaved $\frac{8}{100}$ of a second off the course's best lap time. Which decimal represents the time saved?

A. 0.8
B. 0.08
C. 0.008

ProCorp Assembly

Shift	Defect Rate
Morning	$\frac{6}{1000}$
Evening	$\frac{1}{100}$
Swing	$\frac{6}{100}$

9. The Utvich family spends 0.3 of their income on rent. What fraction of their income is spent on rent?

A. $\frac{3}{10}$
B. $\frac{3}{100}$
C. $\frac{3}{1000}$

10. In a recent survey, 85 out of every 100 people asked said that they eat fast food at least twice a week. Which decimal represents this group?

A. 0.0085
B. 0.085
C. 0.85

11. Which assembly line shift had a defect rate of 0.06?

A. the morning shift
B. the evening shift
C. the swing shift

12. Explain Did the morning or the swing shift make errors at a lower rate? Explain how you know which fraction is smaller.

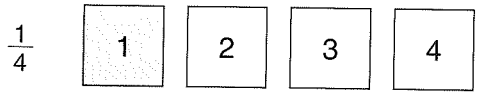
13. Which shift had the lowest defect rate?

Answers start on page 183.

DIFFERENT FORMS OF FRACTIONS

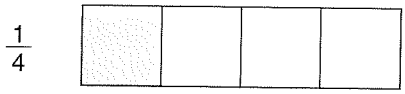
Fractions represent a part of a whole. They can also represent division.

The fraction $\frac{1}{4}$ can mean "1 out of 4 parts."



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

$\frac{1}{4}$ can also mean "1 divided by 4." The fraction bar in a fraction means "divided by."



1 divided by 4 is $\frac{1}{4}$ of a whole.

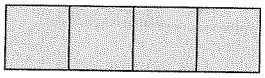
Every fraction has two numbers: a numerator and a denominator. In a **proper fraction,** the numerator is smaller than the denominator.

$\frac{\text{numerator}}{\text{denominator}}$ ← top number ← bottom number

Sometimes a fraction will take a different form. A fraction with the top number equal to or greater than the bottom number is called an **improper fraction.**

When the numerator is *the same as* the denominator, the fraction *is equal to* 1.

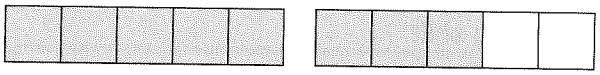
Example $\frac{4}{4} = 1$ because 4 divided by 4 is 1.



$\frac{4}{4}$ is one whole.

When the numerator *is greater than* the denominator, the fraction *is greater than* 1.

Example $\frac{8}{5} > 1$ because 8 divided by 5 is 1 with a remainder of 3.



$\frac{8}{5}$ is one whole plus 3 fifths.

A **mixed number** is a "mix" of a whole number and a fraction. An improper fraction can be written as a mixed number using division.

WRITING AN IMPROPER FRACTION AS A MIXED NUMBER

Example Write $\frac{8}{5}$ as a mixed number.

Step 1
Divide the numerator by the denominator.

$\frac{8}{5} = 5\overline{)8}^{1\text{ R3}}$

Step 2
The quotient becomes the whole number part.

Put the remainder over the original denominator to make the fraction part.

$\frac{8}{5} = 1\frac{3}{5}$

Write each fraction as a whole number or as a mixed number. The first one has been done for you.

1. $\frac{7}{5} = 7 \div 5 = 1\frac{2}{5}$ $\frac{4}{3}$ $\frac{11}{2}$ $\frac{6}{6}$

2. $\frac{6}{3}$ $\frac{12}{7}$ $\frac{5}{4}$ $\frac{7}{3}$

CHANGING MIXED NUMBERS TO FRACTIONS

To write a fraction as a mixed number, you divide. To write a mixed number as a fraction, you do the opposite—multiply.

WRITING A MIXED NUMBER AS A FRACTION

Example Write $2\frac{1}{4}$ as a fraction.

Step 1
Multiply the whole number by the denominator. Write this product over the denominator of the fraction.

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

Step 2
Add the original numerator to the product found in Step 1. Write the total over the denominator.

$2\frac{1}{4} = \frac{8}{4} + \frac{1}{4} = \frac{9}{4}$

Change these mixed numbers into fractions.

