Topic 10 – Relative Masses and Percentage Composition

Learning outcome:

(a) define **relative atomic mass**, A_r
(b) define **relative molecular mass**, M_r, and **calculate** relative molecular mass (and relative formula mass) as the sum of relative atomic masses
(c) **calculate the percentage mass of an element** in a compound when given appropriate information

10.1 Relative Masses (9.1 – 9.2)

Relative atomic mass

The masses of atoms are very small and are not easy to use for calculation. To simplify calculations, we compare the masses of atoms.

Atom	Mass / g
Hydrogen (H)	1.67×10^{-24}
Carbon (C)	1.99×10^{-23}

Relative atomic mass (A_r)

Average mass of one atom of the element when compared to $\frac{1}{12}$ the mass of one carbon-12 atom

Formula:

$$\text{Relative atomic mass } (A_r) \text{ of an atom} = \frac{\text{average mass of one atom of the element}}{\frac{1}{12} \text{ mass of an atom of carbon-12}}$$

A_r of an element
- is not the mass of the atom
- has **no units** as it is a relative mass
- can be obtained from the Periodic Table

A_r is a **weighed average value**
→ each element likely has different isotopes with different relative atomic masses

Relative molecular mass

Relative molecular mass (M_r)

Average mass of one molecule of the element / compound when compared to $\frac{1}{12}$ the mass of one carbon-12 atom

A_r of an element
- is not the mass of the atom
- has **no units** as it is a relative mass
- **sum of A_r** of all atoms in the molecule

Formula:

$$\text{Relative molecular mass } (M_r) \text{ of a molecular substance} = \frac{\text{average mass of one molecule of the element / compound}}{\frac{1}{12} \text{ mass of an atom of carbon-12}}$$

Relative formula mass (M_r) – ionic compounds

10.2 Percentage Composition (9.4)

Formula:

$$\text{Percentage by mass of an element in a compound} = \frac{\text{number of atoms of the element in the formula} \times A_r \text{ of the element}}{M_r \text{ of the compound}} \times 100\%$$

Points to take note in calculation:

- Statements with workings for clarity of steps
- Units
- Significant figures – 3 s.f.