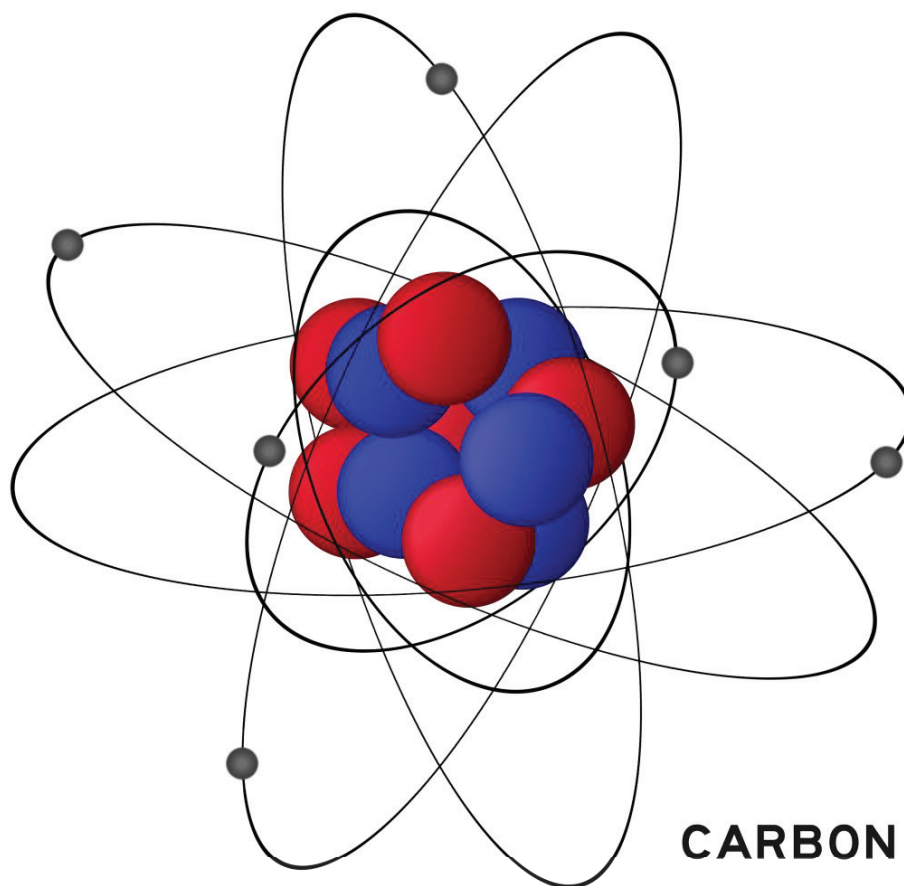


# STRUCTURE OF ATOM



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# STRUCTURE OF ATOM

## Introduction:

The word "atom" has been derived from the Greek word 'atoms' which means 'indivisible'. These early ideas were mere speculation and there was no way to test them experimentally.

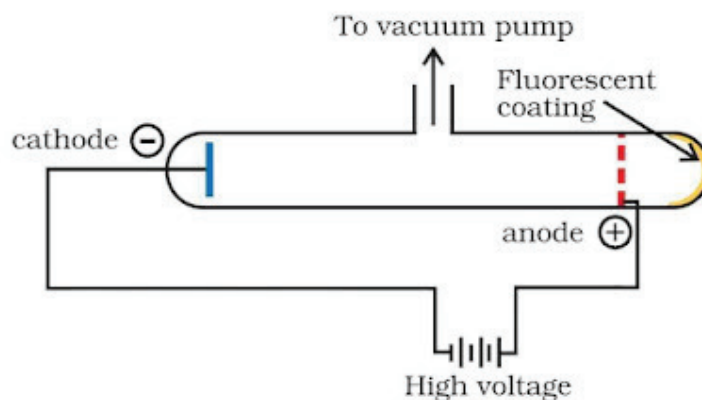
## Atomic Structure:

Atom is made up of smaller units like proton, neutron and electron. Some other particles like positron, neutrino, antineutrino,  $\pi$ -meson,  $\mu$ -meson,  $k$  meson etc are also present which are very short lived.

Particle	Mass	Charge	Special Remark
Electron	$9.1 \times 10^{-31}$ kg	$-1.6 \times 10^{-19}$ C	Discovered by J.J. Thomson
Proton	$1.67 \times 10^{-27}$ kg	$+1.6 \times 10^{-19}$ C	Discovered by Gold Stein
Neutron	$1.67 \times 10^{-27}$ kg		Discovered by Chadwick
Positron		$+1.6 \times 10^{-19}$	Anderson
$\pi$ meson	$\pi^0$ - 264 Me $\pi^+$ - 273 Me $\pi^-$ - 273 Me		Yukawa

## Discovery of Electron

In 1879, **William Crooks** studied the conduction of electricity through gases at low pressure. He performed the experiment in a discharge tube which is a cylindrical hard glass tube about 60 cm in length. It is sealed at both the ends and fitted with two metal electrodes. The electrical discharge through the gases could be observed only at very low pressures and at very high voltages.



