Periodic Prop^t's

[Learn Periodic Table from Prev. Chem Notes]

Period	Stable $\bar{e}$ config.	No. of Elements
1	$1s^2$	2
2	$2s^2\ 2p^6$	8
3	$3s^2\ 3p^6$	8
4	$4s^2\ 3d^{10}\ 4p^6$	18
5	$5s^2\ 4d^{10}\ 5p^6$	18
6	$6s^2\ 4f^{14}\ 5d^{10}\ 6p^6$	32

Q) If spin q.tnm. no. can have 4 values $-1, -1/2, 1/2, 1$ in a hypothetical universe, then how many elements would be in 6th period.

A) If $2\bar{e}$ in 1 orbital → 6th period 32 elements

$\Rightarrow$ $4\bar{e}$ in 1 orbital → 6th period 64 elements

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Determination of Groups, Blocks & Periods:-

1) **Block:** Orbital in which last e^- enters.

2) **Period:** Max. value of n (principal Q. No.)

3) **Groups:** First find block.

- **s Block:** Group No. → (no. of valence e^-)
- **p Block:** Group No. → 12 + (no. of outermost p e^-)
- **d Block:** Group No. → (No. of ns e^-) + (No. of (n-1)d e^-)

Q) Find block, group & period of —

i) $Z = 33$ ii) $Z = 28$

iii) $Z = 82$

A) i) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^3$

Block – p , Period – 4 , Group – 15

ii) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

Block – d , Period – 4 , Group – 10

He 2
Ne 10
Ar 18
Kr 36
(5) Xe 54 ← (82)
(6) Rn 86

iii) $[Xe]\ 6s^2\ 4f^{14}\ 5d^{10}\ 6p^2$

Block – p
Period – 6
Group No. – 14

Nomenclature for Z > 100 –

0 – nil
1 – un
2 – bi
3 – tri
4 – quad
5 – pent
6 – hex
7 – sept
8 – oct
9 – non

Eg – 102 → Un nil bi ium

119 → Un un non ium

Periodic Prop^ts –

1) At. Size : Dist. from centre of nucleus to outermost shell.

NOTE – The measurement of at. radius is NOT easy. ∴ We defined at radius in 3 ways.

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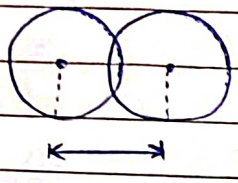
i) Covalent Radii –

~~diatomic~~ Single bonded

C-1: for homoatomic molecule,

H_2



Internuclear dist.

$$\left(\text{Covalent Radii}\right) = \left(\frac{\text{Internuclear Dist.}}{2}\right)$$

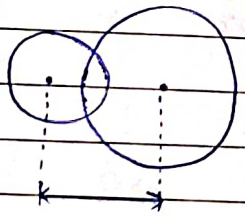
☆ Only valid for SINGLE BONDED homoatomic molecules

~~diatomic~~ Single bonded

C-2 : for heteroatomic molecule,

(all in Å) Pauling Scale

H — Cl



$$r_{HCl} = r_H + r_{Cl} - (0.09)|\Delta EN|$$

Schomaker & Steventiontion formula

Q) Find covalent radii of HF molecule with following given info. –

B.L. of F_2 = 1.44 Å E.N. of F = 4

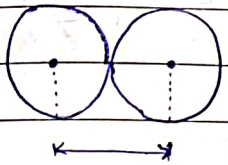
B.L. of H_2 = 0.74 Å E.N. of H = 2.1

A) $r_{HF} = r_H + r_F - (0.09)|\Delta EN| = \left(\frac{1.44}{2}\right) + \left(\frac{0.74}{2}\right) - (0.09)(1.9)$

$\left(\frac{1}{2} r_{F_2}\right)$ $\left(\frac{1}{2} r_{H_2}\right)$

$\Rightarrow$ $\boxed{r_{HF} = 0.919 \text{ Å}}$

ii) Metallic Radii –

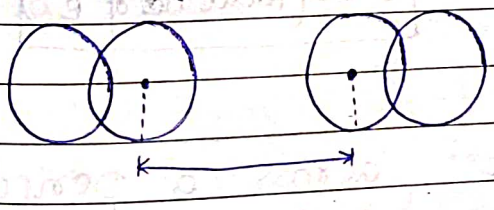


$$\left(\text{Metallic Radii}\right) = \left(\frac{\text{Internuclear Dist.}}{2}\right)$$

If atoms bonded together by metallic bond, then 1/2 of Internuclear dist. b/w 2 adj. atoms is known as metallic radii.

