

Adding and Subtracting Fractions: math lesson, Grade 5 – download the PDF

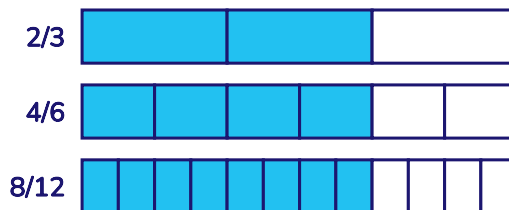
A pizza cut into eight slices, a recipe that calls for half a cup and then a third of a cup, a trail that is three quarters of a mile long: fractions are everywhere, and sooner or later you need to put them together or take them apart. In this chapter you will learn how to add and subtract fractions even when the pieces are **different sizes**, how to handle mixed numbers, and how to check that an answer makes sense.

1. Equivalent fractions

D

Equivalent fractions

Equivalent fractions name the **same amount** with different numerators and denominators. For example, $\frac{2}{3}$, $\frac{4}{6}$ and $\frac{8}{12}$ are all equivalent.



Same shaded length: $\frac{2}{3} = \frac{4}{6} = \frac{8}{12}$

To make an equivalent fraction, multiply (or divide) the numerator **and** the denominator by the **same nonzero number**. You are really multiplying by $\frac{4}{4}$ or $\frac{3}{3}$, and those equal 1, so the amount does not change.

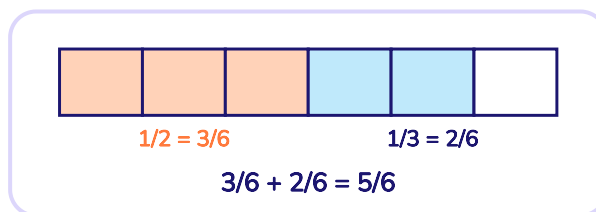
E Example

Find the missing number: $\frac{3}{5} = \frac{?}{20}$.

The denominator changed from **5** to **20**, so it was multiplied by **4**. Do the same to the numerator: $3 \times 4 = 12$. So $\frac{3}{5} = \frac{12}{20}$.

2. Why we need a common denominator

You can add $\frac{2}{8} + \frac{3}{8}$ right away, because both fractions count the **same size** of piece (eighths): $\frac{2}{8} + \frac{3}{8} = \frac{5}{8}$. But $\frac{1}{2} + \frac{1}{3}$ mixes halves and thirds, and you cannot count pieces of different sizes together. First, rewrite both fractions with the **same denominator**, called a **common denominator**.



On the bar, one half is the same as three sixths, and one third is the same as two sixths. Now every piece is a sixth, so we can add: $\frac{3}{6} + \frac{2}{6} = \frac{5}{6}$.



Rule

For fractions with the same denominator d :

$$\frac{a}{d} \pm \frac{b}{d} = \frac{a \pm b}{d}$$



Common mistake

Never add the numerators *and* the denominators. $\frac{1}{2} + \frac{1}{3}$ is **not** $\frac{2}{5}$. The denominator tells the size of the pieces, and that size must stay the same when you add.

3. The least common multiple

Any common multiple of the two denominators works, but the smallest one keeps the numbers small.



Least common multiple (LCM)

The least common multiple of two whole numbers is the smallest positive number that is a multiple of both. When it is used as a denominator, it is called the **least common denominator**.



Method: find the LCM

1. List the multiples of the larger number: it is quicker.
2. Stop at the first one that the other number divides evenly.

E**Example**

Find the LCM of **6** and **15**.

Multiples of **15**: **15, 30, ...** The number **15** is not divisible by **6**, but **$30 = 6 \times 5$** . So the LCM is **30**.

!**Zyro's tip**

If you cannot find the LCM quickly, multiply the two denominators. You will get a common denominator that works, and you can simplify at the end.

4. Adding fractions with unlike denominators**M****Method: add fractions**

1. Find a common denominator (the LCM is best).
2. Rewrite each fraction as an equivalent fraction with that denominator.
3. Add the numerators and keep the denominator.
4. Simplify, and write an improper fraction as a mixed number if you like.

E**Example**

Calculate $\frac{3}{4} + \frac{1}{6}$.

