

CHEMISTRY

MODULE-1, 1ST CLASS

ATOMIC STRUCTURE

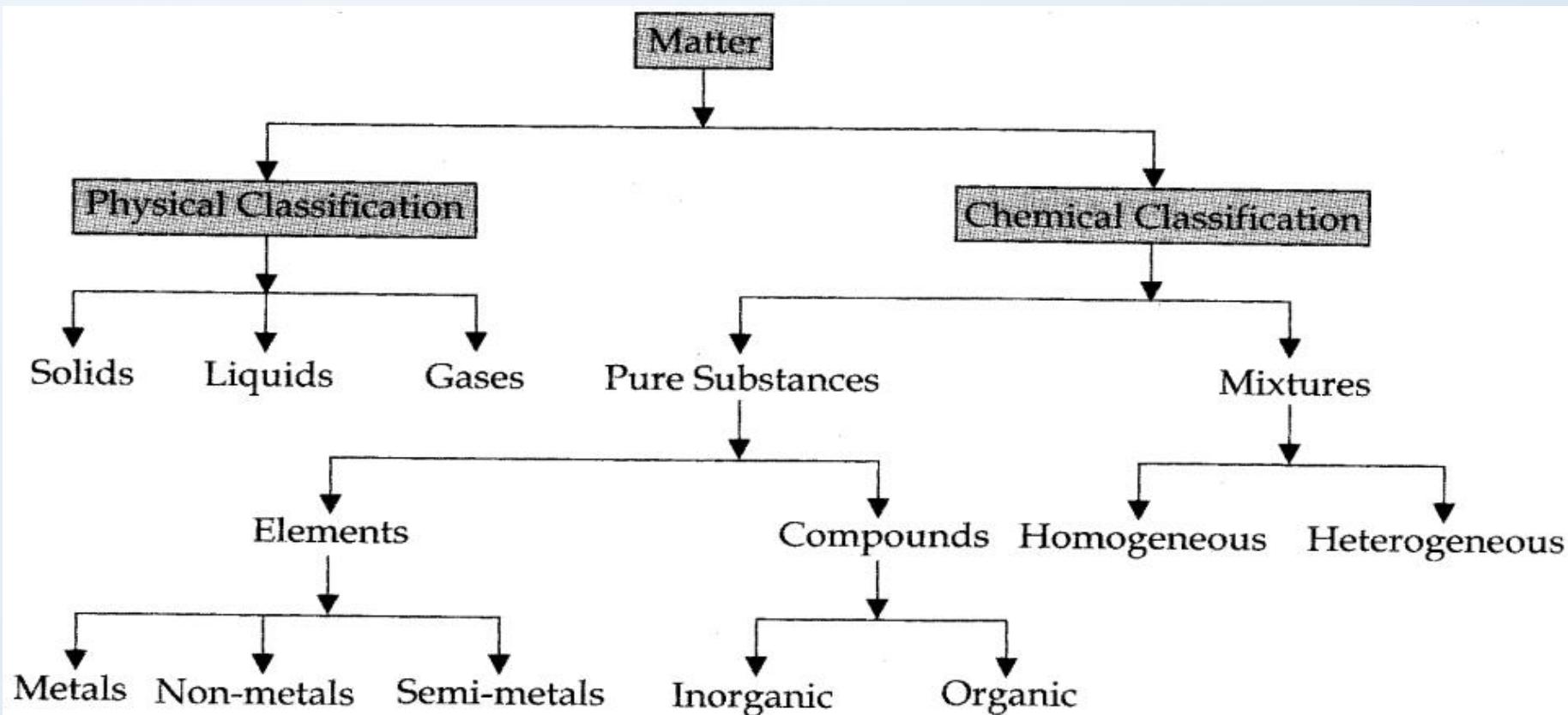
TABLE OF CONTENT

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- Classification of elementary particle according to spin value.