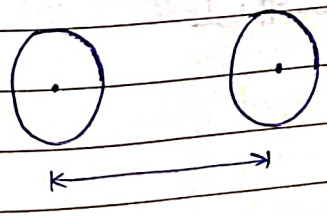
iii) Van der wall Radii –

C-1: For diatomic solid molecules,



It is 1/2 of internuclear dist. b/w 2 adj. at.s belonging to 2 neighbouring molecules in solid state.

C-2: For noble gas,



It is 1/2 of internuclear dist. b/w 2 non bonded atoms at their closest time of approach.

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☆ (Van der Waal Radius) > (Metallic Radius) > (Covalent Radius)

iv) Factors affecting At. Radii :

— Nuclear Charge (Z) → At. Size $\propto \left(\frac{1}{Z}\right)$

— Shielding Effect (σ) —

Redⁿ in force of attraction b/w nucleus and outermost e⁻ due to completely filled innershell.

☆ Order of Screening Effect (Same shell) : $s > p > d > f$

Also, $\sigma \propto$ (Total no. of e⁻)

☆ σ is almost const. across a period
It inc. rapidly down the group.

— Effective Nuclear Charge ($Z_{eff.}$) —

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

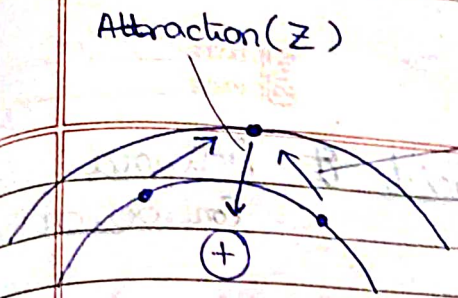
v)

1)

2

☆

vi)



Z_{eff} is Net Nuclear Charge experienced by outermost e⁻

v) General Trend :

1) Down the Group ⟶ At. Size ↑

Explanation – σ ↑ down group as no. of shell ↑.
Z ↑ but $\Delta\sigma > \Delta Z$ ⇒ Z_{eff} ↓.

2) Along Period ⟶ At. Size ↓

Explanation – σ ≈ Const. ⇒ $Z_{eff} \propto Z$ ⇒ Z ↑ & Z_{eff} ↑.

★ Radii of Noble gases largest in their resp. period due to Van der Wall radius.

vi) Exceptions :

d block –

Normal Order

3d Series :	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
4d Series :	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
5d Series :	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
6d Series :	---	---	---	---	---	---	---	---	---	Unb

for all in d block (except Group 3),

(3rd Series) < (4d Series) ≈ (5d Series) ≈ (6d Series)

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Reason: Due to Lanthenoid & Actinoid Contraction

(Lanthenoid Contraction) ⇐ (Very Poor shielding effect of 4f orbital)

(Actinoid Contraction) ⇐ (Very Poor shielding effect of 5f orbital)

Size

$$Sc > Ti > Zn > V > Cr \approx Mn \approx Fe \approx Co \approx Ni > Cu$$

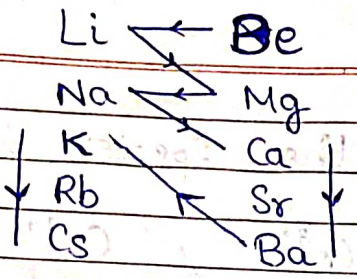
p block –

Group 13 : $B < Ga \lesssim Al < In \approx Tl$

Reason : $Ga \lesssim Al$ as 3d poor shielding effect (Transition Contraction)

$In \approx Tl$ as Lanthenoid Contraction.

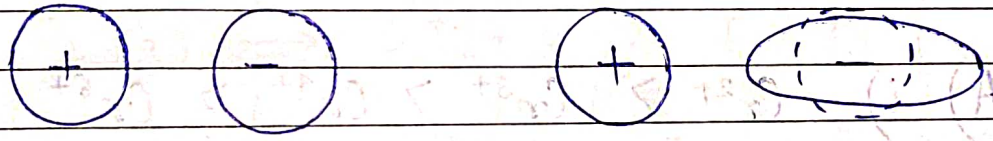
s Block –



Be < Li < Mg < Na < Ca < Sr < Ba < K < Rb < Cs.

vii) Ionic Radii :

Effective dist. from centre of nucleus upto which it exerts its influence on its electronic cloud.



Expected Reality

Note : Ionic Radius $\boxed{A^+ < A < A^-}$

Eg- $F^+ < F < F^-$

	F^+	F	F^-
e^- =	8	9	10
p =	9	9	9

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

$Z \approx$ Const.

