ATOM AND MOLECULES

Maharishi Kanad

He postulated that if we keep on dividing the matter (called 'padarth') we will get smaller and smaller particles and soon we will achieve the smallest of particles (called as 'parmanu') which may not divide further.

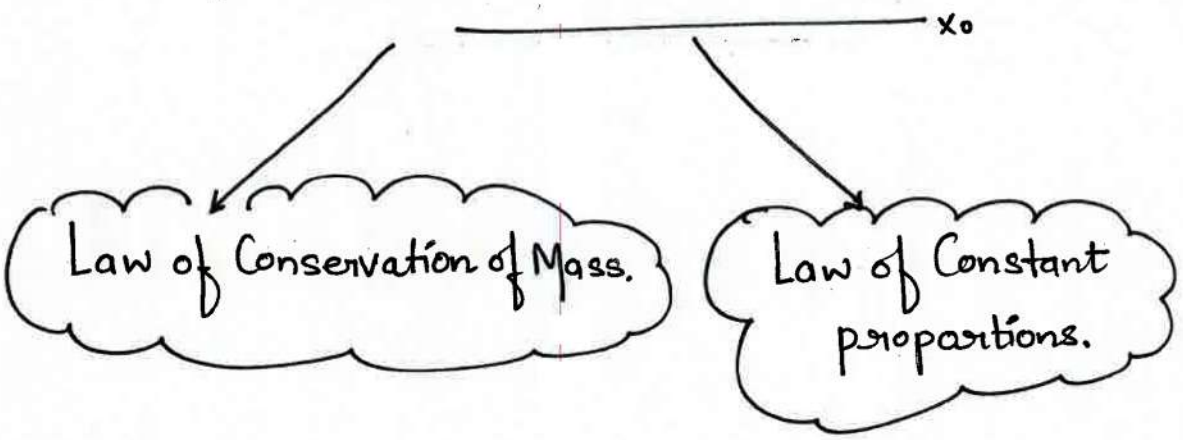
Pakudha Katyayama

He postulated that there are various forms of matter because the particles of matter exist together in combinations.

Democritus and Leucippus:

They suggested that when we keep on dividing the matter there comes a time when no more division of particles can take place. Such particles are called atoms which means being invisible.

LAW OF CHEMICAL COMBINATION



↳ Law of Conservation of mass :- (Lavoisier)

→ "Law of Conservation of mass states that Mass can neither be Created nor destroyed in a Chemical reaction."

Total Mass of the Reactants = Total Mass of the Products

Mass of A + mass of B ⟶ mass of AB

(Reactants) (Product)

↳ Law of Constant proportions :- (Joseph Proust)

→ "In a chemical Substance the elements are always present in definite proportions by mass".

for example:→ Hydrogen and oxygen are present in water in a ratio of 1:8. So if we decompose 9g of water we will obtain 1g of hydrogen and 8g of oxygen.

DALTON'S ATOMIC THEORY

(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.

ATOM :-

→ Atoms are defined as "The Basic building blocks of matter".

→ Atomic radius is measured in Nanometre.

$$1nm = 10^{-9} nm$$

Symbols of Elements :-

→ Dalton was the first Scientist to use the Symbol for elements.

→ Berzelius's atomic Symbols :-

→ The symbols of the most common elements are generally denoted by the First Letter of its English name, written in uppercase.

for example : Hydrogen , Carbon , Fluorine etc.

→ If the first letter of more than one element is the same, then use the first two letters as a Symbol and second letter should be lowercase.

for example : Helium , Lithium , Aluminium etc.

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

for example: Magnesium, Manganese.

→ for elements whose names are derived from their Latin or Greek Origin, the same rules are followed but with their Latin and Greek name.

Name of Element	Latin name	Symbol.
→ Silver	Argentum	Ag
→ Gold	Aurum	Au
→ Iron	Ferrum	Fe

Atomic Mass Unit (amu)

↳ "One atomic mass unit is the mass equal to exactly one-twelfth ($\frac{1}{12}$th) of the mass of one atom of Carbon-12"

