

Before You Watch

This topic covers how to add fractions involving algebra, when the letters are on the top (the numerator) and when they are on the bottom (the denominator).

Before watching this video, it is recommended that you refresh your memory of how to add fractions without using a calculator! The skill of adding fractions without a calculator is necessary when the fractions involve algebra.

A guide on how to add fractions can be found here:

- <https://www.khanacademy.org/math/pre-algebra/fractions-pre-alg/fractions-unlike-denom-pre-alg/v/adding-fractions-with-10-and-100-as-denominators>

This topic also builds on the fundamental concepts of algebra, so make sure you've seen **Introduction to Algebra** before watching this video.

The Video Content

This topic explores how to add algebraic fractions. Algebraic fractions are added in the same way as numerical fractions.

Here is a sample question.

Simplify:

$$3k / 5 + k / 2$$

What does it mean by 'simplify'?

Step 1 Understand the question

Simplifying an expression means to write it (express it) as a single fraction.

Step 2 Develop a plan

How do we add fractions? When adding numerical fractions, we make the numbers on the bottom the same, then add the numbers on the top. In mathematical terms, we call the number on the bottom a denominator, and the number on the top a numerator. It's the same with algebraic fractions: we have to find a common denominator. So this is our plan.

Step 3 Carry out the plan

To simplify:

$$3k / 5 + k / 2$$

we must find a common denominator. So we need a number that can be divided by both 5 and 2. In this case 10 will work.

For $3k / 5$ – the first term – 5 has to be multiplied by 2 to get 10. So we multiply both the top and the bottom by 2. In other words, we multiply by $2 / 2$. The fraction $2 / 2$ is, of course, just 1, so we are really multiplying by 1, which isn't changing the number at all.

For $k / 2$ – the second term – 2 has to be multiplied by 5 to get 10. So we multiply the top and bottom by 5.

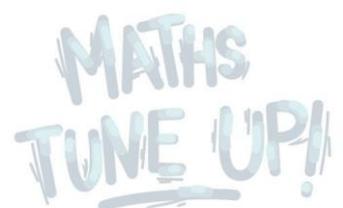
When we multiply fractions we multiply top and bottom. For the first term, $3k / 5$:

$$\begin{array}{ll} \text{top} & 3k \times 2 = 6k \\ \text{bottom} & 5 \times 2 = 10 \end{array}$$

So our first term becomes $6k / 10$.

The second term, using the same method, becomes $5k / 10$. So, to summarise:

$$\begin{aligned} & 3k / 5 + k / 2 \\ & = 3k / 5 \times 2 / 2 + k / 2 \times 5 / 5 \\ & = 6k / 10 + 5k / 10 \end{aligned}$$



Remember, this expression is exactly the same as the first one, because all we did was multiply by 1. But now the denominators are the same, we can add the numerators:

$$6k / 10 + 5k / 10 = (6k + 5k) / 10$$

$$6k + 5k \text{ is simply } 11k$$

The final answer is:

$$(6k + 5k) / 10 = 11k / 10$$

We can't simplify that further, because we don't know what k is, so we're done.

Another example

What if the letters are on the bottom? The approach is the same. Let's try simplifying:

$$5 / a + 7 / 3b$$

Find a denominator that both " a " and " $3b$ " go into. Then multiply both of them together and get $3ab$.

$$a \times 3b = 3ab$$

Here's a hot tip: if you are struggling to find a common denominator, multiplying the denominators together will always work.

a goes into $3ab$ $3b$ times, so we multiply top and bottom of the first part by $3b$.

$3b$ goes into $3ab$ a times, so we multiply top and bottom of the second part by a :

$$5 / a + 7 / 3b$$

$$= 5 / a \times 3b / 3b + 7 / 3b \times a / a$$

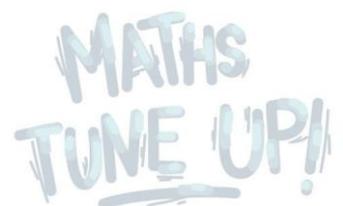
and multiply to get

$$= 15b / 3ab + 7a / 3ab$$

Now we have a common denominator. Next put the numerators all over the same denominator:

$$(15b + 7a) / 3ab$$

Done!



Some Practice Questions

Simplify the following:

1. $x/3 + x/2$

2. $m/4 + m/7$

3. $3/t + t/3$

4. $a/b + c/d$

5. $5/(x+1) + 3/(x+1)$

6. $1/p^3 + 2/k^2$

7. $(k+2)/(x+1) + 3/(x-1)$

8. $7/4w + 2/5wr$

Answers

1. $5x/6$

2. $11m/28$

3. $(9+t^2)/3t$

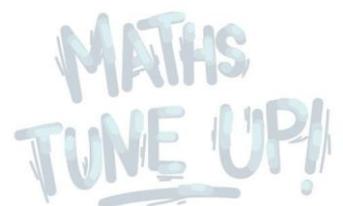
4. $(ad+bc)/bd$

5. $8/(x+1)$

6. $(k^2+2p^3)/k^2p^3$

7. $(kx-k+5x+1)/(x^2-1)$

8. $(35r+8)/20wr$



Take a look at the working out for each answer [here](#).

Now What?

This video introduces working with algebraic fractions, but only deals with addition.

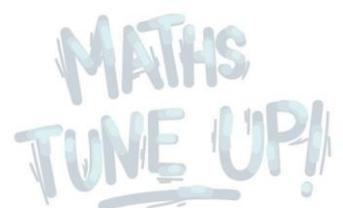
However, subtraction and addition of fractions with algebra are very similar to subtraction and addition of fractions with common, everyday numbers. Multiplication and division of algebraic fractions are also similar to fractions with common, everyday numbers: multiplication of algebraic fractions is done by multiplying the denominators and multiplying the numerators, and division is done by the process of inverse and multiply.

When you're confident with adding algebraic fractions, the next step is to become familiar with subtraction, multiplication and division. Again, this is best done by refreshing your memory of how to subtract, multiply and divide with common, everyday numbers first, then moving onto algebraic fractions after that.

To practise adding, subtracting, multiplying and dividing fractions, see the Other Links section below.

But When Am I Going To Use This?

Just like fractions with everyday numbers, fractions with algebra appear in countless different situations. What if you're splitting the bill of " m " dollars between " n " people? Then the cost per person is m / n . The old formula for gradient, $m = \text{rise} / \text{run}$ is an algebraic fraction. When you pay off a home loan you must divide the total cost over " n " number of months, creating another fraction. Any time you are dividing by an unknown quantity (represented by a letter), or dividing an unknown quantity, you are creating an algebraic fraction.



Other Links

Sophia.org gives several different tutorial videos for each concept, and also has a quiz so you can test yourself.

- <https://www.sophia.org/concepts/algebraic-fractions-with-unlike-denominators>

Mathspace has several worked video examples for addition and subtraction of algebraic fractions, as well as multiplication and division of algebraic fractions. Mathspace is also available on the App Store, Google Play or Microsoft Store. It has questions to test yourself, however, signing up is required to access those features.

- <https://mathspace.co/learn/world-of-maths/algebra/rational-expressions-addsub-unlike-denominators-24309/adding-subtracting-algebraic-fractions-953/>

Maths is Fun provides simple and well-written summaries of the rules, worked examples, and a small selection of sample questions. This page gives a summary of addition, subtraction, multiplication and division, and also explains each operation separately.

- <https://www.mathsisfun.com/algebra/fractions-algebra.html>