$(\#e^-)\uparrow \Rightarrow \sigma \uparrow \Rightarrow (Z_{eff.}\downarrow)$

Also, $\left(\frac{e^-}{p}\right) = \left(\frac{8}{9}\right) \quad \left(\frac{9}{9}\right) \quad \left(\frac{10}{9}\right)$

$(e^-/p)\uparrow \Rightarrow$ Less net attraction

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Q) Arrange the species in ↑ order of size.

i) Cr^{2+} , Cr^{3+} , Cr^{4+} , Cr^{6+}

ii) H^+ , H , H^-

iii) N^{3-} , O^{2-} , F^- , Na^+ , Mg^{2+} , Al^{3+}

★ iv) F^- , Cl^- , Br^- , I^- , H^-

v) Cu , Ag , Au

vi) K^+ , Ca^{2+}

A) i) $Cr^{2+} > Cr^{3+} > Cr^{4+} > Cr^{6+}$

ii) $H^+ < H < H^-$

iii) $N^{3-} > O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

(# e same) ⇒ σ = const. ⇒ $Z_{eff.} \propto Z$

★ iv) $F^- < Cl^- < Br^- < H^- < I^-$

$\left(\frac{e}{p}\right)$ compare. Can't use Z_{eff} as both Z & σ diff./ change easily

v) Cu < Ag ≈ Au

Lanthenoid Contraction.

GOOD WRITE

vi) $K^+ > Ca^{2+}$ $\quad \sigma = \text{Const.} \Rightarrow Z_{eff} \propto Z$

8/7/22

2) Ionization Energy :

Amt. of energy req. to remove e^- from outermost shell of an isolated gaseous atom.

Eg: ✗ $H_2(g) \xrightarrow{E} 2H^+ + 2e^-$; $E \neq I.E.$

✗ $O_2(g) \xrightarrow{E} O_2^+ + e^-$; $E \neq I.E.$

✓ $Mg(g) \xrightarrow{E} Mg^+(g) + e^-$; $E = I.E.$

i) Succesive I.E. –

Eg: $Al \xrightarrow{(I.E_1)} Al^+ \xrightarrow{(I.E_2)} Al^{2+} \xrightarrow{(I.E_3)} Al^{3+}$

Now, $Z \approx \text{Const.}$ & $(\#e)\downarrow \Rightarrow \sigma \uparrow \Rightarrow Z_{eff} \uparrow$

$\Rightarrow$ $\boxed{I.E_1 < I.E_2 < I.E_3}$

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ii) Factors affecting I.E —

- Nuclear Charge : (I.E. $\propto Z$)
- Shielding Effect : (I.E. $\propto 1/\sigma$)
- Effective Nuclear Charge : (I.E. $\propto Z_{eff.}$)
- Half filled & Full filled E.C. :

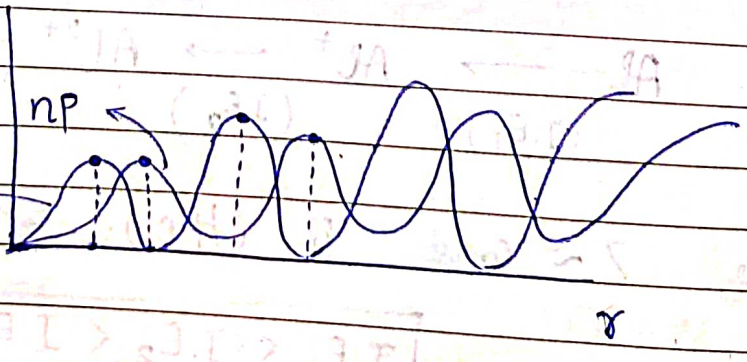
$$I.E_{full} > I.E_{half} > I.E_{partial}$$

- Penetration Power : (I.E $\propto$ 1/P.P.)

(Apply for adj. atoms ONLY)

Ability to e^- to go very close to nucleus.

for same shell, Penetration Power : $s > p > d > f$.



iii) General Trend –

– Down the Group → I.E. ↓

Explanation – At size ↑ & Zeff ↓

– Along the Period → I.E. ↑

Explanation – At. size ↓ & Zeff ↑

iv) Exceptions –

p Block – (Down Group)

13	14	15	16	17
B	C	N	O	F
Al	Si	P	S	Cl
Ga	Ge	As	Se	Br
In	Sn	Sb	Te	I
Tl	Pb	Bi	Po	At

13th group : B > Tl > Ga > Al > In

14th group : C > Si > Ge > Pb > Sn

(Down Group)
d Block –

Group 7, 8, 9, 11, 12 ⇒ 5d > 3d > 4d

Group 4, 5, 6, 10 ⇒ 5d > 4d > 3d

Group 3 ⇒ No change

2nd Period –
(s & p block) Li < (B < Be) < C < (O < N) < F << Ne

Explanation – Be = [He] 2(s^2) (Full) N = [He] 2s^2 2p^3 (Half)

• NOTE – This is for $I.E_1$. For $I.E_2$ write E.C. and apply same rule.

