L-1/10

(CH-3)

CLASSIFICATION OF ELEMENTS & PERIODICITY IN PROPERTIES

Modern periodic Table.

add

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1																		He
2																		Ne
3																		Ar
4			21	22	23							30						Kr 36
5			39	40	41							48						Xe 54
6	55	56	La 57									80						Rn 86
7	87	88	AC 89	104	105	106						112	Nh				Ts	Og 118

grp NO.

GRP=3 { 4f | Lanthanoids (Ce(58) - Lu(71)) | Period = 6

{ 5f | Actinoids (Th(90) - Lr(103)) | Period = 7

Z

⇓

Is Lanthanoids or Actinoids
(58-71) (90-103)

NO → compare with Nearest Inert gas

YES → grp (3) ; Period → L=6, A=7
block (f)

eg. 53 = Z
54-53 ⇒ Δ1

54 Kr → n = 4

Now : 18-1 = 17 (Grp NO.)

n = 4 (period)

p-Block (block)

Total grp (Noble gas grp)

Z = 76

Rn 86 (n=6)

Δ10 ∴ 18-10 = 8

- grp = 8
- period = 6
- block = d

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POSITION OF ELEMENT IN PERIODIC TABLE FROM VALENCE SHELL CONFIGURATION:

S-BLOCK

★ ns^{1-2} ⇒ $n = 2, 3, 4, \ldots$

Group No. = No. of valence e⁻

bcoz 'H' and 'He' are not included in S-block (1st Period)

★ Max. value of 'n' is period No.

p-block :-

$ns^2 np^{1-6}$; $n = 2, 3, 4 \ldots$

→ G. No. = 10 + valence e⁻

d-block : G. No. = sum of d & s e⁻

$ns^{1-2} (n-1)d^{1-10}$ $n = 4, 5, \ldots$

f-block :

$ns^2 (n-1)d^{0,1}$ (0-1 or 0,1), $(n-2)f^{1-14}$; $n = 6, 7, \ldots$

G. No. = 3

★ $4s^2 4p^3$

P. No. = 4

G. No. = (2+3) + 10 = 15 (valence e⁻)

~~3-d series (4f2) = 9%~~

$3d^7 4s^2$

P. No = 4

grp No. = 9

Block = d-block

S-block = Gr-1 to Gr-2

p-block = Gr-13 to Gr-18

d-block = Gr-3 to Gr-12

f-block = Grp-3

NOMENCLATURE:

0	nil
1	un
2	bi
3	tri
4	Quad
5	Pent
6	Hex
7	Sept
8	oct
9	enn

★ 118 : ununoctium (UuO)

PERIODICITY IN PROPERTIES :-

(1) ATOMIC-SIZE : $\xrightarrow{\text{Decreases}}$ Moving in a period from L → R, gradually increases the effective Nuclear charge & thus size of Atom decreases.

Increase ↓

bcoz going down No. of shell ↑ses

NOTE:

3d → Sc, Ti
4d → Y | Zr Nb
5d → La | Hf Ta } Almost same At. size

sizes of elements of 4d & 5d series in a given group are same due to : LANTHANOID-CONTRACTION.

★ Lanthanoid Contraction
↳ $4f^{1-14}$ $5d^{0-1}$ $6s^2$
(Last 3 shells are Incompletely filled)

★ SHIELDING-POWER

s > p > d > f (for same values of n)

→ Due to poor shielding power of f-e⁻, size of elements in Lanthanoid series gradually decreases with ↑ in At. No. and this is called Lanthanoid-contraction.

Good Write

* Size of a cation is smaller than the Parent Atom / cation.

* $Al(g) \longrightarrow Al^{+1}(g) \longrightarrow Al^{2+}(g)$

Size Decreases

* Size of a Anion is greater than the size of Parent Atom / Anion.

$O(g) \longrightarrow O^{-}(g) \longrightarrow O^{2-}(g)$

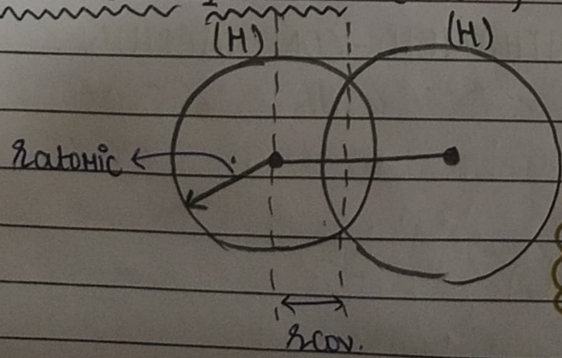
Size Increases

For Isoelectronic species (monoatomic), Higher the At. No., smaller will be the size.

