STRUCTURE OF THE ATOM ELECTRON, PROTON, NEUTRON

✤ DISCOVERY OF NEUTRON

In 1932, **"Chadwick "** bombarded berylium with a stream of a-particle. He observed that penerating radiations were produced which were not affected by electric & magnetic field. These radiations consists of neutral particles, which were called neutron. The nuclear reaction can be shown as as:

+	-®	+	
(Berylium)	(a-particle)	(carbon)	(Neutron)

In this equation the subscript stand for number of protons and the superscript for mass number. It is now clear that the neutron is fundamental consitituent of atom and is located in the nucleus.

Characteristics of a neutron :

Mass : The relative mass of a neutron is almost equal to that of proton. In fact relative mass of neutron is 1.0087 (1.008) amu and that of proton is 1.0073 (1.008) amu.

Charge : Neutron is electrically neutral and has no electric charge. With the discovery of neutrons, we can explain why the atomic mass of helium is 4 amu. **Atomic mass = Mass of proton + Mass of neutron**. **Valency :** An atom of each element has definite combining capacity of the element is called valency. The number of electron (e^-) gained, lost or shared by the atom of an element to complete octet stable: Ex :- Ne²⁰.

Valence electron : The electron present in the outer most shell are called valence electron.

Ex. Na⁺ and N⁻

Ques. How will you find the valency of chlorine, sulphur and magnesium? **[NCERT]**

Positive Rays-Discovery of Proton

In 1886 Eugen Goldstein first observed that a cathode ray tube also generates a stream of positively charged particles that move towards the cathode. These were called canal rays because they were observed occasionally to pass through a channel, or "canal", drilled in the negative electrode.

(a) **E. Goldstein** in 1886 discovered proton by repeating the same discharge tube experiments by using a perforated cathode.



- (b) When a high potential difference was applied, not only cathode rays were produced butalso a new type of rays were produced simultaneously from anode moving towards cathode and passed through the holes of the cathode. These termed as **canal ray** or **anode ray**.
- (c) These positive rays, or positive ions, are created when cathode rays knock elements from the gaseous atoms in the tube, forming positive ions by processes such as

atom cation⁺ + e^- or X X⁺ + e^-

These rays were attracted towards the negative plate in the electric. This means that these rays consist of positively charged particles and were also named positive rays or anode rays.

(d) Characteristics of Anode rays are as follows

- (i) Travel in straight line and cast shadow
- (ii) Deflected by the magnetic and electric fields
- (iii) These rays have kinetic energy and produce heating effect also.
- (iv) Unlike cathode rays, their e/m value is dependent upon the nature of the gas taken in the tube.
- (v) These rays can pass through thin metal foils.
- (vi) They are capable to produce ionization in gases.
- e/m value of proton:

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e/m value of proton was different for different gases taken in cathode ray tube (CRT). Value of e/m of proton is lower for hydrogen gas.

Charge of proton: Charge of proton is $+ 1.6022 \times 10^{-19}$ coulomb.

Mass of proton: Mass of proton was found to be 1.66×10^{-24} gm

 $= 1.66 \times 10^{-27}$ k= 1.0072amu.

Illustration 1

What is the difference in the origin of cathode rays and anode rays? Solution

Cathode rays originate from the cathode whereas anode rays are not produced from the anode. They are produced from the gaseous atoms by knock out of the electrons by high speed cathode rays.

Ques. If an atom contains one electron and one proton, will it carry any charge or not? [NCERT]

Electron:-

The electrons were discovered by J.J.THOMSON in 1897.

Experimental set up

1) It consist of a long cylindrical tube sealed at both ends and is fitted with two metal electrodes.

2) The electrodes are connected to source of high voltage

3) The tube is connected to a vacuum pump as to increase or decrease the pressure.

4) The discharge tube is filled with air.

Experiment

He passed electricity at high voltage through a gas at very low pressure taken in discharge tube.

Observation

(1) When the voltage is high and pressure is 1 atm, no electricity could flow through air.

(2) When the voltage is high and pressure is reduced to 1 mm of Hg, electricity started flowing through the tube. Light was emitted inside tube.

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(3) When the voltage is high and pressure is reduced to 0.001 mm of Hg, walls of discharge tube opposite to cathode started glowing with a greenish light called **fluorescence**.



The fluorescence is due to bombardment of walls of tube by rays emitted from cathode. These are known as **Cathode rays.** They consist of negatively charged particles called electrons.

Characteristics of Electrons

- (1) The charge on an electron is $1.6 \times 10 19$ C. This charge is found to be smallest negative charge carried by any particle. So it is taken as unit negative charge.
- (2) The absolute mass of electron is 9.1 x 10-31 kg .

THOMSON'S MODEL OF AN ATOM:-

- > Detailed model of the atom was first of all proposed by Sir J.J. Thomson.
- Thomson proposed that an atom consist of a uniform sphere of positive charge in which the electrons are distributed more or less uniformly.



- Thomson proposed the model of an atom to be similar to that of a Christmas pudding. The electrons, in a sphere of positive charge, were like currants (dry fruits) in a spherical Christmas pudding. We can also think of a watermelon, the positive charge in the atom is spread all over like the red edible part of the watermelon, while the electron are sudden in the positively charged sphere, like the seeds in the watermelon.
 - Ques. On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole. [NCERT]

Drawback of the Thomson Model:

- An important drawback of this model is that the mass of the atoms is considered to be evenly spread over that atom.
- > It is static model. It does not explain the movement of electron.
- > It could not explain the stability of an atom.