Quantum numbers

To completely define the position of an electron in an atom. It is necessary to know the following four quantum number

Principal quantum numbers(n):

It determine the size of the wave function. It determines the energy shells (or) orbit in which the electron is revolving round the nucleus and is also known as major energy level.

It is denoted by the symbol 'n' and may have any integral value except zero.

n=1,2,3,4 etc .denotes that the electron is in the first (K),second (L) third(M) fourth(N) shell etc respectively .

As the distance of the electrons from the nucleus increase its energy becomes higher and higher.

The maximum number of electrons in a major energy level is $2n^2$. Thus

Value of n	1	2	3	4
Shell designation	K	L	M	N
Maximum number of electron($2n^2$)	2	8	18	32

Azimuthal (or) orbital quantum number(l):

This is called secondary (or) subsidiary quantum numbers.

It determines the shape of the wave function. It is denoted by the symbol 'l' and gives the sun-shell to which the electron belongs as also its angular momentum in its motion around the nucleus . Therefore it is also called azimuthal (or)orbital quantum number.

It may have any value ranging from 0 to (n-1). The sub-shell are also symbolized by letters s,p,d,f.

value of n	Value of l	Sub shell (orbital)	shape

1	0	s	Spherical
2	0,1	S,p	Dum bell
3	0,1,2	S,p,d	Double dum bell
4	0,1,2,3	S,p,d,f	Trible dum bell

For example, when n=3 and l=2. the electron is said to be in 3d sub-shell.

Magnetic quantum numbers(m):

This quantum numbers denoted by 'm' refers to the different orientation of electron cloud in a particular sub-shell. These different orientation are called orbitals. Each orbitals is designated by a magnetic quantum number 'm' and its values depends on the value of 'l'. For each value of 'l' there are (2l+1) values of 'm' ranging from-l to +l including zero. Each orbitals can accommodate up to two electrons.

- When l=0 (s-sub shell) m=0 only one value.
- When l=1(p-sub shell)m=-1,0,+1 three values (p_x,p_y,p_z).
- When l=2 (d-sub shell), m=-2,-1,0,+1,+2 five values(d_{xy},d_{yz},d_{xz},d_x^2-$_y^2$ and d_z^2).

Spin quantum numbers:

- The electron is spinning about its own axis as well as during its motion in an orbit around the nucleus.
- The spin can be clockwise (⇩) (or) anti clockwise (⇧)direction and only two values of s are possible viz +1/2 (for clock wise) and -1/2(for anti clock wise)

Pauli exclusion principle:

- Pauli's exclusion principle state that ''it is impossible for any two electrons in a given atom to have all the four quantum numbers identical.''

- In an atom, two electrons can have maximum three quantum numbers (n,l and m) the same and the fourth(s) will definitely be having a different value.
- Thus if S=+1/2 for one electron should be equal to -1/2 for the other electron.
- In other words, the two electron in the same orbital should have opposite spins()