Adding and Subtracting Fractions

Adding and Subtracting Fractions with <u>Like</u> Denominators

If the denominators are the same, just add or subtract the numerators and write the result over the same denominator.

$$\text{Addition:} \qquad \frac{2}{11} + \frac{5}{11} = \frac{7}{11}$$

$$\text{Subtraction:} \qquad \frac{10}{13} - \frac{4}{13} = \frac{6}{13}$$

Adding and Subtracting Fractions with <u>Unlike</u> Denominators

If the denominators are not the same, equivalent fractions that have a common denominator must be found and used. To find the common denominator the least common multiple (or LCM) of the two denominators must be found.

Suppose you need to add: $\quad \dfrac{2}{11} + \dfrac{1}{5}$

The LCM of 5 and 11 is 55 (see next page for more information on finding LCMs). Equivalent fractions to $\dfrac{2}{11}$ and $\dfrac{1}{5}$ that have a denominator of 55 are needed. To find the equivalent fractions, multiply the numerator and denominator of $\dfrac{2}{11}$ by 5 and multiply the numerator and denominator of $\dfrac{1}{5}$ by 11.

$$\left(\frac{2}{11} \times \frac{5}{5}\right) + \left(\frac{1}{5} \times \frac{11}{11}\right) = \frac{10}{55} + \frac{11}{55}$$

Once the denominators are like (the same), we can add the fractions.

$$\frac{10}{55} + \frac{11}{55} = \frac{21}{55}$$

The process is the same for subtraction.

$$\frac{10}{13} - \frac{1}{2} =$$

$$\left(\frac{10}{13} \times \frac{2}{2}\right) - \left(\frac{1}{2} \times \frac{13}{13}\right) = \frac{20}{26} - \frac{13}{26} = \frac{7}{26}$$

Finding Least Common Multiples

A common multiple of two whole numbers, *a* and *b*, is a number that both *a* and *b* divide into evenly. For example, 63 is a common multiple of 3 and 7. ($63 \div 3 = 21$ and $63 \div 7 = 9$)

The least common multiple (LCM) is the smallest of the common multiples. LCMs are necessary for adding and subtracting fractions with unlike denominators. There are 2 methods below showing how to find the LCM. Both can be used to find LCMs of three or more numbers.

Method 1: List Multiples
One way to find the least common multiple (LCM) is to list the multiples of the numbers. The LCM is the smallest number that appears in both lists.
Example: Find the LCM of 14 and 21.

List the multiples:

For 14: 14, 28, **42**, 56, 70, 84,…

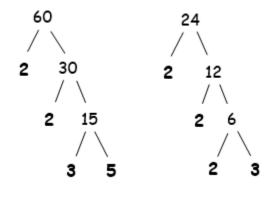For 21: 21, **42**, 63, 84, 105, …

42 is the LCM because it is the smallest number occurring in both lists.

Method 2: Prime Factorization
Listing multiples can become challenging when the numbers are large. Another way to find the LCM is using the prime factors of each number. Determine the prime factors, and then multiply each the factor the greatest number of times it occurs in any of the lists.
Example: Find the LCM of 60 and 24.
Factor both numbers to their prime factors:

$60 = 2 \times 2 \times 3 \times 5$
$24 = 2 \times 2 \times 2 \times 3$

The greatest number of times **2** occurs is three (in the second list).
The greatest number of times **3** occurs is one (in the first and second list).
The greatest number of times **5** occurs is one (in the first list).

Multiply three 2s, one 3, and one 5 to find the LCM.

$LCM = 2 \times 2 \times 2 \times 3 \times 5 = 120$