Similarly for all periods; 3rd, 4th, 5th, ...

Q) Arrange following in order of inc. IE. —

1) Mn^{2+} , Mn^{4+} , Mn^{6+} , Mn^{7+}

A) $Mn^{2+} < Mn^{4+} < Mn^{6+} < Mn^{7+}$

2) Au , Cu , Ag

A) Group 11 : Au > Cu > Ag

Q) Compare $I.E_1$ & $I.E_2$ for Cr & Mn.

A) $Cr = [Ar]\ 4s^1\ 3d^5$ $Mn = [Ar]\ 4s^2\ 3d^5$

Since e^- remove from 4s,

$\boxed{IE_1(Mn) > IE_1(Cr)}$ as Mn full fill 4s & Cr half fill 4s

Now, $Cr^+ = [Ar]\ 3d^5$ $Mn^+ = [Ar]\ 4s^1\ 3d^5$

$\Rightarrow \boxed{IE_2(Cr) > IE_2(Mn)}$ as 4s farther than 3d

Q) Which has greater IE among the following?

1) Ne , Na^+

A) $IE(Na^+) > IE(Ne)$

Z_{eff} more

Z ↑ but σ const.

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2) O^{2-}, F^- A) $O^{2-} < F^-$ — Z_{eff} more, σ const., $Z \uparrow$

3) N, O^+ A) $N < O^+$ — Z_{eff} more, σ const., $Z \uparrow$

4) S^{2-}, Cl^-, K^+, Ca^{2+} A) $S^{2-} > Cl^- > K^+ > Ca^{2+}$ — σ const., $Z \uparrow$

Q) Which has largest jump b/w IE_2 & IE_3: Mg, Al, Cl, P

A) $Mg^{2+} = [Ne] \Rightarrow IE_3 >> IE_2$

14/7/22

3) Electron Affinity

Energy involved when an e^- in added to outermost shell of isolated gaseous atom

Eg - $Cl + e^- \longrightarrow Cl^- + EA$

(e^- gain enthalpy) $\longleftarrow \Delta H_{eg} \approx -EA$. (Exact $\Delta H_{eg} = -EA - \frac{5}{2}RT$)

$\Delta H_{eg} > 0 \Rightarrow$ Endothermic. $\Delta H_{eg} < 0 \Rightarrow$ Exothermic

GOOD WRITE

Eg — $O + e^- \underset{IE}{\overset{EA}{\rightleftharpoons}} O^-$; $EA_1(O) = IE_1(O^-)$

i) Successive E.A. —

Eg:

$$O + e^- \longrightarrow O^- + 140\ kJ \quad \text{(Exo.)}$$
$$O^- + e^- \longrightarrow O^{2-} - 744\ kJ$$
$$O + 2e^- \longrightarrow O^{2-} - 604\ kJ \quad \text{(Endo.)}$$

If $> 1\ e^-$ added in outermost shell of isolated gaseous atom, then overall energy is ABSORBED.

In add^n of 1st e^-, energy REALISED bcoz of attraction b/w nucleus and added e^-.

In add^n of 2nd e^-, energy ABSORBED to overcome repulsion b/w (-ve) charged anion & e^- added.

$\boxed{|EA_2| > |EA_1|}$ & $\boxed{(\forall i \geq 2)(EA_i < 0)}$

Q) In which processes energy is absorbed?

a) $O(g) \longrightarrow O^-(g)$ Release

b) $F(g) \longrightarrow F^-(g)$ Release

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c) $S(g) \longrightarrow S^{2-}(g)$ Absorb.

d) $Cl(g) \longrightarrow Cl^{-}(g)$ ~~Absorb~~ Release

ii) Factors affecting EA —

— Nuclear Charge : (EA ∝ Z)

— Shielding Effect : (EA ∝ 1/6)

— Effective Nuclear Charge : (EA ∝ Zeff)

— Half filled & full filled EC :

More Stable ⇒ $\bar{e}$ gain tendency ↓ ⇒ EA ↓

☆ EA for Noble gases = 0 due to full filled
EA for Nitrogen family is VERY LESS due to half filled.

iii) General Trend —

— Down the Group → EA ↓

Explanation : At. size ↑ & Zeff ↓.

