# Chapter 2

# Atomic Structure

**Day - 1**

## INTRODUCTION

The word .atom has been derived from the Greek word *atomio* which means .un-cutable or non-divisible.

## DALTON'S ATOMIC THEORY

The matter is composed of small indivisible particles called atoms (from Greek word atomio, meaning indivisible). In 1808 Dalton proposed the following theory

1. Matter consists of atoms, which cannot be divided further.
2. All the atoms of a given element have identical mass. Atoms of different elements differ in mass.
3. Atoms combine in a fixed ratio to form Compounds.
4 The atoms cannot be created or destroyed.

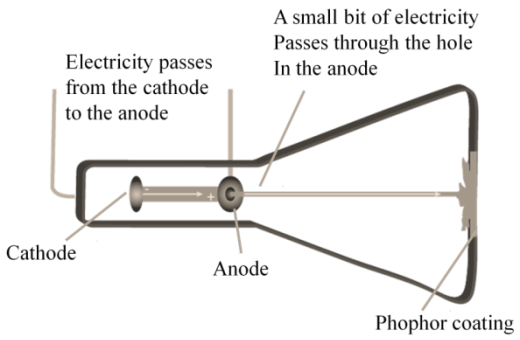
## SUCCESS OF DALTON'S ATOMIC THEORY

1. Atoms are the smallest part of matter
2. Atoms cannot be created of destroyed
3. Atoms of same element are similar in mass
4. Atoms combine with each other in simple ratios.

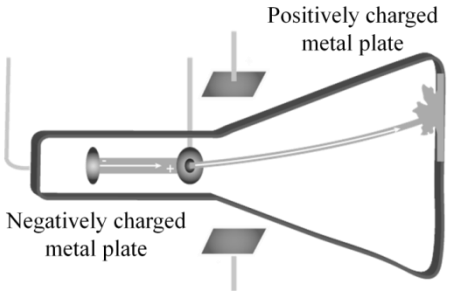
## FAILURES OF DALTON'S ATOMIC THEORY

It could explain lows of chemical combination, as on today we know that all four points are not correct.

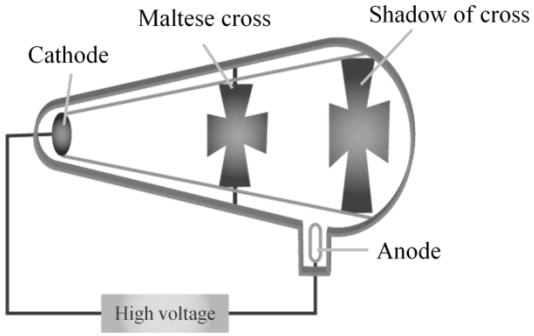
## CATHODE RAYS



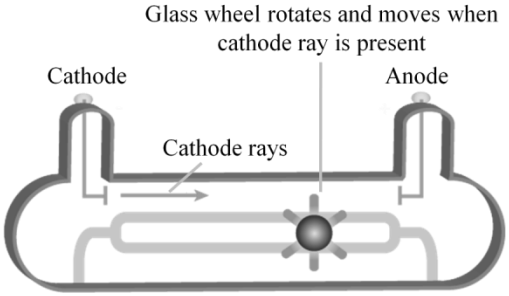

## CATHODE RAYS ARE NEGATIVELY CHARGED



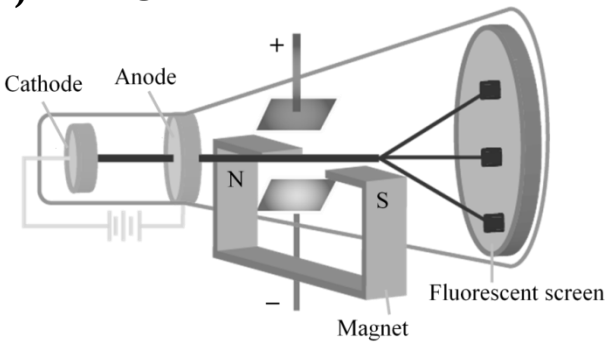

## CATHODE RAYS TRAVEL IN STRAIGHT LINE.




## CATHODE RAYS ARE PARTICLES




## CHARGE /MASS (E/M) RATIO




In 1897 JJ. Thomson determined the e/m value of cathode rays.