Note: ↳ $1\,amu = 1.67377 \times 10^{-24}$ grams

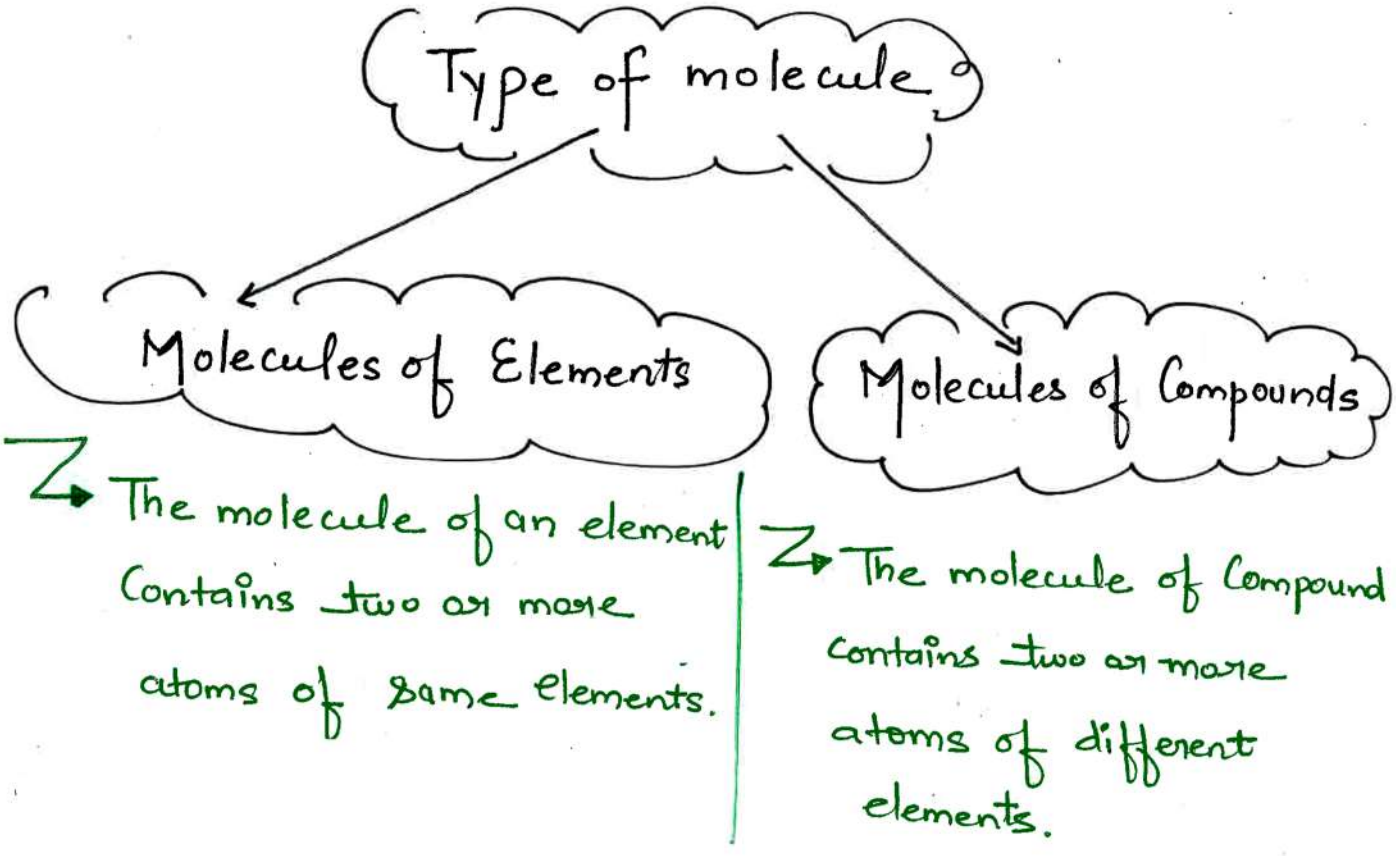
Can ATOMS EXIST INDEPENDENTLY?

Atoms cannot survive independently. So, atoms join together and form molecules or ions.

MOLECULE

→ "Group of two or more atoms that are chemically bonded together."

→ A molecule can be defined as the smallest particle of an element or a compound that is capable of an independent existence.



