MOT
Dipole
Weak Bonds
Ionic Bond

IOC Mega Revision

● Live at 8:00 PM

1st March - 13th March

Faculty of the Series

2116

84-85%

Prateek Gupta Sir
eSaral Chemistry Faculty

- **IIT Bombay,** Metallurgy
- **Online** Creativity & Visualization Expert
- **Mentored** Lakhs of Students

Master Planners & Faculties

Infinity

Deewana Bana De

Most
Stable Team

Saransh Gupta Sir

eSaral Physics HoD

- **IIT Bombay**, CS
- **AIR-41** IIT-JEE
- **Air-71** AIEEE (JEE Main)
- **AIR-4** NSO
- **1%** In Top INPHO
- **8+** Years of Teaching Experience
- **Mentored** Lakhs of Students

Master Planners & Faculties

Retirement ← 54 → Crore

Father

4 baje
10 baje } 15 min

N.K. Gupta Sir

eSaral Math Faculty & Master Planner

- **IIT Kanpur**, Mechanical
- Ex **Vice President & Academic Head**, Allen, Kota
- Mentored many of **Rank 1** & **Top 100** Students
- **30+ years** of Teaching Experience
- **Mentored** over 3,00,000 Students

Master Planners & Faculties

Kota
highest ranked Bio

Dr. Anshuman Agarwal

eSaral Biology Faculty

- **MBBS, MD, FIPM**
- **AIR-196,** AIPMT(NEET)
- **ARR-46,** RPMT
- **NTSE Scholar**
- **Ex HoD Biology,** Resonance, Kota
- **10+ years** of Teaching Experience
- **Mentored** over thousands of doctors

Master Planners & Faculties

Dr. Kushika Taneja

eSaral Biology Faculty

- **Ex-HoD Biology,** Pace IIT and Medical, Indore
- Biology faculty at Rao Academy, Kota
- **7+ years** of Teaching Experience
- **Mentored** over thousands of doctors

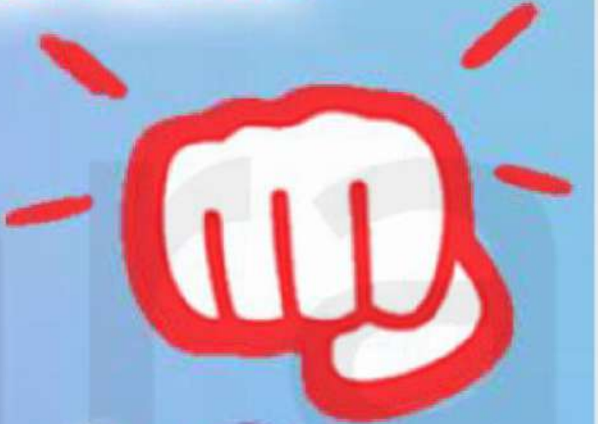
What you get inside eSaral course?

Sheet sol^
Vid sol → DST → DLC → Phone

- Study from Kota's **Top IITian Faculties** & Doctor
- **650+ Hours of PCM**/B **Videos** Lectures with best Visualisation
  5 March
- **30000+** Solved Qs
  Day 1
- Personalised date wise Time-table
- Live **4-Layered Doubt Solving** System
- Personalised 3-Layered **One to One Mentorship**
- **115** Fully Solved Topic wise segregated **Practice Sheets** with **homework index** & **video solutions**
- Solved **Prev 10 years Chapterwise Qs**
- Quick Revision Video Lectures and **90+ Mind Maps**
- **97 JEE Main** and **94 JEE advanced** 1hr Topic wise **Tests**
- 3 Hour Regular Review tests and Test Series
- Instant Test Analysis Report
- Regular Motivation and Strategy Sessions

39-99.51

1000
200+




HURRY
UP!

⇒
11??

⇐

Physics
⇓
God

I Love Chemistry

Complete Chemistry Mega Revision Timetable

1 March	Coordination Compounds	✓
3,4 March	Chemical Bonding	✓
5 March	p–block (Class 12)	✓
6 March	p–block (class 11) + Periodic Table	✓
8 March	Metallurgy	✓
10 March	s-block + Hydrogen	
12 March	d & f-block	
13 March	**Surprise Gift**	

Complete Chemistry Mega Revision PYQs & Quiz Timetable

Practice makes Perfect

2 March

Coordination Compounds

PYQs (JEE+NEET)

Quiz

4 March

Chemical Bonding

PYQs

Quiz

5 March

p–block (Class 12)

PYQs

Quiz

7 March

p–block (class 11) and Periodic Table

PYQs

Quiz

11 March

Metallurgy

PYQs

Quiz

12 March

s-block + Hydrogen

PYQs

Quiz

13 March

d & f-block

PYQs

Quiz


Samjho, dekho & yaad karo

1. The bond dissociation energy of B–F in BF_3 is 646 kJ mol^{-1} whereas that of C–F in CF_4 is 515 kJ mol^{-1}. The correct reason for higher B–F bond dissociation energy as compared to that of C–F is :- **[AIEEE-2009]**

(1) Significant pπ – pπ interaction between B and F in BF_3 whereas there is not possibility of such interaction between C and F in CF_4.

