

**The mole,  $M_r$ ,  $M$ .**

To calculate the masses of reactants and products using balanced chemical equations, we use a unit called the **mole**. One mole of a substance is the quantity whose mass, in grams, is numerically equal to its molecular or atomic weight in atomic mass units (amu), as given in the periodic table. Maybe numerically equal is not the best expression, but numbers are going to be the same, units are going to be different, atomic masses – units amu, the masses of mole will be in grams.

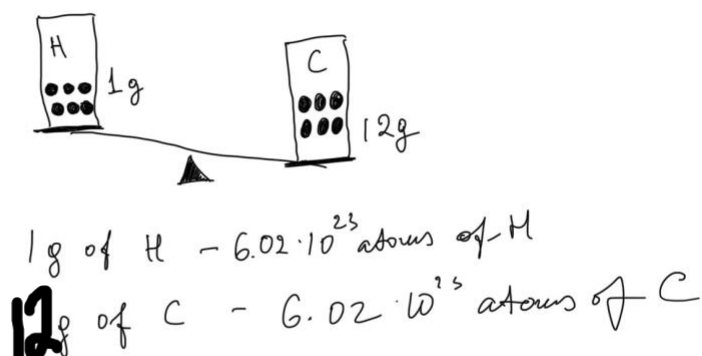
This means that the molecular (or atomic) weight of any substance is equivalent to its molar mass in grams.

For example, referring to the periodic table:

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



- *A mole of anything has  $6.022 \times 10^{23}$  particles.* This is called Avogadro's number, after Amedeo Avogadro, who first suggested that equal volumes of gas have equal numbers of molecules.
  - Knowing relative atomic weights ( $A_r$ ) of elements 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?



$$12.04 (A_r \text{ of C}) + 4 \times 1.01 (A_r \text{ of H}) = 16.08$$

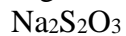
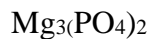
What is relative molecular mass of magnesium chloride?



$$24.3 + 35.5 \times 2 = 95.3$$

### Questions:

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



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