

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.

$$\begin{array}{r} \frac{2}{3} \quad 3, 6 (\times 2) \\ + \frac{1}{2} \quad 2, 4, 6 (\times 3) \\ \hline \end{array}$$

Step 2

Write equivalent fractions using the new denominator.

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

Step 3

Add the like fractions.

$$\begin{array}{r} \frac{4}{6} \\ + \frac{3}{6} \\ \hline \frac{7}{6} \end{array}$$

Step 4

Simplify and write a mixed number as necessary.

$$\frac{7}{6} = 6 \overline{)7} \begin{array}{l} 1 \text{ R}1 \\ 6 \\ \hline 1 \end{array} = 1 \frac{1}{6}$$

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.

$$\begin{array}{r} \frac{2}{3} \quad 3, 6 (\times 2) \\ - \frac{1}{6} \quad 6 \\ \hline \end{array}$$

Step 2

Write equivalent fractions using the new denominator.

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

Step 3

Subtract the like fractions.

$$\begin{array}{r} \frac{4}{6} \\ - \frac{1}{6} \\ \hline \frac{3}{6} \end{array}$$

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?

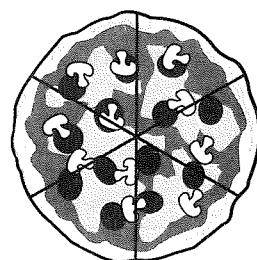
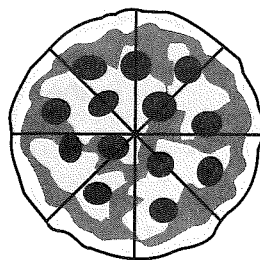
A. $\frac{1}{24}$ pound
B. $\frac{4}{11}$ pound
C. $\frac{1}{6}$ pound
D. $\frac{17}{24}$ pound

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?



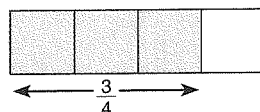
8. **Multiple Answers** If Ricardo buys both pizzas, what combinations of slices would add up to less than $\frac{1}{3}$ of a pizza?

MULTIPLYING FRACTIONS

When you multiply a fraction by a fraction, you are taking something small and breaking it into even smaller parts. You can expect the answer to be smaller than either of the fractions you started with.

MULTIPLYING FRACTIONS

Example 1 Sylvia had $\frac{3}{4}$ pound of candy. She wanted to give each of her 3 grandchildren $\frac{1}{3}$ of the candy. How much candy should Sylvia give each grandchild?



Step 1

Multiply $\frac{3}{4}$ by $\frac{1}{3}$. Look for ways to cancel (or factor out) a multiple common to the numerator and the denominator. This makes the problem simpler.

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

Step 2

Cancel the numerator of the first fraction and the denominator of the second fraction.

$$\frac{\cancel{3}}{4} \times \frac{1}{\cancel{3}_1}$$

Step 3

Multiply across using the new numerators and denominators.

$$\frac{1}{4} \times \frac{1}{1} = \frac{1}{4} \text{ pound}$$

Example 2 Multiply $\frac{6}{7}$ by $\frac{7}{9}$.

Step 1

Look for ways to cancel. Notice that canceling may include both numerators and denominators.

$$\frac{6}{7} \times \frac{7}{9}$$

Step 2

Cancel the numerator of the first fraction and the denominator of the second fraction.

$$\frac{\cancel{6}^2}{7} \times \frac{\cancel{7}_1}{\cancel{9}_3}$$

Step 3

Cancel the numerator of the second fraction and the denominator of the first fraction.

$$\frac{\cancel{2}}{\cancel{7}_1} \times \frac{\cancel{7}^1}{\cancel{3}_3}$$

Step 4

Multiply across using the new numerators and denominators.

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

If you did not cancel the fractions before multiplying, you would still get the same answer. However, the answer would have a larger numerator and denominator, and you would have to simplify your answer after multiplying. Therefore, it is much easier to cancel first.

