Tutorial – Converting GRAMS to MOLES to ATOMS or MOLECULES
Using the grid & bridge concepts (Std 3 in Ch 8)

bridge 1 **bridge 2** **bridge 3**
milligrams <---> grams <---> moles <---> atoms or molecules

> **Bridges are fractions that equal 1**. They allow us to change one unit of measure to another, like crossing a bridge over a river from one side to the other. Notice that each bridge can go in two directions, just like a real bridge over a river. For a bridge to work, the top and bottom of the fraction must equal each other . That is why the value of all bridges = 1.

The following equivalent equations will be made into bridges (fractions that = 1) to do go back and forth from one unit of measure to another:

bridge type 1 (3 kinds)
1000 milligrams = 1 gram
1000 grams = 1 kg
1.0×10^6 μg (microgram) = 1 gram

bridge type 2
1 molar mass in grams (or gram molecular wt if we are using elements) = 1 mole

bridge type 3
6.022×10^{23} atoms (or molecules) = 1 mole (remember Avogadro !!!)

Your job is to create fractions that will take you the way you need to go. The example will use both the bridge concept and conversion grids. Here's the example:

Example 1
You are given 850 mg of Ca and asked to find out how many atoms that represents. Each bridge is made as follows:

Solution – Ex 1
bridge 1 1000 mg = 1 g
bridge 2 40.1 g Ca = 1 mole Ca
bridge 3 1 mole = 6.02×10^{23} atoms

We make each fraction from the bridge that takes us from one unit of measure to another. The side of the fraction that goes on top, is the one with unit of measure we **are changing to**. Here is how it works:

starting fraction: 850 mg/1 (the number one) ending fraction: atoms/1

bridge 1	bridge 2	bridge 3
850 mg Ca	1 g	1 mol Ca	6.02 x 10^{23} atoms
1	1000 mg	40.1 g Ca	1 mol Ca

Now let's see what the grid looks like when we cancel units:

850 ~~mg~~ ~~Ca~~	1 ~~g~~	1 mol ~~Ca~~	6.02 x 10^{23} Ca atoms
1	1000 ~~mg~~	40.1 ~~g~~ ~~Ca~~	1 mol ~~Ca~~

The final fraction looks like this:

5,117 x 10^{23} Ca atoms
40,100

Now all we have to do is divide the two numbers at the end:

0.128 x 10^{23} Ca atoms

For correct scientific notation we must move the decimal one place to the right. When we do that we must adjust the exponent of 10 to be one number less, or we change the value of the number.

FINAL ANSWER = 1.28 x 10^{22} Ca atoms

Example 2

You are given 4.35 x 10^{19} atoms of Mg. You are supposed to find how many grams that represents.

Solution

First let's see what the grid looks like:

bridge 1	bridge 2	bridge 3
4.35 x 10^{19} atoms Mg	1 mole	24.3 g Mg
1	6.20 x 10^{23} atoms	1 mole Mg

Now let's cancel units and see what is left:

4.35 x 10^{19} ~~atoms Mg~~	1 ~~mole~~	24.3 g Mg
1	6.02 x 10^{23} ~~atoms~~	1 ~~mole Mg~~

This is equal to:

105.7 x 10^{19} g Mg
6.02 x 10^{23}

As in Example 1, we now divide the numbers. This time though we do the "normal" numbers separately from the 10's with the exponents:

$105.7 / 6.02 = 17.6$ $\qquad$ $10^{19} / 10^{23} = 10^{-4}$

Now we "reassemble" the numbers to read

17.6×10^{-4}

This time to change to scientific notation we must move the decimal to the left one place. In order to keep the same number we must adjust the exponent of 10 to be 3.

FINAL ANSWER = $\underline{\mathbf{1.76 \times 10^{-3}}}$

If this didn't make sense to you, go back over it slowly a few times and let it "sink in".