Guidance for tutors

The table below outlines useful information for tutors as well as some suggested approaches and resources.

Outcome	AEx3	**Student can consistently:**	Simplify indices using the index laws.
How the topic is examined	• 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 power’.		

Prior knowledge	• Students should be confident with:
	  ○ Powers and roots.
	  ○ Negative numbers.
	• In addition questions involving indices can have links to:
	  ○ Expanding brackets (AEx1)		

Suggested tuition approaches	• There are three index laws that students should know and be able to use.		

Index Law	Examples
Multiplication law : $a^n \times a^m = a^{n+m}$ When two terms are multiplied together, the powers are added.	(a) $g^6 \times g^4 = g^{10}$ (b) $c^3 \times c = c^4$ (c) $3m^5 \times 2m^2 = 6m^7$
Division law : $a^n \div a^m = a^{n-m}$ When two terms are divided, the powers are subtracted.	(a) $e^6 \div e^2 = e^4$ (b) $\frac{p^5}{p} = p^4$ (c) $\frac{15g^4}{3g^3} = 5g$
Power law : $(a^m)^n = a^{mn}$ When you raise a power to another power, the two powers are multiplied together.	(a) $(u^2)^5 = u^{10}$ (b) $(3m^2)^4 = 81m^8$

- More complicated questions include examples:
  - Where more than one index law is used (e.g. $\frac{d^d \times d}{d^3}$)
  - Where multiple letters are involved (e.g. $5a^2b^3 \times 4ab^5 = 20a^3b^8$
  - Where negative powers are used (e.g. $y^{-2} \div y^{-5} = y^3$)
- Students need to be aware that they don't add powers if the letters are different.
- For higher attaining students you might get them to explain why these laws work.
- Another common exam question is power 0. An expression to the power 0 is always equal to 1. This can be explained using the division law (e.g. $7^0 = 1$ $d^0 = 1$)

Common errors and misconceptions

- A common error is students writing examples like a x a x a x a as 4a instead of a^4
- Students don't use the index laws and just multiply the powers or divide the powers instead of adding and subtracting (e.g. students write $g^6 \times g^4 = g^{24}$.
- When you have an expression like $(3m^2)^4$ students tend to multiply the 3 x 4 = 12 and write $12m^8$. They need to realise that they have to raise any coefficient to the power of the bracket. One way to explain this is to write $(3m^2)^4 = 3m^2 \times 3m^2 \times 3m^2 \times 3m^2 = 81m^8$ using the multiplication law.
- Students think expressions like $5d^0$ is equal to 1. This is not the case. This expression is 5 x d^0 = 5 x 1 = 5. If the

	expression said $(5d)^0$ then the answer would be 1. • Students struggle when negative powers are used, especially when using the division law. These questions are rare but could come up.

Suggested resources	• Questions
	  ○ http://www.cimt.org.uk/projects/mepres/allgcse/bka1.pdf (pp 5 - 9)
	  ○ https://corbettmaths.files.wordpress.com/2013/02/laws-of-indices-17-pdf.pdf
	  ○ https://corbettmaths.files.wordpress.com/2013/02/laws-of-indices-algebra-pdf.pdf
	• Past GCSE Questions
	  ○ https://keshgcsemaths.files.wordpress.com/2013/11/63_algebra_indices.pdf
	• Video tutorial
	  ○ http://corbettmaths.com/2013/03/13/laws-of-indices-algebra/