

## Science Class 9 Notes – Atoms and Molecules

**1. Law of conservation of mass :** This law was stated by **Lavoisier** in 1744. It states that “In all physical and chemical changes, the total mass of reactants is equal to total mass of products.”

**2. Law of constant proportions (or constant composition) :** This law was first stated by Proust in 1797. According to the law “a chemical compound is always found to be made up of the same elements combined together in the same proportions by weight” e.g. the ratio of hydrogen and oxygen in pure water is always 1: 8 by weight. This law is also called **law of definite proportions**.

**3. Dalton’s Atomic theory :** Postulates of Dalton Atomic Theory

- Matter is made up of extremely small indivisible particles called **atoms**.
- Atoms of the same substance are identical in all respects i.e., they possess same size, shape, mass, chemical properties etc. Atoms of different substances are different in all respects i.e., they possess different size, shape, mass etc.
- Atom is the smallest particle that takes part in a chemical reaction.
- Atoms of different elements May combine with each other in a fixed simple, whole number ratio to form **compound atoms**.
- Atoms can neither be created nor destroyed i.e., atoms are indestructible.

**4. Atom :** It is the smallest particle of an element which can take part in a chemical change. It may or may not be capable of independent existence.

**5. Symbol:** The abbreviation used for lengthy names of elements are termed as their symbols.

The symbol of an element is the first letter or the first and another letter of English name or Latin name of the element. While writing a symbol, the first letter is always capital and the second is always small.

**6. Molecule :** It is the smallest particle of an element or compound that is capable of independent existence and shows all the properties of that substance.

[The molecules of an element is made up of only one and same type of atoms, while the molecule of a compound is made up of dissimilar atoms]

**7. Atomicity :** The number of atoms present in a molecule of an element or a compound is known as its atomicity. e.g. the atomicity of oxygen is 2 while atomicity ozone is 3.

**8. Ion :** It is an electrically charged atom or group of atom. It is formed by the loss or gain of electrons by an atom. Ions are of two types :

(i) Cation : It is positively charged ion and is formed by the loss of electron from an atom e.g.  $H^+$ ,  $Na^+$ ,  $Ca^{2+}$ ,  $Al^{3+}$ ,  $NH_4^+$  etc.

(ii) Anion : It is negatively charged ion and is formed by the gain of electrons by an atom, e.g.  $Cl^-$ ,  $O^{2-}$ ,  $C^{4-}$ ,  $F^-$ ,  $CO_3^{2-}$ ,  $PO_4^{3-}$  etc.

**9. Valency :** The combining power (or capacity) of an element is known as its valency.

**10. Formula of simple and molecular compounds** Binary compounds are those compounds which are made up of two different elements e.g.  $NaCl$ ,  $KBr$ ,  $CaO$  etc. Following rules are to be followed for writing the formula.

(i) The valencies or charges on the ions must be balanced.

(ii) For a compound made up of a metal and a non-metal, the symbol of metal is written first.

(iii) In compounds formed with polyatomic ions, the ion is enclosed in a bracket before writing the number to indicate the ratio.

**11. Atomic mass of an element :** The atomic mass of an element is the numerical number which indicates how many times an atom of an element is heavier than  $1/12$  of mass of an atom  $12$  of carbon- $12$ . For example, the atomic mass of magnesium ( $Mg$ ) is  $24$  which indicates that one atom of magnesium is  $24$  times heavier than  $1/12$  of a carbon- $12$  atom.

**12. Gram atomic mass :** The atomic mass of an element expressed in grams is known as gram atomic mass. (Gram atomic mass is also known as gram atomic weight)

**13. Molecular mass :** The number of times a molecule of a compound is heavier than the  $1/12$  of the mass of  $C-12$  atom, is known as its molecular mass.

The molecular mass is equal to the sum of the atomic masses of all atoms present in one molecule of the substance. For example  $H_2$  contains two atoms of hydrogen, so molecular mass of  $H_2$  is  $2$  ( $2 \times 1 = 2$ )

**14. Formula unit mass :** It is equal to the sum of atomic masses of all the atoms in a formula unit.

In case of ionic compounds like  $NaCl$  formula mass is  $58.5$  ( $23 + 35.5 = 58.5$ )

**15. Molecular Mass and Mole Concept :** Mole the unit of a substance. It is a collection of  $6.023 \times 10^{23}$  particles.

The mass of  $1$  mole particles is equal to its mass in grams.

Thus  $1$  mole =  $6.023 \times 10^{23}$  particles

$1$  mole atoms =  $6.023 \times 10^{23}$  atoms

1 mole electrons =  $6.023 \times 10^{23}$  electrons  
1 mole protons =  $6.023 \times 10^{23}$  protons  
1 mole ions =  $6.023 \times 10^{23}$  ions  
1 mole molecules =  $6.023 \times 10^{23}$  molecules

**16. Avogadro's constant or Avogadro's number:** The number of particles present in one mole (i.e.  $6.023 \times 10^{23}$  particles) is called Avogadro's number or Avogadro's constant.

### 17. Mole

1 mole =  $6.023 \times 10^{23}$  particles.

= mass of 1 mole particles in grams

= 22.4L of a gas at N.T.P.

1 mole atoms = gram atomic mass

1 mole molecules = gram molecular mass

N.T.P. stands for normal temperature ( $0^\circ\text{C}$ ) and normal pressure (1 atmosphere or 76 mm of mercury.)

### 18. Formulas of number of moles :

Number of moles = Mass of substance in grams/grams molecular mass

Number of moles = Volume of gas in litre (at N.T.P.)/22.4

Number of moles = number of particles/  $6.023 \times 10^{23}$

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[nirapendra.singh@gmail.com](mailto:nirapendra.singh@gmail.com)

Thanks