Year 8 - Unit 2: Indices

Learning Journey:

Prior Learning

- Use index notation with positive whole number powers & substitute values into algebraic expressions.
- Factorise simple expressions and identify common factors.

Next Steps

- Solve more complex algebraic problems involving fractional indices & standard form.
- Manipulate algebraic fractions in equations & apply these skills to higher-level GCSE algebra

By the end of this unit, you should be able to:

- Apply index laws to simplify expressions involving positive and negative indices.
- Simplify algebraic fractions by factorising expressions and cancelling common factors correctly.

Keywords:

Index notation – A way of writing repeated multiplication using powers
Base – The number or letter being multiplied repeatedly.
Exponent – The small number showing how many times to multiply the base.
Negative power - An index that shows the reciprocal of a power.
Reciprocal - The value of 1 divided by a number.
Factor - A number or expression that multiplies with another.
Algebraic fraction - A fraction containing algebraic expressions.
Factorise - Write an expression as a product of factors.

Index rules with positive and negative indices

Law	Description	How it works
$a^1 = a$	Anything to the power of 1 is itself	$x^1 = x$
$a^0 = 1$	Anything to the power of 0 is 1	$b^0 = 1$
$a^m \times a^n = a^{m+n}$	To multiply indices with the same base, add their powers	$c^3 \times c^2$ $= (c \times c \times c) \times (c \times c)$ $= c^5$
$a^m \div a^n = \frac{a^m}{a^n} = a^{m-n}$	To divide indices with the same base, subtract their powers	$d^5 \div d^2$ $= \frac{d \times d \times d \times \cancel{d} \times \cancel{d}}{\cancel{d} \times \cancel{d}}$ $= d^3$
$(a^m)^n = a^{mn}$	To raise indices to a new power, multiply their powers	$(e^3)^2$ $= (e \times e \times e) \times (e \times e \times e)$ $= e^6$
$a^{-1} = \frac{1}{a}$ $a^{-n} = \frac{1}{a^n}$	A negative power is the reciprocal	$j^{-1} = \frac{1}{j}$ $k^{-3} = \frac{1}{k^3}$

Simplifying expressions using index laws

- **Apply the index law:** subtract the powers when dividing.
- **Simplify the numerator and denominator.**
- **Write the final answer with positive indices.**

Fully simplify $\frac{a^{13}}{a^3 b^7}$

$$\frac{\overset{a^{13-3}}{\cancel{a^{13}}}}{\underset{1}{\cancel{a^3}}\, b^7} = \frac{a^{10}}{b^7}$$

Simplifying algebraic fractions by cancelling common factors

- Factorise the numerator fully.
- Cancel common factors from the numerator & denominator.
- Write the simplified fraction.

E.g. Fully simplify:

$\frac{20(a+5)}{5b}$

$$\frac{\overset{4}{\cancel{20}}(a+5)}{\underset{1}{\cancel{5}}\, b} = \frac{4(a+5)}{b}$$