

Arithmetic Operations with Rational Numbers

Part A: Adding and Subtracting Like Fractions

Adding and Subtracting Like Fractions

Words: To add or subtract fractions with the same denominator, write the sum or difference of the numerators over the denominator.

Numbers: $\frac{4}{9} + \frac{1}{9} = \frac{5}{9}$

$\frac{9}{11} - \frac{2}{11} = \frac{7}{11}$

Algebra: $\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}, c \neq 0$

$\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}, c \neq 0$

Example 1: find the sum of $\frac{77}{100}$ and $\frac{9}{100}$.

$$\begin{aligned} \frac{77}{100} + \frac{9}{100} \\ = \frac{77+9}{100} \end{aligned}$$

Write sum of numerators over denominators.

$$= \frac{86}{100} = \frac{43}{50}$$

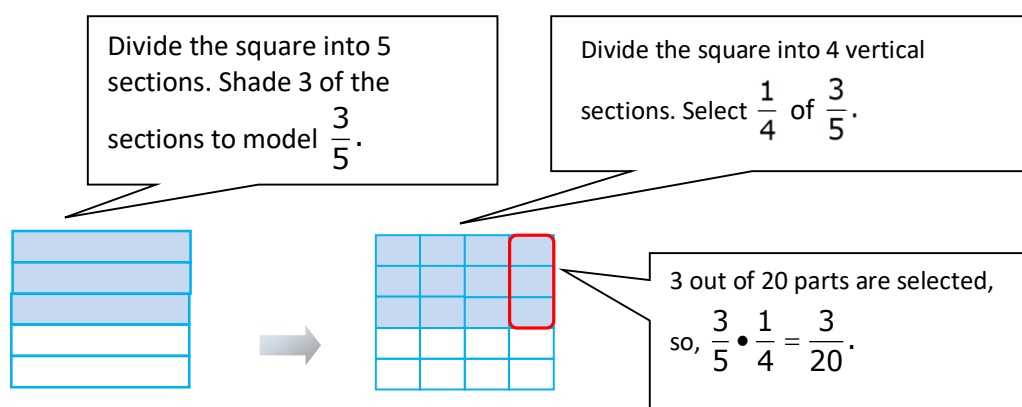
Add. Then simplify.

Part B: Adding and Subtracting Unlike Fractions

To add or subtract fractions with different denominators, begin by using the LCD of the fractions to write equivalent fractions that have the same denominator.

Part C: Multiplying Fractions

You can use an area model to find the product of two fractions, such as $\frac{3}{5} \cdot \frac{1}{4}$.



The area model suggests the following rule for multiplying fractions.

Multiplying Fractions

Words: The product of two or more fractions is equal to the product of the numerators over the product of the denominators.

Numbers: $\frac{3}{5} \cdot \frac{4}{7} = \frac{3 \cdot 4}{5 \cdot 7} = \frac{12}{35}$

Algebra: $\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$, where $b \neq 0$ and $d \neq 0$

Part D: Dividing Rational Numbers

Two nonzero numbers whose product is 1 are **reciprocals**.

The pairs of numbers below are examples of reciprocals.

Number	Reciprocal	Justification
5	$\frac{1}{5}$	$5 \cdot \frac{1}{5} = 1$
$\frac{2}{7}$	$\frac{7}{2}$	$\frac{2}{7} \cdot \frac{7}{2} = 1$
$-\frac{5}{8}$	$-\frac{8}{5}$	$-\frac{5}{8} \left(-\frac{8}{5}\right) = 1$
0.1	10	$0.1(10) = 1$

Using Reciprocals to Divide

Words: To divide by any nonzero number, multiply by its reciprocal.

Numbers: $\frac{2}{9} \div \frac{3}{7} = \frac{2}{9} \cdot \frac{7}{3} = \frac{14}{27}$

Algebra: $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \cdot \frac{d}{c} = \frac{ad}{bc}$, where $b \neq 0$, $c \neq 0$, and $d \neq 0$