<table>
<tr><td>Outcome</td><td>AEx6</td><td>Student can consistently:</td><td>Add and subtract algebraic fractions in order to simplify and write as a single fraction.</td></tr>
<tr><td>How the topic is examined</td><td colspan="3">

Examined through test paper questions.
Questions are equally likely to appear on calculator or non-calculator papers.
Questions will ask students to ‘Simplify’ or ‘Write as a single fraction’.
Questions may have numerical or algebraic denominators.

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<tr><td>Prior knowledge</td><td colspan="3">

Students should be confident with:

Adding and subtracting fractions.
Simplifying expressions (AEx2)
Expanding expressions (AEx1)

In addition questions involving this topic can have links to:

Solving algebraic fractions
Simplifying algebraic fractions (AEx9)

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<tr><td>Suggested tuition approaches</td><td colspan="3">

Questions involving adding and subtracting algebraic fractions are generally quite similar. There is usually very little variation in these questions.
There are two types of problems that students may come across.

Where the denominator is a number
Where the denominator is an expression.

1) <u>Denominator a number</u>

A typical questions looks like this

$$\frac{3x+5}{4}+\frac{x-4}{6}$$

The steps involved in these questions are very similar to adding and subtracting numerical fractions. This question is simply an extension of this.
First find a common denominator, preferably the lowest common multiple of the two denominators. In the above example the lowest common denominator would be 12, but 24, 36 … are all possibilities.

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- Now multiply the numerators by the required value (e.g. if you have multiplied the denominator by 3 to change it to a 12, you need to multiply the numerator by the same number). Students should show all their working and should make use of brackets.

$$\frac{3(3x+5)}{12}+\frac{2(x-4)}{12}$$

- Now denominators are equal you can add the numerators.

$$\frac{3(3x+5)+2(x-4)}{12}$$

- Now expand and simplify the numerator and then check whether anything cancels.

$$\frac{9x+15+2x-8}{12}=\frac{11x+7}{12}$$

- Some students don't use brackets and go straight for the expanded expression. This is fine, although it is always worthwhile encouraging students to show all their working out.
- When subtracting expressions, encourage students to be careful when simplifying. See the notes on this in the simplifying expressions (AEx2) section.
- A rare example which challenges students in when you are asked to add a non-fractional term to a fractional term. When this is the case, you should think of the non-fraction as being a fraction with a denominator of 1.
  e.g.

$$3+\frac{5y-1}{4}=\frac{3}{1}+\frac{5y-1}{4}$$

2) <u>Denominators are linear expressions</u>

These problems are as common and the steps are very similar, they just lead to more errors are there is a greater level of manipulation involved.

A typical questions looks like this

$$\frac{4}{3x+5}+\frac{2}{x-4}$$

- First find a common denominator. In the above example the lowest common denominator $(3x+5)(x-4)$
- Now multiply the numerators by the required value (e.g. if you have multiplied the denominator by $(x-4)$ to change it to $(3x+5)(x-4)$, you need to multiply the numerator by the same expression). Students should show all their working and should make use of brackets.

$$\frac{4(x-4)}{(3x+5)(x-4)}+\frac{2(3x+5)}{(3x+5)(x-4)}$$

- Now denominators are equal you can add the numerators.

$$\frac{4(x-4)+2(3x+5)}{(3x+5)(x-4)}$$

- Now expand and simplify the numerator and then check whether anything cancels.

$$\frac{4x-16+6x+10}{(3x+5)(x-4)}=\frac{10x-6}{(3x+5)(x-4)}$$

- It is worthwhile factorising the numerator if you can, to check whether anything cancels.

$$\frac{4x-16+6x+10}{(3x+5)(x-4)}=\frac{2(5x-3)}{(3x+5)(x-4)}$$

- You can see from this example that nothing cancels. Note we have not expanded the denominator. There is no need, unless the question asks you to write it in a particular form.

- The same rules for subtracting fractions apply as above. Be careful when multiplying out the second set of brackets.

Common errors and

- The majority of students make a mistake on this question when they subtract two algebraic fractions. See the notes on

misconceptions	subtracting expressions with two brackets in the simplifying expressions (AEx2) section.

Suggested resources	• Questions
	  ○ http://www.cimt.org.uk/projects/mepres/allgcse/pr2-es.pdf (pp 22 - 24)
	  ○ https://corbettmaths.files.wordpress.com/2013/02/algebraic-fractions.pdf
	• Past GCSE Questions
	  ○ https://keshgcsemaths.files.wordpress.com/2013/11/99_algebraic-fractions.pdf
	• Video tutorial
	  ○ http://corbettmaths.com/2013/01/19/adding-algebraic-fractions/