**J.J. Thomson** took a discharge tube and applied a voltage of a 10000 volt potential difference across it at a pressure of 10–2 mm of Hg. He found some glowing behind anode. It means some invisible rays produced at cathode strike behind anode and produce fluorescence. He named them cathode rays.

### Properties of Cathode Rays

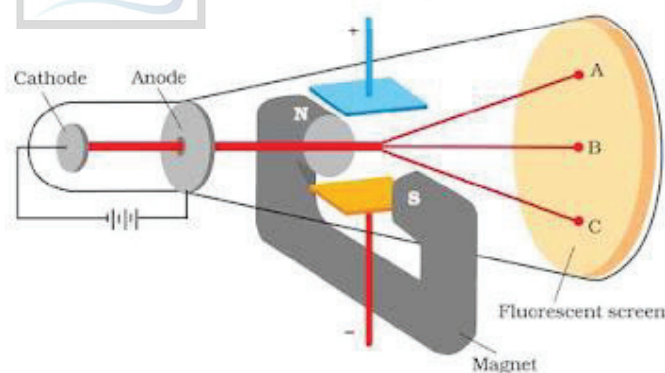
- i. These rays have mechanical energy and travel in straight line.
- ii. These rays are deflected towards positive plate of electric field. It means these are made up of negatively charged particle called **electron**.
- iii. Colour observed is independent from nature of gas.
- iv. Mulliken determined the charge on electron which is  $1.602 \times 10^{-19}\text{C}$ .
- v. Specific charge on electron is calculated by J.J. Thomson.

### Charge to mass ratio

**J.J. Thomson** for the first time experimentally determined charge/mass ratio called  $e/m$  ratio for the electrons. For this, he subjected the beam of electrons released in the discharge tube as cathode rays to influence the electric and magnetic fields. These were acting perpendicular to one another as well as to the path followed by **electrons**.

According to Thomson, the amount of deviation of the particles from their path in presence of electrical and magnetic field depends on,

1. Magnitude of the negative charge on particle
2. Mass of particle
3. Strength of magnetic field



When electric field is applied, deviation from path takes place. If only electric field is applied, cathode rays strike at A. If only magnetic field is applied, cathode rays strike at C. In absence of any field, cathode rays strike at B.

By carrying out accurate measurements on the amount of deflections observed by the electrons on the electric field strength or magnetic field strength, Thomson was able to determine the value of  $e/m_e = 1.758820 \times 10^{11} \text{ C kg}^{-1}$

where  $m_e$  = Mass of the electron in kg

$e$  = magnitude of charge on the electron in coulomb (C).

## Discovery of anode rays

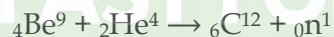
In 1886, Goldstein modified the discharge tube by using a perforated cathode. On reducing the pressure, he observed a new type of luminous rays passing through the holes or perforations of the cathode and moving in a direction opposite to the cathode rays. These rays were named as positive rays or anode rays or as canal rays. Anode rays are not emitted from the anode but from a space between anode and cathode.

## Properties of anode rays

1. These rays deflect towards negative plate of applied electric field. It means these are made up of positively charged particle.
2. Property of anode rays depends on nature of gas.
3. These rays travel in straight line and have mechanical energy.

## Discovery of Neutron

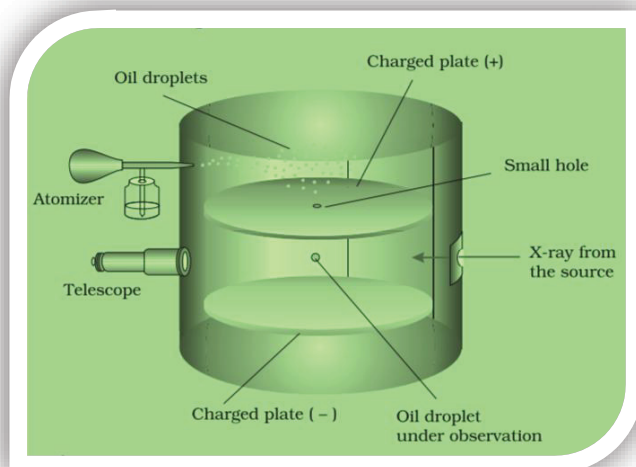
Chadwick in 1932 found the evidence for the production of neutron in given reaction.



Neutron is chargeless particle and have mass equal to proton.

## Millikan's Oil Drop Experiment

In this experiment, some fine oil droplets were allowed to enter through a tiny hole into the upper plate of electrical condenser. These oil droplets were produced by atomiser. The air in the chamber was subjected to the ionization by X-rays. The electrons produced by the ionization of air attach themselves to the oil drops.





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