Index Notation

Year 9
Mathematics

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Learning Objectives

By the end of the lesson I hope that you understand and can apply the following to a range of questions from the Year 9 Mathematics course.

- Understand why we use Indices
- Know how to explain the base and index
- Know how to write something in expanded form
- Know what it means to evaluate powers
- Know how to write something in index form
- Know how to use a factor tree

Recap: BIDMAS

We know, in Mathematics, there is a law which states the order we should approach problems. This is referred to as BIDMAS.

The 'I' stands for Indices (or as I call them; Floaty Numbers)

Indices are really important in Mathematics and will be used in all areas for the rest of the courses you will undertake.

We will start the course gently and then the work will get progressively more complex.

Barry has been at it again

The only reason Mathematics is hard is because someone is paid to make it hard.

This is Barry. He is paid to try and find as many stupid names as possible can be used for the same thing.

So, for example, we have the following all meaning the same thing:

- Power
- Exponent
- Floaty Number
- Index

WHY?? Why does there need to be so many names for the same thing???

Because someone wants to make it look like Maths is hard. Sigh.

Expanded form

Expanded form simply means that you take a base written to an index and write it out **long hand**.

For example:

Write x^4 in expanded form.

$x \times x \times x \boxed{\times x}$

$\boxed{x}$

index

x^4

$x \times x \times x \times$

Another example:

Write $(xy)^4$ in expanded form

$\boxed{x}$

$(xy)^4$

$=$

$xy \times xy \times xy \times xy$

$x^3 = x \times x \times x$

$x^{10} =$

Evaluate

Again … here is a Mathematical word which has what it's asking you to do as one of its syllables!

E-VALUE-ATE

When you evaluate something, you need to find the value of it.

So, if I wanted to expand and evaluate the following, it would mean that I need to find a numerical answer.

$\boxed{5^3}$

$5 \times 5 \times 5 = 125$

25×5

125

What about $(-2)^5$?

$(-2)^5$

$-2 \times -2 \times -2 \times -2 \times -2$

$= 4 \times 4 \times -2$

$= 16 \times -2 = -32$

Fractions

Fractions are awesome. No. Really.

We can now raise fractions to powers. We can do it the **long way** and **the easy way**.

For example. Expand the following and then evaluate:

$$\boxed{\left(\frac{2}{5}\right)^3}$$

$$\left(\frac{2}{5}\right)^3 = \frac{2}{5} \times \frac{2}{5} \times \frac{2}{5}$$

$$= \frac{8}{125}$$

$$\begin{array}{r} 25 \\ \times\ 5 \\ \hline 125 \end{array}$$

What can be done forwards can also be done backwards!

So we know how to write in expanded form. We can reverse the process by writing something in **index notation**. Notice the word index in the title. It means write is simpler using floaty numbers.

For example:

Write each of the following in index form:

$$6 \times x \times x \times x \times x \times x$$

$$= 6 \times x^5$$

$$= 6x^5$$

Doesn't matter how hard the example …

It doesn't matter how hard the example is! We can do it … just look for like letters or numbers:

Write the following in index form:

1. $\frac{3}{7}\times\frac{3}{7}\times\frac{4}{5}\times\frac{4}{5}\times\frac{4}{5}$ $= \left(\frac{3}{7}\right)^2 \times \left(\frac{4}{5}\right)^3$

What about the following:

$$8\times a\times a\times 8\times b\times b\times a\times b$$

$= 8\times 8\times a\times a\times a\times b\times b\times b$

$= 8^2 \boxed{\times} a^3 \times b^3$

$= 64a^3b^3$

Product of primes

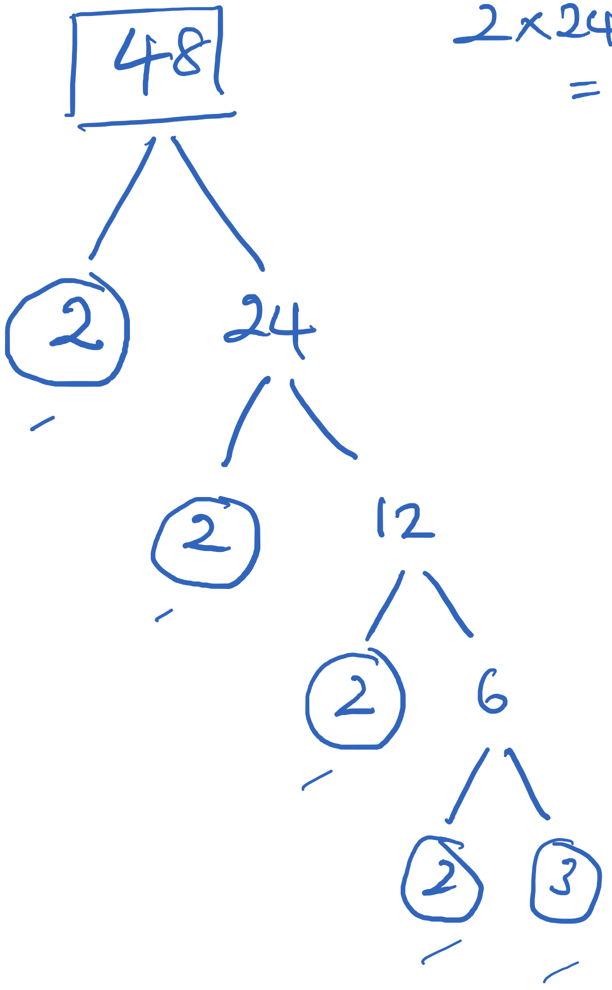
Remember … a prime number is a number which only has two factors. Product means to multiply or times.

[Note: Another one of Barry's master strokes to use two words to mean the same thing!]

So, we can express a number as its product of primes by using something called a factor tree.

These are awesome!

Express 48 as a product of its prime factors in index form.



$2 \times 24 = 48$

$48 = 2 \times 2 \times 2 \times 2 \times 3$

$\therefore 48 = 2^4 \times 3$

Finding the missing number

Again, what we can do forwards we can do backwards!

I can give you the answer and ask you to find the question.

For example:

Find the missing number.

a $3^{\square} = 81$

$3^{\square} = 81$

$3^4 = 81$

$$\begin{array}{r} 3 \\ \times\, 3 \\ \hline 9 \\ \times\, 3 \\ \hline 27 \\ \times\, 3 \\ \hline \boxed{81} \end{array}$$

Don’t get tricked by negative numbers

The questions which seem to confuse the most as those with negative signs.

When an even number of negative numbers multiply by each other, they become positive.

$$\left.\begin{matrix} + + \\ - - \end{matrix}\right\} +$$

$$\left.\begin{matrix} + - \\ - + \end{matrix}\right\} -$$

When an odd number of negative numbers multiply by each other, they become negative.

$$(-3)^3 = -27$$

$$(-2)^5 = -2 \times -2 \times -2 \times -2 \times -2$$

$$= \boxed{-}32$$

$$(-2)^4 = -2 \times -2 \times -2 \times -2$$

$$= 16$$