(2) Lower degree of pπ – pπ interaction between B and F in BF_3 than that between C and F in CF_4

(3) Smaller size of B-atom as compared to that of C-atom

(4) Stronger σ bond between B and F in BF_3 as compared to that between C and F in CF_4

Back Bonding

BO = 1.33

C-F = 1

Ans 1

Decreasing order of bond angle is - **[AIIMS-2011]**

(1) $BeCl_2 > NO_2 > SO_2$
(2) $BeCl_2 > SO_2 > NO_2$
(3) $SO_2 > BeCl_2 > NO_2$
(4) $SO_2 > NO_2 > BeCl_2$

VG Question

$$\overset{180^\circ}{Cl-Be-Cl}$$

$BeCl_2$ NO_2 SO_2

Ans 1

The structure of IF_7 is :- **[AIEEE-2011]**

(1) octahedral
(2) pentagonal bipyramid
(3) square pyramid
(4) trigonal bipyramid

10 sec

fokat ke
4 marks
↓
10000 rank

Ans 2

The molecule having smallest bond angle is :- **[AIEEE-2012]**

(1) PCl_3 (2) NCl_3 (3) $AsCl_3$ (4) $SbCl_3$

1) PCl_3

Least EN ② NCl_3

Sb ③ $AsCl_3$

$\ddot{Cl}$ $\bar{Cl}$ $\ddot{Cl}$ ④ $SbCl_3$

Ans 4

For the compounds CH_3Cl, CH_3Br, CH_3I and CH_3F, the correct order of increasing C-halogen bond length is :

(1) $CH_3F < CH_3Br < CH_3Cl < CH_3I$

(2) $CH_3F < CH_3Cl < CH_3Br < CH_3I$

(3) $CH_3Cl < CH_3Br < CH_3F < CH_3I$

(4) $CH_3F < CH_3I < CH_3Br < CH_3Cl$

Size

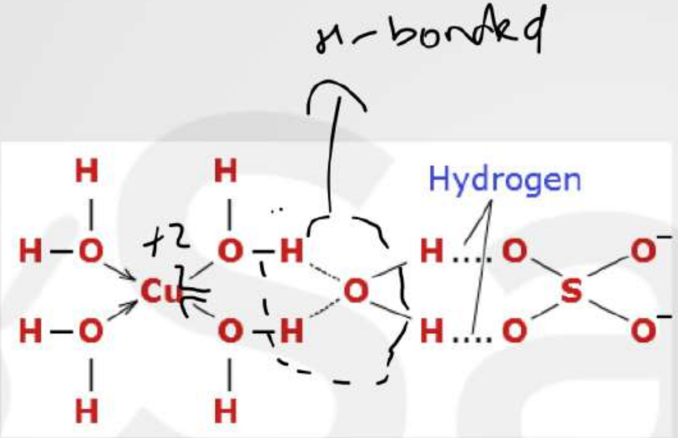
Ans 2

In $CuSO_4.5H_2O$ all Cu – O bond length are not equal. The total number of shorter Cu – O bonds will be :- **[AIIMS 2013]**

(1) 4 (2) 1 (3) 2 (4) 3

✓✓✓✓✓✓✓/XI/Imp

Ans 1



Must Learn

VBT × → MOT

Paramagnetic

⇑

The life of Oxygen

Diamagnetic ← VBT

Molecular Orbital Theory

The molecular orbitals like the atomic orbitals are filled in accordance with the **Aufbau principle** obeying the **Pauli Exclusion principle** and the **Hunds Rule of Maximum Multiplicity.** But the filling order of these molecular orbitals is always experimentally decided, there is no rule like (n + l) rule in case of atomic orbitals.