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

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

CORE CONNECTIONS: Calculators and Fractions

Calculators display fractions as decimals. You can easily change any fraction to a decimal using your calculator.

Example: Write $\frac{6}{5}$ as a decimal.

Remember, the fraction bar means "divided by," so $\frac{6}{5}$ means $6 \div 5$.

Divide using a calculator: 6 ÷ 5 [ENTER] The display reads: 6÷5 1.2

The fraction $\frac{6}{5}$ equals the decimal **1.2**

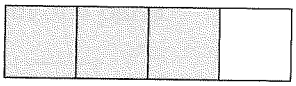
Use a calculator to change these fractions to decimals.

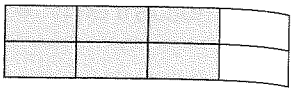
1. $\frac{3}{5}$
2. $\frac{7}{8}$
3. $\frac{1}{2}$
4. $\frac{1}{8}$
5. $\frac{3}{4}$
6. $\frac{2}{5}$

Answers start on page 184.

EQUIVALENT FRACTIONS

Write a fraction to express the shaded portion of each figure.

$\frac{\text{number of shaded parts}}{\text{number of total parts}}$ 

$\frac{\text{number of shaded parts}}{\text{number of total parts}}$ 

The shaded parts of the two figures above are the same size. $\frac{3}{4}$ and $\frac{6}{8}$ are **equivalent fractions** because they represent equal amounts.

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

Two fractions are equivalent if their **cross products** are equal. Cross products are the results of multiplying diagonally across the equal sign.

$\frac{3}{4} \times \frac{6}{8}$

Find the cross products.
$4 \times 6 = 24$
$3 \times 8 = 24$

Both cross products equal 24.
Since the cross products are equal, the fractions are equivalent fractions.

The numbers in a fraction can be called **terms.** When working with fractions, it is often helpful to write an equivalent fraction using higher or lower terms. To do this, use a key math principle:

Multiplying or dividing a number by 1 doesn't change the number's value.

RAISING A FRACTION TO HIGHER TERMS

Example Raise $\frac{1}{4}$ to a fraction with a denominator of 16.

Step 1
Think: To raise 4 to 16, multiply by 4.

$\frac{1}{4} = \frac{\square}{16}$

Step 2
Write 1 as a fraction using 4 as both the numerator and the denominator.

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

Step 3
Multiply $\frac{1}{4}$ by $\frac{4}{4}$.

$\frac{1}{4} \times \frac{4}{4} = \frac{1 \times 4}{4 \times 4} = \frac{4}{16}$

Step 4
Use cross products to check your work.

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

$4 \times 4 = 16$
$1 \times 16 = 16$

The final answer to a problem should be simplified, or written in **lowest terms.** A fraction is in lowest terms when there is no number that can evenly divide both the numerator and the denominator except for 1.

SIMPLIFYING A FRACTION

Example Write $\frac{10}{15}$ in lowest terms.

Step 1
Think: What number can both 10 and 15 be divided by?

Both can be divided by 5.

Step 2
Write 1 as a fraction using 5 as both the numerator and the denominator.

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

Step 3
Divide $\frac{10}{15}$ by $\frac{5}{5}$.

$\frac{10}{15} \div \frac{5}{5} = \frac{10 \div 5}{15 \div 5} = \frac{2}{3}$

Step 4
Use cross products to check your work.

$\frac{10}{15} = \frac{2}{3}$

$15 \times 2 = 30$
$10 \times 3 = 30$

$\frac{2}{3}$ is in lowest terms because 2 and 3 cannot be divided by any number except 1.

Write equivalent fractions. The first one in each row is started.

1. $\frac{3}{8} = \frac{\square}{16}$ (×2, ×2) $\quad \frac{1}{2} = \frac{\square}{12} \quad \frac{2}{7} = \frac{\square}{21} \quad \frac{5}{8} = \frac{\square}{40} \quad \frac{5}{6} = \frac{\square}{18}$

2. $\frac{2}{9} = \frac{\square}{36}$ (×4, ×4) $\quad \frac{3}{5} = \frac{\square}{50} \quad \frac{1}{4} = \frac{\square}{48} \quad \frac{2}{3} = \frac{\square}{33} \quad \frac{7}{10} = \frac{\square}{100}$

3. $\frac{8}{11} = \frac{\square}{55}$ (×5, ×5) $\quad \frac{3}{4} = \frac{\square}{20} \quad \frac{4}{5} = \frac{\square}{100} \quad \frac{4}{7} = \frac{\square}{28} \quad \frac{5}{12} = \frac{\square}{60}$

Simplify each fraction by writing it in lowest terms.

