

ATOMIC STRUCTURE

Syllabus :-

- ① Matter
- ② Classical concepts of atoms.
- ③ Definition of atoms.
- ④ fundamental particles :- e^- , p^+ , n .

* MATTER

DEFINITION:- "Matter is anything which has mass & occupies space."

Eg:- Sugar, sand, Iron, wood, rocks, minerals, ice, water, milk, oxygen, Hydrogen etc.

Kinds of Matter :- ① On the basis of physical state
→ Solid, liquid, gas.

② On the basis of chemical constituents :- Elements, compounds, mixtures.

* CLASSICAL CONCEPTS OF ATOMS

① 400 BC → Indian Philosopher "MAHARSHI KANNAD" proposed that matter is made up of very small particles called PARMANU. PARAMI means Ultimate & ANU means "Particles". Greek Philosopher Democritus called the Parmanu as "Atom" which comes from Greek word Atomos meaning indivisible.

② 1800 AD → John Dalton's Atomic theory (An English scientist).

③ 1897 → Discovery of electron

Scientist → J.J. Thomson.

Experiment → CRT Experiment (Cathode ray tube experiments).

Properties of electron:-

- Electron was discovered by J.J. Thomson by discharge tube experiments.
- The main sources of e^- is cathode rays.
- Absolute Mass = 9.1×10^{-28} gm
- Absolute Charge = -1.6×10^{-19} C
- Relative Mass = $\frac{1}{1840}$ a.m.u.
- Relative Charge = -1 esu (electrostatic unit).
- Location = Extra nuclear part (outer part of the nucleus).

④ Discovery of Proton:-

Proton was discovered by E. Goldstein (German Scientist).

The main sources of proton is Anode rays.

Absolute Mass = 1.6×10^{-24} gm.

Absolute Charge = $+1.6 \times 10^{-19}$ C.

Relative Mass = $+1$ a.m.u.

Relative charge = $+1$ e.s.u.

Location = Inside the nucleus.

3) Initial Atomic Model

- (A) THOMSON'S ATOMIC MODEL :- (Plum Pudding model).
- (B) RUTHERFORD ATOMIC MODEL :- (Discovery of nucleus).

4) Discovery of Neutron:-

Properties:-

Neutron was discovered by James Chadwick by bombardment of α -particles experiments.

Neutron was discovered in 1932

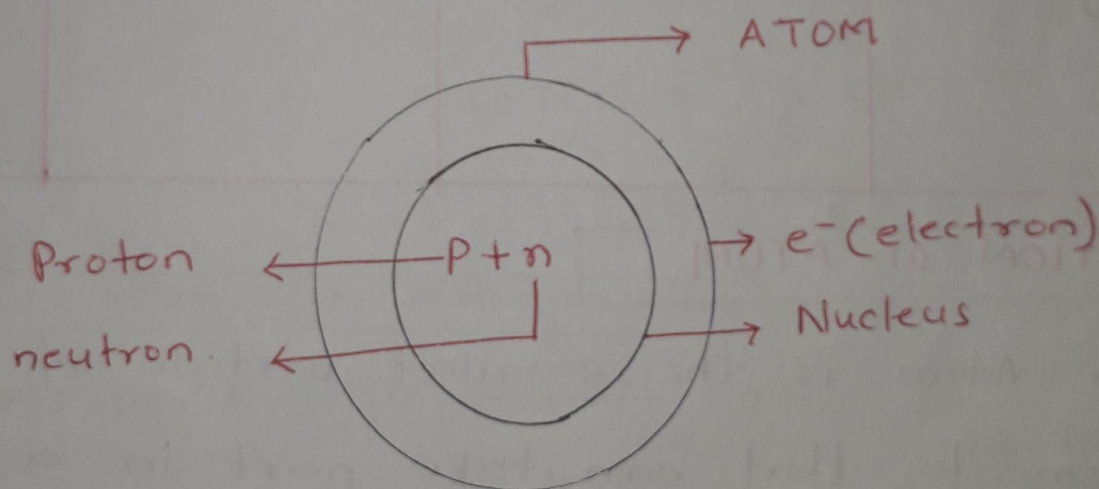
Absolute Mass = $+1.6 \times 10^{-24} \text{ gm.}$

Absolute Charge = Zero (0)

Relative Mass = 1 amu.

Relative charge = zero (0).

Location = Inside the Nucleus.



Initial Atomic Model

(A) THOMSON'S ATOMIC MODEL:- (Plum Pudding model).

