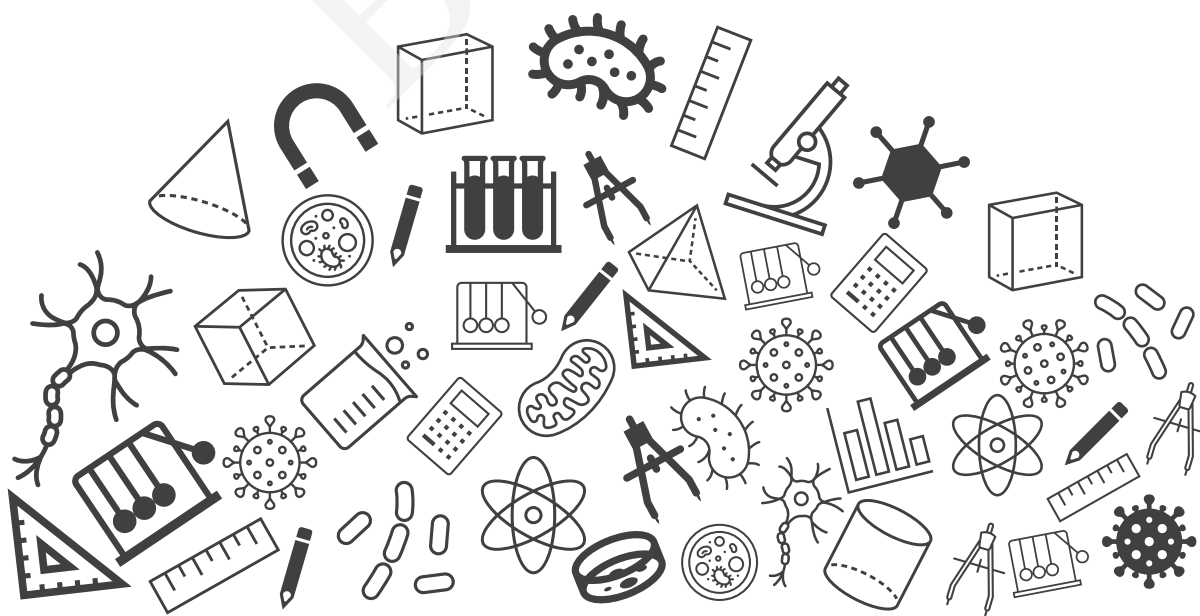




Grade 09

Science Chapter Notes

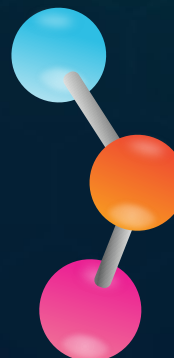


BYJU'S Classes

Chapter Notes

Atoms and Molecules

GRADE 09



Topics to Be Covered

1. Atom

- 1.1 Introduction to atom
- 1.2 Element
- 1.3 Representation of elements
- 1.4 Atomic mass

