4.2.3 Bohr's model of atom

In order to overcome the objections raised against Rutherford's model of the atom, Neils Bohr put forward the following postulates about the model of an atom:

(i) Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.

(ii) While revolving in discrete orbits the electrons do not radiate energy.

Neils Bohr (1885-1962) was born in Copenhagen on 7 October 1885. He was appointed professor of physics at Copenhagen University in 1916. He got the Nobel prize for his work on the structure of atom in 1922. Among Professor Bohr's numerous writings, three appearing as books are:
(i) The Theory of Spectra and Atomic Constitution, (ii) Atomic Theory and, (iii) The Description of Nature.

These orbits or shells are called energy levels. Energy levels in an atom are shown in Fig. 4.3.

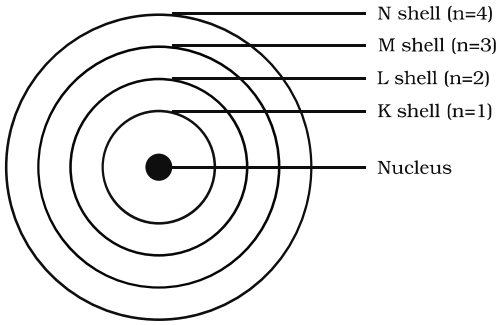

Fig. 4.3: *A few energy levels in an atom*

These orbits or shells are represented by the letters K,L,M,N,... or the numbers, n=1,2,3,4,....

Questions

1. *On the basis of Thomson's model of an atom, explain how the atom is neutral as a whole.*
2. *On the basis of Rutherford's model of an atom, which sub-atomic particle is present in the nucleus of an atom?*
3. *Draw a sketch of Bohr's model of an atom with three shells.*
4. *What do you think would be the observation if the α-particle scattering experiment is carried out using a foil of a metal other than gold?*

4.2.4 Neutrons

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

Questions

1. *Name the three sub-atomic particles of an atom.*
2. *Helium atom has an atomic mass of 4 u and two protons in its nucleus. How many neutrons does it have?*

4.3 How are Electrons Distributed in Different Orbits (Shells)?

The distribution of electrons into different orbits of an atom was suggested by Bohr and Bury.

The following rules are followed for writing the number of electrons in different energy levels or shells:

(i) The maximum number of electrons present in a shell is given by the

formula $2n^2$, where 'n' is the orbit number or energy level index, 1,2,3,.... Hence the maximum number of electrons in different shells are as follows:
first orbit or K-shell will be = $2 \times 1^2 = 2$, second orbit or L-shell will be = $2 \times 2^2 = 8$, third orbit or M-shell will be = $2 \times 3^2 = 18$, fourth orbit or N-shell will be = $2 \times 4^2 = 32$, and so on.

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

(iii) Electrons are not accommodated in a given shell, unless the inner shells are filled. That is, the shells are filled in a step-wise manner.

Atomic structure of the first eighteen elements is shown schematically in Fig. 4.4.

The composition of atoms of the first eighteen elements is given in Table 4.1.

Questions

1. *Write the distribution of electrons in carbon and sodium atoms.*
2. *If K and L shells of an atom are full, then what would be the total number of electrons in the atom?*