Class 9
Chemistry
L.4 Structure of Atom

No. Of Modules : 2

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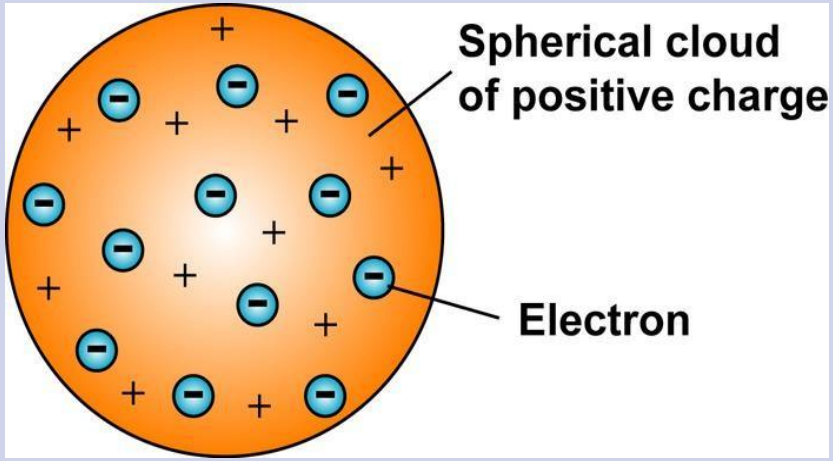
Module: 1/2

1. Constituents of the atom :
2. Models of an Atom
    a. Thomson’s Model of Atom
    b. Rutherford Model of Atom
    c. Bohr’s Model of an Atom
3. Discovery of Neutron

Constituents of atom/ Existence of Charged Particles in Matter :

- Dalton in 1808 suggested through his Atomic Theory that atom is the smallest indivisible particle of matter.
- Further experiments were performed during the years 1895- 1905 which showed that atom is not the smallest particle but is made up of still smaller charged particles called *sub-atomic particles.*
- The Three main sub atomic particles were electrons, protons and neutrons.
- In other words , an atom has an internal structure of its own.
- Goldstein in 1886 performed discharged tube experiments using perforated cathode through which some rays passed out and later named as anode rays, positive rays or canal rays. These anode rays were made up of positive charged particles having one unit positive charge and mass nearly equal to that of hydrogen atom and were called as protons.
- J.J. Thomson in 1897 carried out discharged tube experiments in which the rays emitted from the cathode(negative terminal) are called cathode rays wherein the constituent particles of the cathode rays are called electrons. It's charge is one unit negative charge and mass is $1/1840^{th}$ of that of hydrogen atom.

Models of Atom

Model of Atom	Important Features
1. J.J Thomson's Model of Atom 	i) An Atom consists of a sphere of positive charge in which electrons were embedded just like seeds in the watermelon. ii) Total positive charge on the sphere is equal to the total negative charge present on the electrons so that atom as a whole is electrically neutral.

Drawback Of Thomson's Model Of Atom : It could not explain the results of Rutherford's Scattering experiments.

Rutherford's alpha Scattering experiment:

Procedure performed in Rutherford scattering experiment:

Apparatus:

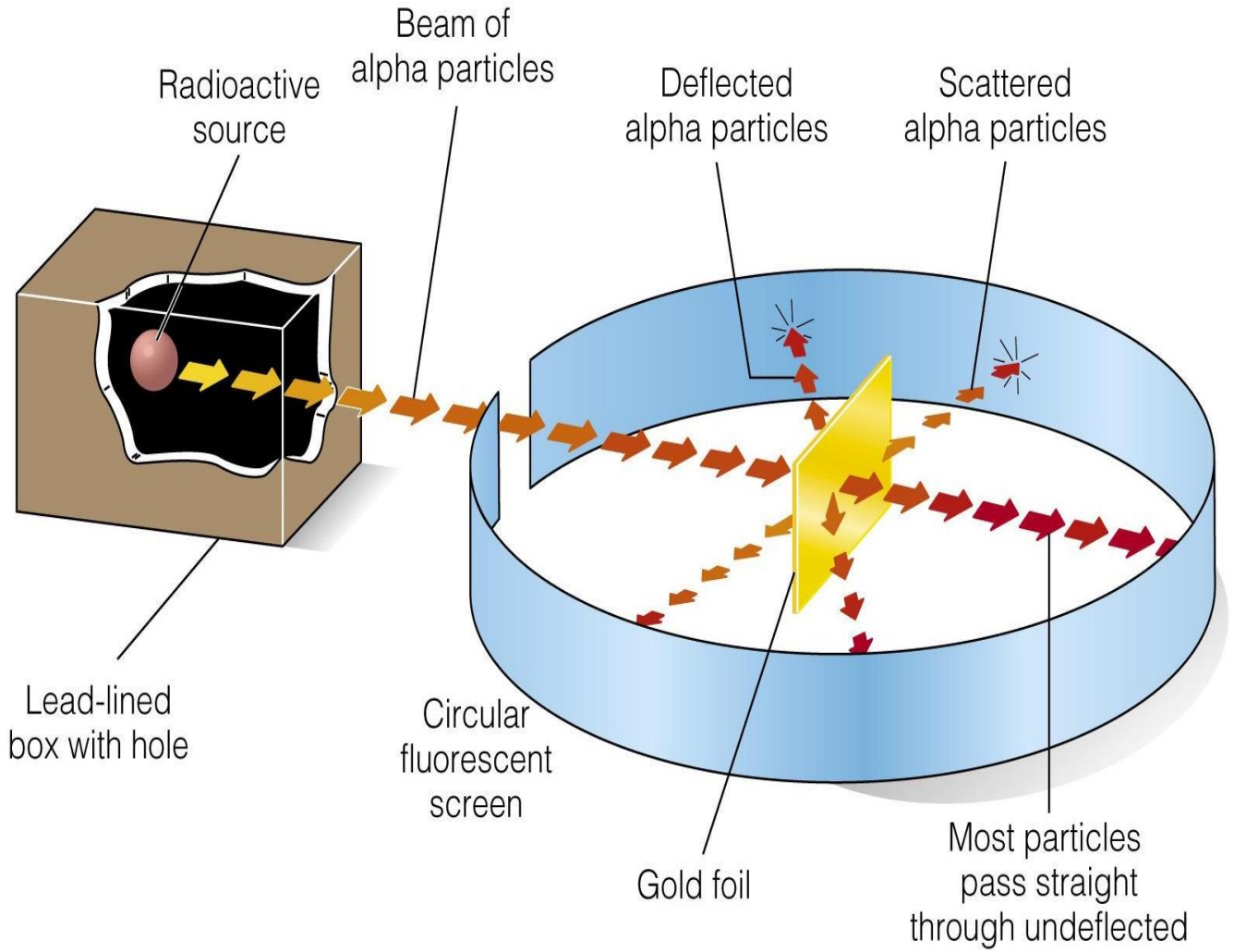
Radioactive source emitting alpha particles, a thin sheet of gold foil, a fluorescent detection screen.

Procedure:

Rutherford's experiment with the gold foil was done by his assistants, Geiger and Marsden. An alpha source was set up. Alpha particles are helium nuclei,(two protons and two neutrons). A lead(Pb) block with a slit served as the source. A radioactive substance (giving Alpha particle emission) was put inside. The slit acted as the only means of escape for the alpha particles. The slit was pointed at the thin gold foil. The foil was set up a short distance from the source and in a line with the opening in the lead block.

Using the foil as the center of the collision or scattering events, they took a long strip of material that was coated with zinc sulfide and set it up in an almost complete circle.

They turned off the light. That way they could see the scintillations, the little blinks of light that resulted when an alpha particle hit the screen.They expected all the particles to go right through the thin gold foil, but they noticed some reactions along the sides.



Observations of Rutherford's scattering experiment:

Most of the fast moving α-particles passed straight through the gold foil.

Some of the α-particles were deflected by the foil by small angles.

Surprisingly one out of every 12,000 alpha particles appeared to rebound.

