

Steps to Simplify (Reduce) Fractions

1. Write out problem.
2. Factor the numerator and denominator completely to prime numbers and use factor trees on right side if necessary.
3. Cancel out the common factors in the numerator and denominator.
4. Write the numerator and denominator with their remaining factors.
5. Multiply remaining factors.

Example: Simplify $\frac{6}{8}$.

Comments	Steps	Trees
Write out problem.	$\frac{6}{8} = \frac{\cancel{2}(3)}{\cancel{2}(2)(2)}$	$\begin{array}{c} 6 \\ \swarrow \searrow \\ 2 \cdot 3 \end{array}$
Factor numerator and denominator completely and cancel like factors.	$= \frac{(3)}{(2)(2)}$	$\begin{array}{c} 8 \\ \swarrow \searrow \\ 2 \cdot 2 \\ \swarrow \searrow \swarrow \searrow \\ 2 \cdot 2 \cdot 2 \end{array}$
Write the fraction with remaining factors.		
Multiply remaining factors.	$= \frac{3}{4}$	

Steps to Simplify Fractions that Contain Hundred's, Thousands, etc.

1. Write out problem.
2. First factor the problem so that numerator and denominator are written as a number times, 10, 100, 1000. Use number of zeros, for example two zeros means 100.
3. Cancel out the factors of 10, 100, 1000, etc.
4. Rewrite fraction without the 10, 100, 1000, etc. and reduce as usual.

Example: Simplify $\frac{1800}{2400}$

Comments	Steps	Trees
Write out problem.	$\frac{1800}{2400} = \frac{(18)(\cancel{100})}{(24)(\cancel{100})}$	$ \begin{array}{c} 18 \\ \swarrow \quad \searrow \\ 2 \cdot 9 \\ \swarrow \quad \searrow \\ 2 \cdot 3 \cdot 3 \end{array} $
Rewrite 1800 and 2400 as products of numbers times 100. Cancel like factors of 100 in numerator and denominator	$= \frac{18}{24}$	$ \begin{array}{c} 24 \\ \swarrow \quad \searrow \\ 4 \cdot 6 \\ \swarrow \quad \searrow \\ 2 \cdot 2 \cdot 2 \cdot 3 \end{array} $
Now reduce $\frac{18}{24}$ as you usually would.	$= \frac{(2)(3)(3)}{(2)(2)(2)(3)}$	
	$= \frac{(3)}{(2)(2)}$	
	$= \frac{3}{4}$	

Steps to Multiply Fractions

1. Write out problem.
2. If you are multiplying whole numbers as well as fractions, write each whole number as a fraction by writing it over 1. For example, $\frac{2}{7} \cdot 5$, needs to be written as, $\frac{2}{7} \cdot \frac{5}{1}$, on the next step before doing any other work. Change any mixed number to an improper fraction. For example, $3\frac{1}{2}$, needs to be written as $\frac{7}{2}$.
3. Factor all numerators and denominators.
4. Put all factors in all fractions in one fraction.
5. Follow steps to simplify a fraction by cancelling, writing and multiplying remaining factors.

Example: $\frac{3}{16} \cdot \frac{4}{5}$

Comments	Steps
Write out problem, factor all fractions.	$\frac{3}{16} \cdot \frac{4}{5} = \frac{(3)}{(2)(2)(2)(2)} \cdot \frac{(2)(2)}{(5)}$
Write down a new fraction with all factors and cancel like factor pairs in numerator and denominator.	$= \frac{(3)(\cancel{2})(\cancel{2})}{(\cancel{2})(\cancel{2})(2)(2)(5)}$
Write remaining factors.	$= \frac{(3)}{(2)(2)(5)}$
Multiply remaining factors.	$= \frac{(3)}{4(5)}$
	$= \frac{3}{20}$

Division of fractions requires the knowledge of a reciprocal of a fraction.

Reciprocal of a Fraction: Is the inverse of a fraction in that the denominator becomes the numerator and the numerator becomes the denominator.

For example, the reciprocal of $\frac{2}{3}$ is $\frac{3}{2}$.

Steps to Divide Fractions

1. Write out problem.
2. Change mixed numbers to improper fractions and change whole numbers into fractions.
3. We will now change the division problem into a multiplication by multiplying first fraction by the reciprocal of second fraction.
4. Multiply the fractions using: ***Steps to Multiply Fractions.***

Example: $\frac{3}{7} \div 5$

Comments	Steps
Write out problem.	
Since we have a whole number, the 5, which is not a fraction, we first change it into a fraction before doing other steps.	$\frac{3}{7} \div 5 = \frac{3}{7} \div \frac{5}{1}$
We will now change the problem into a multiplication problem by multiplying first fraction by the reciprocal of the second fraction.	$= \frac{3}{7} \cdot \frac{1}{5}$
We now have a multiplication problem; follow the steps to multiply fractions.	$= \frac{3 \cdot 1}{7 \cdot 5}$
	$= \frac{3}{35}$

Addition and Subtraction of Fractions

There is a fundamental difference between adding or subtracting fractions **and** multiplying or dividing fractions. Multiplying and dividing fractions does not require common denominators but adding or subtracting fractions does require common denominators.

If fractions do not have common denominators, then we need to find the lowest common denominator for the fractions. The lowest or least common denominator (LCD) is the lowest **multiple** of the denominators.

Multiple: Is the product of multiplying an whole number times a number.

For example, 10, 15, 20, 25, . . . are all multiples of 5 because you are multiplying 5 times different whole numbers to get 10, 15, 20, 25,

We use the word **common** in LCD because we need to find the lowest number that is a common multiple of each denominator.

If we have denominators of 6 and 8 we first start looking at the multiples of 6 and 8.

Multiples of 6: 6, 12, 18, **24**, 30, 36, 42, 48 ...

Multiples of 8: 8, 16, **24**, 32, 40, 48, 56, 64, ...

Steps for Adding and Subtracting Fractions

1. Write out problem.
2. Write mixed numbers as improper fractions and whole numbers as fractions.
3. Find the LCD on right side of problem by finding multiples or by stacking all of the prime factors.
4. Compare each denominator to the LCD. Notice what number you have to **multiply** by the denominator of each fraction to get the LCD.
5. Take the number you just found and insert that number in the numerator and denominator of a new fraction.
6. Simplify multiplication in each fraction and notice that all denominators are now the same.
7. Write all of the numerators into one new fraction and insert the **+** or **–** signs. The new fraction has **one** number in the denominator.
8. Add or subtract the numbers in numerator.
9. Reduce fraction if possible.

Example: $\frac{3}{4} - \frac{1}{6}$.

Comments	Steps	Side Work
Write out original problem.	$\frac{3}{4} - \frac{1}{6} = \frac{(3)(3)}{(4)(3)} - \frac{(1)(2)}{(6)(2)}$	4: 4, 8, <u>12</u> 6: 6, <u>12</u> , 18
Go off to side and find the LCD of 12.		
The 4 in the denominator of first fraction needs to be multiplied by 3 to get 12. In the second fraction, 6 needs to be multiplied by 2 to get 12. We then insert these two new numbers in both fractions in <u>both</u> the numerator and denominator.		LCD = 12
Simplify multiplication and notice that each fraction now has the same denominator of 12.	$= \frac{9}{12} - \frac{2}{12}$	
Combine the numerators separated by a – sign and put them over <u>one</u> denominator.	$= \frac{9 - 2}{12}$	
Subtract the numbers in the numerator.	$= \frac{7}{12}$	