

# The Mole

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## 1 Development of a mole

- **Amedeo Avogadro** is responsible for the unit of measurement of particles and atoms.

### DEFINITION

#### Mole.

*One mole of a substance is the amount of that substance that contains  $6 \times 10^{23}$  particles.*

## 2 Molar Mass

- The **molar mass** of a substance is the mass in grams of one mole of the substance.
- The molar mass has the same numerical value as its relative molecular mass, but its **units** are **grams(g)**.

### 2.1 Calculating Molar Mass

- Add together the atomic masses of each atom in the compound.

#### EXAMPLE 2.1

*Calculate the relative molecular mass of Sulfuric acid,  $H_2SO_4$ .*

#### Solution

$$Mr = \underbrace{(2 \times 1)}_H + \underbrace{(1 \times 32)}_S + \underbrace{(4 \times 16)}_O = 98$$

#### EXAMPLE 2.2

*A sulfur atom weighs twice as much as an oxygen atom. If a chemist has 16 grams of oxygen atoms, how many grams of sulfur would contain the same number of atoms as in the sample of oxygen atoms?*

#### Solution

It would be 32 grams, because each atom is twice as heavy.

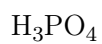
### 2.2 Converting Grams to Moles

$$\text{No. of moles of an element} = \frac{\text{Mass of the element}}{\text{Relative atomic mass}}.$$

**Note:** ‘*element*’ can be interchanged for molecules or compounds, depending on the question.

**EXAMPLE 2.3**

*How many moles are in 10 grams of  $H_3PO_4$ ?*

**Solution**

$$Mr = \underbrace{(3 \times 1)}_H + \underbrace{(1 \times 31)}_P + \underbrace{(4 \times 16)}_O = 98g.$$

We have 10 grams, thus the number of moles is

$$\frac{10}{98} = 0.1 \text{ Moles.}$$

**EXAMPLE 2.4**

*How many moles are in 8g of Oxygen?*

**Solution**

$$\begin{aligned} Mr \text{ O}_2 &= 32 \\ \implies 8/32 &= 0.25 \text{ moles.} \end{aligned}$$

**EXAMPLE 2.5**

*How many atoms are present in 0.54 moles of carbon?*

**Solution**

We want to go from moles to atoms, so multiply by  $6 \times 10^{23}$ .

$$Mr \text{ } 0.54 \cdot (6 \times 10^{23}) = 3.24 \times 10^{23} \text{ atoms.}$$