UG part I (SUBSIDIARY)

Topic - Periodicity (Ionisation Energy)

Ionisation Potential OR Ionisation Energy OR Ionisation Enthalpy

Definition :-

Minimum energy required to remove most loosly held outer most shell electron (e^-) in ground state from an isolated gaseous atom is known as ionisation potential.

(Isolated means without any bonding with other atom).

Successive Ionisation Energy -

a) For an atom M, successive ionisation energies are as follows -

$M + E_1 \longrightarrow M + e^-$ $\quad E_1$ = Ist Ionisation potential

$M^+ + E_2 \longrightarrow M^{+2} + e^-$ $\quad E_2$ = 2nd Ionisation potential.

$M^{2+} + E_3 \longrightarrow M^{+3} + e^-$ $\quad E_3$ = 3rd Ionisation potential

Order of Successive Ionisation Energy

Ist ionisation potential < 2nd ionisation potential < 3rd Ionisation potential

b) Electron can not be removed from solid state of an atom. It has to convert in gaseous form. Energy required for conversion from solid state to gaseous state is called Sublimation energy.

c) Ionisation potential is always an exothermic process (ΔH = +ve)

d) It is measured in eV/atom (electron volt/atom) or kcal/mole or kJ/mole.

2. Factors affecting Ionisation potential

a) Atomic size

Larger the atomic size, smaller is the Ionisation potential. It is due the fact that when the size of atom increases the outermost electrons (e^-) farther away from the nucleus and nucleus loses the attraction on the electrons and hence can be easily removed.

$$\text{Ionisation potential} \propto \frac{1}{\text{Atomic size}}$$

b) Effective nuclear charge (Z_{eff})

Ionisation potential increases with the increase in nuclear charge between outermost electrons and nucleus.

$$\text{Ionisation potential} \propto \text{Effective nuclear charge}$$

c) Screening effect

Higher is the screening effect on the outermost electrons causes less attraction from the nucleus and can be easily removed, which is leading to lower value of Ionisation potential.

$$\text{Ionisation potential} \propto \frac{1}{\text{screening effect}}$$

d) Penetration power of subshell

Penetration power describes the proximity to which an electron can approach to the nucleus. order of attraction of subshells towards nucleus (penetration power) is $s > p > d > f$

So, higher the penetration power of outermost orbital higher will be Ionisation energy.

Stability of half filled and fully filled orbitals

Half filled p^3, d^5, f^7 or fully filled s^2, p^6, d^{10}, f^{14} are more stable than others. so it requires more energy.

Periodic variation of ionisation energy —

Variation in period among the representative elements

Ionisation energy generally increases along the period because in moving left to right. in a period the effective nuclear charge per outermost electron increases while the corresponding principal quantum number remains same.

Variation in a group among the representative elements

The ionisation energy generally decreases in moving from top to bottom because the size increases due to the increase of the principal quantum number. On the othe hand the effective nuclear charge Z_{eff} for the outermost electron remains the same along the group.