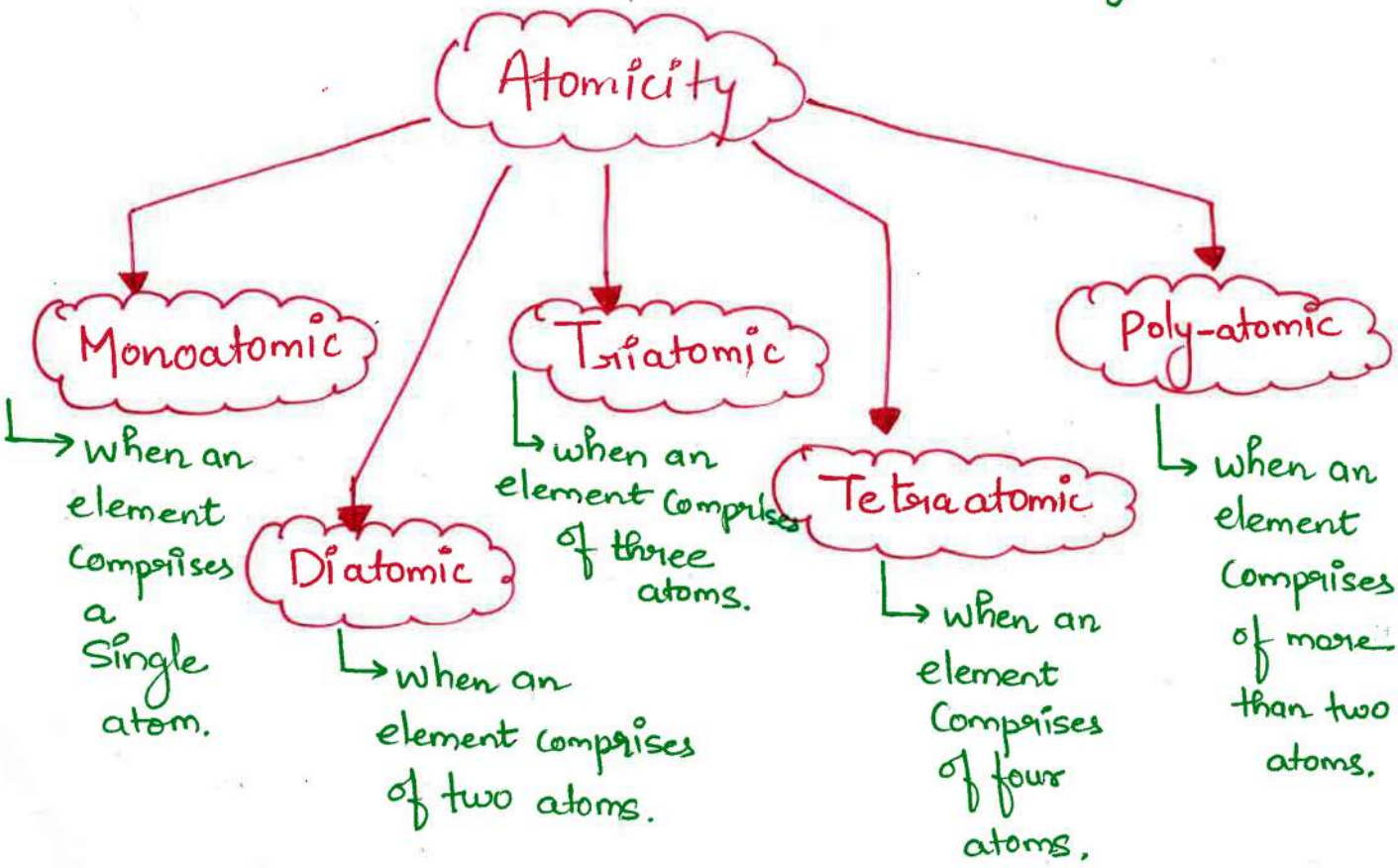
Molecule of Elements

for example :→ Oxygen, Ozone, phosphorus, Sulphur etc.

Molecule of Compounds.

for example :→ Carbon dioxide, Water, Ammonia etc.