Ques:- 1 ; 7 ; 9 ; 10 → opt ④ → opt ③ ; 14 ↳ opt ③ ; 15 ↳ opt ② ; 17 ↳ opt ③

pg 67 ↓ opt ① ; opt ②

COVALENT-RADIUS ($r_{cov.}$)



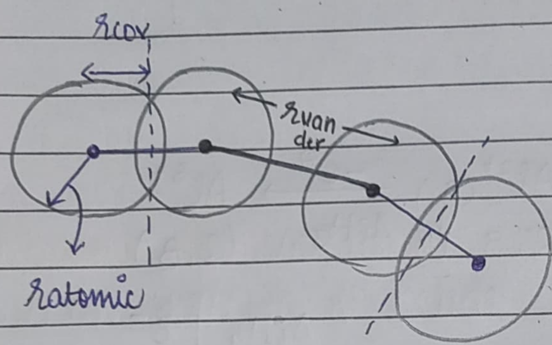
It is half of the Bond length b/w 2 same Atom.

$N \equiv N \quad N = N \quad N - N$

$r_{cov} < r_{cov} < r_{cov}$

* $Xe(g)$; $O_2(g)$ same I.E.
define ↳ for atom
↳ for Molecule

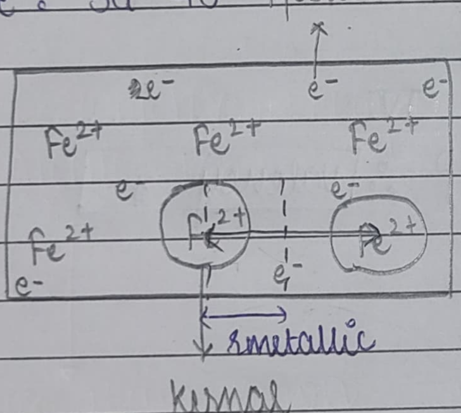
VAN-DER WAALS RADIUS



$r_{vander} > r_{metallic} > r_{atomic} > r_{cov}$
FOR SAME ATOM

METALLIC RADIUS

Fe : $3d^6 4s^2$ Mobile e^-



It is half of distt b/w 2 consecutive kernals in metallic crystal lattice. (core)

IONIZATION ENTHALPY :-

It is the min. amount of energy required to remove an e^- from Isolated gaseous Atom.

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P.T. I.E. Increases ~~Decreases~~ →
I.E. Decreases ↓

Li $\boxed{\text{Be B}}$ C $\boxed{\text{N O}}$ F
$2s^1$ $2s^2$ $2p^1$ $2p^2$ $2p^3$ $2p^4$ $2p^5$

- order of I.E. → (2nd Period)
  Li < B < Be < C < O < N < F

Half filled subshell & full filled subshell are More stable than partially filled subshell (for similar size)
↳ consecutive elements

- order of I.E of 3rd Period :-
  Na < Al < Mg < Si < S < P < Cl < Ar

Q.6 Q.16 Q.18 Q.27 Q-30 Q.32
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$\frac{270 \times 10^{-3}}{27} \times N_A$

6×10^{21}

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In a given period, I.E. of inert gas (group-18) is Max^m.

Successive Ionization energy.

$$\underset{(2,8,3)}{Al(g)} \xrightarrow[\Delta_i H_1]{-e^-} \underset{(2,8,2)}{Al^+(g)} \xrightarrow[\Delta_i H_2]{-e^\ominus} \underset{(2,8,1)}{Al^{2+}(g)} \xrightarrow[\Delta_i H_3]{-e^\ominus} \underset{(2,8)}{Al^{3+}}$$

$$Al^{3+} \xrightarrow[\Delta_i H_4]{e^-} \underset{(2,7)}{Al^{4+}}$$

bcoz stable configuration breakup

For Al: $\underbrace{\Delta_i H_1 < \Delta_i H_2}_{I} < \underbrace{\Delta_i H_3}_{II} \underbrace{<< \Delta_i H_4}_{III} \underbrace{< \Delta_i H_5}_{IV}$

energy-gap (↑est) ∴ $\boxed{\text{valency} = 3}$

Ques^n. 47
pg 73

$\underbrace{\Delta E_1 >>}\ \Delta E_2 > \Delta E_3$

↓ ∴

No. of valence e^- = 1 Ans.

Ques^n. 49 ΔE_3 is highest ∴ valence e^- = 3
pg 74

∴ formula = MX_3

Ques^n. 32 $Al(g) \xrightarrow{578} Al^+(g) \xrightarrow{1817} Al^{2+}(g) \xrightarrow{2745} Al^{3+}(g)$
PYQ

27g $(Al \longrightarrow Al^{3+}) \Rightarrow E = 578 + 1817 + 2745 = 5140$ KJ

∴ 270×10^{-3} g $\longrightarrow \frac{5140 \text{ KJ}}{27} \times 270 \times 10^{-3}$

⇒ 51.40 KJ.