3. Molecular Mass and Formula Unit Mass

- 3.1 Molecular mass
- 3.2 Formula unit mass

5. Dalton's Atomic Theory

- 5.1 Postulates of Dalton's atomic theory

7. Writing Chemical Formulae

- 7.1 Rules to write a chemical formula
- 7.2 Formula of simple compounds

2. Molecule

- 2.1 Introduction to molecule
- 2.2 Atomicity

4. Laws of Chemical Combination

- 4.1 Law of conservation of mass
- 4.2 Law of constant proportions

6. Ion

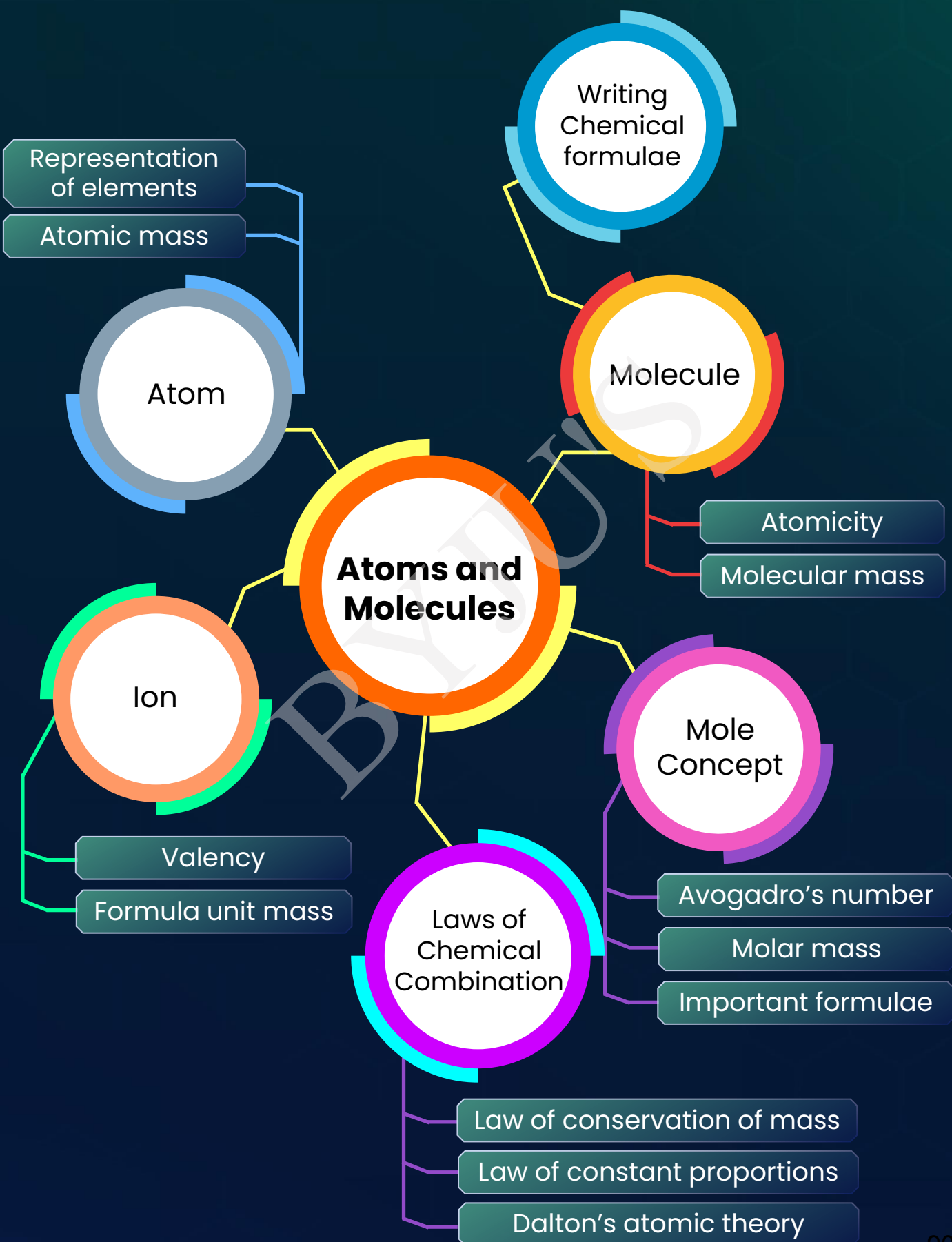
- 6.1 Introduction to ion
- 6.2 Valency

8. Mole Concept

- 8.1 Mole
- 8.2 Relationship between mass, mole and Avogadro's number

Mind Map

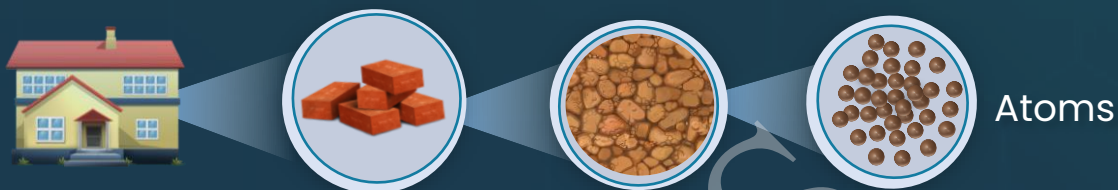
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1. Atom

1.1 Introduction to Atom

An atom is the smallest particle of matter and is considered as its building block.



