Theory and exercises on adding, subtracting, multiplying and dividing fractions

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Grade 7 Mathematics
9 March 2026

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Lowest common denominator revision

To add, subtract, multiply and divide two fractions which have different denominators, we need to convert them both to their lowest common denominator (LCD) first.

Example 1

Convert $\frac{5}{7}$ *and* $\frac{8}{9}$ *to fractions with their lowest common denominator.*

(You can do most of this process in your head if you know your times tables!
Think: "what is the smallest number that both 7 and 9 go into?")

1	What are the two denominators?	7 and 9
2	Which one is smaller?	7
3	Multiply the smaller denominator by 2	$7 \times 2 = 14$
4	Divide the answer by the bigger denominator and see if there is a remainder	$14 \div 9 = 1\ r\ 5$
5	If there is a remainder, increase the number you multiplied the smaller denominator by in step 3 by 1, and repeat steps 3, 4 and 5 until there is no remainder in step 4.	$7 \times 3 = 21$ $21 \div 9 = 2\ r\ 3$ $7 \times 4 = 28$ $28 \div 9 = 3\ r\ 1$ ... $7 \times 9 = 63$ $63 \div 9 = 7$
6	Your answer with no remainder from step 3 is the LCD.	$LCD = 63$
7	Use multiplication to convert the denominator of your two fractions to their LCD. Whatever multiplication you perform on the denominator, you must also perform on the numerator.	$\frac{5}{7} = \frac{5 \times 9}{7 \times 9} = \frac{45}{63}$ $\frac{8}{9} = \frac{8 \times 7}{9 \times 7} = \frac{56}{63}$

Adding fractions

We will now discuss a method for adding two fractions without a calculator.

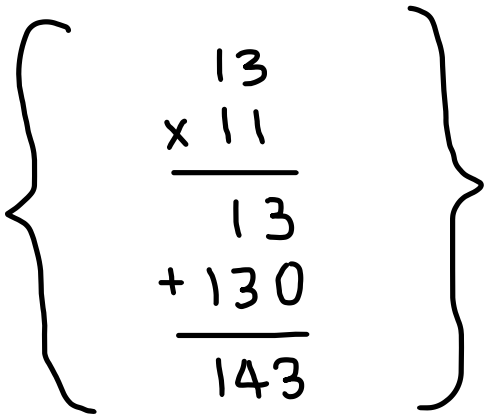
Example 2

Evaluate $\frac{2}{11}+\frac{3}{13}$

1. Convert both fractions to their LCD.

$$\frac{2}{11}+\frac{3}{13}=\frac{2\times13}{11\times13}+\frac{3\times11}{13\times11}$$

$$=\frac{26}{143}+\frac{33}{143}$$



2. Add the numerators and write the answer over the LCD.

$$=\frac{26+33}{143}$$

$$\frac{2}{11}+\frac{3}{13}=\frac{39}{143}$$

Exercises on adding fractions

Please find the sums of the following fractions without a calculator, and simplify your answers where possible:

a. $\frac{3}{4}+\frac{5}{7}$ b. $\frac{2}{10}+\frac{9}{11}$ c. $\frac{13}{15}+\frac{6}{13}$ d. $\frac{12}{14}+\frac{15}{17}$ e. $\frac{18}{21}+\frac{19}{23}$

f. $2\frac{1}{3}+\frac{4}{5}$ g. $4\frac{2}{5}+3\frac{4}{11}$ h. $7\frac{3}{7}+5\frac{5}{17}$ i. $10\frac{12}{23}+11\frac{9}{27}$

Subtracting fractions

Subtracting two fractions with different denominators is a similar process to their addition.

Example 3

Evaluate $\frac{14}{27} - \frac{5}{21}$

1. Convert both fractions to their LCD.

$$\frac{14}{27} - \frac{5}{21} = \frac{14 \times 21}{27 \times 21} - \frac{5 \times 27}{21 \times 27}$$

$$= \frac{294}{567} - \frac{135}{567}$$

2. Subtract the numerators and write the answer over the LCD.

$$= \frac{294 - 135}{567}$$

$$\frac{14}{27} - \frac{5}{21} = \frac{159}{567}$$

Exercises on subtracting fractions

Please find the differences between the following fractions without a calculator, and simplify your answers where possible:

a. $\frac{4}{5} - \frac{5}{8}$ b. $\frac{3}{11} - \frac{8}{10}$ c. $\frac{14}{16} - \frac{5}{14}$ d. $\frac{13}{15} - \frac{14}{19}$ e. $\frac{17}{20} - \frac{20}{24}$

f. $3\frac{1}{4} - \frac{5}{6}$ g. $5\frac{1}{6} - 4\frac{5}{12}$ h. $8\frac{2}{8} - 5\frac{4}{16}$ i. $11\frac{13}{24} - 12\frac{10}{28}$

