

Atoms and Molecules

The Universe is made up of atoms, which contain protons (positively charged particles), neutrons (particles with no charge) and electrons (negatively charged particles). Molecules form when two or more atoms bond together.

Atoms:- They are the basic building blocks of ordinary matter. Atoms join together to form molecules, which in turn form most of the objects around us.

Dalton's atomic theory:- According to Dalton's atomic theory, all matter, whether an element, a compound or a mixture is composed of small particles called atoms.

Molecules:- Molecules are the smallest particle of a substance that retains the chemical and physical properties of that substance. Example:- two atoms of hydrogen and one atom of oxygen react to form one molecule of water.

Law of constant proportions:- The law of constant proportions also called Proust's law states that a given chemical compound always contains its component elements in a fixed ratio (by mass) and does not depend on its source and method of preparation.

Atomic mass:- Atomic mass of an element may be defined as the average relative mass of an atom of an element as compared with the mass of an atom of carbon (C-12 isotope) taken as 12amu.

$$\text{Atomic mass} = \frac{\text{Mass of 1 atom of an element}}{1/12^{\text{th}} \text{ of the mass of atom of C-12}}$$

Gram atomic mass:- The atomic mass of an element expressed in grams is known as gram atomic mass.

Atomicity:- The number of atoms present in a molecule of an element or a compound is known as its atomicity.

Example:- atomicity of oxygen (O₂) is 2 while the atomicity of ozone (O₃) is 3.

Molecular mass:- The molecular mass is the total mass of a compound. It is equal to the sum of the individual atomic masses of each atom in the molecule. It is expressed in daltons (Da or u). Different molecules have different molecular masses that depend upon the elements constituting the molecule such as the molecular mass of O₂ is 16 amu, whereas the molecular mass of chlorine is 35.45 amu.

Calculation of molecular mass:-

- Determine the molecular formula of the molecule.
- Use the periodic table to determine the atomic mass of each element in the molecule.
- Multiply each element's atomic mass by the number of atoms of the element in the molecule. This number is represented by the subscript next to the element symbol in the molecular formula.
- Add these values together for each different atom in the molecule.

Example:- molecular mass of $\text{H}_2\text{O} = (2 \times 1) + (1 \times 16)$

$$= 2 + 16$$

$$= 18$$

Mole Concept:-

In a chemical reaction equation, it is more convenient to use the quantity of the substance in the number of its molecules or atoms rather than their masses, so we use a new unit called a mole.

If we weigh an element equal to its atomic mass in grams, then it contains 6.023×10^{23} atoms of the element. The gram atomic mass of the element as well as 6.023×10^{23} atoms of the elements, both represent 1 mole of an element. 1 mole of any species (atoms, molecules, ions) is equal to its atomic mass or molecular mass in grams. The number 6.023×10^{23} is known as Avogadro's number.