Multiply the following fractions. Use canceling to make the work easier, or simplify your answers.

1. $\frac{\cancel{2}^1}{5} \times \frac{1}{\cancel{2}_1}$

$$\frac{7}{8} \times \frac{2}{3}$$

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

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

2. $\frac{\cancel{2}}{4\cancel{2}} \times \frac{\cancel{2}^1}{\cancel{2}_1}$

$$\frac{9}{10} \times \frac{2}{3}$$

$$\frac{4}{9} \times \frac{3}{8}$$

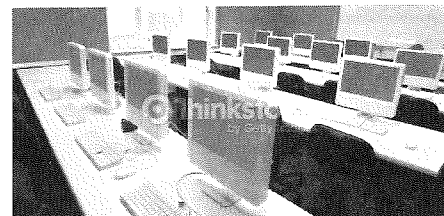
$$\frac{6}{7} \times \frac{1}{3}$$

Choose the correct answer for each problem below.

3. Mustafa had a section of paneling $\frac{2}{3}$ yard long. He had to use $\frac{1}{2}$ of the section to repair a wall. How much of the paneling did Mustafa use?
- A. $\frac{1}{2}$ yard
B. $\frac{2}{3}$ yard
C. $\frac{1}{3}$ yard
D. $\frac{1}{6}$ yard
4. Tony has $\frac{7}{8}$ pound of hamburger meat in the freezer. If he uses $\frac{2}{3}$ of the meat to make meatballs, how much of the meat will Tony have used?
- A. $\frac{5}{24}$ pound
B. $\frac{7}{12}$ pound
C. $\frac{3}{4}$ pound
D. $\frac{5}{7}$ pound
5. Margaret's recipe called for her to grate $\frac{3}{4}$ cup of cheese. The next step was to set aside $\frac{1}{2}$ of the cheese. How much of the cheese is to be set aside?
- A. $\frac{3}{2}$ cup
B. $\frac{3}{4}$ cup
C. $\frac{3}{8}$ cup
D. $\frac{1}{4}$ cup
6. Five office workers decide to split $\frac{15}{16}$ fluid ounce of perfume evenly. If they each get $\frac{1}{5}$ of the perfume, how much will each of them get?
- A. $\frac{3}{5}$ fluid ounce
B. $\frac{3}{8}$ fluid ounce
C. $\frac{1}{5}$ fluid ounce
D. $\frac{3}{16}$ fluid ounce

Min is taking a computer class. The instructor separated the class in half. Then one of the halves was to break into 3 equal groups.

7. What fraction of the entire class is in each of the 3 smaller groups?
8. If there are 24 students in the class, how many are in each of the 3 smaller groups?
9. The instructor estimates that $\frac{1}{4}$ of the students in the smaller groups will miss a class while at least $\frac{1}{2}$ of the students in the larger group will miss a class.



According to the instructor's estimates

- a. How many students would be absent in the smaller groups?
- b. How many students in the larger group would be absent?

Discuss Choose a proper fraction and an improper fraction. Multiply $\frac{3}{4}$ by the fractions you chose. Compare the answers to your original fraction and $\frac{3}{4}$. One answer is less than $\frac{3}{4}$. The other is greater than $\frac{3}{4}$. Why does this happen? Discuss your results with a partner.

DIVIDING FRACTIONS

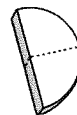
Division and multiplication are opposite operations. This important fact allows you to change division into multiplication.

To divide a fraction, change the division symbol to multiplication and invert the number you are dividing by. The inverted fraction is the **reciprocal** of the original fraction.

Examples of reciprocals: $\frac{3}{4}$ and $\frac{4}{3}$ $\frac{2}{1}$ and $\frac{1}{2}$ $\frac{5}{8}$ and $\frac{8}{5}$

DIVIDING BY A FRACTION

Example Angela has to give her cat $\frac{1}{4}$ of a pill twice a day. If she has $\frac{1}{2}$ of a pill left, how many more times can she give her cat its medicine?



