Have model of an atom :-

The Quantum Numbers :-

In Bohr-Sommerfeld, four quantum numbers (n, l, m_l and s) were introduced.

Assuming Schrödinger wave equation provides the correct behaviour of the atomic system, the acceptable solutions of the wave equation gives the different ψ-functions or, orbitals.

1) The Principal Quantum no. (n) –

- It determines the energy levels of electrons in an atom.

$$E = -\frac{me^4 Z^2}{8\epsilon_0^2 n^2 h^2}$$

- As n increases, energy increases. Thus, increasing values of n indicate successive higher energy of the electron.
- The radial wavefunction depends on n.

$$R(n, l)$$

2) The Azimuthal Quantum no. (l) –

- It determines the magnitude of orbital angular momentum of the electron.

$$L = \sqrt{l(l+1)}\,\frac{h}{2\pi}$$

- The acceptable values of l are related to n, $l = 0$ to $(n-1)$.

- In designation of orbitals, $l = 0, 1, 2, 3, \ldots$ correspond to s, p, d, f, g ..... orbitals.

3) The Magnetic Quantum no. (m_l) –

- It determines the orientation of angular momentum vector of the electron with respect to an externally applied magnetic field.
- The allowed orientations are those for which the components of the angular momentum vector along the direction of the magnetic field have values equal to $m_l \frac{h}{2\pi}$ where

  $m_l = +l \ldots 0 \ldots -l$

- It introduces the concept of space quantization.

4) The Spin Quantum no. (m_s and s) –

- An electron is a charged particle, its spin gives rise to magnetic moment.
- The spin may be clockwise or, anticlockwise.
- Spin angular momentum,

$$S = \sqrt{s(s+1)}\ \frac{h}{2\pi}$$

- The value of $s = +1/2$ (clockwise)
  $= -1/2$ (anticlockwise)

Electronic Configuration of atoms :-

The assigning of electrons to atomic orbitals successively is called electronic configuration.

1) Aufbau Principle -

- A system of particles is stable when its total energy is minimum. The order of energy levels -

  $1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < \ldots$

  Electrons are filled from lowest to highest energy levels.

- Only one electron can exist in any particular quantum state.
- The ground state of an atom is one with maximum total spin possible, i.e., one having maximum parallel spins.

2) Pauli's Exclusion Principle -

No two electrons in an atom can exist in the same quantum state.

So two electrons can have same values of not more than 3 quantum numbers.

3) Hunds Rules -

The ground state of an atom should contain the maximum number of unpaired electrons (within the same subshell) with their parallel spins.

H^{1} : $1s^1$

He^{2} : $1s^2$

Li^{3} : $1s^2\ 2s^1$

Be^{4} : $1s^2\ 2s^2$

B^{5} : $1s^2\ 2s^2\ 2p^1$

C^{6} : $1s^2\ 2s^2\ 2p^2$

N^{7} : $1s^2\ 2s^2\ 2p^3$

O^{8} : $1s^2\ 2s^2\ 2p^4$

F^{9} : $1s^2\ 2s^2\ 2p^5$

Ne^{10} : $1s^2\ 2s^2\ 2p^6$

Na^{11} : $1s^2\ 2s^2\ 2p^6\ 3s^1$

Mg^{12} : $1s^2\ 2s^2\ 2p^6\ 3s^2$

Al^{13} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

Si^{14} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

P^{15} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

S^{16} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

Cl^{17} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

Ar^{18} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

K^{19} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

Ca^{20} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

Sc^{21} : $[Ar]\ 4s^2\ 3d^1$

Ti^{22} : $[Ar]\ 4s^2\ 3d^2$

V^{23} : $[Ar]\ 4s^2\ 3d^3$

Cr^{24} : $[Ar]\ 4s^1\ 3d^5$

Mn^{25} : $[Ar]\ 4s^2\ 3d^5$

Fe^{26} : $[Ar]\ 4s^2\ 3d^6$

Co^{27} : $[Ar]\ 4s^2\ 3d^7$

Ni^{28} : $[Ar]\ 4s^2\ 3d^8$

Cu^{29} : $[Ar]\ 4s^1\ 3d^{10}$

Zn^{30} : $[Ar]\ 4s^2\ 3d^{10}$