Pauli's exclusion principle:

- No two electrons in the same atom can have the same set of values for all the four quantum numbers.
- Two electrons in a given orbital have the same values of *n, l* and *m* but differ in spin quantum numbers.

Aufbau principle:

- The orbitals are successively filled in the order of their increasing energy.
- Among the available orbitals, the orbitals of lowest energy are filled first.
- The relative energy of orbital can be known by (n+ℓ) formula.
- If two orbitals have the same value of (n + ℓ), the orbital having lower n value is first filled.
- As atomic number increases, (n + ℓ) formula is not useful to predict the relative energies of orbitals
  a) for example, up to z = 20, 3d > 4s
     Beyond z = 20, energy difference narrows up.
     Beyond z = 57, 3d < 4s.
  b) upto to z = 57,4f > 59
     beyond z = 57, 4f > 5p
     At z = 90, 4f < 5s.
- The order of filling of orbitals can be known from Moellar's diagram.

Hund's rule of maximum multiplicity

- Orbitals having the same values for n and ℓ are called degenerate orbitals.
- Pairing of orbitals will begin after the available degenerate orbitals are half filled.
- Orbitals with highest resultant spin value are more stable.
- The degenerate orbtials are filled to have like spins as far as possible.
- As per Hund's rule, the number of unpaired electrons in the ground state of C, N, O are 2, 3, 2 respectively.
- In the absence of Hund's rule, the number of unpaired electrons in C, N, O are 0, 1, 0 respectively.
- The filling of orbital is governed by Pauli's principle.
- The filling of sub-orbit is governed by Hund's rule.
- The filling of orbitals of various suborbits is governed by Aufbau principle.
- The maximum number of electrons that are present in the outer most shell of any atom = 8
- The maximum number of electrons that are present in the (n–1) most shell of any atom = 18
- The maximum number of electrons that are present in the (n–2) most shell of any atom = 32

Anomalous electronic configurations:

1. Half filled and completely filled degenerate orbitals give greater stability to atoms.
2. Chromium (Z = 24) and copper (Z = 29) have anamalous electronic configuration due to this reason.
3. Electronic configuration of chromium atom is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$ or [Ar] $3d^5 4s^1$ but not $1s^2 2s^2 2p^6 3s^2 3p^6 3d^4 4s^2$.
4. Electronic configuration of copper atom is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ or [Ar] $4s^1 3d^{10}$ but not $1s^2 2s^2 2p^6 3s^2 3p^6 3d^9 4s^2$.

Magnetic properties

- Atoms molecules, ions or any species having unpaired electrons exhibit para-magnetism.
- These are attracted into the magnetic field when they are placed in an external magnetic field.
- Atoms having the completely paired electrons are repelled by the external magnetic field and are called diamagnetic.
- The unpaired electrons produce magnetic field in atoms due to their resultant spin.
- The magnetic moment of atoms containing unpaired electrons is given by the formula $\mu = \sqrt{n(n+2)}$ B.M> Where 'n' is the number of unpaired electrons. Unit of magnetic moment is Bohr magneton (B.M.)

  If n = 1, μ = 1……B.M, If n = 2, μ = 2……B.M,

  If n = 3, μ = 3……B.M and so on.

Stability of atoms:

- Theory of exchange forces will explain why Cr has (Ar) $3d^5\ 4s^1$ but not (Ar) $3d^4 4s^2$.
- According to this theory, greater the number of unpaired electrons, greater is the number of possible exchange pairs of electrons and more is the exchange energy released and the atom is more stable.
- For $C_r \rightarrow$ (Ar) $3d^5\ 4s^1$, the possible number of exchange pairs = 15.
- If energy released for each exchange pair is k, the total exchange energy is 15 k.
- For Cr $\rightarrow$ (Ar) $3d^4\ 4s^2$, the possible number of exchange pairs = 10 and total exchange energy is only 10k.
- Therefore Cr $\rightarrow$ (Ar) $3d^5\ 4s^1$ is more stable than Cr(Ar) $3d^4\ 4s^2$.