

Fractions



What is a fraction?

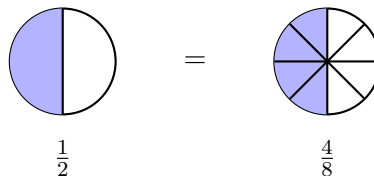
A **fraction** represents a part of a whole.

$$\frac{5}{7} = \frac{\text{Numerator}}{\text{Denominator}} = \frac{\text{parts taken}}{\text{total parts}}$$

Equivalent fractions

Equivalent fractions represent the same amount. Multiply or divide both numerator and denominator by the same number.

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



Reducing to lowest terms

Divide numerator and denominator by their greatest common factor (GCF).

Example: Reduce $\frac{49}{63}$ to lowest terms.

Factors of 49: 1, 7, 49

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

GCF = 7, so: $\frac{49}{63} = \frac{49 \div 7}{63 \div 7} = \frac{7}{9}$

Addition and subtraction

To add or subtract fractions, they must have a **common denominator**.

Steps:

1. Find the lowest common denominator (LCD)
2. Convert each fraction to an equivalent fraction with the LCD
3. Add or subtract the numerators
4. Reduce if possible

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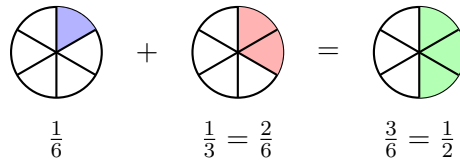
studentlearning@ontariotechu.ca

ontariotechu.ca/studentlearning



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Example: $\frac{1}{6} + \frac{1}{3}$



The LCD is 6 (multiples of 6: 6, 12, 18, ... and multiples of 3: 3, 6, 9, 12, ...).

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

Example: $\frac{5}{6} - \frac{3}{8}$

The LCD is 24 (multiples of 6: 6, 12, 18, 24, ... and multiples of 8: 8, 16, 24, ...).

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

Multiplication

To multiply fractions, multiply numerators together and denominators together.

$$\frac{a}{b} \times \frac{c}{d} = \frac{a \times c}{b \times d}$$

Example: $\frac{2}{3} \times \frac{4}{7} = \frac{2 \times 4}{3 \times 7} = \frac{8}{21}$

Tip: You can simplify before multiplying by canceling common factors.

Example: $\frac{3}{16} \times \frac{4}{65}$

Notice that 4 and 16 share a factor of 4:

$$\frac{3}{16} \times \frac{4}{65} = \frac{3}{\cancel{16}^4} \times \frac{\cancel{4}_4}{65} = \frac{3 \times 1}{4 \times 65} = \frac{3}{260}$$

Division

To divide fractions, **flip and multiply** (multiply by the reciprocal).

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$$

Example: $\frac{1}{4} \div \frac{1}{8}$

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

Example: $\frac{5}{12} \div \frac{3}{4}$

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

Mixed numbers and improper fractions

A **mixed number** has a whole part and a fraction part: $2\frac{3}{4}$

An **improper fraction** has a numerator greater than the denominator: $\frac{11}{4}$

Mixed to improper: Multiply whole by denominator, add numerator.

$$2\frac{3}{4} = \frac{2 \times 4 + 3}{4} = \frac{11}{4}$$

Improper to mixed: Divide numerator by denominator.

$$\frac{11}{4} = 11 \div 4 = 2 \text{ remainder } 3 = 2\frac{3}{4}$$

Quick reference

Operation	Method
Add/Subtract	Find LCD, convert, add/subtract numerators
Multiply	Multiply numerators, multiply denominators
Divide	Flip second fraction and multiply
Reduce	Divide top and bottom by GCF
Mixed \rightarrow improper	$a\frac{b}{c} = \frac{ac+b}{c}$
Improper \rightarrow mixed	Divide; quotient is whole, remainder is numerator

Practice problems.

1. Reduce: $\frac{27}{18}$
2. Reduce: $\frac{84}{60}$
3. Reduce: $\frac{275}{25}$
4. Reduce: $\frac{130}{169}$
5. $\frac{3}{7} + 5$
6. $\frac{9}{10} - \frac{6}{5}$
7. $\frac{7}{14} - \frac{5}{17}$
8. $\frac{3}{4} + \frac{1}{5} - 1$
9. $\frac{9}{16} \times \frac{3}{65}$
10. $4 \times \frac{5}{2} \times \frac{2}{8}$
11. $\frac{14}{5} \div \frac{5}{2}$
12. $21 \div \frac{7}{3}$

Answers: 1. $\frac{3}{2}$ 2. $\frac{7}{5}$ 3. 11 4. $\frac{10}{13}$ 5. $\frac{38}{7}$ 6. $-\frac{3}{10}$
 7. $\frac{49}{238}$ 8. $-\frac{43}{20}$ 9. $\frac{27}{1040}$ 10. $\frac{5}{2}$ 11. $\frac{28}{25}$ 12. 9