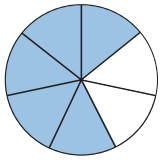
Fractions

Fractions are numbers that are parts of a whole. $\frac{5}{7}$ ← **Numerator** ← **Denominator**



Equivalent Fractions:

Equivalent fractions are fractions that represent the same amount. You can obtain an equivalent fraction by multiplying the numerator and denominator by the same number.

For example, $\frac{\mathbf{1}}{\mathbf{2}} = \frac{\mathbf{1x4}}{\mathbf{2x4}} = \frac{\mathbf{4}}{\mathbf{8}}$

Equivalent fractions are used to **reduce** answers into numbers that are easier to work with. A fraction can be reduced if both the numerator and denominator can be divided by the same number. A fraction is **reduced to lowest terms** when the numerator and denominator are divided by their largest common factor.

$$\frac{\mathbf{49}}{\mathbf{63}} = \frac{\mathbf{49 \div 7}}{\mathbf{63 \div 7}} = \frac{\mathbf{7}}{\mathbf{9}}$$

Factors of 49: 1, **7**, 49
Factors of 63: 1, 3, **7**, 9, 21, 63

Here, $\frac{7}{9}$ is equal to the same amount as $\frac{49}{63}$ but is easier to understand and use.

Reduce the following fractions to lowest terms:

a) $\frac{18}{27}$ b) $\frac{60}{84}$ c) $\frac{25}{275}$ d) $\frac{169}{130}$

Answers: a) $\frac{2}{3}$ b) $\frac{5}{7}$ c) $\frac{1}{11}$ d) $\frac{13}{10}$

Note: $\frac{13}{10}$ is an *improper fraction* since the numerator is greater than the denominator.

Addition and Subtraction

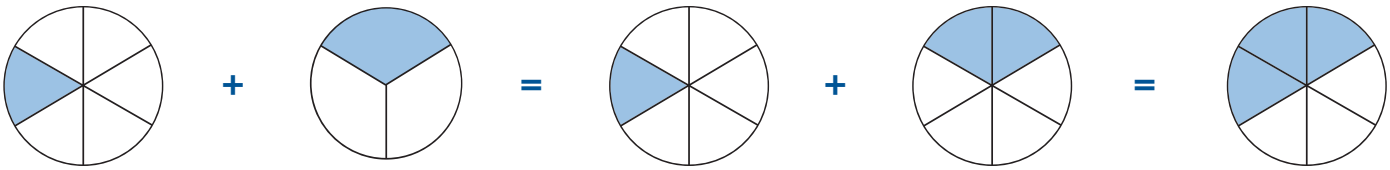
In order to add (or subtract) fractions together they need to be divided into equally sized parts (i.e. They need to have a common denominator). Once the fractions have a common denominator you just add (or subtract) the numerators. Using the lowest common denominator (LCD) will simplify the adding and subtracting.

$$\frac{1}{6} + \frac{1}{3} = \frac{1}{6} + \frac{\mathbf{1 \times 2}}{\mathbf{3 \times 2}} = \frac{1}{6} + \frac{2}{6} = \frac{1+2}{6} = \frac{3}{6} = \frac{1}{2}$$

The LCD is 6. Look at the multiples of 6 and 3 and identify the lowest one they have in common:

6, 12, 18, ... 3, **6**, 9, 12, 18, ...

Visualizing this example:



$$\frac{5}{6} - \frac{3}{8} = \frac{\mathbf{5 \times 4}}{\mathbf{6 \times 4}} - \frac{\mathbf{3 \times 3}}{\mathbf{8 \times 3}} = \frac{20}{24} - \frac{9}{24} = \frac{11}{24}$$

The LCD is 24. Look at multiples of 6 and 8:
6, 12, 18, **24**, 36, 48, ...
8, 16, **24**, 32, 40, 48, ...

Multiplication

To multiply fractions you just need to multiply the numerators together and the denominators together.

For example, $\frac{2}{3} \times \frac{4}{7} = \frac{2 \times 4}{3 \times 7} = \frac{8}{21}$

Division

To divide fractions, we can do something similar to multiplying where we divide the numerators by each other and divide the denominators by each other. But more commonly we use a short cut where we flip and multiply the second term.

For example, $\frac{1}{4} \div \frac{1}{8} = \frac{1 \div 1}{4 \div 8} = \frac{1}{\frac{1}{2}} = \frac{1}{\frac{1}{2}} \times \frac{\mathbf{2}}{\mathbf{2}} = \frac{2}{1} = 2$

Multiply by $\frac{2}{2}$ to get rid of the fraction in the denominator.

Or this can be completed using the short cut where you multiply by the reciprocal of the second term: $\frac{1}{4} \div \frac{1}{8} = \frac{1}{4} \times \frac{8}{1} = \frac{8}{4} = 2$

Flip and multiply

For example, $\frac{5}{12} \div \frac{3}{4} = \frac{5}{12} \times \frac{4}{3} = \frac{20}{36} = \frac{5}{9}$

Try the following exercises:

a) $\frac{7}{3} + \frac{1}{5}$ b) $\frac{10}{9} - \frac{5}{6}$ c) $\frac{5}{7} - \frac{17}{14}$ d) $\frac{3}{12} + \frac{4}{5} - \frac{1}{3}$

e) $\frac{8}{9} \times \frac{2}{3}$ f) $\frac{3}{4} \times \frac{4}{5} \times \frac{1}{2}$ g) $\frac{13}{14} \div \frac{3}{5}$ h) $\frac{10}{21} \div \frac{5}{7}$ i) $\frac{3}{\frac{4}{5}}$

Answers: a) $\frac{38}{15}$ b) $\frac{5}{18}$ c) $\frac{-1}{2}$ d) $\frac{43}{60}$ e) $\frac{16}{27}$ f) $\frac{3}{10}$ g) $\frac{65}{32}$ h) $\frac{2}{3}$ i) $\frac{15}{4}$

Thinking Ahead:

The same rules of arithmetic for fractions are used when simplifying rational expressions. These types of questions typically also require knowledge of factoring and exponent laws to complete.

An example of a rational expression: $\frac{x^2 - 9}{5(x+3)^2} \div \frac{4x - 12}{2x}$

This can be simplified to: $\frac{x}{10(x+3)}$

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