ABMO

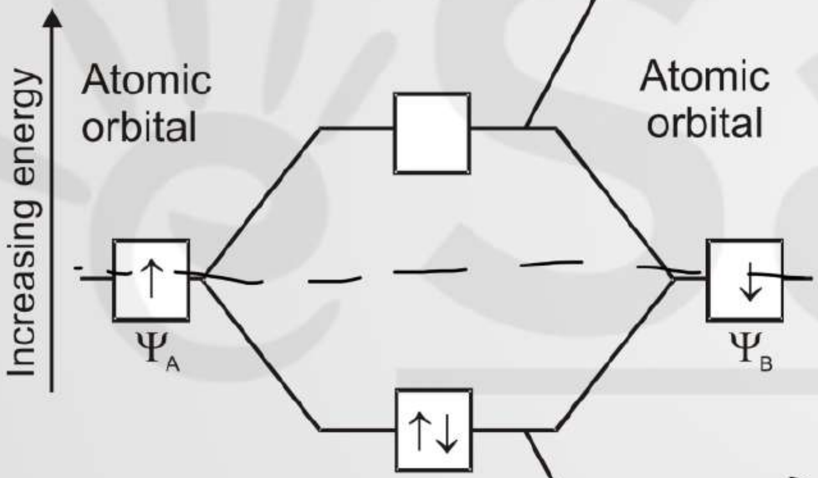
3

1 3

Molecular orbitals

Antibonding orbital

higher enrgy than that of atomic orbitals



2 2

1

Bonding orbital

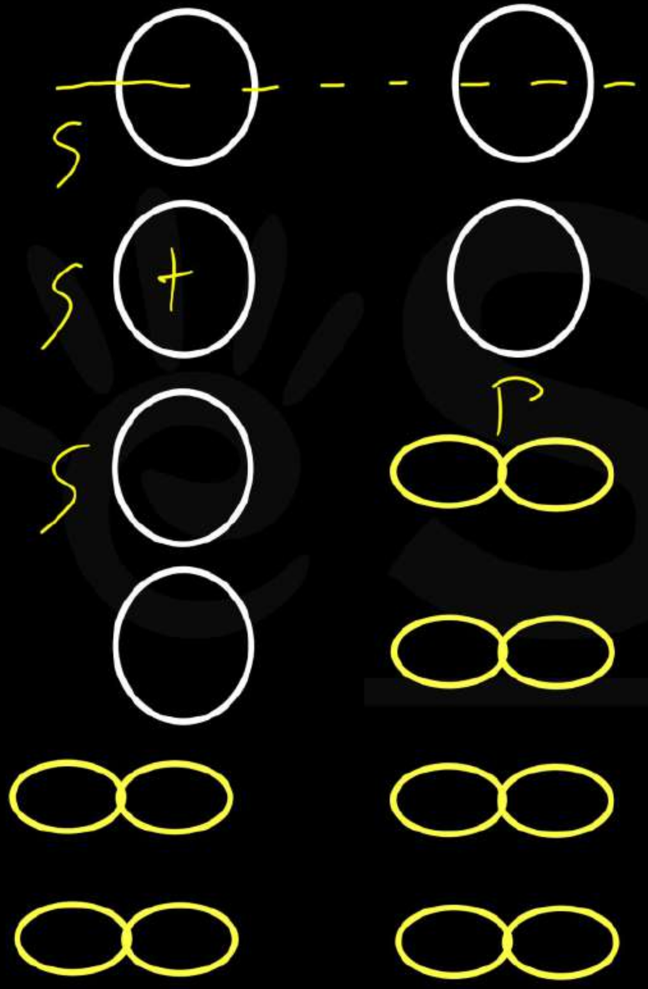
lower energy than that of atomic orbital

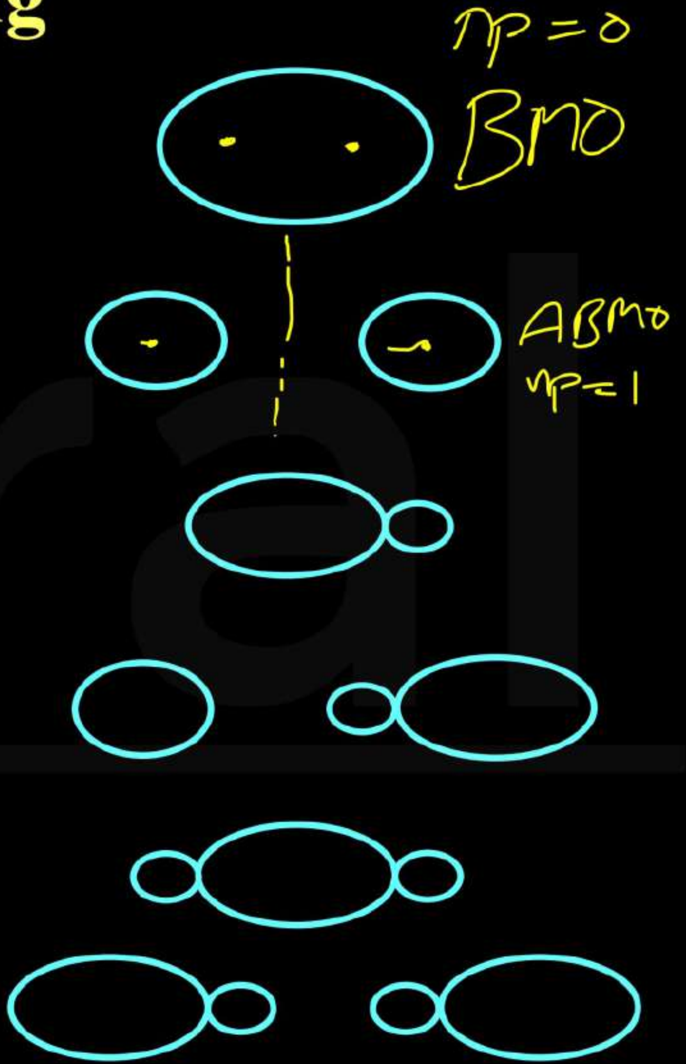
BMO

Nodal Planes

Nodal planes are regions around atomic nuclei where the likelihood of finding electrons is zero.