MATTER & IT'S CLASSIFICATION

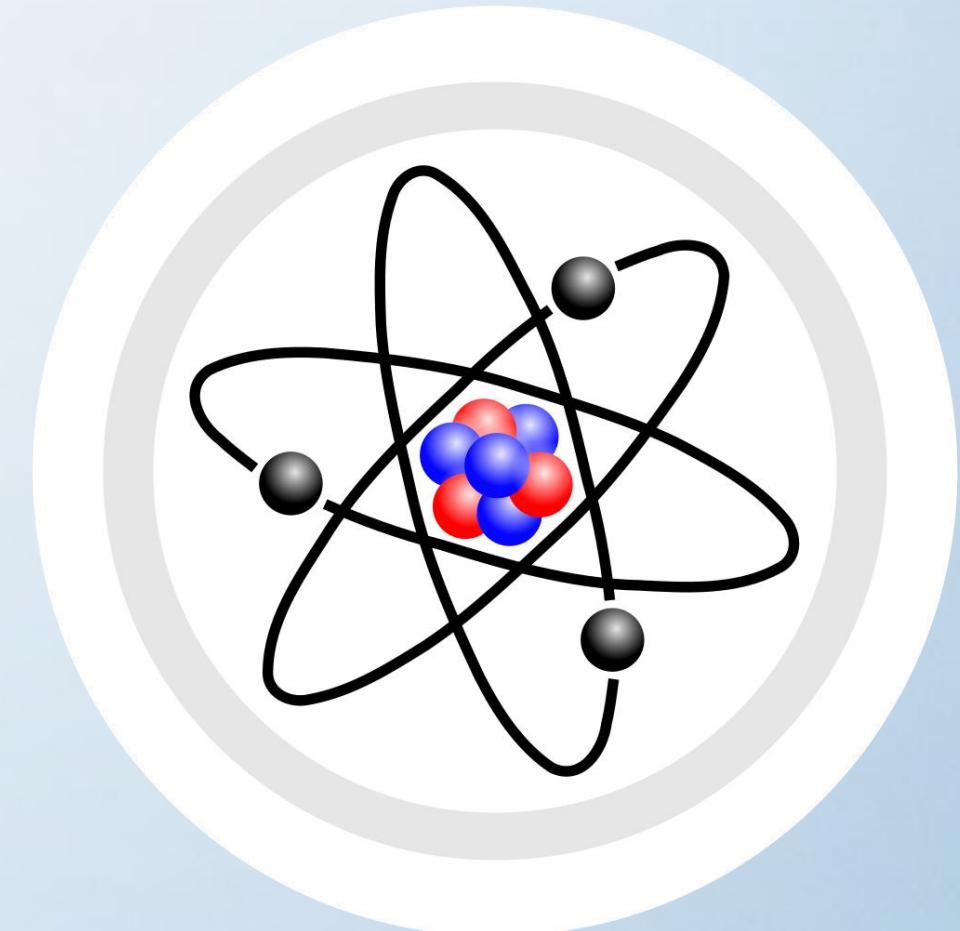
Matter is something that has mass, occupies some space and can be perceived by our senses.





ATOMS

- The smallest part of any element is known as ATOM.
- Atom is neutral. [Number of Protons = Number of Electrons]
- Atom does not exist in free state; it always takes part in chemical reaction.
- The term Paramanu was coined by: Kanad
- The term Atom was coined by Democritus.
- Atomic theory: John Dalton.



POSTULATES OF ATOMIC THEORY

- Matter consists of indivisible atoms.
- All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.
- Compounds are formed when atoms of different elements combine in a fixed ratio.
- Chemical reaction only involve reorganization of atoms. They are neither created nor destroyed in a chemical reaction.



SUB-ATOMIC PARTICLES: ELECTRON

- Electron was discovered by J. J. Thomson by the Cathode ray experiment.
- The term electron was coined by Stoney.
- Electron is the negatively charged particle, and its charge first time calculated by Millikan (oil drop experiment)
- Electron is the lightest fundamental particle.
- The chemical property of an atom depends on electron.
- Formula :- $_{-1}e^0$
- Mass :- 9.11×10^{-31} kg (SI Unit) or 9.11×10^{-28} gm (CGS Unit)
- Charge :- SI unit (-) 1.602×10^{-19} C or in CGS unit (-) 4.8×10^{-10} esu

PROTON

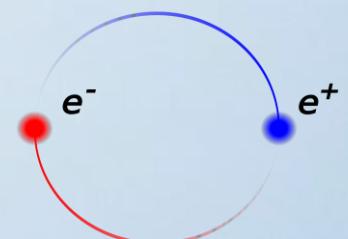
- Proton was discovered by Rutherford.
- Proton is positively charged particle.
- The number of proton present in an atom is called atomic number.
- In an atom the number of proton and the number of electron is equal.
- Proton is called the ionised hydrogen atom. (H^+)
- Formula :- $_1H^1$
- Mass:- 1.6725×10^{-24} gm
- (Proton is almost 1836 times heavier than electron)
- Charge:- (+) 1.602×10^{-19} c (SI unit) or (+) 4.8×10^{-10} e.s.u

NEUTRON

- Neutron was discovered by Chadwick by bombarding the alpha particle on Beryllium plate .
- The late discover of neutron is due to its neutral character.
- Neutron is the heaviest fundamental particle.
- If neutron is added or emitted from the nucleus of an atom then their will be no chemical change.
- Charge:- 0 or neutral
- Mass :- 1.675×10^{-27} kg.
- A neutron's mass is almost 1837 times heavier than electron.