Everything around us is made up of atoms.



Atomic radius is measured in nanometres.

$$1 \text{ m} = 10^9 \text{ nm}$$

1.2 Element

The simplest substance made up of one kind of atom that cannot be further broken down by chemical processes is known as an element.

E.g., Oxygen, nitrogen, silver, gold, hydrogen, etc.

1. Atom

1.3 Representation of Elements

Dalton was the first scientist to propose symbols for elements.



Hydrogen



Carbon



Oxygen



Sulphur

Rules of **Berzelius** system:

Rule 1:

The symbols of the most common elements are generally denoted by the first letter of its English name, written in uppercase.

E.g., **H**ydrogen- H

Rule 2:

If the first letter of two elements are the same, then the first two letters are used for the symbols, where the first letter is in uppercase and the second one is in lowercase.

E.g., **He**lium- He

Rule 3:

If the first two letters of two elements are the same, then the next prominent letter is used.

E.g., **Cl**hlorine- Cl

Rule 4:

For elements whose names are derived from their Latin or Greek origin, above rules are followed but with their Latin and Greek name.

E.g., **Na**trium- Na



Nowadays, **I**nternational **U**nion of **P**ure and **A**ppplied **C**hemistry approves the names of elements.

1. Atom

1.4 Atomic Mass

In 1961, the carbon-12 atom was chosen as the standard reference for measuring atomic masses for a universally accepted atomic mass unit.

One **atomic mass unit** (amu or u) is defined as the mass unit equal to one-twelfth ($1/12^{\text{th}}$) of the mass of one carbon-12 atom.

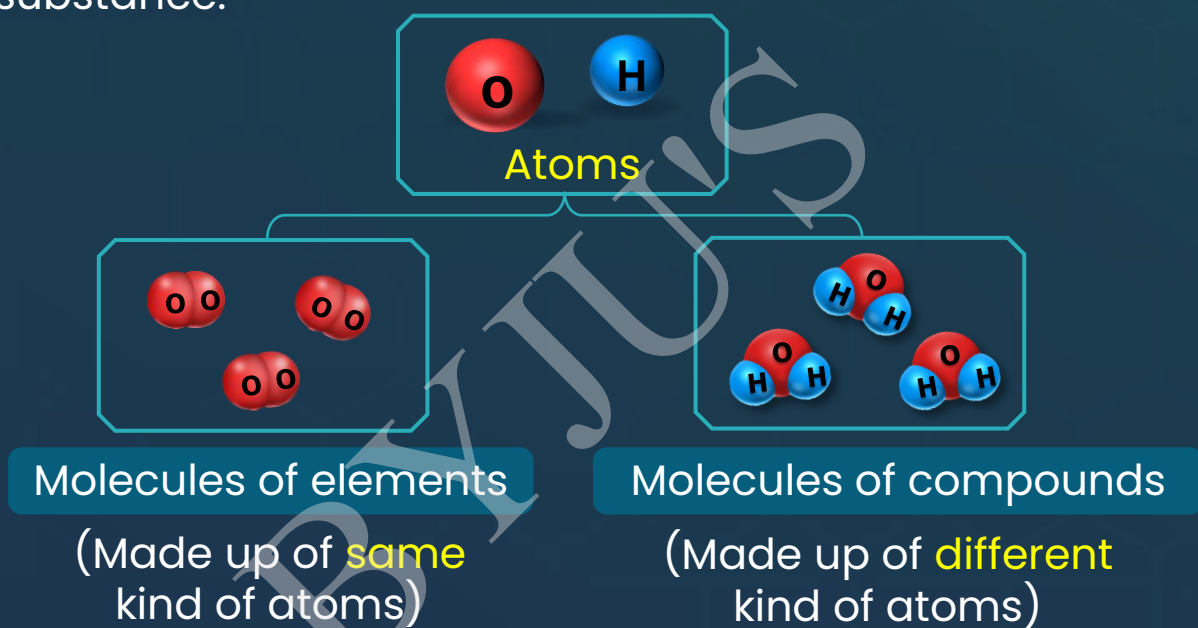
Atomic masses of a few elements:

Elements	Atomic mass (amu or u)
Hydrogen (H)	1
Carbon (C)	12
Nitrogen (N)	14
Oxygen (O)	16
Magnesium (Mg)	24
Calcium (Ca)	40
Sodium (Na)	23

2. Molecule

2.1 Introduction to Molecule

- A molecule is a group of two or more atoms that are chemically bonded together and have an independent existence.
- It is defined as the smallest particle of an element or a compound that shows all the properties of that substance.



2.2 Atomicity

The total number of atoms that constitute a molecule is known as its atomicity.



Argon

Monoatomic



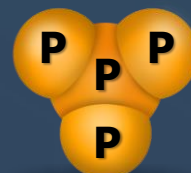
Nitrogen

Diatomic



Ozone

Triatomic



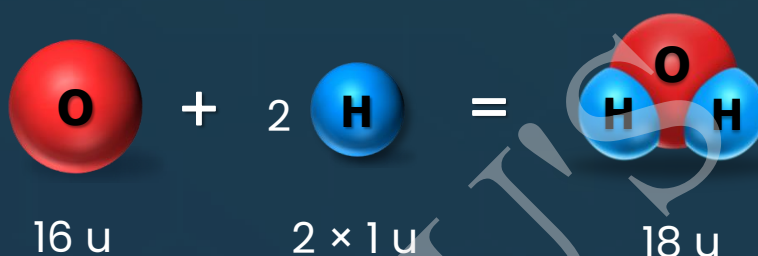
Phosphorus

Polyatomic

3. Molecular Mass and Formula Unit Mass

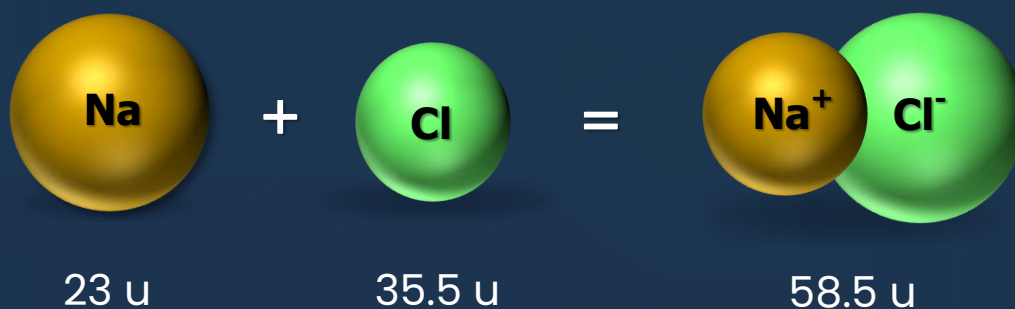
3.1 Molecular Mass

The sum of the atomic masses of all the atoms in a molecule is called molecular mass.



3.2 Formula Unit Mass

The sum of atomic masses of all atoms in a formula unit of a compound is called formula unit mass.



4. Laws of Chemical Combination

4.1 Law of Conservation of Mass

Law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction.

Total mass of
the reactants

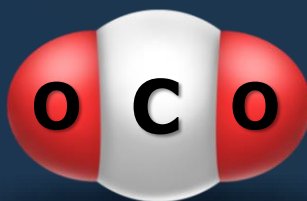
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Total mass of
the products

4.2 Law of Constant Proportions

Law of constant proportions states that in a chemical substance, the elements are always present in definite proportions by mass.

E.g.,



$$\frac{\text{Mass of one carbon atom}}{\text{Mass of two oxygen atoms}} = \frac{12 \text{ u}}{2 \times 16 \text{ u}} = \frac{12}{32} = \frac{3}{8}$$

5. Dalton's Atomic Theory

5.1 Postulates of 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.

The postulates are as follows:

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

6. Ion

6.1 Introduction to Ion

Compounds composed of metals and non-metals contain charged species. The charged species are known as ions.

