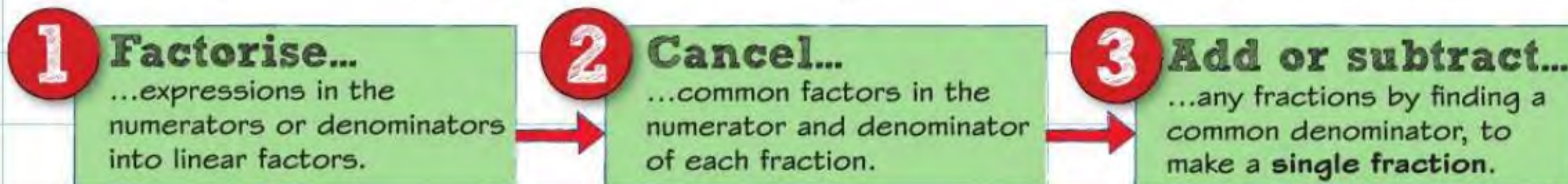


Summary of key points

- 3** To multiply fractions, cancel any common factors, then multiply the numerators and multiply the denominators.
- 4** To divide two fractions, multiply the first fraction by the reciprocal of the second fraction.
- 5** To add or subtract two fractions, find a common denominator.

Algebraic fractions

You will usually be able to simplify algebraic fractions in your exam using these steps:



If you **factorise** and **cancel** first then your fractions will be easier to **add** or **subtract**.

You might need to do steps 1 and 2 again once you have added or subtracted your fractions.

Common denominators

To add or subtract algebraic fractions with different denominators you need to find a common denominator. Here are two examples:

1 $\frac{3}{x} + \frac{5}{2x+1} = \frac{3(2x+1)}{x(2x+1)} + \frac{5x}{x(2x+1)} = \frac{3(2x+1) + 5x}{x(2x+1)}$ The common denominator is the **product** of the two denominators.

2 $\frac{2}{x+1} - \frac{2x}{(x+1)(x-2)} = \frac{2(x-2)}{(x+1)(x-2)} - \frac{2x}{(x+1)(x-2)} = \frac{2(x-2) - 2x}{(x+1)(x-2)}$

Once you are confident you might be able to skip the step shown in green above.

The denominators already **share** a factor of $(x+1)$, so you only have to change the first fraction.

After this step, you can simplify the fractions further by expanding the brackets in the numerator and collecting like terms.

Worked example

Express $\frac{2(3x+2)}{9x^2-4} - \frac{2}{3x+1}$ as a single fraction in its simplest form. (4 marks)

$$\begin{aligned} \frac{2(3x+2)}{9x^2-4} - \frac{2}{3x+1} &= \frac{2(3x+2)}{(3x+2)(3x-2)} - \frac{2}{3x+1} \\ &= \frac{2}{3x-2} - \frac{2}{3x+1} \\ &= \frac{2(3x+1) - 2(3x-2)}{(3x-2)(3x+1)} \\ &= \frac{6}{(3x-2)(3x+1)} \end{aligned}$$

You will probably have to do **multiple steps** so get used to writing out your working neatly. You can show which factors you are **cancelling** by drawing a neat line through them.

After you have added or subtracted your fractions you should expand the brackets in the numerator and simplify again:

$$2(3x+1) - 2(3x-2) = \cancel{6x} + 2 - \cancel{6x} + 4 = 6$$

You can leave the final denominator factorised like this, or multiply it out.

Now try this

1 Simplify fully $\frac{3x^2-8x-3}{x^2-9}$ (3 marks)

2 Express $\frac{x+5}{2x^2+7x-4} - \frac{1}{2x-1}$ as a single fraction in its simplest form. (4 marks)

Watch out for the difference of two squares. Use $a^2 - b^2 = (a+b)(a-b)$