

The smallest particle of an element that can possibly exist is known as an atom while molecules are a cluster of atoms bonded together representing the tiniest basic unit of a chemical compound which can take part in a chemical reaction. Get access to class 9 chapter 3 atoms and molecules notes right here.

Topics Covered in Chapter 9 Atoms And Molecules:

- **Laws of Chemical Combination**
- **What is an Atom?**
- **What is a Molecule?**
- **Writing Chemical Formulae**
- **Molecular Mass and Mole Concept**

Laws of Chemical Combination

Experimentations by Lavoisier and Joseph Proust led to the establishment of the following two laws:

- Law of conservation of mass - Law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction.
- Law of constant proportions - also known as law of definite proportions states that “In a chemical substance the elements are always present in definite proportions by mass”.

As per Dalton’s atomic theory, all matter, whether an element, a compound or a mixture is composed of small particles called atoms. The postulates of this theory can be stated as follows:

- All matter is made of very tiny particles called atoms, which participate in chemical reactions.
- Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.
- Atoms of a given element are identical in mass and chemical properties.
- Atoms of different elements have different masses and chemical properties.
- Atoms combine in the ratio of small whole numbers to form compounds.
- The relative number and kinds of atoms are constant in a given compound.

Atoms & Molecules

- An atom is the smallest particle of the element that cannot usually exist independently and retain all its chemical properties.
- A molecule is the smallest particle of an element or a compound capable of independent existence under ordinary conditions. It shows all the properties of the substance.
- Atoms of most of the elements are not able to exist independently. Atoms form molecules and ions. These molecules or ions aggregate in large numbers to form the matter that we can see, feel or touch.

Atomic Mass

An atomic mass can be defined as the mass of a single atom of a chemical element. It includes the masses of the 3 subatomic particles that make up an atom: protons, neutrons and electrons. It can be expressed in grams.

1 atomic mass unit is defined as 1/12 of the mass of a single carbon -12 atom

Molecules of elements

Molecules of an element are constituted by the same type of atoms. Molecules of several elements such as Argon (Ar), helium, (He) are comprised of only one atom of that element but this does not hold good for most of the nonmetals. Example - a molecule of oxygen consists of two atoms of oxygen and hence it is termed as a diatomic molecule, O_2 . The number of atoms constituting a molecule is known as its atomicity

Molecules of Compounds

Atoms of different elements join together in definite proportions forming molecules of compounds.

Example - water. The joining elements here are Hydrogen and Oxygen in the ratio (by mass) 1:8.

Ions

These are the charged species of compounds composed of metals and non-metals Ions can consist of a single charged atom or a group of atoms having a net charge on them. These ions can be negatively(anion) or positively charged(cation). Example - NaCl where sodium ions (Na^+) are positively charged and (Cl^-) is negatively charged.

Writing Chemical Formula

The chemical formula of a compound is a symbolic representation of its composition. The combining power (or capacity) of an element is known as its valency. Valency can be used to

find out how the atoms of an element will combine with the atom(s) of another element to form a chemical compound.

Listed below are the rules for writing chemical formula:

- the valencies or charges on the ion must balance.
- when a compound consists of a metal and a non-metal, the name or symbol of the metal is written first. For example: calcium oxide (CaO), sodium chloride (NaCl), iron sulphide (FeS), copper oxide (CuO) etc., where oxygen, chlorine, sulphur are nonmetals and are written on the right, whereas calcium, sodium, iron and copper are metals, and are written on the left.
- in compounds formed with polyatomic ions, the number of ions present in the compound is indicated by enclosing the formula of ion in a bracket and writing the number of ions outside the bracket. For example, Mg (OH)₂. In case the number of polyatomic ions is one, the bracket is not required. For example, NaOH.

Molecular Mass and Mole Concept

Molecular Mass - The molecular mass of a substance is the sum of the atomic masses of all the atoms in a molecule of the substance. It is, therefore, the relative mass of a molecule expressed in atomic mass units (u).