Good Write

* Most Abundant Inert gas = Ar.

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($\Delta_{eg}H$)

Electron gain enthalpy :-

→ Enthalpy change when an e^- is added to the outer most shell of an Isolated gaseous atom, is called e^- gain enthalpy of an Atom.

Electron gain enthalpy of an atom can be +ve or -ve.

* An atom having stable configuration has +ve value for $\Delta_{eg}H$, * In general.

eg. For - INERT GAS
- Be, N, Mg

~~ΔH_{eg}~~ $\Delta_{eg}H$ is +ve.

EGE → '-ve' EGE Increases

↓ -ve, EGE decreases

* In a given period, Grp-17 element has most -ve value of EGE.

→ -ve EGE Decreases

In grp-17 : Cl > F > Br > I

In grp-16 : S > Se > Te > Po > O

Grp-16 & Grp-17   Cl > F > Br > I > S > Se > Te > Po > O

* In periodic Table, 'Cl' has most '-ve' value for $\Delta_{eg}H$.

SUCCESSIVE $\Delta_{eg}H$: STABILITY ⇒ $O^- > O > O^{2-}$

standard i.e. P & T

P → 1bar, T → 25°C

* $O(g) + e^- \longrightarrow O^-(g)$ $\Delta_{eg}H_1^\circ = -141$ KJ/mol

2, 6   2, 7

* $O^-(g) + e^- \longrightarrow O^{2-}(g)$ $\Delta_{eg}H_2^\circ = +780$ KJ/mol

2, 7   2, 8

* Acc. to Pauling scale, F has value 4.0 (No unit)

least electronegative = Cs (0.7)

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1st e^- gain enthalpy of an Atom can be +ve or −ve but second onwards will be always +ve.

ELECTRONEGATIVITY

Tendency of an atom to attract the bonded pair of e^- towards itself within a chemical species is called its ELECTRONEGATIVITY.

$\overset{\delta+}{H} - \overset{\delta-}{F}$ → more e^- density

'Fluorine' is the most electronegative element in P.T.

EN → EN Increases

↓ EN Decreases

- Electronegativity value acc. to Pauling scale :-

Li (1)	Be (1.5)	B (2)	C (2.5)	N (3)	O (3.5)	F (4.0)
		Al (1.5)				Cl (3.1)
		Ga (1.6)				Br (2.8)
		In (1.7)				I (2.6)
		Tl (1.8)				

order of electronegativity in accordance with Hybridization :

$-\overset{|}{\underset{|}{C}}-\overset{|}{\underset{|}{C}}-$ $>C=C<$ $-C\equiv C-$

sp^3 sp^2 sp

EN :- $sp^3 < sp^2 < sp$ (% of s-character)

(2.5) (2.7) (2.9)

Good Write

OXIDES

Basic = Metal oxide

Acidic = Non-metal Oxide

Neutral = CO, NO, N_2O, H_2O

* Amphoteric =

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Ques^n-20 pg 71

$\Delta_i H (Li) = 5.4\ eV$

$\Delta_{eg} H_{(Cl)} = -3.61$

$\therefore \Delta H = 5.4 - 3.61$

$= 1.79\ eV$ Ans.

Amphoteric-metals

Zn, Be, Al, Ga, Sb, As, Pb, Sn

Zna Be Ali Gaye Sb Aghe Punjabi song

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NOTE:

Q.17 pg 67

$Na \longrightarrow Na^+ + e^{(-)}$ $\Delta H = x$ ~~kJ/mol~~ eV

$Na^+ + e^- \longrightarrow Na$ $\Delta H = -x\ eV$

- $\chi_{mulliken} = \dfrac{|E.A.| + |I.E.|}{2}$ eV atom^{-1}

- $\chi_{pauling} = \dfrac{|E.A.| + |I.E.|}{5.6} = \dfrac{|EA| + |IE|}{2 \times 2.8} = \dfrac{\chi_{mulliken}}{2.8}$

GROUP-OXIDATION STATE & VALENCY

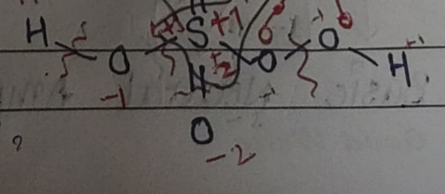
* Grp-oxidation state = Max^m possible oxidation state shown by an element in a group

1	2	13	14	15	16	17	18
+1	+2	+3	+4	+5	+6	+7	+8
Li	Be	B	C	N	O	F	Ne
LiH	BeH_2	BH_3	CH_4	NH_3	H_2O	HF	

* 'H' forms a single-Bond
{ No. of bonds = valency

- In a given period valency wrt H increases from 1 to 4 gradually and then Decreases to 1.

