The Mole

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December 7, 2018

1 Development of a mole

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

DEFINITION

Mole.

One mole of a substance is the amount of that substance tht contains 6×10^{23} *particles.*

2 Molar Mass

- The **molar mass** of a substance is the mass in gram sof one mole of the substance.
- The molar mass has the same numerical value as it's relative molecular mass, but it's **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 weights 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

H_3PO_4

$$\text{Mr} = \underbrace{(3 \times 1)}_{H} + \underbrace{(1 \times 31)}_{P} + \underbrace{(4 \times 16)}_{O} = 98\text{g}.$$

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

$$\text{Mr } O_2 = 32$$
$$\implies 8/32 = 0.25 \text{ moles}.$$

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 6×10^{23}.

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