Multiplying fractions

We will now discuss a method for multiplying two fractions, $\frac{a}{b} \times \frac{c}{d}$ without a calculator.

Example 3

Evaluate $\frac{35}{42} \times \frac{23}{37}$ $\quad (\frac{a}{b} \times \frac{c}{d})$

1. Create a new fraction which has a numerator $a \times c$ and a denominator of $b \times d$.

$$\frac{35}{42} \times \frac{23}{37} = \frac{35 \times 23}{42 \times 37}$$

$$\frac{35}{42} \times \frac{23}{37} = \frac{805}{1554}$$

2. Simplify this result if possible.

$$\frac{805}{1554} = cannot\ simplify, which\ is\ okay!$$

But, if our answer were $\frac{805}{1555}$ instead:

$$\frac{805}{1555} = \frac{805 \div 5}{1555 \div 5} = \frac{161}{311}$$

Exercises on multiplying fractions

Please find the products of the following fractions without a calculator, and simplify your answers where possible:

a. $\frac{3}{4} \times \frac{5}{7}$ b. $\frac{2}{10} \times \frac{9}{11}$ c. $\frac{13}{15} \times \frac{6}{13}$ d. $\frac{12}{14} \times \frac{15}{17}$ e. $\frac{18}{21} \times \frac{19}{23}$

f. $2\frac{1}{3} \times \frac{4}{5}$ g. $4\frac{2}{5} \times 3\frac{4}{11}$ h. $7\frac{3}{7} \times 5\frac{5}{17}$ i. $10\frac{12}{23} \times 11\frac{9}{27}$

Dividing fractions

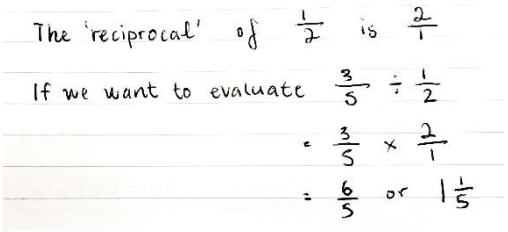
We will now discuss a method for dividing two fractions, $\frac{a}{b} \div \frac{c}{d}$ without a calculator.

Example 3

Evaluate $\frac{23}{45} \div \frac{38}{51}$ $\quad (\frac{a}{b} \div \frac{c}{d})$

1. Flip the numerator and the denominator of the second fraction. Turn $\frac{c}{d}$ to $\frac{d}{c}$. This is called converting a fraction to its 'reciprocal'.
   Whenever we convert $\frac{c}{d}$ to its reciprocal, we must change the sign of our expression from ÷ to ×.

$$\frac{23}{45} \div \frac{38}{51} = \frac{23}{45} \times \frac{51}{38}$$



2. Multiply (and simplify if possible) the two fractions using the method that we previously discussed.

$$\frac{23}{45} \div \frac{38}{51} = \frac{23}{45} \times \frac{51}{38} = \frac{23 \times 51}{45 \times 38}$$

$$= \frac{1173}{1710}$$

$$= \frac{1173 \div 3}{1710 \div 3}$$

$$= \frac{391}{570}$$

Exercises on dividing fractions

Please find the quotients of the following fractions without a calculator, and simplify your answers where possible:

a. $\frac{4}{5} \div \frac{5}{8}$ b. $\frac{3}{11} \div \frac{8}{10}$ c. $\frac{14}{16} \div \frac{5}{14}$ d. $\frac{13}{15} \div \frac{14}{19}$ e. $\frac{17}{20} \div \frac{20}{24}$

f. $3\frac{1}{4} \div \frac{5}{6}$ g. $5\frac{1}{6} \div 4\frac{5}{12}$ h. $8\frac{2}{8} \div 5\frac{4}{16}$ i. $11\frac{13}{24} \div 12\frac{10}{28}$