— Across the Period → EA ↑

Explanation: At. Size ↓ & Zeff ↑

iv) Exceptions —

— Down the group (p Block)

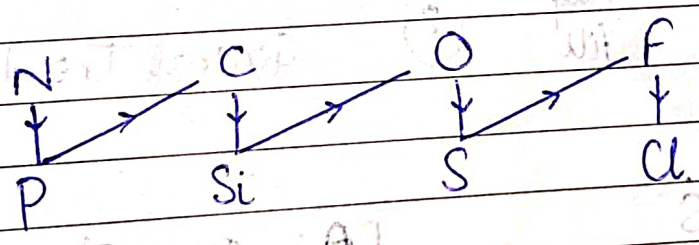
B	C	N	O	F
Al	Si	P	S	Cl
Ga	Ge	As	Se	Br
In	Sn	Sb	Te	I
Tl	Pb	Bi	Po	At

(EA of 2nd Period) < (EA of 3rd period)

Cl > F > Br > I

S > Se > Te > O

P > As > Sb > N



EA

Cl > F > S > O > Si > C > P > N

Q) Why EA of Cl more than EA of F?

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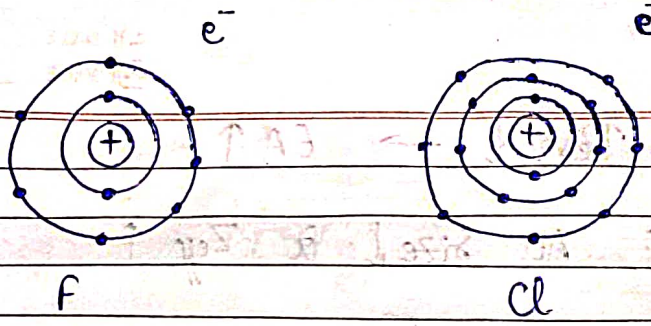
A)



Size of F very compact, as compared to Cl, with both having 7 valence e^-. $\therefore$ $e^- - e^-$ repulsion more in F. $\Rightarrow$ $EN(Cl) > EN(F)$

— Across the period

For 2nd period (only);

$$Ne < Be < N < B < Li < C < O < F$$

Noble gas — Full fill — Half fill — (?) — General Trend

★ EN: I > S , EA: Bi > Pb (Even though N family)

★ $A + e^- \rightleftharpoons A^- \Rightarrow |EA(A)| = |IE(A^-)|$

$A \rightleftharpoons A^+ + e^- \Rightarrow |IE(A)| = |EA(A^+)|$

GOOD WRITE

★Q) Compare I.E. —

★1) F, F^-, Cl, Cl^-

A) IE: $F > F^-$ (Successive IE)
IE: $Cl > Cl^-$ (Successive IE)
EA: $Cl > F$
IE: $Cl^- > F^-$

$\boxed{F > Cl > Cl^- > F^-}$

★2) O, O^-, S, S^-

A) IE: $O > O^-$ (Successive IE)
IE: $S > S^-$ (Successive IE)
EA: $S > O$
IE: $S^- > O^-$

$\boxed{O > S > S^- > O^-}$

Q) IE of an element A is 'x', and EA of the element A is 'y'. Compare x & y

A) $EA(A) = IE(A^-)$.

By successive IE, $IE: A > A^-$

$\Rightarrow IE(A) > EA(A) \Rightarrow \boxed{x > y}$

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4) Electronegativity

Rel. tendency of atom to attract shared pair of e^- towards itself in a covalent bonded molecule. It is UNITLESS.

$$A \xrightarrow{+\delta \quad -\delta} B \qquad EN: B > A$$

$A - B$ $\qquad$ $A \text{ —— } B$ $\qquad$ EN: $B = A$

$$A \xleftarrow[+\delta]{-\delta} B \qquad EN: B < A$$

i) Factors affecting EN –

– $EN \propto Z_{eff.} \propto \left(\frac{1}{\text{Size}}\right) \propto \left(\frac{\text{(+ve) charge}}{\text{(-ve) charge}}\right)$

– Hybridisation

ii) General Trend –

– Down group $\longrightarrow$ EN ↓

Explanation: At size ↑ & $Z_{eff.}$ ↓.