POSITRON

- Positron means positive electron or the anti particle of electron.
- It was discovered by Anderson.
- The charge of positron is same as proton and the mass of positron is same with electron.
- Formula :- ${}_{+1}e^0$





- Discovered :- Yu-Ka-Wa
- It is represented by π sign. (It has three charge character π^+ , π^- and π^0)
- Due to the continuous conversion of neutron and proton in the nucleus this meson is formed and it binds the proton and neutron in the nucleus by the nuclear force or Yu-Ka-wa force.

NEUTRINO

- Discovered :- E. Pauli and the term was coined by Fermi.
- This particle has no mass no charge only spin is present.
- This particle is called Ghost particle.

HIGGS-BOSON

- Discovered:- S. N. Bose
- It is called the God particle because it provides the mass to the fundamental particle.
- It has positive integer value.(0,1,2,3....)

MOLECULES

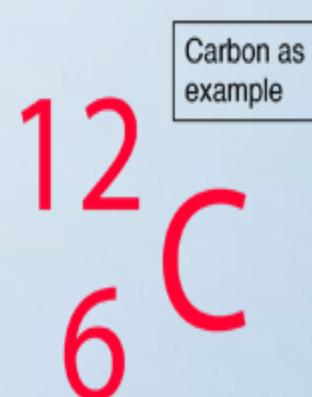
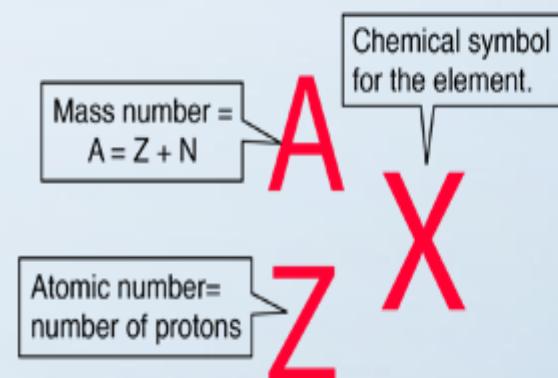
- O → atom of oxygen
- O₂ → molecule of oxygen.
- The term molecule was coined by: Avogadro
- Molecules are of two types:
- Homoatomic molecules eg: O₂, P₄
- Heteroatomic molecules eg: NaCl, H₂O, C₆H₁₂O₆

ATOMICITY

- Atomicity is the number of atoms present in a molecule.
- Atomicity of :H₂O = 2+1= 3, C₆H₁₂O₆= 6+12+6=24
- Atomicity of some homoatomic molecules:
 - Sulphur=8,
 - Phosphorus=4
 - Ozone=3
 - Oxygen, Nitrogen and Hydrogen=2
 - Halogens=2
 - Inert gases=1

ATOMIC NUMBER & MASS NUMBER

- Atomic Number : Number of proton
- Mass Number : Number of proton + Number of neutron
- For, ${}_{\text{8}}^{\text{16}}\text{O}$ → Atomic Number 16 → Mass Number
- So, in oxygen, Number of Proton = 8
- Number of Neutron = $16 - 8 = 8$
- Number of electron = 8



ISOTOPE (same number of proton)

Isotope	Atomic number	Mass number	Neutron number
Protium $_1\text{H}^1$	1	1	0
Deuterium $_1\text{H}^2$	1	2	1
Tritium $_1\text{H}^3$	1	3	2

- Same atomic number with different neutron.
- Their chemical properties are same but physical properties different.
- Sodium has no natural isotope.
- Tin has maximum number of natural isotopes.

ISOTONE (same number of neutron)



ISOBAR (Same mass number)

${}_{\text{18}}^{\text{40}}\text{Ar}$ and ${}_{\text{20}}^{\text{40}}\text{Ca}$ both have same mass number so they are called Isobar.

ISODIAPHAR

- Same (N-P) difference or same isotopic number.
- Isotopic number is:- Mass number – ($2 \times$ atomic number)
- $_{92}U^{235}$ and $_{90}Th^{231}$
- $(N-P) = 51 = (N-P)$
- As similar their isotopic number also same .
- If the atomic number difference is two unit and mass number difference is four unit then the relation becomes isodiaphar

ISOSTER

Same number of electrons and same number of atoms

Example 1:

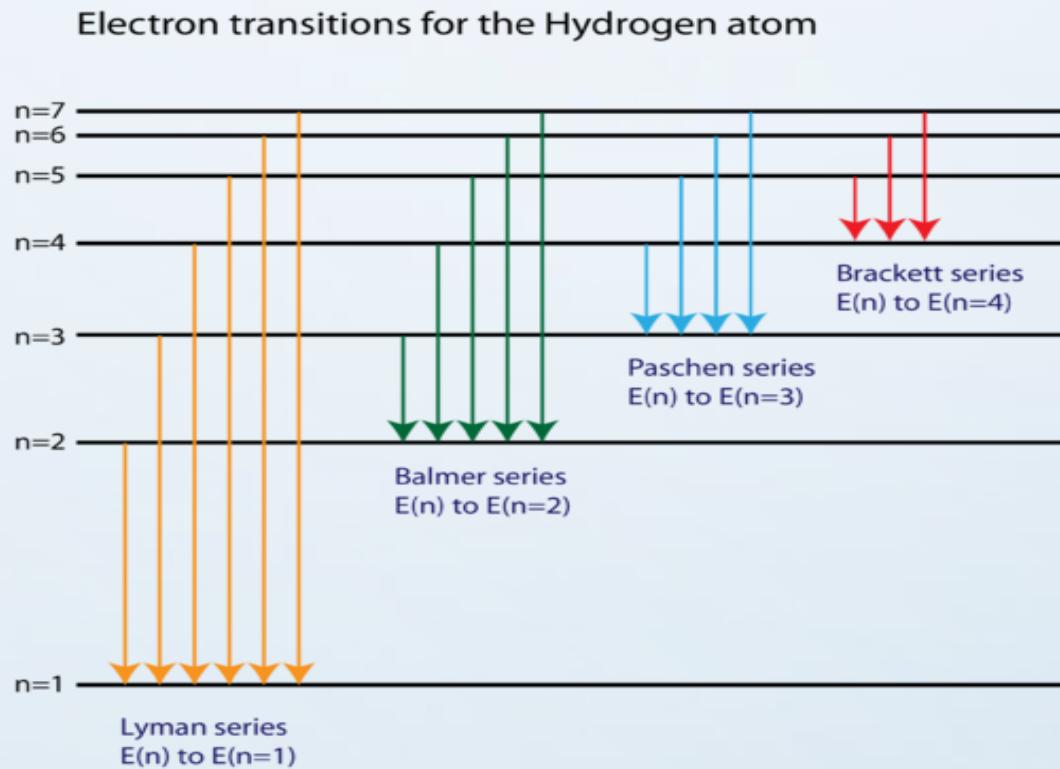
CO_2	N_2O
Atom=3	Atom=3
Electron=22	Electron=22

Example 2:

N_2	CO
Atom=2	Atom=2
Electron=14	Electron=14



HYDROGEN SPECTRUM



- When, electron jumps from higher orbit to 1st orbit :Lyman Series & Ultra Violet (UV) regions
- When electron jumps from higher to 2nd Orbit :Balmer series & Visible region
- When electron jumps from higher orbit to 3rd orbit :Paschen series & Infra Red (IR) region

CONTINUOUS SPECTRUM

- It is the superimposed image of both absorption and emission spectra.
- No gaps is present.
- Contain all the wave lengths of a given range.
- Example- rainbow, black body, Sun, a bulb, a molten metal, candle.

LINE SPECTRUM

- It is either an absorption or emission spectrum.
- Many gaps are present between lines.
- Contain only a few wave lengths.
- Example- mercury vapour lamp/ CFL, emission & absorption spectra of hydrogen.

ELEMENTARY PARTICLE (SPIN)

Fermions (any positive odd integral multiple of $\frac{1}{2}$) $\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$ etc.

Example- Quarks, Leptons (electron, neutrino), Baryon(proton & neutron).

Boson (any positive integer) 0,1,2,3 etc.

Example- photon, meson, Higgs-Boson.

PREVIOUS YEAR QUESTIONS

1. Which one of the following generally known as “God Particle”? [WBCS Preli]
a) Neutrino b) Neutron c) Higgs boson d) Quark

2. Who discovered electrons? [WBCS Main]
a) Ernest Rutherford b) J. J. Thomson c) Niels Bohr d) James Chadwick

3. The nucleons are— [WBCS Main]
a) Protons and electrons b) Neutrons and electrons c) Protons and neutrons d) None of these

4. The isotope tritium of hydrogen has— [CDS]
a) No neutrons and one proton b) One neutrons and two protons
c) One electron and two neutrons d) One proton and one neutron

5. Who discovered electrons? [WBCS Main]

- a) Ernest Rutherford b) J. J. Thomson c) Niels Bohr d) James Chadwick

6. _____ have similar chemical properties but different atomic masses. [RRB]

- a) Isotopes b) Isotones c) Isobar d) Isoster

7. Protons & neutrons are bound in a nucleus by the— [NDA]

- a) Short range—strong interaction
- b) Short range—weak interaction
- c) long range—electromagnetic interaction
- d) long range—gravitational interaction



THANK YOU