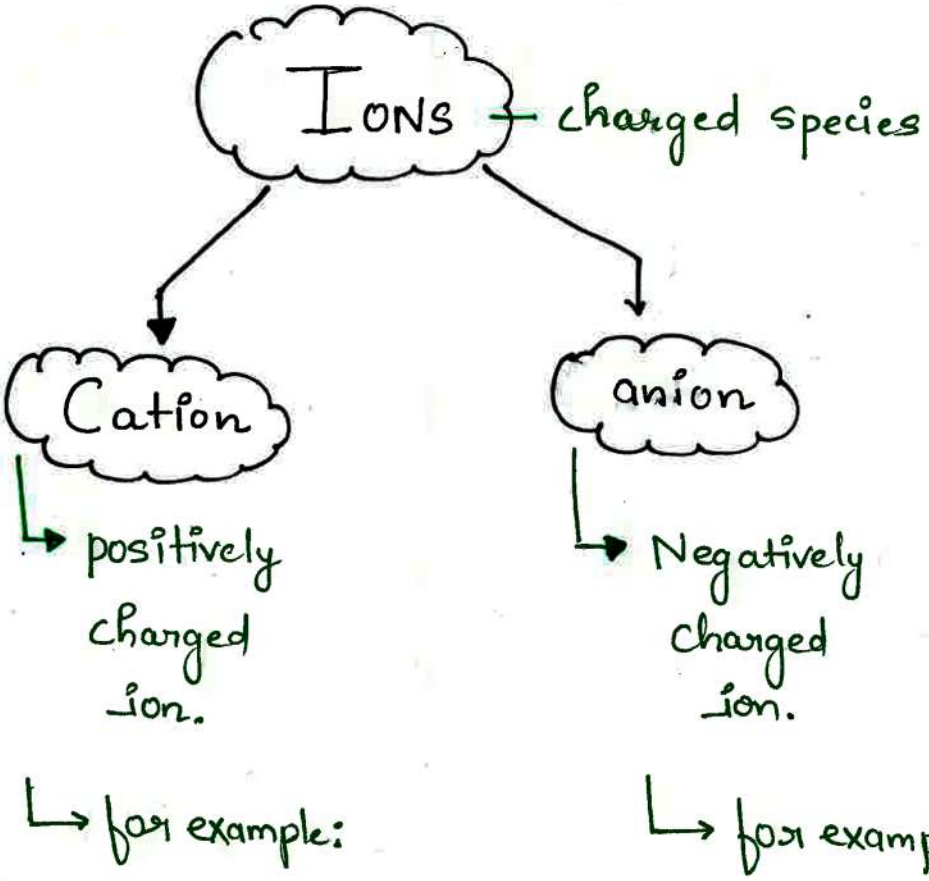
ATOMICITY :→ "The exact number of atoms in a molecule of an element is Called its atomicity."



few examples of atomicity of elements :→

Name	Atomicity	formula
Argon	Monoatomic	Ar
Helium	Monoatomic	He
Oxygen	Diatomic	O_2
Hydrogen	Diatomic	H_2
Nitrogen	Diatomic	N_2
Chlorine	Diatomic	Cl_2
phosphorous	Tetra-atomic	P_4
Sulphur	Poly-atomic	S_8

IONS :→ "Ions may consist of a single charged atom or a group of atoms that have a net charge on them."



Note:- When a group of atoms carries a charge in a compound it is called a polyatomic ion.

Chemical formula

"It is the Symbolic representation of the composition of a Compounds."

Valency :-

"The Combining power (or Capacity) of an element is known as its Valency."

for example :-

	Valency
Hydrogen (H) –	1
Nitrogen (N) –	3
Sodium (Na) –	1

Rules for writing Chemical formulas:

(i) We have to first write symbols of elements which form a compound.

(ii) Below the symbol of an element, we should write their valency.

(iii) Now cross over the Valences of Combining atoms

formula of Simple Compound

1. formula of Hydrogen chloride

Symbol H Cl

Valency 1 1

HCl

2. Formula of Hydrogen Sulphide

Symbol H S

Valency 1 2

H_2S

3. formula of Aluminium Oxide

Symbol Al O

Valency 3 2

Al_2O_3

Some Important polyatomic ions

Valency

- Sulphate (SO_4^{2-}) → 2
- Sulphite (SO_3^{2-}) → 2
- Sulphide (S^{2-}) → 2

- Nitrate (NO_3^{-}) → 1
- Nitrite (NO_2^{-}) → 1
- Nitride (N^{3-}) → 3

- Hydrogen Carbonate (HCO_3^{-}) → 1
- Carbonate (CO_3^{2-}) → 2
- phosphate (PO_4^{3-}) → 3
- Ammonium (NH_4^{+}) → 1

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.

for example: The Molecular mass of H_2O

$= (2 \times 1) + (1 \times 16)\ u$

$= 18u.$

Formula Unit Mass

"The formula unit mass of a Substance is the Sum of the atomic masses of all atoms in a formula unit of a Compound.

for example: Sodium Chloride has a formula unit Nacl.

→ formula Unit Mass of Nacl = $23u + 35.5u$

$= 58.5u$