Chemistry Study Materials for Class 11 (NCERT Based Notes of Chapter- 02)

Ganesh Kumar Date:- 10/09/2020

Structure of Atom

Quantum Numbers

These are certain numbers used to explain the size, shape and orientation of orbitals. Or, Quantum numbers are the address of an electron. There are four quantum numbers which describe the electron in an atom. They are Principal Quantum number (n), Azimuthal Quantum number (l), Magnetic Quantum number (m or m_l) and Spin Quantum number (s)

1. Principal Quantum Number (n)

The following informations are obtained from n.

1. It gives the size the orbit.
2. It gives the energy of electron in an orbit.
3. It gives the shell in which the electron is found.
4. It also gives the average distance between the electron and the nucleus. As the value of n increases, the distance between the electron and the nucleus also increases.

The possible values of n are 1, 2, 3, 4, 5 etc.

If n = 1 the electron is in K shell

n = 2 the electron is in L shell

n = 3 the electron is in M shell

n = 4 the electron is in N shell and so on.

2. Azimuthal Quantum Number (l)

[Subsidiary or orbital angular momentum Quantum number]

The following informations are obtained from l.

1. It gives the shape of the orbital.

2. It gives the sub shell or sub level in which the electron is located.

3. It also gives the orbital angular momentum of the electron.

For a given value of n, l can have n values ranging from 0 to n – 1.
That is, for a given value of n, the possible value of l are : l = 0, 1, 2, (n-1).

For example, when n = 1, value of l is only 0.

For n = 2, the possible value of l can be 0 and 1.

For n = 3, the possible l values are 0,1 and 2.

For n = 4, the possible l values are 0, 1, 2 and 3.

l = 0 represents s orbital,

l = 1 represents p orbital,

l = 2 represents d orbital

and l = 3 represents f orbital

The number of sub shells in a principal shell is equal to the value of n.

For example,

When n = 1, l= 0.

i.e. K shell contains only one sub shell - s sub shell

when n = 2, l = 0 and1.

i.e. L shell contains two sub shells - s and p sub shells

when n = 3, l = 0, 1 and 2.

i.e. M shell contains three sub shells – s, p and d sub shells

when n = 4, l = 0, 1, 2 and 3.

i.e. N shell contains four sub shells – s, p,d and f sub shells

3. Magnetic Quantum Number (m or m_l)

It gives information about the orientation of orbitals in space.
For a given 'l' value, there are 2l+1 possible values for m and these values are given by : m = – l to 0 to + l

Thus for l = 0, m_l = 0 [2(0)+1 = 1].

i.e. s sub shell contains only one orbital called s orbital.

For l = 1, m_l = –1, 0 and +1 [2(1)+1 = 3].

i.e. p subshell contains three orbitals called p orbitals (p_x, p_y and p_z).

For l = 2, m_l = –2, –1, 0, +1 and +2, [2(2)+1 = 5]. i.e. d subshell contains five orbitals called d orbitals (d_{xy}, d_{xz}, d_{yz}, dx^2 -y^2 and dz^2)

4. Spin Quantum Number (s or m_s)

It is the only experimental Quantum number and it gives the spin orientation of electrons. This spin may be either clockwise or anticlockwise. So the values for s may be +½ or -½.

+½ represents clock-wise spin and -½ represents anticlock-wise spin.

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