Axial Overlapping

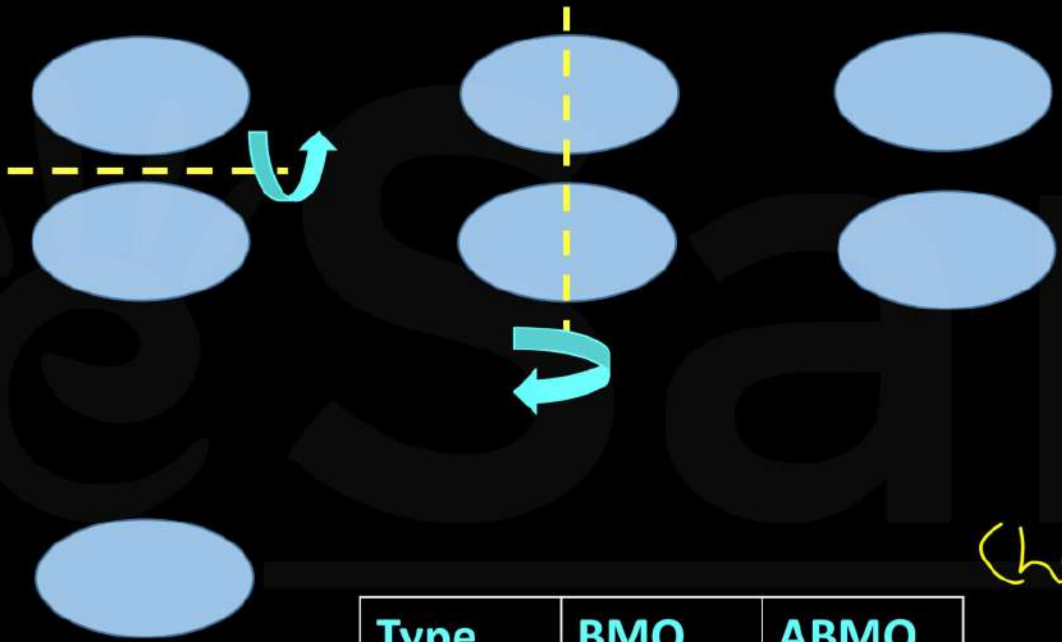




Sideways Overlapping

Gerade and Ungerade

not important



Chap 10

Type	BMO	ABMO
σ	g, np=0	U, np=1
π	u, np=1	g, np=2

BMO, ABMO

Energy Level Order For Molecular Orbitals

Experimental

$\sigma 1s < \sigma^*1s < \sigma 2s < \sigma^*2s < \sigma 2_{pz} < (\pi 2_{px} = \pi 2_{py}) < \pi^*2_{px} = \pi^*2_{pz} < \sigma^*2_{pz}$

BMO BMO

For elctrons > 14

Example: O_2, F_2

16 18

$\sigma 1s < \sigma^*1s < \sigma 2s < \sigma^*2s < (\pi 2_{px} = \pi 2_{py}) < \sigma 2_{pz} < \pi^*2_{px} = \pi^*2_{py} < \sigma^*2_{pz}$

BMO BMO

For electrons ≤ 14

Example: C_2, N_2

Electronic configuration and molecular behaviour

N_b-number of e^- in BMO

N_a-number of e^- in ABMO

σ^*_{1s} [↑] ABMO

σ_{1s} [↑↓] BMO

BO>0

molecule stable

BO≤0

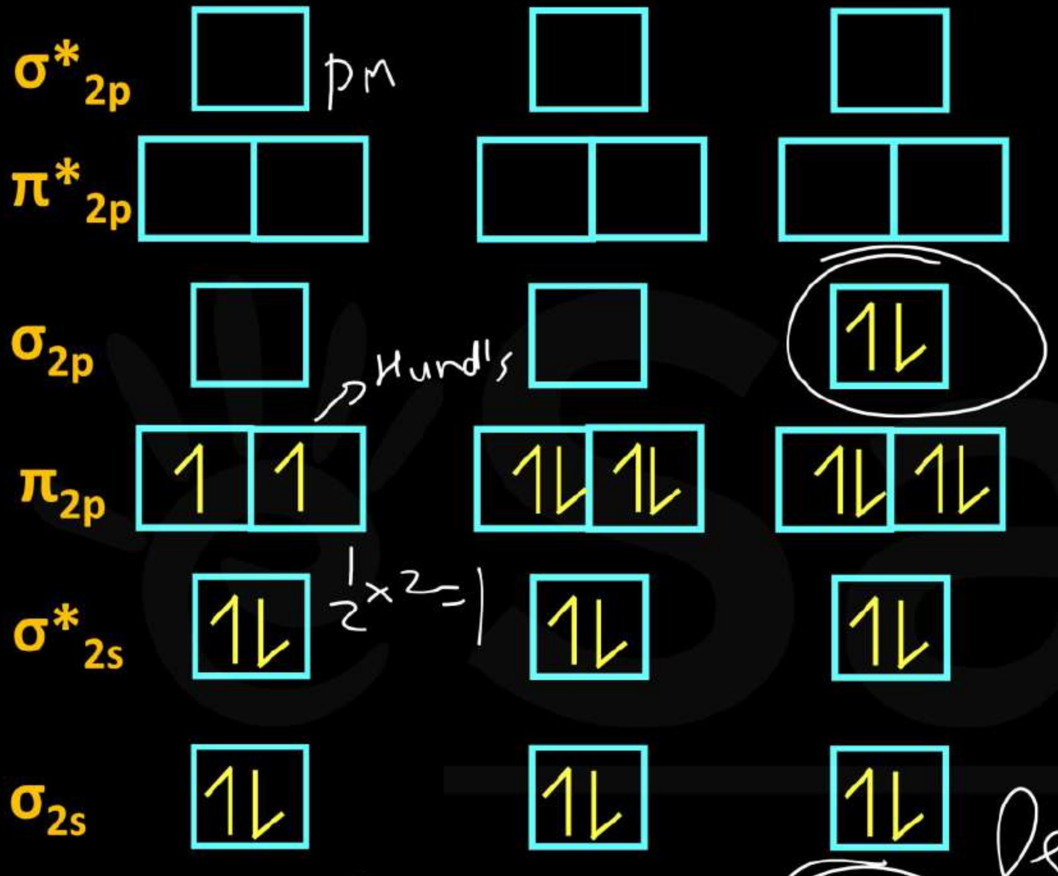
molecule unstable

(i) The molecule is stable if N_b is greater than N_a

(ii) The molecule is unstable if N_b is less than N_a

Bond order (B.O.) = ½ (N_b - N_a)

