Dalton's Atomic Theory

In 1809 John Dalton regarded the atom as a hard dense and smallest indivisible particle of matter. The main postulates of Dalton's atomic theory are,

(i) **Atoms of a particular element are all alike but differ from atoms of another element. This accounted for identical behavior of different samples of the same element and different behavior of different elements.**

(ii) **Atoms of each element have a characteristic mass. This explained the fact that macroscopic samples at material substances have mass.**

(iii) **Atoms are indestructible, i.e. they can neither be created nor destroyed.**

(iv) **Atoms combine to form molecules, which accounts for the observation that elements combine to form compounds.**

Dalton's atomic theory was successful in offering explanations for the following facts:

(i) **It gave satisfactory explanation for the chemical combination.**

(ii) **It explained most of the properties of gases and liquids known at that time.**

However, Dalton's atomic theory failed to explain the following facts:

(i) **Why atoms of different elements should differ in their masses, valences, etc.?**

(ii) **The existence of isotopes and isobars.**

(iii) **Why there should not be some material difference in the "make up of atoms of different element?**

CATHODE RAYS AND DISCOVERY OF ELECTRON

PROPERTIES OF CATHODE RAYS

- Cathode rays travel in straight lines with a high-speed approaching to that of light. Their linear propagation is shown by the fact that they cast shadows of the solid objects placed in their path.
- They produce temperature rise in any object they strike.
- They pass through thin films of metals but are stopped by thicker foils.
- Cathode rays can produce mechanical effect e.g. when allowed to fall on a small paddle wheel they cause rotation of wheel. This experiment shows that cathode rays consist of material particles.
- The cathode rays can be deflected by electric and magnetic field. The direction of deflection is always such that these particles bear a negative charge.
- Finally, no matter what the nature of the cathode or the gas in the discharge tube, the negatively charged particles are always the same as reflected by the same e/m ratio by J.J. Thomson.

POSITIVE RAYS (ANODE RAYS) OR CANAL RAYS

Since electron is an essential constituent of atom and since atom as a whole is electrically neutral. it follows that an equal magnitude of positive charge must be present in an atom. In 1886 Goldstein discovered that there are present in a discharge tube not only cathode rays composed of electrons moving towards anode but also positive rays moving in opposite direction. By perforating the cathode these positive rays can be made to pass through the hole. The properties of positive rays were investigated by J.J. Thomson.

Properties of Anode Rays

a) Unlike cathode rays, mass of positively charged particles depends upon the nature of gas present in the cathode ray tube. These are simply the positively charged gaseous ions.
b) The charge to mass ratio of the particles depends on the gas from which these originate.
c) Some of the positively charged particles carry a multiple of the fundamental unit of electrical charge.
d) The behaviour of these particles in the magnetic or electrical field is opposite to that observed for electron or cathode rays.

★ The mass of positively charged particle is virtually the same as that of the atoms from which they are derived, Wein (1898) determined the value of e/m for positive particles and found that it was different for different gases. When hydrogen gas was taken in the discharge tube, the lightest positively charge particle was found. It's mass was nearly the same as that of H atom ($1.673 \times 10^{-24} g$) and carried a positive charge exactly equal and opposite to that of an electron. This positively charged particle was named proton.

Discovery of Neutron

Discovered by Chadwick (1932) by bombarding a thin sheet of beryllium by α-particles. It is electrically neutral having a mass slightly greater than that of protons.

THOMSON'S (PLUM PUDDING OR RAISIN-PUDDING) MODEL

Thomson did not know exactly how positive electric charge is distributed in an atom so he considered the case that was easiest to describe mathematically. He developed a model in which the positive charge is uniformly distributed in a sphere and the electrons are imbedded in the sphere in such a way that their attraction for the positive charge just offsets the repulsions among electrons.