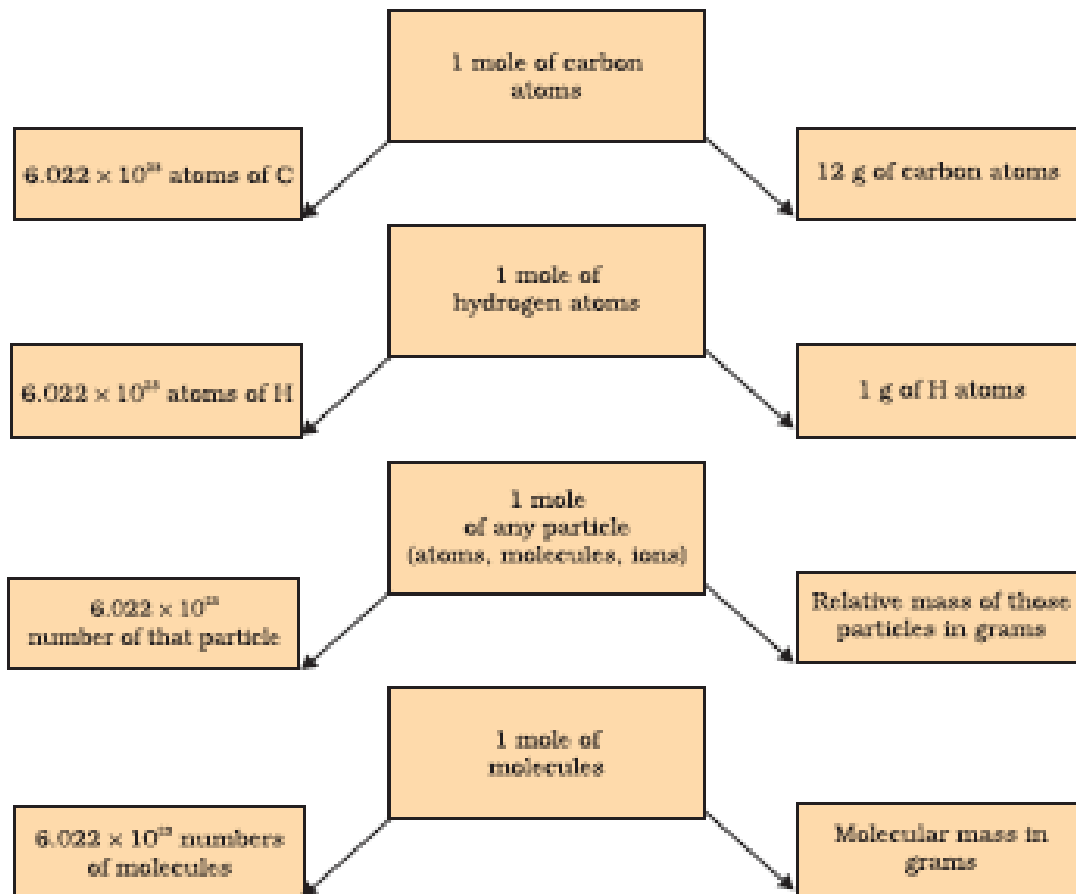
Formula unit mass - It is the sum of the atomic masses of all atoms in a formula unit of a compound. Formula unit mass is calculated in the same manner as we calculate the molecular mass. The only difference is that we use the word formula unit for those substances whose constituent particles are ions. For example, sodium chloride as discussed above has a formula unit NaCl. Its formula unit mass can be calculated as-

$$1 \times 23 + 1 \times 35.5 = 58.5 \text{ u}$$

Mole Concept

One mole of any species such as an atom, molecule, ion or particles is the quantity in number having a mass equal to its atomic or molecular mass in grams. The number of particles (atoms, molecules or ions) present in 1 mole of any substance is fixed, with a value of 6.022×10^{23} . This is an experimentally obtained value. This number is called the Avogadro Constant or Avogadro Number (represented by N_A).

$$1 \text{ mole (of anything)} = 6.022 \times 10^{23} \text{ in number,}$$



Relationship between mole, Avagadro number and mass