Scientific Notation

when dealing with extremely large or extremely small numbers we need a notation that can make it easier.

We use the power of 10 (and rules of exponents) to convert those number in the **__scientific notation__**

so

10^6 = 1 000 000 and 10^−6 = 0.000 001

One way is to convert them into a number which is between 1 and 10 (and use powers to represent the zeros)

this is what is called **__standard form__**

Let's take 26 800 000 as an example. The only way to make this a number between 1 and 10 is to move the decimal place until we get a number that lies in this range.

For example,

26 800 000.0 put in the decimal point

Now move it until it shows a number between 1 and 10.

$2.6\overset{3}{8}\overset{2}{0}\overset{1}{0}0000.$ stop at 2.6 as this is > 1 but < 10

How many times did we move the decimal to the left?

$2.6\overset{7}{8}\overset{6}{0}\overset{5}{0}\overset{4}{0}\overset{3}{0}\overset{2}{0}\overset{1}{0}0$

We moved it 7 times so the correct standard form is

2.68000000×10^{7}

2.68×10^{7}

Let's take another real-world example:

In 2006 Warren Buffett, one of the US's richest people, donated $4 350 000 000 to charity.

This number is both unwieldy (hard to work with) and so large that it is difficult to imagine. Outside of mathematics and sciences, this number would most often be referred to 4.35 billion dollars. But in standard form, or scientific notation, it would be:

$4\overset{9}{3}\overset{8}{5}\overset{7}{0}\overset{6}{0}\overset{5}{0}\overset{4}{0}\overset{3}{0}\overset{2}{0}\overset{1}{0}0.$

$\downarrow$

(4.35×10^{9}) … 7 zeros

+ 2 hops to get 4.35

9

So 10^{9} is the order of magnitude.

If Mr Buffett decided to double his contribution to global charitable causes, it is an easy calculation to complete in this form, i.e.

$(4.35 \times 10^{9}) \times 2 = 8.7 \times 10^{9}$ dollars

But what about an extremely small number?

0.000 000 004 4

4.4 would be the number between 1 and 10 but how do we get there?

$0.\overset{1}{0}\overset{2}{0}\overset{3}{0}\overset{4}{0}\overset{5}{0}\overset{6}{0}\overset{7}{0}\overset{8}{0}\overset{9}{0}4.4$

We 'jumped' 9 times to get to 4.4, but we jumped to the *right* this time so the standard form would be

4.4×10^{-9}

Here's another example. A popular website hosts an emergency and natural disaster service so people can check in to say they are safe and let their loved ones around the world know they are ok. A powerful earthquake hit a city of almost 4 million people. Following the earthquake, the website's servers showed 2.4×10^{2} people 'checked in' every minute on average for the first six hours after the disaster. How many people used the service?

$(2.4 \times 10^{2}) \times 60 \times 6 = 8.64 \times 10^{4}$ people

= 86 400 people were confirmed safe.

Let's take another real-world example but this time it will be 'out of this world'. A comet is travelling extremely fast at 204 000 metres per hour. How far will it travel in 4500 hours?

If we use the formula from Physics:

distance = speed × time

distance = 204 000 × 4500

distance = 918 000 000

Let's get rid of the zeros

distance = 918×10^{6}

But 918 is not between 1 and 10 and does not satisfy standard form, so let's move the decimal

∴ distance = 9.18×10^{8}

The power has increased by 2 because we moved the decimal twice.

So the final answer is that the comet travelled 9.18×10^{8} metres in that time.