- Across period → EN ↑

Explanation: At size ↓ & Z_{eff} ↑

☆ EN: F > O > N > Cl > Br > I ≈ S ≈ C > P ≈ H

EN: Ga > Al , Tl > In , Pb > Sn

iii) Methods to Calc. EN —

- Pauling Scale:

$$\Delta EN = (0.208)\sqrt{\Delta_{A-B}}$$

in (kcal/mol)

$$\Delta_{A-B} = E_{A-B} - \sqrt{E_{A-A} \cdot E_{B-B}}$$

Bond Energy

Resonance Energy

- Mulliken Scale:

$$\chi_m = \left(\frac{IE + EA}{2}\right)$$

in eV/atom

Note - $$\chi_p = \left(\frac{\chi_m}{2.8}\right)$$

Pauling Scale

Mulliken Scale

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— Alred-Rochow Scale :

It is based on force of attraction b/w nucleus & valence e^-.

$$X_{AR} = \frac{(0.357)\, Z_{eff.}}{r^2} + 0.744$$

r → radius of atom in Å

iv) Application —

- Polarity of Bond $\propto \Delta EN$
- Ionic Character $\propto \Delta EN$

Henny Smith Formula

$$(\%\ \text{Ionic Character}) = 16(\Delta EN) + 3.5(\Delta EN)^2$$

- Nature of XOH bond : (O retains more EN atom)

EN(X) > 2.1	EN(X) < 2.1
$XOH \rightarrow XO^- + H^+$	$XOH \rightarrow X^+ + OH^-$
Acidic Sol^n	Basic Sol^n

Nature of Oxides, Hydroxides, Oxyacids & Metal Hydrides.

1) **Acidic Oxides:** React with bases, & form oxyacids with water.

★ (Non mettallic oxide ⟷ Acidic)

(Across period, EN dominant
Down group, Size dominant)

★ (Acidic Strength) ∝ EN ∝ O.S. (with sign)
(Priority)

(if O.S same, then EN)

2) **Basic Oxides:** React with acids, & form hydroxides with water.

★ (Metallic oxide ⟷ Basic.)

★ (Basic Strength) ∝ $\left(\frac{1}{EN}\right)$ ∝ $\left(\frac{1}{O.S.}\right)$ (with sign)

Exception:

Acidic - H_3PO_2 (>) H_3PO_3 (>) H_3PO_4

O.S. of P- +1 +3 +5

(Even though)

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3) Amphoteric Oxides :

- Suno (SnO, SnO_2) janabe (ZnO)(BeO) aali (Al_2O_3) ve (V_2O_3)

  Sab (Sb_2O_3) punjabi (PbO, PbO_2) mann (MnO) se

  gale (Ga_2O_3) hain [redacted] aish (As_2O_3) karte (Cr_2O_3) hain.

- Metals

  Besan gal geeb par

  Be, Sn, Ga, Al, Zn, Pb

  Their oxides and hydroxides are amphoteric

- Imp Rx^ns :

$$H_2\uparrow + BeCl_2 \xleftarrow{HCl} Be \xrightarrow{NaOH} Na_2BeO_2 + H_2\uparrow$$

$$H_2\uparrow + AlCl_3 \xleftarrow{HCl} Al \xrightarrow{NaOH} NaAlO_2 + H_2\uparrow$$

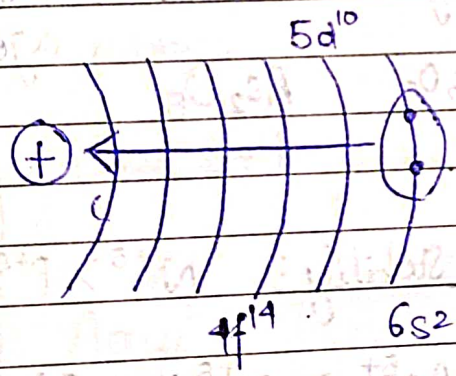
4) Neutral Oxides : CO, N_2O, NO, H_2O

Inert Pair Effect –

(A) The inertness of outermost ns orbital e^- towards bond formation, is called inert pair effect.

Reason: Outermost ns^2 e^- do not participate in bond formation, due to strong hold of nucleus bcoz of very poor sheilding of inner filled d & f orbital es

Eg: Z = 83



5d & 4f poor sheilding

P.P. : 6s > 6p.

$\Rightarrow$ $6s^2$ e^- strongly held

This effect applicable in p block (B, C, N, O f family) down the group.
(Strong, Weak)

Eg: N
P
As
Sb
Bi

O.S. = +5 (Stability dec. down group) $\xrightarrow{(-2)}$ O.S. = +3 (Stability inc. down group)

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Q) Which of the following is least stable —

(1) SnI_4, CI_4, PbI_4, GeI_4

A) Max. O.S. of Group 14 = +4.