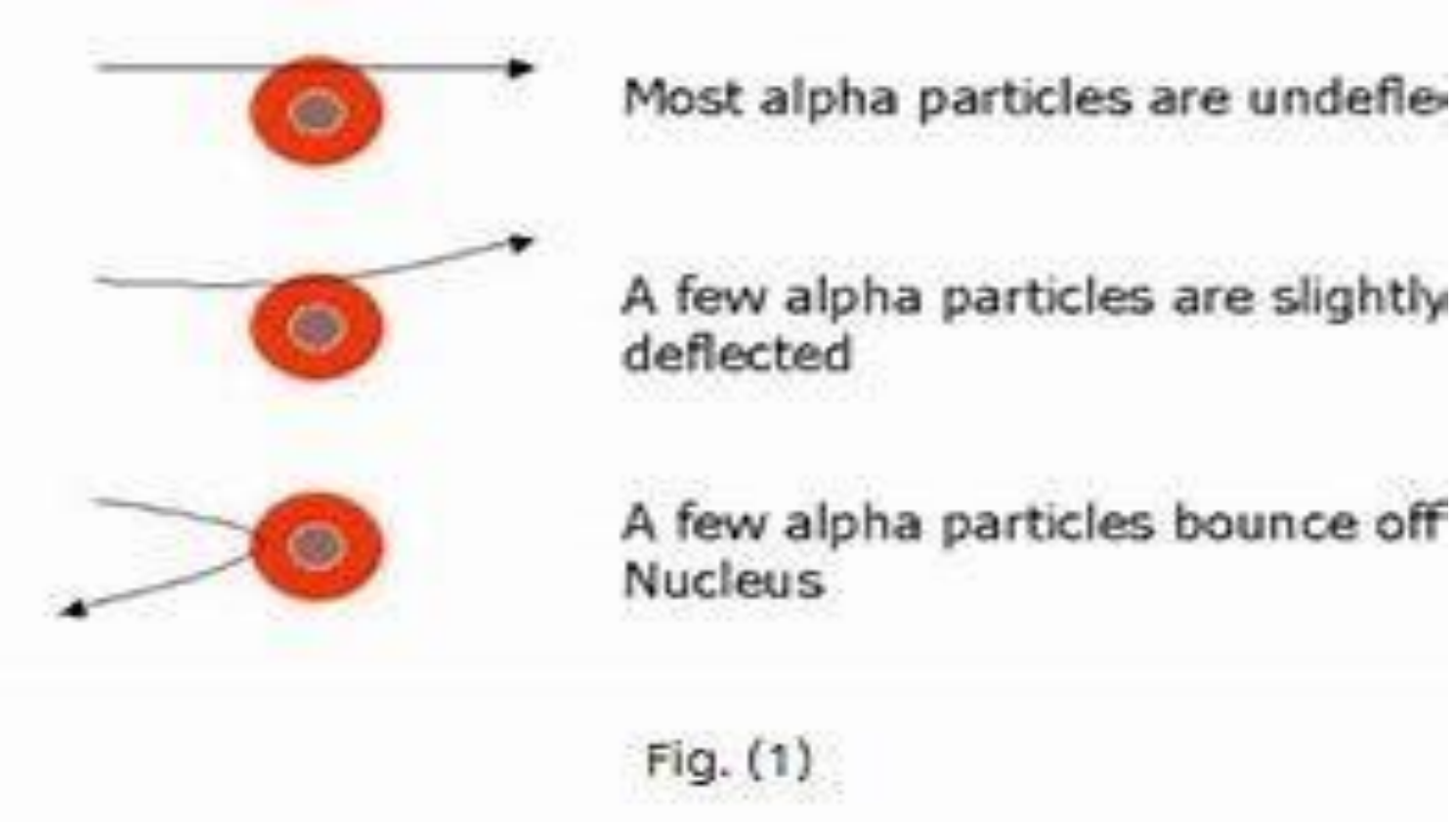
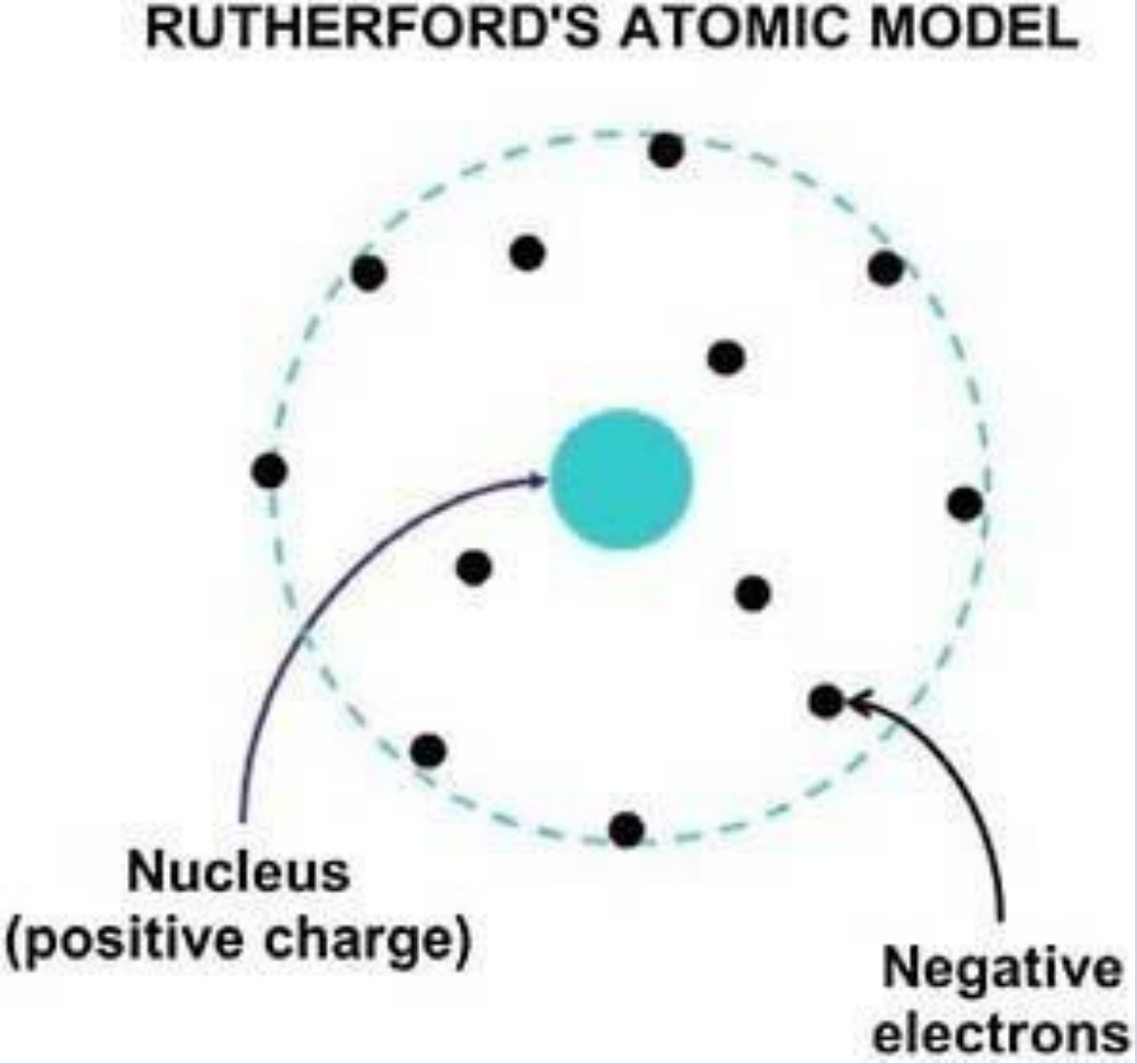
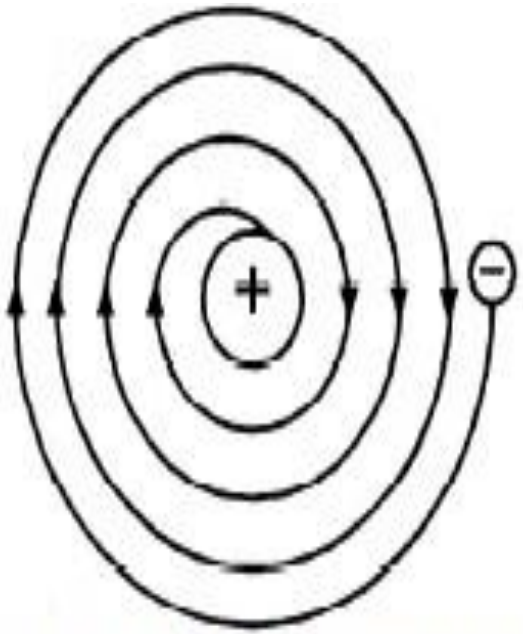