$\frac{1}{2}(2-1) = \frac{1}{2} = BO$



$\sigma_{1s} = 2$

MOT $\sigma^*_{1s} = 2$ $B_2 = 5 \times 2 = 10$

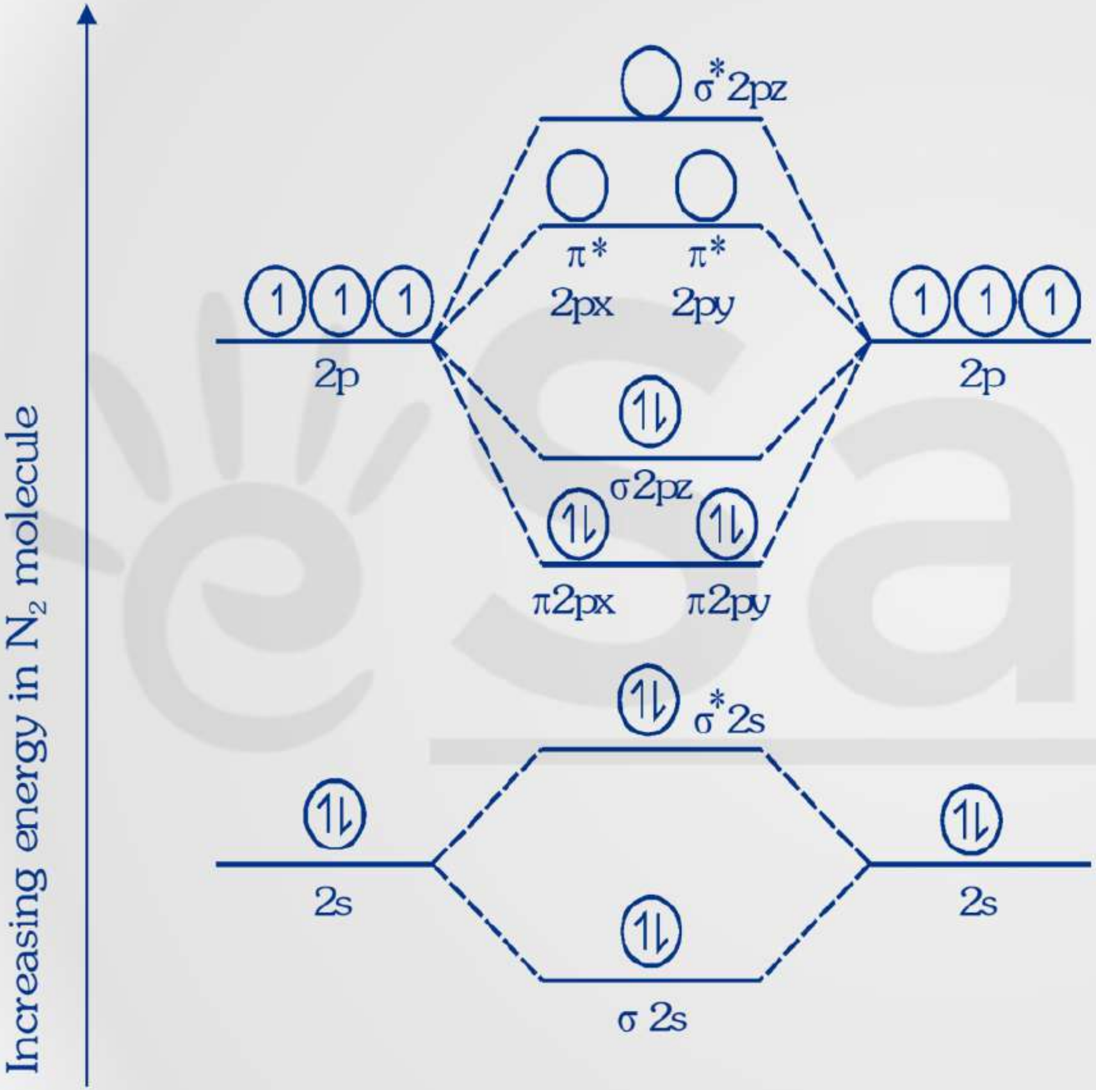
diagrams

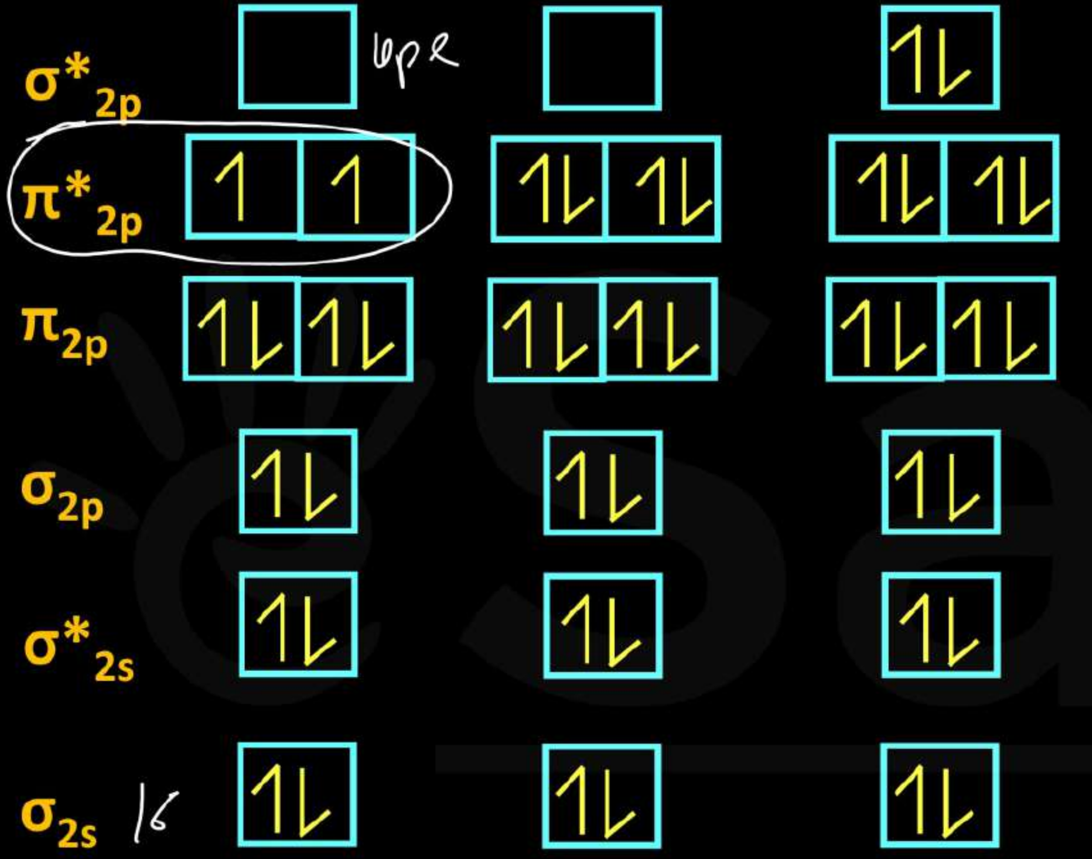
$e^- \leq 14$

$B_2 = 1$ BO $C_2 = 2$ $N_2 = 3$

$\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < (\pi_{2px} = \pi_{2py}) < \sigma_{2pz} < \pi^*_{2px} = \pi^* 2_{py} < \sigma^* 2_{pz}$

For electrons ≤14

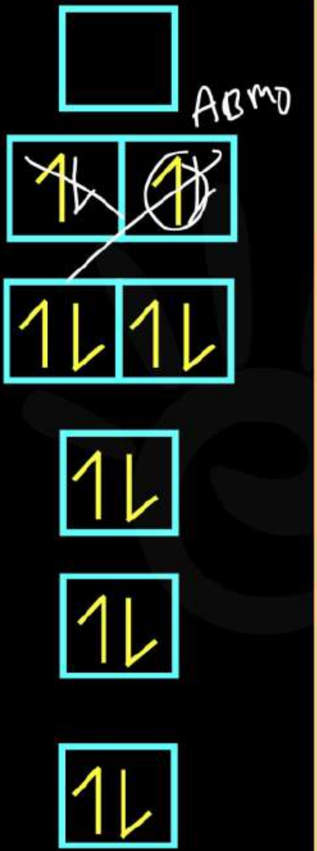

Increasing energy in N_2 molecule
σ^*2pz
π^* 2px
π^* 2py
1 1 1
2p
1 1 1
2p
$\sigma2pz$
$\pi2px$
$\pi2py$
σ^*2s
2s
2s
σ 2s



$e^- > 14$

$O_2 = 2$ $F_2 = 1$ $Ne_2 = 0$

$\sigma_{1s} < \sigma^*_{1s} < \sigma_{2s} < \sigma^*_{2s} < \sigma_{2pz} < (\pi_{2px} = \pi_{2py}) <$
$\pi^*_{2px} = \pi^*_{2py} < \sigma^*_{2pz}$ For elctrons > 14



$\frac{1}{2}(\overset{2}{N}_b - N_a)$

Bond order ↑ $O_2 = \frac{1}{2}[8-4] = 2$

Stability ↑ $O_2^{+} = \frac{1}{2}[8-3] = 2.5$

BL ↓ $O_2^{-} = \frac{1}{2}[8-5] = 1.5$

$O_2^{2-} = \frac{1}{2}[8-6] = 1$

$O_2^{+2} = 3$

Stability order –

$O_2^{+2} > O_2^{+} > O_2 > O_2^{-} > O_2^{2-}$

Bond length –

$O_2^{2-} > O_2^{-} > O_2 > O_2^{+} > O_2^{+2}$

$O_2 \rightarrow \pi^*$

$N_2 \rightarrow \sigma$

90%

$1e^- \rightarrow$ ABMO $\rightarrow$ BO ↑ $\frac{1}{2}$

$1e^- \rightarrow$ ABMO $\leftarrow$ BO ↓ $\frac{1}{2}$

During change of O_2 to O_2^- ion, the electron adds on which one of the following orbitals ? **[AIPMT Mains-2012]**