4. $\frac{8}{14} \div \frac{2}{2}$ $\quad \frac{12}{20} = \quad \frac{21}{24} = \quad \frac{10}{12} =$

5. $\frac{25}{35} = \quad \frac{6}{18} = \quad \frac{18}{36} = \quad \frac{8}{14}$

Are these fractions in lowest terms? If yes, write the fraction in the space provided. If not, put the fraction in lowest terms.

6. $\frac{4}{5} =$ _____ $\quad \frac{12}{18} =$ _____ $\quad \frac{2}{8} =$ _____ $\quad \frac{5}{7} =$ _____

7. $\frac{20}{24} =$ _____ $\quad \frac{16}{30} =$ _____ $\quad \frac{4}{6} =$ _____ $\quad \frac{3}{12} =$ _____

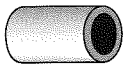
MedLab Manufacturing makes rubber tubing with the diameters shown on the chart to the right. Use the chart to solve the problems.

8. Ae Ri calculates that she needs tubing with a diameter of $\frac{8}{32}$ inch. Which model of tubing should she order?

9. A hospital has a large stock of Model #5E on hand. If tubing with a diameter of $\frac{20}{64}$ inch is needed, is Model #5E too large, too small, or just right?

10. Explain A company supervisor suggests that the tubing list be rewritten so that every measurement is listed in thirty-seconds of an inch. How should the measurement for Model #6GH be written? Explain how you know your answer is correct.

MedLab Tubing



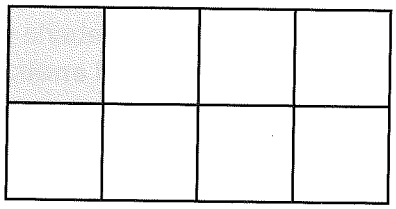
Model Number	Diameter
#4AB	$\frac{1}{32}$ in
#4C	$\frac{1}{16}$ in
#5D	$\frac{1}{4}$ in
#5E	$\frac{5}{16}$ in
#6F	$\frac{3}{8}$ in
#6GH	$\frac{1}{2}$ in

Answers start on page 184.

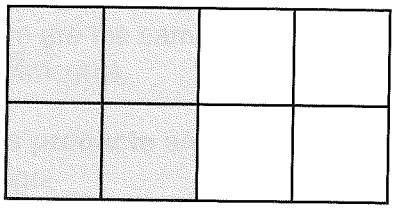
COMPARING FRACTIONS

Your work with fractions will make more sense if you know about how large a fraction is. A proper fraction is smaller than 1, but is it a lot smaller than 1, close to $\frac{1}{2}$ or very close to 1?

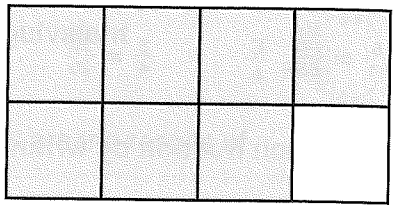
The diagrams below represent $\frac{1}{8}$, $\frac{4}{8}$, and $\frac{7}{8}$.



$\frac{1}{8}$ is the smallest fraction you can make with eighths.



You know $\frac{4}{8}$ is exactly half because $8 \div 2 = 4$.



$\frac{7}{8}$ is the greatest proper fraction you can make with eighths.

The examples show:

- If the numerator is very small compared to the denominator, the fraction is small.
- If the numerator is close to half of the denominator, the fraction is close to $\frac{1}{2}$.
- If the numerator is almost as great as the denominator, the fraction is almost 1.

It is easy to compare fractions that have the same denominator.

Example Which is greater, $\frac{4}{9}$ or $\frac{7}{9}$?
You can quickly see that $\frac{7}{9}$ is greater than $\frac{4}{9}$ because 7 is greater than 4.

To compare fractions with different denominators, raise one or both fractions so that they have the same denominator.

