

Scientific Notation

In chemistry, we will be working with some very very very small numbers and some very very very large numbers. In order to make calculations simpler, we put these numbers into scientific notation.

4,300,000,000 = four billion three hundred million

This would be a difficult value to work with

When we put it into scientific notation, we want to move the decimal until the number is somewhere between 1 and 10.

4.3×10^9 - we determine the exponent based on how many positions the decimal moved. Since it moved over 9 times, then the value in scientific notation is 4.3×10^9

If we were looking at a very small number, such as 0.00000037, we can do the same. Move the decimal over until we have a number between 1 and 10.

3.7×10^{-7} For the exponent in this case, we will still count how many positions it moved over (7) but since we moved in the other direction, the exponent will be negative. 3.7×10^{-7}

In general – if the original number is greater than 1 (such as 4,300,000,000), then the exponent will be positive. If the original number is less than 1 (such as 0.00000037), then the exponent will be negative.

Multiplying and Dividing

Multiplication and division with scientific notation can be quite simple.

For multiplication – you multiply the coefficients and add the exponents

$$(2.37 \times 10^4)(3.9 \times 10^5)$$

Multiply the coefficients: $2.37 \times 3.9 = 9.243$

Add the coefficients: $4 + 5 = 9$

Answer is 9.243×10^9

Don't forget to check sig figs. Since we are multiplying, we want to make sure that our final answer has the same number of sig figs as our initial answer with the fewest sig figs – in this case, 3.9 has the fewest number of sig figs so our final answer should be rounded to two sig figs. $\rightarrow 9.2 \times 10^9$

For division – you divide the coefficients and subtract the exponents

$$5.42 \times 10^9 / 6.2 \times 10^4$$

Divide the coefficients: $5.42 / 6.2 = .8741935484$ (from calculator)

Subtract the denominator exponent from the numerator exponent: $9 - 4 = 5$

Answer is $.8741935484 \times 10^5$

This answer is not in sig figs – we need to move the decimal to the right by one place. To do that, we multiply the current answer by 10, so we would decrease our exponent by 1.

8.741935484×10^4

Now we can check sig figs. Our final answer should have 2 sig figs $\rightarrow 8.7 \times 10^4$

Forgot to change to scientific notation in the video. Watch the addition/subtraction video for the explanation – it is at the beginning

Adding and Subtracting

Addition and subtraction can get a bit more challenging. Fortunately, the same rule applies to both.

In order to add or subtract numbers in scientific notation, they must have the same exponent. When you are given two different numbers with different exponents, you will need to change one (or both) of the numbers in order to make them both have the same exponent.

$$3.24 \times 10^4 + 4.58 \times 10^6$$

We can change either of these values. Let's change 3.24×10^4 to have an exponent of 10^6

Since the exponent is increasing by 2, we need to move the decimal over two places and the coefficient must decrease.

$$.0324 \times 10^6$$

Now the two numbers can be added together.

$$(4.58 \times 10^6) + (.0324 \times 10^6)$$

All you have to do is add the two coefficients and tack on the exponent. Nothing special has to be done with the exponent at this point.

$$4.58 + .0324 = 4.6124 \rightarrow 4.6124 \times 10^6$$

Check sig figs: must have 3 sig figs $\rightarrow 4.61 \times 10^6$

Make sure you are not also adding the exponents in this case.

Try the suggested practice problems!!