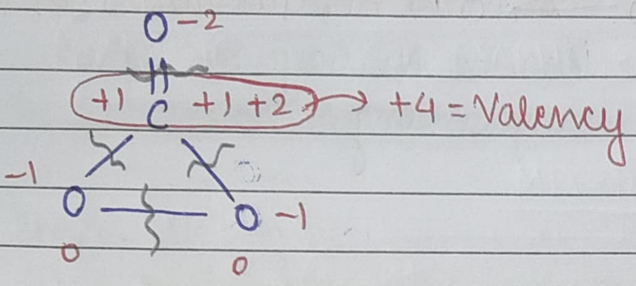
* H_2SO_5 = Peroxosulphuric-acid
= Karose-acid



same atom, same EN, same charge

Good Write

* CO_3



Na Mg Al Si P S Cl Ar

NaH MgH_2 AlH_3 SiH_4 PH_3 H_2S HCl

Valency : (wrt oxygen)

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7
1	2	3	4	5	6	7

1
||
No. of Bond

2 bonds → 2 Atoms (Na)
(by oxygen)

∴ 1 Atom = 1 bond
= Valency

In a given period valency wrt oxygen increases from 1 to 8 gradually.
(XeO_4)

NATURE OF OXIDES :

↳ Ox. No. of 'O' is '-2'

∴ OF_2 is not a oxide but fluoride.

simple-oxides → Relatively (wrt water)

Mixed-oxides

Acidic Basic Neutral Amphoteric

Good Write

* Oxides of Non-Metals are generally ACIDIC-NATURE, Higher the Non-Metallic character more acidic will be the oxide.

* $P_2O_5 < SO_3 < Cl_2O_7$

$\xrightarrow{\text{ACIDIC-STRENGTH}}$

$H_3PO_4 \quad H_2SO_4 \quad HClO_4$

Acidic-strength
∝ ox. No. of elements
∝ Non-metallic Character

* $\underbrace{\overset{+1}{N_2O} \quad \overset{+2}{NO}}_{\text{Neutral-oxides}}$ $\quad \overset{+3}{N_2O_3} < \overset{+4}{NO_2} < \overset{+5}{N_2O_5}$

$\xrightarrow{\text{ACIDIC-STRENGTH}}$

* $\overset{+1}{Cl_2O} < \overset{+3}{Cl_2O_3} < \overset{+5}{Cl_2O_5} < \overset{+7}{Cl_2O_7}$

$\xrightarrow{\text{Acidic strength} \uparrow}$

* Metal-oxides are generally Basic in Nature & Higher the Metallic-character more will be the basic strength of the oxide.

$Na_2O < K_2O < Rb_2O < Cs_2O$

$\xrightarrow{\text{Basic strength}}$

$NaOH \quad KOH \quad RbOH \quad CsOH$

$\underbrace{BeO}_{\text{Amphoteric}} \quad MgO < CaO < SrO < BaO$

$\xrightarrow{\text{Basic character}}$

$Mg(OH)_2 \quad Ba(OH)_2$

• AMPHOTERIC-OXIDES

BeO, Al_2O_3, SnO, SnO_2, PbO, PbO_2, ZnO, Ga_2O_3, Mn_2O_3 etc.

Good Write

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NOTE:

+2	+3	+4	+5	+7
MnO	Mn_2O_3	MnO_2	Mn_2O_5	Mn_2O_7
BASIC	AMPHOTERIC	AMPHOTERIC	AMPHOTERIC	ACIDIC

MIXED-OXIDES

* Fe_3O_4

Fe^{2+} O^{2-} → FeO
Fe^{3+} O^{2-}
Fe^{3+} O^{2-}
O^{2-} → Fe_2O_3

Pb_3O_4

Pb^{2+} O^{2-}
Pb^{2+} O^{2-} → $2PbO$
Pb^{4+} O^{2-}
O^{2-} → PbO_2

DIAGONAL-RELATIONSHIP

Period No. \ Grps	①	②	③	④
①	Li	Be	B	
②	Na	Mg	Al	Si

→ Nitride — stable
→ Hydrates

same behaviour in Li & Mg

$LiCl \cdot 2H_2O$
↳ Hydrated

*Reason for diagonal relationship :-

- Having similar size
- Having same Polarizing power