A single atom carrying a charge is known as a **monoatomic ion**. E.g., Mg^{2+} , Br^-

A group of atoms carrying a charge is known as a **polyatomic ion**. E.g., NH_4^+ , NO_3^-

An ion can be negatively or positively charged:

Cation

The positively charged ion is called a cation.
E.g., NH_4^+ , Mg^{2+}

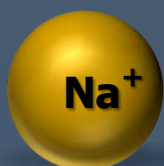
Anion

The negatively charged ion is called an anion.
E.g., Br^- , NO_3^-

6.2 Valency

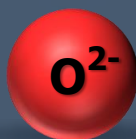
The **combining** capacity of an **atom/ion of an element** to form a compound is called valency.

Sodium ion



Valency: 1

Oxide ion



Valency: 2

Aluminium ion



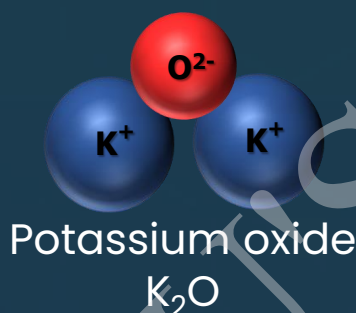
Valency: 3

7. Writing Chemical Formulae

7.1 Rules to Write a Chemical Formula

Rule 1

The valencies or charges on the ions must balance.



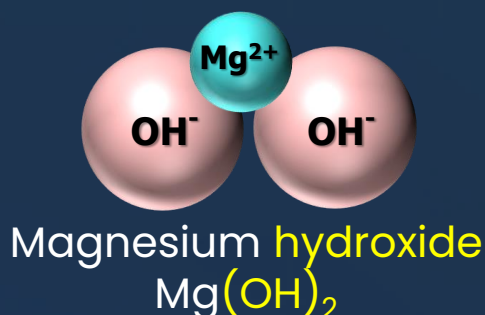
Rule 2

When a compound consists of a metal and a non-metal, the name or symbol of the metal is written first.



Rule 3

For polyatomic ions, the formula of ion is enclosed in a bracket and the number of ions written outside the bracket. If the number of polyatomic ions is 1, the bracket is not required.



7. Writing Chemical Formulae

7.2 Formula of Simple Compounds

While writing the chemical formulae for compounds, we write the constituent elements and their valencies. Then we must crossover the valencies of the combining atoms.

Sodium nitrate

Symbol:



Valency:



Formula:



Calcium oxide

Symbol:



Valency:



Formula:



The valencies of the elements are the same, so we may arrive at the formula Ca_2O_2 . But upon simplifying, the formula becomes CaO .

8. Mole Concept

8.1 Mole

One mole of any species (atoms, molecules, ions or particles) contains a fixed number of particles which is 6.022×10^{23} .

This number is called Avogadro's constant or **Avogadro's number** (represented by N_A).

$$1 \text{ mole of atoms} = 6.022 \times 10^{23} \text{ atoms}$$

$$1 \text{ mole of molecules} = 6.022 \times 10^{23} \text{ molecules}$$

$$1 \text{ mole of ions} = 6.022 \times 10^{23} \text{ ions}$$

The mass of 1 mole of a substance is equal to its atomic or molecular mass in grams.

The molar mass of atoms is also known as gram atomic mass.

For example, the atomic mass of hydrogen = 1 u.
So, the gram atomic mass of hydrogen = 1 g.

8. Mole Concept

8.2 Relationship between Mass, Mole and Avogadro's Number

$$\text{Number of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$\Rightarrow n = \frac{m}{M}$$

$$\text{Number of moles} = \frac{\text{Given number of particles}}{\text{Avogadro's number}}$$

$$\Rightarrow n = \frac{N}{N_A}$$

$$\text{Mass} = \text{Molar mass} \times \text{Number of moles}$$

$$\Rightarrow m = M \times n$$