

Periodic Properties

- ① Effective Nuclear charge (Z_{eff}) :- Net +ve charge experienced by valence e^- .
- Nuclear charge (Z) :- +ve charge experienced by valence e^- .
 - Screening effect (σ) :- Repulsion experienced by valence e^- by inner cell e^- .

$$Z_{eff} = Z - \sigma$$

$$F = \frac{k q_1 q_2}{r^2} = \frac{k Z e^2}{r^2}$$

$\leftarrow Z_{eff}, \text{ or } Z_{eff} \downarrow$

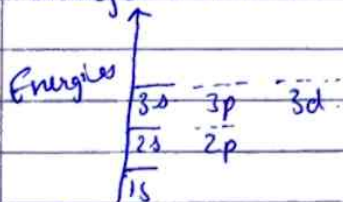
→ Factors affecting Z_{eff} :-

- 1) If Distance from nucleus (D) \uparrow , $\sigma \uparrow$, $Z_{eff} \downarrow$
 Eg:- $Z_{eff}(1s) > Z_{eff}(2s) > Z_{eff}(3p) > Z_{eff}(4p)$
- 2) Diffused orbitals experience $\downarrow Z_{eff}$.
 $Z_{eff} \text{ } s > p > d > f$ $Z_{eff}(4s) > Z_{eff}(4p)$

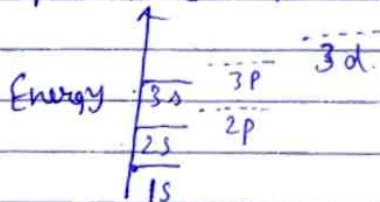
② Variation in s, p, d, f orbital energies

In single e^- atom species :- H, He^+, Li^{++}

Energies :- $1s < (2s = 2p) < (3s = 3p = 3d) < (4s < 4p = 4d = 4f)$



Single e^-



Multi e^- atom

$s < p < d < f$

$(n+l) \uparrow$ energy \uparrow .

$(n+l)$ when same thing which has higher $n \uparrow$ energy \uparrow

$$1s < 2s < 3d < 4s < 4p < 5s$$

$$\begin{aligned} s, l &= 0 \\ p, l &= 1 \\ d, l &= 2 \\ f, l &= 3 \end{aligned}$$

* Cr: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$ } Exceptions

Cu: $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^{10}$

Half filled and fully filled orbitals are more stable

* Atomic and Ionic sizes

$Na > Na^+$

$Na = 11, Na^+ = 11 - 1 = 10$

$Cl < Cl^-$

$Cl = 17, Cl^- = 17 + 1 = 18$

* Electron Affinity: - Amount of energy ~~loss~~ released when an e^- is added to a neutral atom to form a negatively charged ion.

→ Successive E. A.



ΔH +ve generally



ΔH -ve always



ΔH -ve always

} as -ve ion oppose e^- having -ve charge
↓
to EA

Exceptions: - Noble gases have 0 E.A., Half & fully filled orbitals have Be & Mg of 2nd group have 0 E.A. because they have fully filled orbitals.

→ Factors on which E. A. depends.

Atomic size ~~increases~~ ↓

• $EA \propto \frac{1}{\text{Atomic Size}} \propto Z$

nuclear charge ↑, EA ↑

Atomic Size ↑
EA ↓

• Exception: - $Cl > F > Br > I$

Cl has higher E.A. as size of fluorine atom is very small & it cannot accept e^-

★ Electronegativity - Tendency of an atom to attract shared pair of e^- in covalent bond

Eg:- HCl , ~~Cl~~ B.N:- $Cl > H$

→ Factors on which E.N depends.

① $EN \propto \frac{1}{\text{Atomic Size}} \propto Z$

② $EN \propto \text{charge on cation}$. Eg:- $Fe^{2+} < Fe^{3+}$, $Mn^{2+} < Mn^{4+}$

③ $EN \propto \frac{1}{\text{Charge on anion}}$. Eg:- $N^{1-} > N^{2-} > N^{3-}$

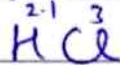
④ $EN \propto \% \text{ of } s \text{ character}$ $sp > sp^2 > sp^3$

↑ $EN \downarrow$ as Atomic Size ↑

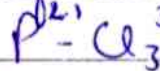
→ $EN \uparrow, N.C \uparrow$

→ Exception, E.N of Noble gas is 0.

→ It helps in nomenclature of binary compound, $EN \uparrow$ ide in last name



Hydrogen chloride



Phosphorus trichloride

↑ First I.E. $\xrightarrow{I.E.}$

↓ E.G. E.G. less - ve down the group