

CHEMISTRY

CLASS NOTES FOR CBSE

Chapter 04. Structure of the Atom

Atoms are made up of these subatomic particles : electrons, protons and neutrons. protons and neutrons are present in a small nucleus at the centre of the atom. Electrons are outside the nucleus. the atoms of different elements differ in the number of electrons, protons and neutrons.

Charged particles in matter If we rub a comb in dry hair then this comb attracts small pieces of paper. And if we rub a glass rod with a piece of silk cloth and bring it near an inflated balloon, then the glass rod attracts the balloon. Where does that electric charge come from ? The obvious answer : from within the atoms present in the comb and glass rod. These simple experiments tell us that some charged particles are present in the atoms of matter. So, the atom is divisible.

01. Discovery of Electron

The existence of electrons in an atom was shown by J.J. Thomson in 1897 Thomson passed electricity at high voltage through a gas at very low pressure taken in a discharge tube. Streams of minute particles were given out by the cathode (negative electrode). These streams of particles are called cathode rays (because they come out of cathode) The mass and charge of the cathode ray particles does not depend on the nature of gas taken in the discharge tube Cathode rays consist of small, negatively charged particles called electrons, Since all gases form cathode rays, it was concluded that all the atoms contain negatively charged particles called electrons.

Characteristic of an electron

- (a) **Mass of an electron** The absolute mass of an electron is, however, 9×10^{-28} gram.
- (b) **Charge of an electron** The absolute charge on an electron is 1.6×10^{-19} coulomb of negative charge. the relative charge of an electron is, -(minus one).

02. Discovery of Proton

The existence of protons in the atoms was shown by E Goldstein. when Goldstein passed electricity at high voltage through a gas at very low pressure taken in a discharge tube, streams of heavy particles were given out by the anode (positive electrode). These stream of particles are called anode rays. anode rays consist of positively charged particles. The mass and charge of the anode nature of gas taken in the discharge tube.

Characteristic of a proton

- (a) **Mass of a proton.** The mass of a proton is equal to the mass of a hydrogen atom. the relative mass of a proton is 1 u. the absolute mass of a proton is 1.6×10^{-24} gram.



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- (b) **Charge of a proton** the charge of a proton is equal and opposite to the charge of an electron, So, the absolute charge of a proton is 1.6×10^{-19} coulomb of positive charge. the relative charge of a proton is +1(plus one)

03. Discovery of Neutron

A carbon atom contains 6 proton and 6 electrons. Now, the mass of electrons is so small that it can be ignored. So the atomic mass of carbon should be only 6 u, which is the mass of 6 protons. This, however, is wrong because the actual atomic mass of carbon is 12 u. then, how do we explain this extra mass of 6 unites, This problem was solved by the discovery of another subatomic particles by James Chadwick in 1932. this particle is called neutron. the neutron. is a neutral particle found in the nucleus of an atom. the subatomic particle not present in a hydrogen atom is neutron.

Subatomic particle	Relative mass	Relative charge	Location in the atom
(i) Proton	1u	+1	In the nucleus
(ii) Neutron	1u	0	In the nucleus
(iii) Electron	$\frac{1}{1840}$ u	-1	Outside nucleus

04. Structure of Atom

Thomson's model of the atom

When J. J Thomson proposed his model of the atom in 1903, then only electrons and protons were known to be present in the atom. According to Thomson's model of the atom :

- An atom consists of a sphere (or ball) of positive charge with negatively charged electrons embedded in it.
- The positive and negative charges in an atom are equal in magnitude, due to which an atom is electrically neutral. It has no overall positive or negative charge.

Thomson's model of the atom is similar to that of a Christmas pudding. The electrons embedded in a sphere of positive charge are like the currants (dry fruits) in a spherical Christmas pudding.

Rutherford's experiment-discovery of nucleus

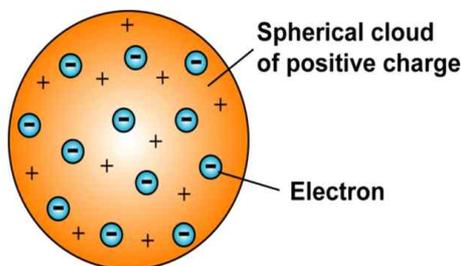
After the discovery of electrons, protons and neutrons, it became clear that an atom is made up of these three subatomic particles. It was Rutherford's alpha particle scattering experiment which led to the discovery of a small positively charged nucleus in the atom containing all the protons and neutrons. when fast moving alpha particles are allowed to strike a very thin gold foil in vacuum, it is found that :

- Most of the alpha particles pass straight through the gold foil without any deflection from their original path.
- A few alpha particles are deflected through small angles and a few are deflected through large angles.



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- (c) A very few alpha particles completely rebound on hitting the gold foil and turn back on their path (just as a ball rebounds on hitting a hard wall).

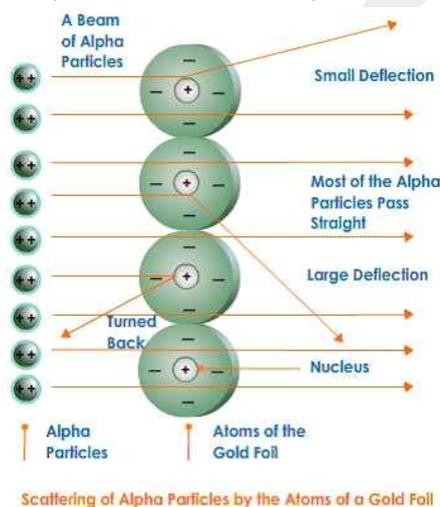
Rutherford explained these observations in the following way :

Since most of the alpha particles pass straight through the gold foil without any deflection, it shows that there is a lot of empty space in the atom. The observation that some of the alpha particles are deflected through small and large angles shows that there is a 'centre of positive charge on the atom which repels the positively charged alpha particles and deflects them from their original path. The observation that a very few alpha particles completely rebound on hitting the gold foil shows that the nucleus is very dense and hard which does not allow the alpha particles to pass through it. Rutherford's alpha-particle scattering experiment shows the presence of a nucleus in the atom. It also gave the following important information about the nucleus of an atom :

- Nucleus of an atom is positively charged
- Nucleus of an atom is very dense and hard.
- Nucleus of an atom is very small as compared to the size of the atom as a whole.

05. Rutherford's Model of the Atom

On the basis of alpha particle scattering experiment, Rutherford gave a nuclear model of the atom. Rutherford's model of atom (or structure of atom) can be described as follows:



- (a) An atom consists of a positively charged, dense and very small nucleus containing all the protons and neutrons (protons have positive charge whereas neutrons have no charge). Almost the entire mass of an atom is concentrated in the nucleus.