Fig. (1)

Model of Atom

Rutherford's Model of Atom	Important Features
	1. An Atom consists of a small positively charged nucleus in the centre and the electrons were revolving around it. 2. There is very large empty space between the nucleus and the electrons. 3. All the mass of the atom is mainly concentrated in the nucleus.

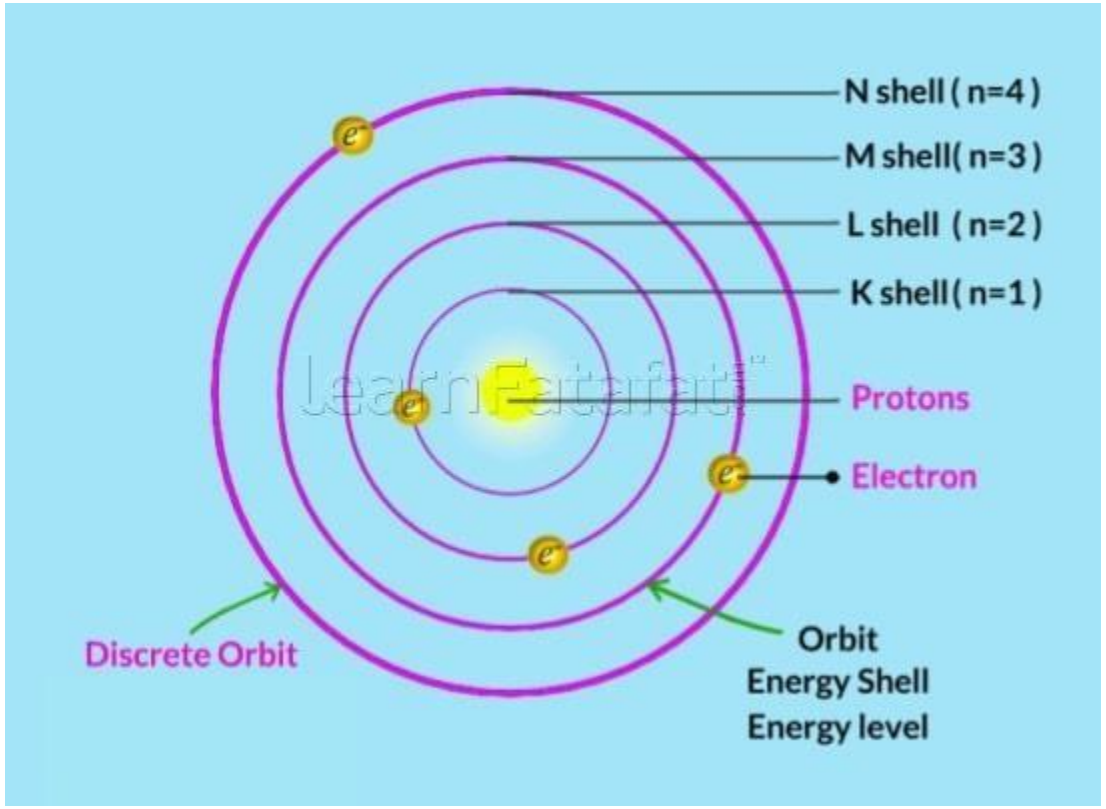
Drawback of the Rutherford Model of an Atom.



: Continuous loss of energy by revolving electron

- The revolving electron will be accelerated towards the nucleus as shown in the fig. Hence it will lose energy . Its orbit will become smaller and smaller as shown and ultimately the electron will fall into the nucleus. But this doesn't happen.
- Rutherford could not explain why the electron doesn't fall into the nucleus.

Neils Bohr Model of an Atom



- Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.
- While revolving in discrete orbits the electrons do not radiate energy.
- These orbits or shells are called energy levels represented by the letters K,L,M,N … or the numbers, n=1,2,3,4… as shown in fig.

Rules for writing the number of electrons in different energy levels or shells.

i) The maximum number of electrons which can be accommodated in a given shell or energy level is given by formula $2n^2$

ii) 'n' is the orbit number, shell number or energy level.

First Orbit , n=1 i.e. K shell will contain $2 \times 1^2 = 2$ electrons

Second Orbit , n=2 i.e. L shell will contain $2 \times 2^2 = 8$ electrons

Third Orbit, n=3 i.e. M shell will contain $2 \times 3^2 = 18$ electrons

Fourth Orbit, n=4 i.e. N shell will contain $2 \times 42 = 32$ electrons

iii) The maximum number of electrons that can be accommodated in the outermost orbit is 8.

iv) Unless inner shells are filled outer shells are not filled. That is,shells are filled in stepwise manner.

Discovery of Neutrons.

- In 1932 J. Chadwick discovered another subatomic particle which had no charge and a mass nearly equal to the mass of a proton.
- It was eventually named as neutron.
- Except hydrogen, neutrons are present in all atoms.
- It is represented by ‘n’.
- The mass of an atom is therefore given by the sum of the masses of protons and neutrons present in the nucleus.

End of Module 1 of structure of atom