COMPARING FRACTIONS WITH DIFFERENT DENOMINATORS

Example Which is greater, $\frac{5}{8}$ or $\frac{2}{3}$?

Raise both fractions to higher terms so that they have the same denominator. You can find a common denominator by multiplying the denominators of the fractions: $8 \times 3 = 24$.

Step 1
Raise both fractions.

$\frac{5}{8} = \frac{\square}{24}$ $\quad \frac{5}{8} \times \frac{3}{3} = \frac{15}{24}$

$\frac{2}{3} = \frac{\square}{24}$ $\quad \frac{2}{3} \times \frac{8}{8} = \frac{16}{24}$

Step 2
Compare the numerators.

$\frac{16}{24}$ is greater than $\frac{15}{24}$ because 16 is greater than 15.

Step 3
Compare the original fractions.

$\frac{2}{3}$ is greater than $\frac{5}{8}$.

You can also use a calculator to compare fractions. Change both fractions to decimals using a calculator and then compare the decimals: $0.666 > 0.625$, so $\frac{2}{3} > \frac{5}{8}$.

$5 \div 8$ $\quad 0.625$
$2 \div 3$ $\quad 0.666666667$

There is a shortcut that you can use to compare fractions. Shortcuts are helpful as long as you memorize them carefully and make sure you understand why they work. Whenever you use a shortcut, always look at your answer and make sure it makes sense.

USING CROSS MULTIPLICATION TO COMPARE FRACTIONS

Example Which is greater, $\frac{5}{6}$ or $\frac{3}{4}$?

Step 1
Write the fractions with a space between them. In the space draw two arrows pointing upward.

$\frac{5}{6}$ ⤫ $\frac{3}{4}$

Step 2
Now multiply in the direction of the arrows. Write the answer next to the numerator where the arrow is pointing.

$4 \times 5 = 20$
$6 \times 3 = 18$

$^{20}\frac{5}{6}$ ⤫ $\frac{3}{4}{}^{18}$

Step 3
The greater product is next to the greater fraction.

$\frac{5}{6} > \frac{3}{4}$ because $20 > 18$.

Why does the shortcut work? Raise both fractions so that they have a denominator of 24.

$$\frac{5}{6} \times \frac{4}{4} = \frac{20}{24} \qquad \frac{3}{4} \times \frac{6}{6} = \frac{18}{24}$$

What do you notice? The numerators of the raised fractions are the same as the results from the shortcut. Multiplying up allows you to compare the numerators without doing all the work of raising the fractions to higher terms.

Circle the fractions that are less than $\frac{1}{2}$.

1. $\frac{3}{8}$ $\frac{6}{11}$ $\frac{2}{5}$ $\frac{4}{7}$ $\frac{7}{12}$

Circle the fractions that are greater than $\frac{1}{2}$.

2. $\frac{5}{12}$ $\frac{13}{20}$ $\frac{3}{10}$ $\frac{9}{14}$ $\frac{8}{15}$

Compare the fractions. Write < (less than), > (greater than), or = (equal to) between the fractions to show the correct relationship.

3. $\frac{5}{7}$ _____ $\frac{9}{20}$ $\frac{6}{9}$ _____ $\frac{2}{3}$ $\frac{1}{6}$ _____ $\frac{3}{11}$

4. $\frac{3}{8}$ _____ $\frac{7}{15}$ $\frac{6}{7}$ _____ $\frac{8}{10}$ $\frac{4}{20}$ _____ $\frac{2}{8}$

5. $\frac{5}{3}$ _____ $\frac{9}{7}$ $\frac{4}{5}$ _____ $\frac{12}{15}$ $\frac{15}{12}$ _____ $\frac{3}{2}$

Answers start on page 184.

ADDING AND SUBTRACTING LIKE FRACTIONS

Like fractions are fractions that have the same denominator. For example, $\frac{1}{8}$ and $\frac{3}{8}$ are like fractions. $\frac{1}{8}$ and $\frac{2}{4}$ are **unlike fractions** because they have different denominators.

To add like fractions, just add the numerators. The denominator remains the same. $\frac{1}{8} + \frac{3}{8} = \frac{4}{8}$ ← 1 + 3 = 4

The answer to an addition or subtraction problem may need to be simplified. Always write your answers in lowest terms. Change improper fractions to mixed numbers.