(1) σ^* orbital
(2) σ orbital
(3) π^* orbital
(4) π orbital

$O_2 \longrightarrow \pi^*$

$N_2 \longrightarrow \sigma$

Ans 3

The correct order of bond dissociation energy among N_2, O_2, O_2^- is shown in which of the following arrangements? **[JEE-MAINS(Online) 2014]**

(1) $N_2 > O_2 > O_2^-$ (2) $O_2 > O_2^- > N_2$

(3) $N_2 > O_2^- > O_2$ (4) $O_2^- > O_2 > N_2$

$N_2 = 3$
$O_2 = 2$
$O_2^- = 1.5$

Ans 1

According to molecular orbital theory, which of the following will not be a viable molecule ? $\rightarrow BO \leq 0$

[JEE-MAINS 2018]

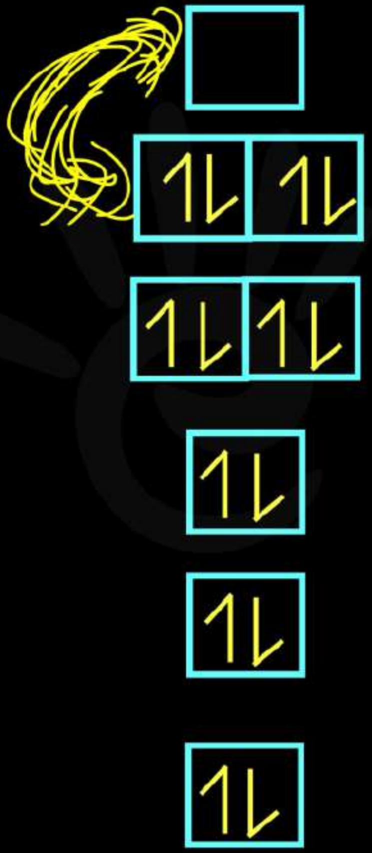
(1) He_2^+ (2) H_2^- (3) H_2^{2-} (4) He_2^{2+}

Ans 3

F_2	Pale Yellow
Cl_2	Greenish
Br_2	Red-Brown
I_2	Violet

HOMO-LUMO Transition

F_2



LUMO

HOMO

e^- transition

↓

Visible range

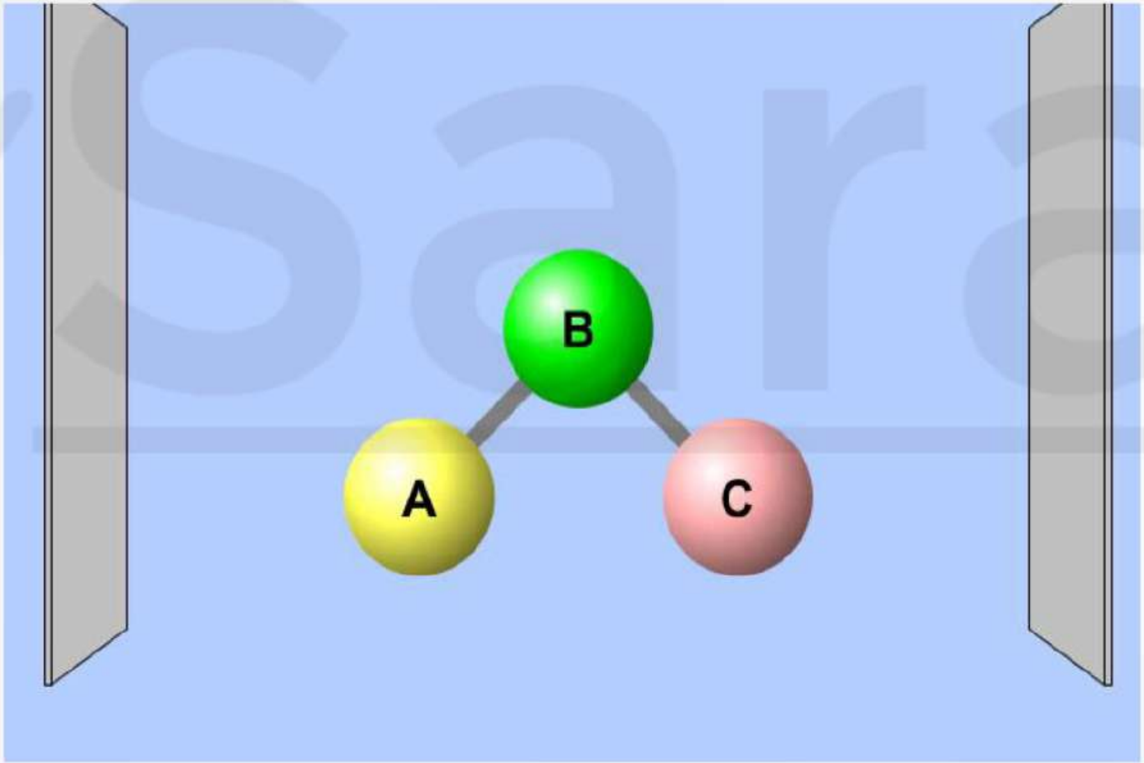
↓

Coloured

400-700nm

Polarity in Molecules

H_2O H_2O



Dipole Moment

$$\boxed{\mu = q \times d}$$

q = magnitude of charge on any one of the atom of the bond.

d = distance between two atoms of the bond.

