The mole, M_r.

The mole is simply a counting unit, just like "dozen" means 12. One mole means 6.022×10^{23} particles (atoms, molecules, ions, etc.).

Atoms and molecules are incredibly tiny. To work with amounts we can actually see and measure in a lab, we need to count them in enormous groups. The mole bridges the gap between atomic scale and the human scale. Imagine counting grains of sand. You wouldn't count them one by one, you would use a measuring cup. The mole is chemistry's 'measuring cup" for atoms and molecules.

To convert moles into grams we have to look at the periodic table and find the atomic weight of an element, and it will give you the mass in grams that you have to weigh if you want to have 1 mole of atoms.

For example, referring to the periodic table:

- **12 grams of Carbon (C)** equals **1 mole** of Carbon and contains **6.022×10^{23} atoms** of Carbon.
- **63.5 grams of Copper (Cu)** equals **1 mole** of Copper and contains **6.022×10^{23} atoms** of Copper.
- **40 grams of Argon (Ar)** equals **1 mole** of Argon and contains **6.022×10^{23} atoms** of Argon.

This fundamental concept allows us to relate mass to the number of particles in a given sample and is essential in stoichiometric calculations.

One mole is the amount of substance that contains the same number of particles (atoms, ions, molecules etc.) as there are carbon atoms in 12 g of carbon 12

1g of H — $6.02 \cdot 10^{23}$ atoms of H

12g of C — $6.02 \cdot 10^{23}$ atoms of C
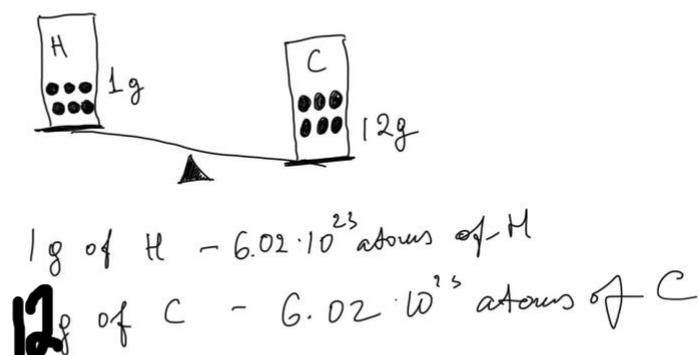
- *A mole of anything has 6.022 x 10^{23} particles*. This is called Avogadro's number, after Amedeo Avogadro, who first suggested that equal volumes of gas have equal numbers of molecules.

How to do calculations with molecules? Knowing relative atomic weights (A$_r$) of elements (look at the periodic table) we can calculate relative molecular mass M$_r$ of the molecules.

M$_r$ is the sum of the relative atomic masses of the individual atoms making up a molecule.

What is relative molecular mass of methane?

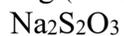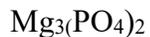CH$_4$

12.04 (A$_r$ of C) + 4x1.01 (A$_r$ of H) = 16.08

What is relative molecular mass of magnesium chloride?

MgCl$_2$

24.3 + 35.5x2 = 95.3

Questions:

1. Work out the relative molecular masses (M$_r$) of the following compounds:

C$_2$H$_5$OH
PCl$_5$
Mg$_3$(PO$_4$)$_2$
Na$_2$S$_2$O$_3$

2. Calculate how many grams of Ca you have to take to have 1mole of calcium.
3. Calculate how many grams of gold you have to take to have 1mole of gold.