⇒ Stability : $C^{+4} > Ge^{+4} > Sn^{+4} > Pb^{+4}$
(Inert Pair Effect)

⇒ PbI_4 least stable.

Q) Which of following is best oxidising agent —

N_2O_5, Bi_2O_5, P_2O_5, As_2O_5

A) By Inert Pair Effect, Stability: $N^{+5} > P^{+5} > As^{+5} > Bi^{+5}$

⇒ Reactivity: $Bi^{5+} > As^{5+} > P^{+5} > N^{5+}$

⇒ Bi_2O_5 best oxidising agent.

Diagonal Relⁿ –

Li — Be — B — C
Na — Mg — Al — Si

show similar propls.

Reason: Ionic Potential (Charge / Size)

☆ Size: Al < Li < Mg (Metallic Radius)

Size: Li^{+} ≳ Mg^{+2} > Al^{3+} (Ionic Radius)

☆ Gabbar fir se harega | Liq. at room temp.
(Ga Br) (Fr) (Cs) (Hg)

Aayi teri sabzi puri 80 kg (Metalloids)
(At) (Te) (Sb Ge) (Po) (As) (Si)

Hydration Energy –

☆ Always (-ve) i.e. released.

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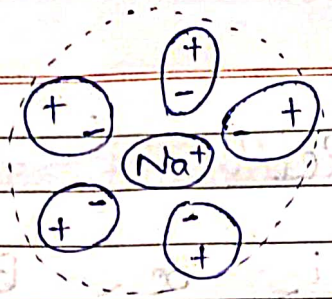
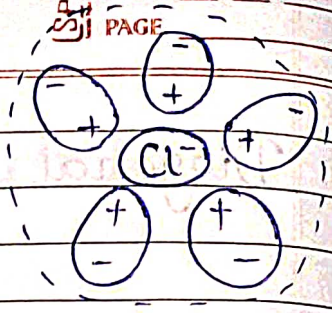
NaCl + H—OH → Na^+ (aq.) + Cl^- (aq.)





Energy amt. released when 1 mol of an ion is surrounded by sufficient no. of water molecules to form hydrated ion, is called hydration energy.

☆ $H.E. \propto \frac{|Charge|}{Size}$ (Charge is dominant factor)

