[Scientific notation calculator]

Scientific notation involves application of the index laws. Remember that when we multiply indices with the same base, the result is just adding the powers together.

When we express a number in scientific notation, we essentially identify the place value of the leading non-zero number. We can do this by counting, either forwards or backwards.

In this case, I might start by thinking that 37 is the same as 3.7 x 10^1, and so starting from here, I can count the number of places until I get to the end. So this number is 3.71891 multiplied by 10^19 in standard scientific notation.

For small numbers. Again, starting with a kind of benchmark, I could think that 0.1 is the same as 1 x 10^-1, and so counting in this direction, I can see that the 1 is in the 10^-13 position. Anyway that helps you remember is fine – the tricky thing is remembering that the units position is 10^0, not 10^1.

Now when we multiply or divide in scientific notation, the bulk of the work is done by rearranging the equation. With multiplication, remember we have commutativity and associativity rules, so we can rearrange it like this, and we'll just be multiplying the two a values and then multiplying the two powers of 10, which means we'll add the b values.

When dividing, in this case we need brackets, because we're dividing by the whole second number, not dividing by 3.22 and then afterwards multiplying by 10^3. We'll set this up as a fraction to make it a little clearer, and we can break this down into a multiplication again, where we have a1 on a2 and the power of 10 will be b1 minus b2.

So any multiplication and division in scientific notation we can break down into multiplying or dividing the a values, then adding or subtracting the b values, depending on whether it's multiplication or division.

The only further problem we have, is when we obtain a number that isn't in standard scientific notation. For example, the a value may be less than 1. So here, we need 4 to be in the units position, so we'll multiply by 10. But we want the number to still represent the same value. Since we multiplied the first number by 10, we need to divide the power of 10 by 10 to compensate. So this now is the same number, but in scientific notation.

If we have our a value greater than 10, we need to do the opposite. Divide by 10 so that 4 is in the units place, then compensate for this by multiplying the power by 10. For a string of multiplication, multiplying by 10 and then dividing by 10 is the same as just multiplying by 1, so it doesn't change the overall value.

Now to practice these, let's make a calculator in scratch.

We'll set up a multiplication first.

Remember the format, each number will be A multiplied by 10 to the power of B. There's a special block for the power of 10. And we can see that just changing the numbers we can work out the result – but it's not in scientific notation.

So let's go to a bit more effort and set it up so that the result is displayed in scientific notation on the screen.

The variables we'll need are A and B for our first number, then A and B for our second number. Then for our answer, we'll call these new A and new B. If we're doing division, the new A is a from the first number divided by a from the second number. And B is the first b minus the second B.

Now we'll use the display in scratch that allows us to display variables. And set it out in the right format.

We can see this works well for showing the calculation on the screen – but it doesn't always show the number in scientific notation – so we need to implement this final step of the algorithm.

Remember that if A was less than 1, we multiply it by 10, then divide the power by 10, which is the same as subtracting 1.

Then if A is greater than 10, we do the opposite.

So now you can practice multiplying and dividing numbers in standard scientific notation and be able to check your answer.