

1.

Know, use and understand the term standard form

Q...When numbers get real big (or real small..!) we need a better way of writing numbers down. A number like sixteen billion can be written down as 16, 000, 000, 000 but that's a lot of zeros! Knowing 'Place Value' can be a first step in helping us to write this number down a bit easier.

Firstly, we need to remember our place value and put the 16 part of the number sixteen billion into the correct columns. See below a place value chart. Try putting the '1' and the '6' of the number sixteen billion into the correct columns. Notice they have a x10 also in the columns which we will ignore for now.

Hundred Billion	Ten Billion	Billion	Hundred Million	Ten Million	Million	Hundred Thousand	Ten Thousand	Thousand	Hundred	Ten	Ones	Tenths	Hundredths	Thousands	Ten Thousandths
$\times 10^{11}$	$\times 10^{10}$	$\times 10^9$	$\times 10^8$	$\times 10^7$	$\times 10^6$	$\times 10^5$	$\times 10^4$	$\times 10^3$	$\times 10^2$	$\times 10^1$	$\times 10^0$	$\times 10^{-1}$	$\times 10^{-2}$	$\times 10^{-3}$	$\times 10^{-4}$

Hint... sixteen billion is made up of ten billion and six lots of one billion. Put the one in the correct column and then the six in the correct column. The powers of ten are what is meant by STANDARD FORM as all numbers in the decimal system are just powers (groups) of ten !

2.

Convert between ordinary numbers and in standard form

Q... Now we can take the number sixteen billion and convert it into STANDARD FORM by writing it down as a 'POWERS OF TEN'. This just means how many in each column you have and calling each column a multiple of ten instead of its name.

Eg> sixteen billion is 16 x 1 billion which is also 16 x 10x10x10x10x10x10x10x10x10

which is also 16 x 10⁹ (see powers in part 4)

There is a rule for STANDARD FORM though which is that the number you are multiplying x10 by cannot be bigger than 10. So 16 is 1.6 x 10 itself. This means we can write 16 billion as.....

$$\begin{aligned}
 16 \text{ billion} &= (16) \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \\
 &= (1.6 \times 10) \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \\
 &= 1.6 \times 10^{10} \quad \text{This is now in STANDARD FORM (notice there are ten tens in a row!)}
 \end{aligned}$$

Have a go yourself trying to write the numbers (converting) below into standard form or from standard form back to normal decimal numbers.

84,000,000

0.007

1.2×10^5

Hint... try using a place value chart as in part 1 to help you put the digits in the correct columns and counting across to find the correct number of powers of ten to write.

3.

Order and calculate with numbers written in standard form (with powers)

Q... Because STANDARD FORM is just another way of writing ordinary decimal numbers down, just as we can do sums with ordinary numbers, we can also do sums with STANDARD FORM numbers too.

Eg. $23,000 \times 140 = 3,220,000$ can be written $2.3 \times 10^4 \times 1.4 \times 10^2 = 3.22 \times 10^6$

Notice that 2.3×1.4 is just 3.22 and that the power numbers of 4 and 2 appear to have been **added** to get 6

Eg. $50,000 \div 250 = 200$ can be written $5 \times 10^4 \div 2.5 \times 10^2 = 2 \times 10^2$

Notice that $5 \div 2.5$ is just 2 and that the power numbers of 4 and 2 appear to have been **subtracted** to get 2

Using this knowledge that powers are added when you are multiplying and they are subtracted when you are dividing, try these questions.

150,000 x 1800

$$2.4 \times 10^{10}$$

$$8 \times 10^4$$

Hint... change numbers to standard form, multiply the numbers then add the powers, or for division, divided the numbers and subtract the powers. Careful to check at the end if your number is still in standard form. Remember that a standard form number is only between 1-9 !

Log into 'Moodle'. Watch the video/s, read and practice using the online materials. Read your GCSE maths AQA book



<https://padlet.com/mathsm230774/5hi0d9q7c1hh>

<https://padlet.com/mathsm230774/ncdpjivih8zu>

N11 Power (index) numbers

$$2^3 = 2 \times 2 \times 2 = 8$$



A04 Algebraic Indices (powers)

$2^2 \times 2^3 = 2^{2+3} = 2^5$	$a^m \times a^n = a^{m+n}$
$2^5 \div 2^2 = 2^{5-2} = 2^3$	$a^m \div a^n = a^{m-n}$
$(2^2)^3 = 2^6$	$(a^m)^n = a^{m \times n}$



4.

Use a power number to simplify repeated multiplication

Q... As seen above in the topic of standard form, we can use a simplification trick to write down long strings of multiplication of the same number again and again. This is called a 'power' or 'indice'.

Eg $3 \times 3 \times 3 \times 3$ is a long sum to write so we can write instead as 3^4 .

The number 4 is small and raised to the right of the number being multiplied. The number 3 in this case is call the base number.

base \rightarrow 3^4 \leftarrow power

Try writing out these long strings of multiplication is simplified 'index' notation (powers, indices).

$$5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5$$

$$2(2)(2)(2)(2)(2)$$

$Y \times Y \times Y \times Y \times t \times t \times t$

$4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 5$

Hint... simply count how many times the number (or letter in the case of algebra) has been multiplied by itself and write this as a small raised number to the upper right-hand side of the base number. Watch out though, you can only count them all up if they are the SAME !!

5.

Use power laws to calculate with power numbers (indices)

Q... See below a list of some laws that can be used when dealing with power numbers.

- $x^0 = 1$
- $x^{-n} = \frac{1}{x^n}$
- $x^n \cdot x^m = x^{n+m}$
- $x^n \div x^m = x^{n-m}$
- $(x^n)^m = x^{n \cdot m}$
- $x^{\frac{n}{m}} = \sqrt[m]{x^n}$

Your tutor will demo each of these in the session and show examples of them being used and how they come about. Try matching up the below sums with their law above.... Extension: try to solve the sums below!

$$5^{-3} =$$

$$9^0 =$$

$$(7^2)^3 =$$

$$5^{10} \div 5^4 =$$

$$4^{(2/3)} =$$

$$4^5 \times 4^3 =$$

END OF PREPATORY ASSIGNMENT

What to do now....

1. Ensure you have marked in each box if you feel confident in each topic or not (this will inform you and your tutor which activities you should do in the session)
2. Bring this yellow assignment with you to your next session and check with your tutor answers given
3. Add this to your folder of work IN ORDER YELLOW...GREEN... (and any BLUE you achieve)!



The whole observable universe is 9.3×10^{10} light years in diameter !