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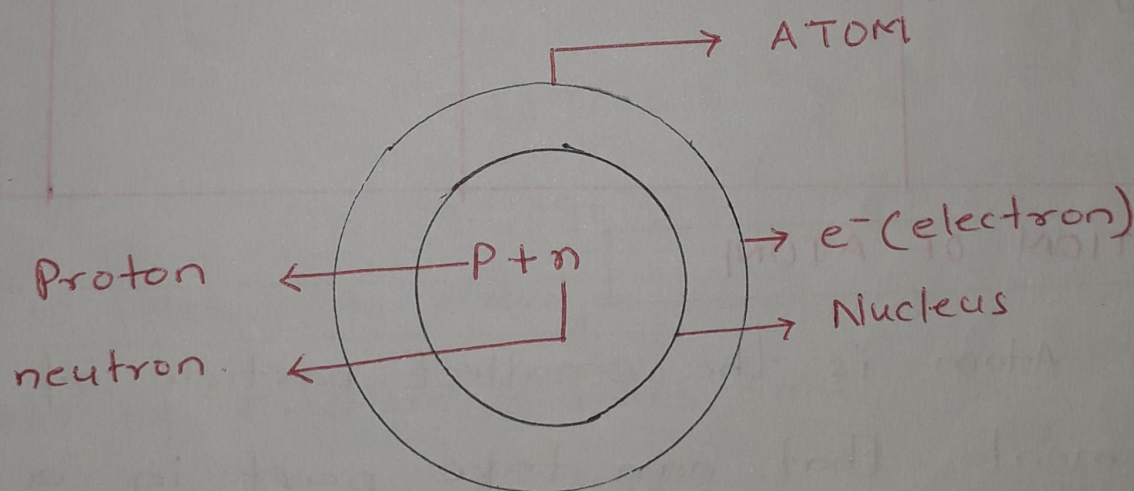
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PROPERTIES OF FUNDAMENTAL PARTICLES

PROPERTIES	Electron	Proton	Neutron
Discoverer	J.J. Thomson	e. Goldstein	James Chadwick
Symbol	$e, -1e^0$	$P, 1P^1, H^+$	$n, 0n^1$
Location	Extranuclear part	Nucleus	Nucleus.
Mass (gm)	9.1096×10^{-28}	1.672×10^{-24}	1.675×10^{-24}
Charge (c)	-1.602×10^{-19}	$+1.602 \times 10^{-19}$	0
Relative Mass	0.000549	0.00727	0.00866
Relative Charge	-1	+1	0
e/m ratio [Charge/mass]	$1.76 \times 10^5 C/g$	$0.957 \times 10^5 C/g$	0

DEFINITION OF ATOM

“An Atom is the smallest particle of an element that can take part in a chemical reaction.”

* Calculation of Mass and Charge of an e^- & p^+ .

In 1897 J.J. Thomson measured the ratio of electrical charge (e) to the mass of electron by using cathode ray tube & applying electrical & Magnetic field perpendicular to each other.

MASS OF e^-

Thomson experiment $\frac{e}{m} = -1.758820 \times 10^8 \text{ C/g}$.

Millikan oil drop experiment $e = -1.60 \times 10^{-19} \text{ C/electron}$.

$$\text{Mass of } e^- = \frac{e}{e/m}$$

$$= \frac{-1.6022 \times 10^{-19} \text{ C/electron}}{-1.758820 \times 10^8 \text{ C/g}}$$

$$= 9.1096 \times 10^{-28} \text{ g/electron}$$

$$= 9.1096 \times 10^{-31} \text{ kg/electron}$$

MASS OF e^- relative to Hydrogen Atom

$$\text{Mass of H-atom} = 1.008 \text{ amu}$$

$$= 1.008 \times 1.66 \times 10^{-24} \text{ g}$$

$$= 1.673 \times 10^{-24} \text{ g}$$

$$[\because 1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}]$$

$$\frac{\text{Mass of H-atom}}{\text{Mass of } e^-} = \frac{1.673 \times 10^{-24} \text{ g}}{9.1096 \times 10^{-28} \text{ g}} = 1837$$

$$\text{Mass of } e^- = \frac{1}{1837} \times \text{Mass of H-atom}$$

$$= \frac{1}{1837} \times 1.008 = 0.000549 \text{ amu}$$

MASS OF PROTON

$$\begin{aligned}\text{Mass of proton} &= \frac{e}{e/m} \\ (\text{g/kg}) &= \frac{1.602 \times 10^{-19}}{9.579 \times 10^4} \\ &= 1.672 \times 10^{-24} \text{ g} \\ &= 1.672 \times 10^{-27} \text{ kg}.\end{aligned}$$

$$\begin{aligned}\text{Mass of proton (amu)} &= \frac{1.672 \times 10^{-24}}{1.66 \times 10^{-24}} \\ &= 1.0072 \text{ amu}.\end{aligned}$$

LIMITATIONS OF BOHR'S ATOMIC THEORY.

- * It does not explain the spectra of multielectron atom.
- * When a high resolving power spectroscope is used, it is observed that a spectral line in the hydrogen atom is not a single line but it is a collection of several lines which are very close to one another. This is known as Fine Spectrum. Bohr's theory does not explain the fine spectra of even hydrogen atom.
- * It does not explain the splitting of spectral lines into group of finer lines under the influence of magnetic field (called Zeeman effect) & electric field (Stark effect).
- * It does not explain the 3D model of an atom.
- * It does not explain the shapes of molecules.