ADDING LIKE FRACTIONS

Example $\frac{5}{8} + \frac{4}{8}$

Step 1
Add the numerators.

$\frac{5}{8} + \frac{4}{8}$ ← 5 + 4 = 9

Step 2
Place the result over the denominator.

$\frac{5}{8} + \frac{4}{8} = \frac{9}{8}$ ← 5 + 4 = 9

Step 3
Change to a mixed number if necessary.

$\frac{9}{8} = 8\overline{)9}$ $\begin{matrix}1\text{ R1}\end{matrix}$ $= 1\frac{1}{8}$

Turn to page 70 for a review of changing improper fractions to mixed numbers.

SUBTRACTING LIKE FRACTIONS

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

Step 1
Subtract the numerators.

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

Step 2
Place the result over the denominator.

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

Step 3
Simplify if necessary.

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

Turn to page 72 for a review of simplifying fractions.

Add or subtract the following fractions. Express fractions in lowest terms. Change improper fractions to whole or mixed numbers.

1. $\frac{4}{5} - \frac{1}{5}$ $\quad \frac{2}{4} + \frac{3}{4}$ $\quad \frac{7}{10} - \frac{3}{10}$ $\quad \frac{8}{9} + \frac{7}{9}$

2. $\frac{3}{8} - \frac{1}{8}$ $\quad \frac{5}{2} + \frac{7}{2}$ $\quad \frac{11}{12} - \frac{7}{12}$ $\quad \frac{5}{6} + \frac{5}{6}$

Solve the following word problems. Pay careful attention to whether you should add or subtract.

3. Colin spent $\frac{3}{4}$ hour driving to the job interview and $\frac{1}{4}$ hour finding a place to park. How long did he spend driving and parking?

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

   B. $\frac{1}{2}$ hour

   C. 1 hour

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

4. Art ran a sheet of wood $\frac{9}{16}$ inch thick through a sander that reduced the wood's thickness $\frac{1}{16}$ inch. What was the thickness of the wood after sanding?

   A. $\frac{3}{8}$ inch

   B. $\frac{1}{2}$ inch

   C. $\frac{5}{8}$ inch

   D. $\frac{3}{4}$ inch

5. In a driving test, Marta's reaction time was $\frac{7}{100}$ second. Todd's time was $\frac{12}{100}$ second. How much faster was Marta's time than Todd's?

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

   B. $\frac{1}{5}$ second

   C. $\frac{19}{100}$ second

   D. $\frac{1}{20}$ second

6. To dye eggs, Minako adds a few drops of food coloring to $\frac{5}{8}$ cup of hot water. She then adds $\frac{1}{8}$ cup of vinegar. How many cups of dye does this recipe make?

   A. $\frac{1}{2}$ cup

   B. $\frac{3}{4}$ cup

   C. 1 cup

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

Adam is a computer technician. He plans his time by estimating how many quarter hours each job will take. The chart below shows how many quarter hours he estimates for each job. Use the chart to answer the questions.

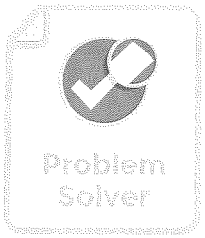
Job	Quarter Hours Scheduled
Hard Drive Installation	2
Troubleshoot Fans	3
Diagnostic	5
System Update	4
Memory Upgrade	3
Virus Scan	1

7. How many hours will Adam schedule to install a hard drive and run a diagnostic? Write your answer as a mixed number.

8. Adam has $1\frac{1}{2}$ hours available. Does he have enough time to troubleshoot fans and perform a memory upgrade?

9. Which jobs cannot be completed in 45 minutes or less? (***Hint:*** Each quarter hour equals 15 minutes.)

Answers start on page 184.



MULTIPLES AND FACTORS

How would you describe this series of numbers? 6, 12, 18, 24, 30, . . .

You may have noticed that each number is 6 more than the previous number. You might also describe the list as "counting by 6."

Both of these observations are true. These numbers are also the answers to the 6 times tables.

$6 \times 1 = 6$ $6 \times 2 = 12$ $6 \times 3 = 18$ $6 \times 4 = 24$ $6 \times 5 = 30$

Mathematicians call this list *the multiples of 6.* The product of two numbers is called a multiple of both those numbers. So 30 is a multiple of both 6 and 5.