Eg – H.E: LiCl > NaCl > KCl > RbCl > CsCl

Hydrated Radii : $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

Mobility : $Cs^+ > Rb^+ > K^+ > Na^+ > Li^+$

☆ $H.E. \propto$ Hydrated Radii $\propto \left(\frac{1}{\text{Mobility}}\right)$

Q) Compare HE of following —

1) F^-, Cl^-, Br^-, I^-

A) $F^- > Cl^- > Br^- > I^-$

Charge same, F size smallest

★2) Be^{2+}, Li^+

A) $Be^{2+} > Li^+$

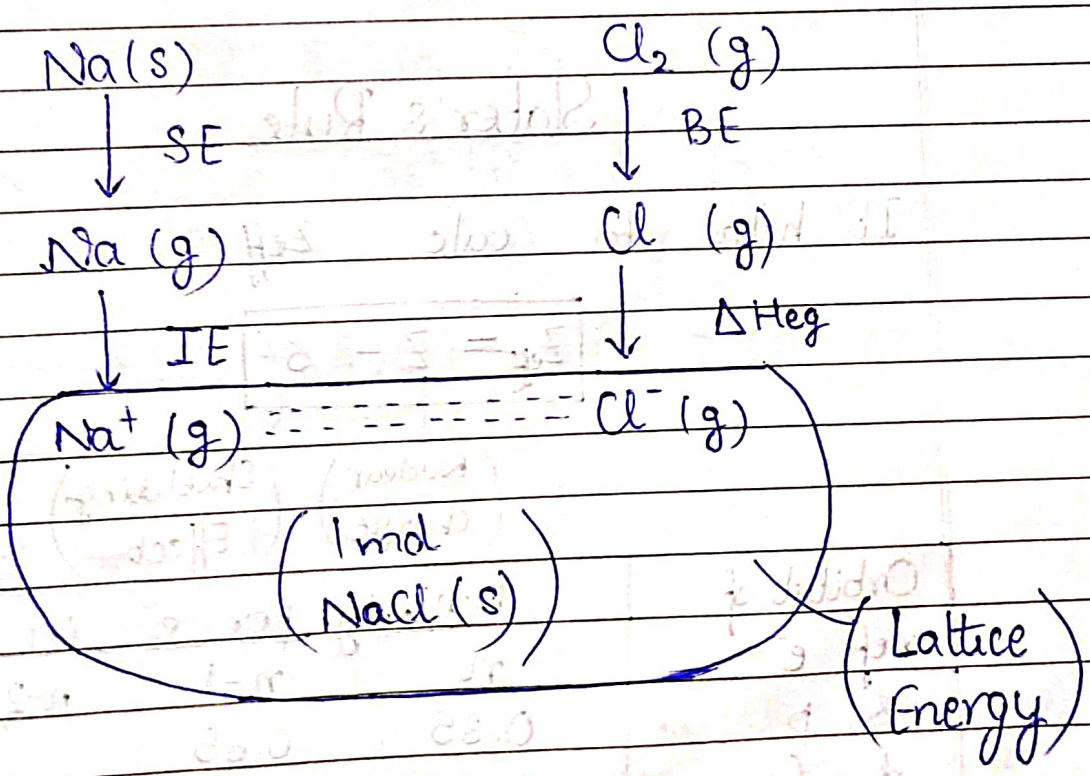
Charge: $Be^{2+} > Li^+$

Size: $Be^{2+} < Li^+$

Lattice Energy —

Amt. of Energy involved when 1 mol of crystalline solid is formed from its constituent particles, sep. by ∞ dist.

Eg:



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★ If HE > LE ⇒ Soluble

If HE < LE ⇒ Insoluble

$$LE \propto \left(\frac{|Charge|}{Size}\right)$$ (Charge is dominant factor)

Eg - LE: $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

": $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+} > Ba^{2+}$

": $N^{3-} > O^{2-} > F^-$

": $NaCl < MgCl_2 < AlCl_3$

Slater's Rule

It helps to calc. Z_{eff}.

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

(Nuclear charge) (Shielding Effect)

Orbital of ref. e^-	Multiply per e^- in orbital		
	n	n-1	n-2, n-3, ...
s, p	0.35	0.85	1
d, f	0.35	1	1

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Rules –

1) Write config. of element, acc. dist. from nucleus.
2) Identify req. subshell. Ignore all subshells after it.
3) Consider 1 e^- in req. subshell as reference, on which σ needs to be calc.
4) Count e^- in each shell and multiply acc.ly.

Q) Calc. σ for 4s e^- in Zn.

A) $Zn = \underbrace{1s^2}_{(n-3)}\ \underbrace{2s^2 2p^6}_{(n-2)}\ \underbrace{3s^2 3p^6 3d^{10}}_{(n-1)}\ \underbrace{4s^2}_{(n)}$

$\sigma = (2-1)(0.35) + (18)(0.85) + (10)(1) \Rightarrow \boxed{\sigma = 25.65}$

Q) Calc. σ for 3d e^- in Zn.

A) $Zn = \underbrace{1s^2}_{(n-2)}\ \underbrace{2s^2 2p^6}_{(n-1)}\ \underbrace{3s^2 3p^6\ 3d^{10}}_{(n)}\ \boxed{4s^2}$ ignore

$\sigma = (18-1)(0.35) + (8)(1) + (2)(1) \Rightarrow \boxed{\sigma = 15.95}$

Q) Calc. σ for 3d & 4s e^- in Ti.

A) $Ti = 1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^2\ 4s^2$

$\sigma_{4s} = (2-1)(0.35) + (10)(0.85) + (10)(1)$

$\Rightarrow \boxed{\sigma_{4s} = 18.85}$

$\sigma_{3d} = (10-1)(0.35) + (10)(1)$

$\Rightarrow \boxed{\sigma_{3d} = 13.85}$

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Imp. Pts. –

1) Size: Li > At [NCERT]

2) $\left(\text{Bond Dissociation Energy}\right) \propto \left(\frac{1}{\text{l.p. repulsion}}\right)$

check if B.O. same.

If not, then B.D.E $\propto$ B.O.

3) $\left(\text{Enthalpy of Soln}\right) = \left(\text{Lattice Energy}\right) - \left(\text{Hydration Energy}\right)$

4) $\left(\text{Red}^{n}\text{ Potential}\right) = \Delta H + \text{I.E.} + \text{H.E}$

Sublimation (+ve) (−ve)

Eg: $Mg \rightleftharpoons Mg^{2+} + 2e^{-}$

$E^{\circ} = (\text{Oxd}^{n}\text{ Potential of Mg}) = -(\text{Red}^{n}\text{ Potential of } Mg^{2+})$

5) Cl_2 highest B.D.E. among halogens.