The LCM of 4 and 6 is 12. Then $\frac{3}{4} = \frac{9}{12}$ and $\frac{1}{6} = \frac{2}{12}$.

$\frac{9}{12} + \frac{2}{12} = \frac{11}{12}$. The fraction cannot be simplified.

5. Subtracting fractions with unlike denominators

Subtraction follows exactly the same steps: common denominator first, then subtract the numerators and keep the denominator.



5/6 shaded, 2/6 crossed out

E**Example**

Calculate $\frac{7}{8} - \frac{1}{6}$.

The LCM of 8 and 6 is 24. So $\frac{7}{8} = \frac{21}{24}$ and $\frac{1}{6} = \frac{4}{24}$.

$\frac{21}{24} - \frac{4}{24} = \frac{17}{24}$.

6. Adding and subtracting mixed numbers

A mixed number has a whole part and a fraction part, like $3\frac{1}{2}$. Add or subtract the whole parts and the fraction parts separately, using a common denominator for the fractions.

E**Example: adding**

Calculate $3\frac{1}{2} + 2\frac{3}{4}$.

Wholes: $3 + 2 = 5$. Fractions: $\frac{2}{4} + \frac{3}{4} = \frac{5}{4} = 1\frac{1}{4}$. Total: $5 + 1\frac{1}{4} = 6\frac{1}{4}$.

E**Example: subtracting with regrouping**

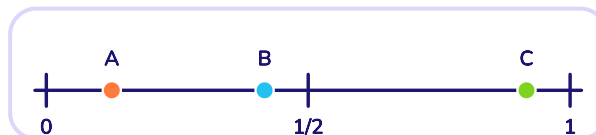
Calculate $4\frac{1}{6} - 1\frac{2}{3}$.

Write $\frac{2}{3} = \frac{4}{6}$. Since $\frac{1}{6}$ is smaller than $\frac{4}{6}$, regroup one whole from the 4: $4\frac{1}{6} = 3\frac{7}{6}$.

Now $3\frac{7}{6} - 1\frac{4}{6} = 2\frac{3}{6} = 2\frac{1}{2}$.

7. Estimating with benchmark fractions

Benchmark fractions are friendly numbers: **0**, $\frac{1}{2}$ and **1**. Round each fraction to the closest benchmark to estimate an answer, then check that your exact answer is close.



A fraction is close to **0** when its numerator is much smaller than the denominator (like $\frac{1}{8}$), close to $\frac{1}{2}$ when the numerator is about half the denominator (like $\frac{5}{12}$), and close to **1** when the numerator is almost the denominator (like $\frac{11}{12}$).

E**Example**

Estimate $\frac{7}{8} - \frac{4}{9}$, then calculate it.

Estimate: $\frac{7}{8} \approx 1$ and $\frac{4}{9} \approx \frac{1}{2}$, so the answer is about $1 - \frac{1}{2} = \frac{1}{2}$.

Exact: the LCM of 8 and 9 is 72, so $\frac{63}{72} - \frac{32}{72} = \frac{31}{72}$, which is a little less than $\frac{1}{2}$.

The answer is reasonable.

8. Fraction word problems

In a word problem, decide first whether the story **puts together** (add) or **takes away or compares** (subtract). Then solve, and answer in a full sentence with the unit.

E**Example**

Priya mixes $\frac{2}{3}$ cup of peanuts with $\frac{3}{8}$ cup of raisins. Will the mix fit in a 1-cup container?

$$\frac{2}{3} + \frac{3}{8} = \frac{16}{24} + \frac{9}{24} = \frac{25}{24} = 1\frac{1}{24} \text{ cups.}$$

The mix is a little more than 1 cup, so it will **not** fit in the container.

Key takeaways

- Equivalent fractions: multiply or divide the numerator and the denominator by the same nonzero number.
- You can add or subtract only fractions with the **same denominator**; the denominator stays unchanged.
- Use the least common multiple of the denominators as the least common denominator.
- For mixed numbers, work on the whole parts and the fraction parts, and regroup when you need to.
- Estimate with the benchmarks 0 , $\frac{1}{2}$ and 1 to check that your answer is reasonable.
- Always simplify your final answer and give the unit in word problems.



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