A multiplication fact has at least three numbers. The numbers being multiplied are **factors.** The answer is a **multiple** of the factors. The answer can also be called the product.

Having a good understanding of factors and multiples will help you add and subtract fractions and simplify fractions to lowest terms.

FINDING THE LEAST COMMON MULTIPLE

Example What is the least common multiple of 8 and 12?
To find the least common multiple, think of the lowest number that is a multiple of both 8 and 12.

Step 1
List a few multiples of both 8 and 12. Remember, to find multiples, count by the number.

8, 16, 24, 32, 40, . . .

12, 24, 36, 48, 60, . . .

Step 2
Examine the two lists. The least common multiple is the lowest number that appears in both lists.

8, 16, 24, 32, 40, . . .

12, 24, 36, 48, 60, . . .

The least common multiple of 8 and 12 is **24.**

Find the least common multiple for each pair of numbers.

1.	4 and 8	4 and 6	5 and 12
2.	6 and 9	10 and 25	9 and 12
3.	7 and 21	2 and 16	12 and 15
4.	30 and 40	8 and 20	18 and 24

Finding the factors of numbers can help you simplify fractions. Factors are the numbers being multiplied in a multiplication fact. You can also think of factors as the numbers that can divide another number without leaving a remainder.

FINDING THE GREATEST COMMON FACTOR

Example What is the greatest common factor of 12 and 16?

Step 1
List the factors of both 12 and 16. Remember, every number has itself and 1 as a factor.

12: 1, 2, 3, 4, 6, 12

16: 1, 2, 4, 8, 16

The greatest common factor of 12 and 16 is 4.

Step 2
Examine the lists. The greatest number that appears in both lists is 4.

12: 1, 2, 3, 4, 6, and 12

16: 1, 2, 4, 8, 16

Find the greatest common factor for each pair of numbers.

5.	5 and 15	12 and 18	18 and 27
6.	30 and 36	20 and 28	15 and 25
7.	36 and 48	32 and 48	45 and 75

CORE CONNECTIONS: Divisibility

A number is divisible by another if it can be divided evenly. In other words, if a number is divisible by another, there will be no remainder. Here are some tests to tell if a number is divisible by another.

- A number is divisible by 2 if the number is an even number.
  Look at the ones place to see if a number is even. 264 is even. 881 is not.
- A number is divisible by 3 if the sum of its digits is divisible by 3.
  Is 471 divisible by 3? Add the digits: 4 + 7 + 1 = 12
  Since 12 is divisible by 3, you know that 471 is divisible by 3.
- A number is divisible by 5 if it ends with a 0 or a 5.
  120 and 155 are divisible by 5. 52 and 167 are not.

Use these numbers to answer the questions: 162 245 430 609 684

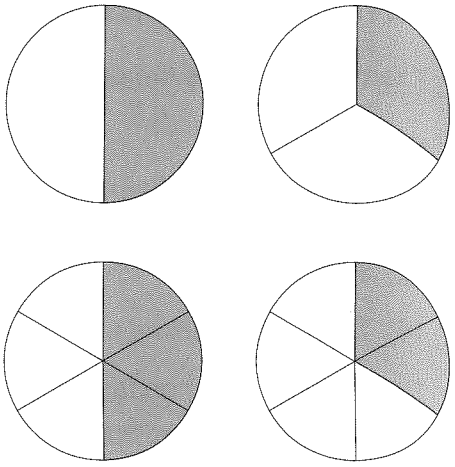
1. Which are divisible by 2?
2. Which are divisible by 3?
3. Which are divisible by 5?
4. Nolan says that an even number that is divisible by 3 must also be divisible by 6. What do you think? Does this test work? Explain your thinking.

Answers start on page 184.

FINDING COMMON DENOMINATORS

You can add and subtract fractions only if they have the same denominators.

Imagine trying to add $\frac{1}{2}$ and $\frac{1}{3}$. The circles are cut into sections of different sizes, so there isn't a way to combine them.



To add them, look for a way to cut both circles into sections of the same size.

Here the circles are cut into sixths. $\frac{1}{2}$ becomes $\frac{3}{6}$. $\frac{1}{3}$ becomes $\frac{2}{6}$.

