Standard Index Form

Tuesday, 10 June 2014

What is Standard Form and why do we need it?...

How heavy do you reckon the sun is?...

I'll tell you, its about: 2 000 000 000 000 000 000 000 000 000 000 kg

Now, I don't know about you, but I can't be bothered either counting or writing out all those zeros… well, fear not, because that is why we have standard form!

Standard form is just a convenient way of writing out really big or really small numbers.

Something really big like 2 000 000 000 000 000 000 000 000 000 000 kg is written as:

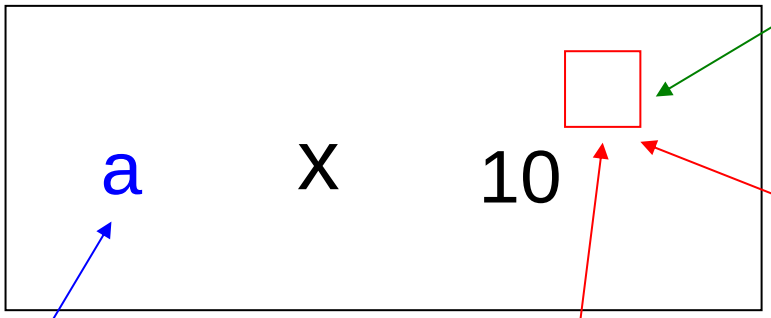
$$2 \times 10^{30} \text{ kg}$$

And something really small like: 0.00000000000000022 seconds is written as

$$2.2 \times 10^{-17} \text{ seconds}$$

The Big Facts about Standard Form

When a number is written in standard form, it looks like this:



This number (the power) tells you how many places to move your decimal point

If this sign is negative, the number is small and you move the decimal point to the left

This number must always be between 1 and 10

If there is no sign here, the number is very big and we move the decimal point to the right

1. Writing Numbers in Standard Form

Method

1. Place you pen where the decimal point is (it may be hidden!)
2. Count backwards or forwards the number of places you have to move to make the starting number between 1 and 10
3. Write your answer in standard form

Example 1 2 3 0 0 0 0 0 0 0 0

Now, with whole numbers like this, the decimal point is hidden at the end:

2 3 0 0 0 0 0 0 0 0.

Now, all we need to do is count how many places we need to move the decimal point until we create a number between 1 and 10

Well, I reckon the number we want is 2.3…

2. 3 0 0 0 0 0 0 0 0

We have moved the decimal point 9 places, so our answer is…

2.3×10^{9}

Example 2 0 . 0 0 0 0 4 6 2 3

Now, with decimals like this we can see the decimal point quite clearly!

0.0 0 0 0 4 6 2 3

Now, all we need to do is count how many places we need to move the decimal point until we create a number between 1 and 10

Well, I reckon the number we want is 4.623…

0. 0 0 0 0 4. 6 2 3

We have moved the decimal point 5 places, so our answer is…

4.623×10^{-5}

2. Changing From Standard Form

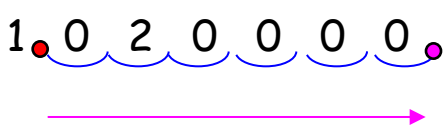
Method

Same thing as before, but this time you kind of need to work backwards.

Crucial: It is so easy to check your answer and so easy to make a mistake, so **check**!

Example 1 1.02×10^6

Okay, so we can see where the decimal point is, and the power is + **6** so we must move it 6 places to the right!



So, it looks like our answer is…

1 0 2 0 0 0 0

But don't take my word for it. Do what we did in the last section, and use your finger to work back from the answer

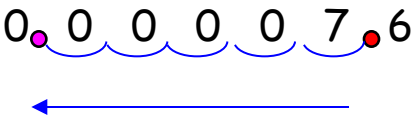
If you start with 1 0 2 0 0 0 0 and move your finger back 6 places, do you end up with… 1.02×10^6

Yes, so you've definitely got it right!

Example 2 7.6×10^{-5}

Okay, so we can see where the decimal point is, and the power is **-5** so we must move it 5 places to the left!

Just like with the previous example, fill in the gaps with zeros…



So, it looks like our answer is…

0 0 0 0 0 7 6

Again, its so easy to check, so do it!

If you start with 0 0 0 0 0 7 6 and move your finger 5 places, do you end up with…

7.6×10^{-5}

Yes, so you've definitely got it right!

3. Multiplying and Dividing with Standard Form

Method

This is actually quite nice. All you need to do is…

Multiply/Divide your big numbers, Add/Subtract your powers

Example 1 $(8\times10^7) \times (5\times10^2)$

Okay, let's follow our method:

Multiply our Big Numbers:

$$8 \times 5 = 40$$

Add our Powers…

$$10^7 \times 10^2 = 10^9$$

So, it looks like our answer is…

$$40 \times 10^9$$

Problem: This answer is NOT in Standard Form, because 40 is not between 1 and 10

So we must use our brains to change it…

$$40 \times 10^9 = 4\times10^{10}$$

Our extra zero… goes here!

Example 2 $\dfrac{3 \times 10^5}{5 \times 10^2}$

Okay, let's follow our method:

Divide our Big Numbers:

$$3 \div 5 = 0.6$$

Subtract our Powers…

$$10^5 \div 10^2 = 10^3$$

So, it looks like our answer is…

$$0.6 \times 10^3$$

Problem: This answer is NOT in Standard Form, because 0.6 is not between 1 and 10

So we must use our brains to change it…

$$0.6 \times 10^3 = 6\times10^2$$

We need to borrow a zero… from here!

You need to use the exponential key $\times 10^x$ on a calculator when doing calculations in standard form.

Examples:

Calculate: $4.56 \times 10^8 \times 3.7 \times 10^5$

4.56	$\times 10^x$	8	×	3.7	$\times 10^x$	5	=	1.6872×10^{14}
								1.7×10^{14} (2sig fig)

Calculate: $5.3 \times 10^{-4} \times 2.7 \times 10^{-13}$

5.3	$\times 10^x$	- 4	×	2.7	$\times 10^x$	- 13	=	1.431×10^{-16}
								1.4×10^{-16} (2 sig fig)

Calculate: $3.79 \times 10^{18} \div 9.1 \times 10^{-5}$

3.79	$\times 10^x$	18	÷	9.1	$\times 10^x$	- 5	=	4.2×10^{22} (2 sig fig)