**4.2 The Mole**

When chemists work with elements and compounds, they cannot deal with quantities as small as individual atoms or molecules. We use a convenient quantity of atoms or molecules, one that can be weight out and worked with in a lab.

The accepted convenient quantity is the mole.

* A mole is defined as the amount of substance that contains the same number of specified particles as there are atoms in 12g of carbon-12.

The number of atoms in 12g of carbon-12 has been experimentally determined to be 6.022045 x 1023. A value of 6.02 x 1023 is commonly used. This number is known as **Avogadro’s constant or number** and has the symbol ***NA*.**

* It is very important to remember that the mole is a number of particles.

When referring to a mole of a substance, it is essential to specify the particle that is being referred to.

‘One mole of oxygen’ could describe 1 mole of oxygen atoms (O) or I mole of oxygen molecules (O2).

The number of particles in 1 mole is given the symbol *NA*.

* 1 mole of hydrogen atoms contains *NA* hydrogen (H) atoms.
* 1 mole of hydrogen molecules contains *NA* hydrogen (H2) molecules
* 1 mole of aluminium atoms contains *NA* aluminium (Al) atoms.
* 1 mole of glucose contains *NA* glucose (C6H12O6) atoms.

Note that

* The symbol for amount of substance is ***n***.
* The unit of measurement for amount of substance is **mol.**
* So *n*(glucose) = 2 is read as ‘the amount of glucose molecules in the sample is 2 moles.’

***NA* = 6.02 x 1023 mol-1**

**Therefore, 1 mol of particles contains 6.02 x 1023 particles.**

**Worked Example 4.2a**

**Calculate the number of O2 molecules in 2.5 mol of oxygen (O2).**

The general relationship can be written as:

Number of particles (*N*) in a given amount of substance (mol) = amount of substance x number of particles in 1 mol (6.02 x 1023) or more simply:

$$N=n × N\_{A}$$

**Worked Example 4.2b**

**Calculate the amount of copper atoms (mol) represented by 3.01 x 1023 copper atoms.**

Again the general relationship can be written as:

Amount of substance (in mol) = number of particles / number of particles in 1 mol (6.02 x 1023) or:

$$n= \frac{N}{N\_{A}}$$

**Worked example 4.2c**

**Calculate the amount (in mol) of oxygen atoms in 5 mol of oxygen (O2).**

**Worked example 4.2d**

**Calculate:**

1. **The amount (in mol) of hydrogen atoms in 2.5 mol of water molecules (H2O).**
2. **Number of hydrogen atoms in 2.5 mol of water molecules (H2O).**

**Text Questions: 5 – 8**