Now you can add: $\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$

In this lesson, you will practice finding a common denominator and writing equivalent fractions.

FINDING A COMMON DENOMINATOR BY MULTIPLYING

You can always find a common denominator by multiplying the denominators.

Example Find a common denominator for $\frac{3}{4}$ and $\frac{1}{6}$, and write equivalent fractions.

Step 1
Multiply the denominators.

$4 \times 6 = 24$

Step 2
Write equivalent fractions with the denominator 24.

$\frac{3}{4} \times \frac{6}{6} = \frac{18}{24}$ $\frac{1}{6} \times \frac{4}{4} = \frac{4}{24}$

Multiplying the denominators isn't the best way to find a common denominator, but it will always work.

The best way to find a common denominator is to find the **least common multiple (LCM)** for both denominators.

FINDING A COMMON DENOMINATOR USING THE LCM

List the first few multiples for each denominator. Then look for the lowest number that both lists have in common.

Example Find a common denominator for $\frac{3}{4}$ and $\frac{1}{6}$, and write equivalent fractions.

Step 1
List a few multiples for both numbers.

4: 4, 8, 12, 16, 20, 24, . . .

6: 6, 12, 18, 24, . . .

Step 2
Find the least common multiple.

The lowest number in both lists is 12.

Step 3
Write equivalent fractions with the denominator 12.

$\frac{3}{4} \times \frac{3}{3} = \frac{9}{12}$ $\frac{1}{6} \times \frac{2}{2} = \frac{2}{12}$

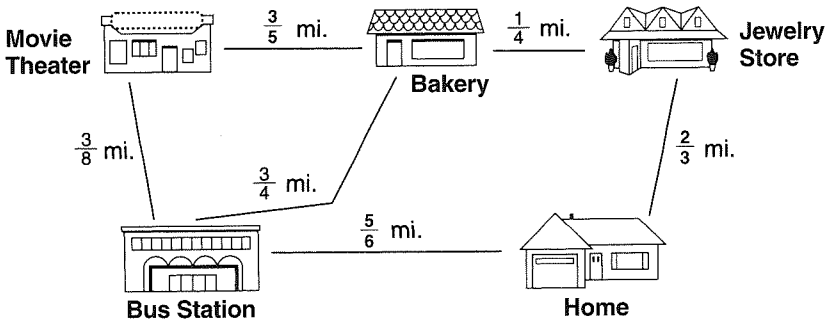
Find the least common denominator for fractions with the following denominators.

1.	8 and 12	7 and 5	12 and 18	9 and 6
2.	3 and 5	4 and 12	6 and 15	2 and 10
3.	2, 3, and 5	4, 8, and 9	2, 9, and 10	4, 5, and 6

For each group of unlike fractions, write equivalent fractions using the lowest common denominator.

4.	$\frac{2}{3}$ and $\frac{3}{5}$	$\frac{1}{4}$ and $\frac{7}{10}$	$\frac{1}{2}$ and $\frac{4}{5}$
5.	$\frac{3}{4}$ and $\frac{5}{6}$	$\frac{4}{9}$ and $\frac{1}{6}$	$\frac{5}{9}$ and $\frac{7}{12}$
6.	$\frac{1}{3}$, $\frac{1}{2}$, and $\frac{2}{5}$	$\frac{1}{4}$, $\frac{5}{6}$, and $\frac{1}{12}$	$\frac{3}{7}$, $\frac{1}{2}$, and $\frac{2}{3}$

Apply your fractions skills to these problems about distance and time.



7. What denominator would you use to add the distances from the bus station to home to the jewelry store?

8. What denominator would you use to add the distances from the bus station to the movie theater to the bakery and back to the bus station?

9. What denominator would you use to add the distances from the bus station to the bakery to the movie theater?

10. What is the least common denominator you could use to rewrite all the fractions on the map with the same denominator?

Answers start on page 184.

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ADDING AND SUBTRACTING UNLIKE FRACTIONS

Before you can add or subtract unlike fractions, you must turn them into equivalent like fractions.

ADDING UNLIKE FRACTIONS

Example Carol has a bag with $\frac{2}{3}$ cup of sugar in it. She also has $\frac{1}{2}$ cup of sugar in a sugar bowl. How much sugar does Carol have in all?