Thomson proved that e/m ratio is same, whatever material is of plates or gas filled in the tube

$$\frac{e}{m} = 1.7588 \times 10^{11} C\ kg^{-1}$$

**Ex.:** Which of the following is never true for cathode rays?

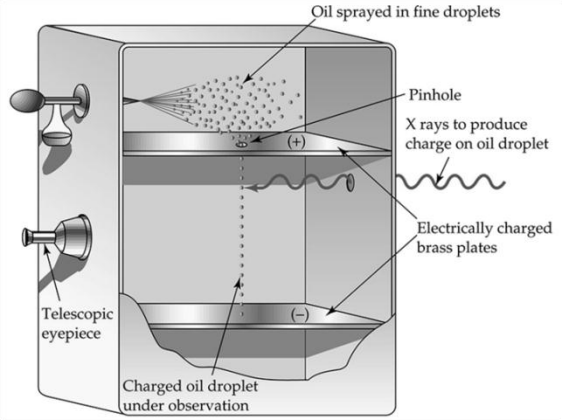
(a) They possess kinetic energy

(b) They are electromagnetic waves

(c) They produce heat

(d) They produce mechanical pressure **Answer (c)**

## MILLIKAN'S OIL DROP EXPERIMENT




## MASS OF ELECTRON

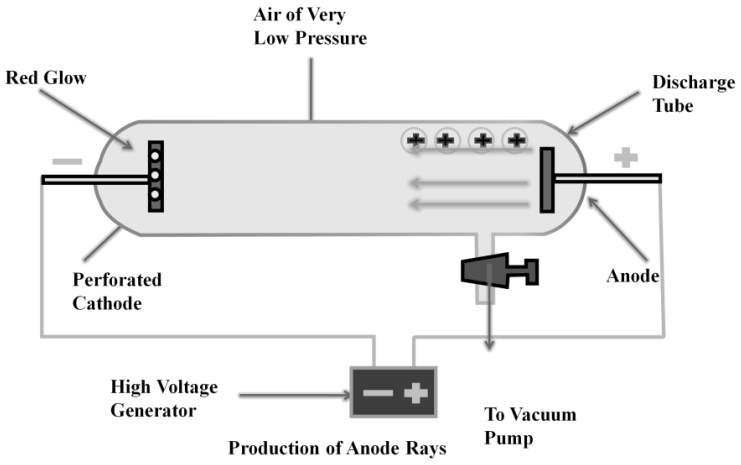
From Millikan's oil drop experiment e = 1.6022 x $10^{-19}$ coulombs

$$m = \frac{e}{e/M} = \frac{1.6022\times10^{-19}}{1,7588\times10^{11}} = 9.1096 \times 10^{-31}\text{kg}$$

$$1\text{amu} = \frac{1}{N_A} = 1.66 \times 10^{-24}\text{gm} = 1.66 \times 10^{-27}\text{kg}$$

$$\text{mass of } e^- = \frac{9.1096\times10^{-31}}{1.66\times10^{-27}} = 0.000549\text{amu}$$

## ANODE RAYS




| Cathode rays | Anode rays |
|---|---|
| 1. Originate from cathode | Originate from anode |
| 2. Travel in straight | Travel in straight live |
| 3. Have momentum | Have momentum |

| | |
|---|---|
| 4. Negative charge | Positive charge |
| 5. Mass constants | Mass depends upon gas |

The smallest and lightest positive ion was obtained from hydrogen and was called **proton. This** characterized in 1919.

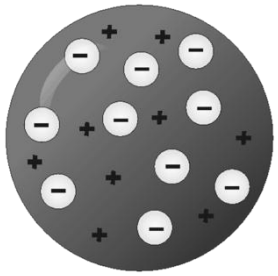
Later the presence of electrically neutral particle was found in the atom. These particles were discovered by Chadwick (1932) by bombarding a thin sheet of beryllium by α-particles, then electrically neutral particles having a mass slightly greater than that of the protons was emitted. He named these particles as **neutrons.**

| Name | Symbol | Absolute charge/C | Relative charge | Mass/ kg | Mass/u |
|---|---|---|---|---|---|
| Electron | e | $-1.6022 \times 10^{-19}$ | -1 | $9.10939 \times 10^{-31}$ | 0.00054 |
| Proton | p | $+1.6022 \times 10^{-19}$ | +1 | $1.67262 \times 10^{-27}$ | 1.00727 |
| Neutron | n | 0 | 0 | $1.67493 \times 10^{-27}$ | 1.00867 |

**Thomson Model of Atom**

Plum pudding model OR

Water melon model



## FUN FACTS JJ THOMSON (NOBEL PRIZE IN 1906)

| Student of JJ Thomson who received the Nobel prize | | | |
|---|---|---|---|
| | Research Supervisor | Nobel Prize | Research recognised by the Nobel Committee |
| Ernest Rutherford | JJ Thomson | 1908 | Investigations into the disintegration of the elements, and the chemistry of radioactive substances |
| Francis William Aston | JJ Thomson | 1922 | Mass spectrograph, isotopes enunciation of the whole-number rule |
| Charles Thomson Rees Wilson | JJ Thomson | 1927 | Cloud chamber, made the paths of electrically charged particles visible by condensation of vapour |
| Lawrence Bragg | JJ Thomson | 1915 | X Ray Crystallography |
| Charles Glover Barkla | JJ Thomson | 1917 | Characteristic Rontgen radiation of the elements |
| Sir Owen Williams Richardson | JJ Thomson | 1928 | Discovery of the Richardson law which explants thermionic phenomenon |
| Edward Victor Appleton | JJ Thomson | 1947 | Discovery of the so-called Appleton–Barnett layer layer in upper atmosphere |