Step 1

Invert the divisor (the number you are dividing *by*).

$$\frac{1}{2} \div \frac{1}{4} \quad \frac{1}{4} \text{ inverts to } \frac{4}{1}$$

Step 2

Change \div into \times . Use canceling, if possible.

$$\frac{1}{\cancel{2}} \times \frac{\cancel{4}^2}{1}$$

Step 3

Multiply across using the new numerators and denominators.

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

Angela can give her cat $\frac{1}{4}$ of a pill **2 more times**.

When you divide by a whole number, you must write the whole number over 1 before you invert it.

Examples: 5 becomes $\frac{5}{1}$ 2 becomes $\frac{2}{1}$

DIVIDING BY A WHOLE NUMBER

Example The Morrison family has $\frac{3}{4}$ of a pie left over. If there are 6 people in the family, what fraction of the original pie will each person get?

Step 1

Write the whole number as a fraction with a denominator of 1. Then invert the fraction.

$$\frac{3}{4} \div \frac{6}{1} \quad \frac{6}{1} \text{ inverts to } \frac{1}{6}$$

Step 2

Change \div into \times . Use canceling, if possible.

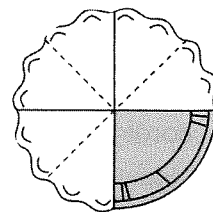
$$\frac{\cancel{3}}{4} \times \frac{1}{\cancel{6}_2}$$

Step 3

Multiply across using the new numerators and denominators.

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

Each person will get $\frac{1}{8}$ of the pie.



Divide the following fractions and whole numbers.

1. $\frac{3}{4} \div \frac{4}{5}$

$\frac{7}{8} \div \frac{7}{10}$

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

$\frac{8}{9} \div \frac{2}{3}$

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

$\frac{5}{6} \div 15$

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

$\frac{2}{5} \div \frac{3}{7}$

3. $\frac{5}{9} \div \frac{2}{11}$

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

$\frac{3}{8} \div 6$

$\frac{8}{13} \div \frac{1}{2}$

4. $\frac{2}{7} \div \frac{5}{7}$

$\frac{3}{8} \div \frac{1}{16}$

$3 \div \frac{6}{11}$

$\frac{7}{8} \div \frac{1}{32}$



CORE CONNECTIONS: Estimating with Fractions

To estimate when you are multiplying and dividing fractions, round only to $\frac{1}{2}$ or 1 if the fraction is close to those numbers. Small fractions should be left as they are.

Example 1: Estimate an answer to $\frac{8}{9} \times \frac{3}{8}$.

$\frac{8}{9} \approx 1$



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



Round: $\frac{8}{9}$ to 1 and $\frac{3}{8}$ to $\frac{1}{2}$

Multiply: $1 \times \frac{1}{2} = \frac{1}{2}$

Check: $\frac{8}{9} \times \frac{3}{8} = \frac{1}{3}$

The estimate, $\frac{1}{2}$, is close to the exact answer, $\frac{1}{3}$.

Example 2: Estimate an answer to $\frac{5}{8} \div \frac{1}{16}$.

$\frac{5}{8} \approx \frac{1}{2}$



$\frac{1}{16}$



Round: $\frac{5}{8}$ to $\frac{1}{2}$; $\frac{1}{16}$ is too small to round to $\frac{1}{2}$ so leave it as is.

Divide: $\frac{1}{2} \div \frac{1}{16} = \frac{1}{2} \times \frac{16}{1} = \frac{8}{1} = 8$

Check: $\frac{5}{8} \div \frac{1}{16} = \frac{5}{8} \times \frac{16}{1} = \frac{10}{1} = 10$

The estimate, 8, is close to the exact answer, 10.

Estimate Use estimation to solve these multiplication and division problems. Then find the exact answer and compare it to your estimate.

1. $\frac{3}{5} \times \frac{6}{7}$

2. $\frac{7}{8} \times \frac{1}{3}$

3. $\frac{4}{5} \div \frac{3}{7}$

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

Answers start on page 186.