Step 1
Choose a common denominator by using multiples.

$\frac{2}{3}$ 3, 6 (× 2)
+ $\frac{1}{2}$ 2, 4, 6 (× 3)

Step 2
Write equivalent fractions using the new denominator.

$\frac{2}{3} = \frac{4}{6}$
$+ \frac{1}{2} = \frac{3}{6}$

Step 3
Add the like fractions.

$\frac{4}{6}$
$+ \frac{3}{6}$
$\frac{7}{6}$

Step 4
Simplify and write a mixed number as necessary.

$\frac{7}{6} = 6\overline{)7}$ $\begin{matrix}1\text{ R1}\\ 6\\ \hline 1\end{matrix}$ $= 1\frac{1}{6}$

Your answer is **$1\frac{1}{6}$ cups.**

SUBTRACTING UNLIKE FRACTIONS

Example What is $\frac{2}{3} - \frac{1}{6}$?

Step 1
Choose a common denominator by using multiples.

$\frac{2}{3}$ 3, 6 (× 2)
− $\frac{1}{6}$ 6

Step 2
Write equivalent fractions using the new denominator.

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

Step 3
Subtract the like fractions.

$\frac{4}{6}$
$- \frac{1}{6}$
$\frac{3}{6}$

Step 4
Simplify.

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

Your answer is $\frac{1}{2}$.

Add or subtract the following unlike fractions. Simplify and write as a mixed number as necessary.

1. $\frac{4}{9} + \frac{1}{3}$ $\frac{7}{8} + \frac{3}{4}$ $\frac{5}{6} + \frac{1}{9}$ $\frac{1}{2} + \frac{7}{10}$

2. $\frac{3}{4} - \frac{2}{3}$ $\frac{8}{9} - \frac{5}{6}$ $\frac{7}{10} - \frac{1}{4}$ $\frac{2}{3} - \frac{3}{5}$

Solve the following word problems. Pay careful attention to whether you should add or subtract.

3. Kimiko has a piece of wood $\frac{5}{16}$ inch long. How much wood will she have left if she trims off $\frac{1}{16}$ inch?

A. $\frac{1}{16}$ inch

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

C. $\frac{1}{8}$ inch

D. $\frac{3}{8}$ inch

4. Pedro had part of a gallon of window washer fluid in his garage. His wife and son each added washer fluid to their cars. At the end of the week, he had $\frac{1}{4}$ gallon left. If there was $\frac{9}{10}$ gallon at the beginning of the week, how much fluid did the family use?

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

B. $\frac{13}{20}$ gallon

C. $\frac{2}{5}$ gallon

D. $\frac{1}{20}$ gallon

5. Lindsey bought $\frac{3}{8}$ pound of shredded cheese. She already had $\frac{1}{3}$ pound at home. How much shredded cheese does Lindsey have altogether?

A. $\frac{1}{24}$ pound

B. $\frac{4}{11}$ pound

C. $\frac{1}{6}$ pound

D. $\frac{17}{24}$ pound

6. It normally takes Boris $\frac{3}{4}$ of an hour to get to work by bus. Today he decided to drive his car instead. If Boris got to work in $\frac{1}{2}$ of an hour, how much sooner did he get to work?

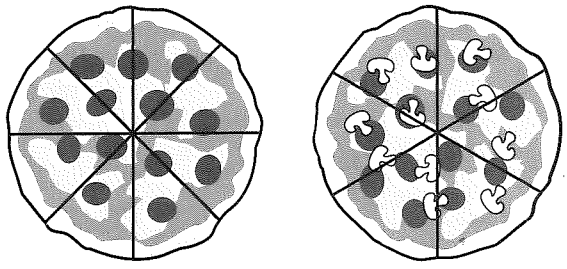
A. $\frac{1}{4}$ hour

B. $\frac{1}{8}$ hour

C. $\frac{3}{8}$ hour

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

Ricardo usually buys a pizza cut into 8 equal pieces. This time he orders the same size pizza cut into 6 pieces.



7. How much more pizza will Ricardo eat if he has 3 pieces of the 6-slice pizza instead of 3 pieces of the 8-slice pizza?

8. Multiple Answers If Ricardo buys both pizzas, what combinations of slices would add up to less than $\frac{1}{3}$ of a pizza?

Answers start on page 185.