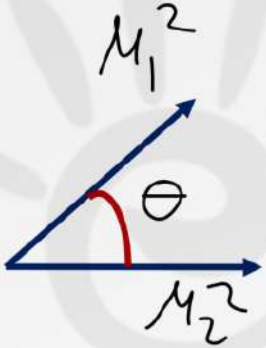
Dipole moment is measured in Debye unit.

1D = 10^{-18} esu cm (magnitude of electronic charge = 10^{-10} esu & the distance between atomic centres i.e., 10^{-8} cm)

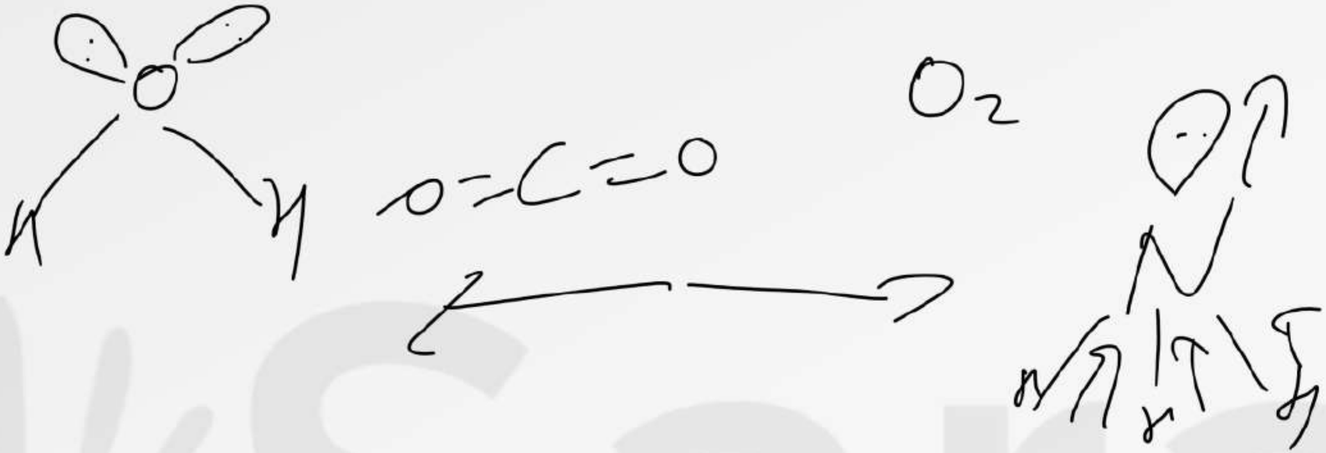
1D = 3.33×10^{-30} coulomb × metre.

Resultant DM

Imp



$$\mu_{resultant} = \sqrt{\mu_1^2 + \mu_2^2 + 2\mu_1\mu_2\cos\theta}$$



If μ = 0 compound is non polar and symmetrical

Example: CO_2, BF_3, CCl_4, CH_4. BeF_2 etc.

If μ ≠ 0 compound will be polar and unsymmetrical.

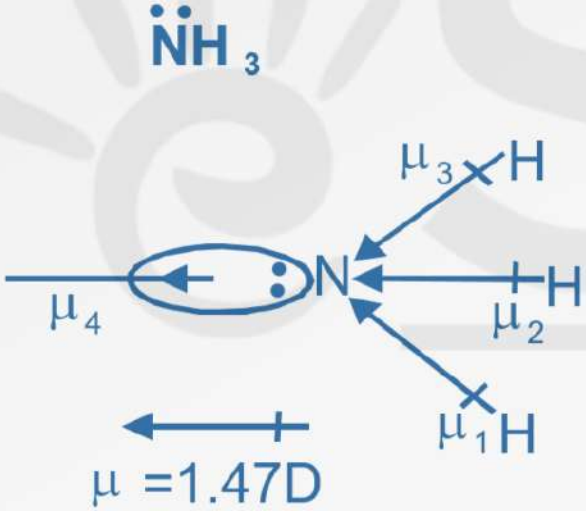
H_2O, SO_2, NH_3, Cl_2O, CH_3Cl, $CHCl_3$ etc.

Q) What is the order of Dipole Moment in HF, HCl, HBr, HI?

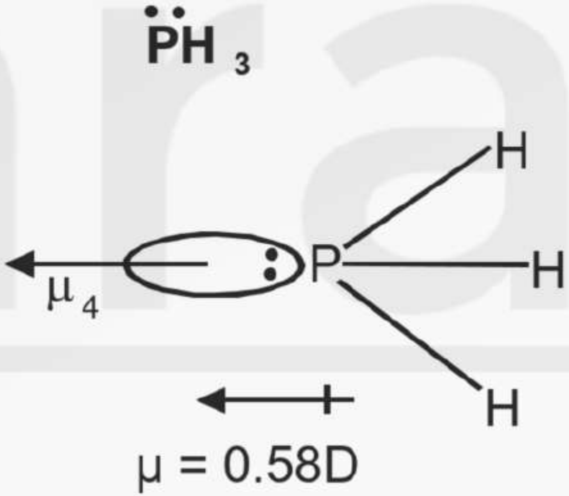
HF > HCl > HBr > HI

1.92D, 1.03D, 0.78D, 0.38D

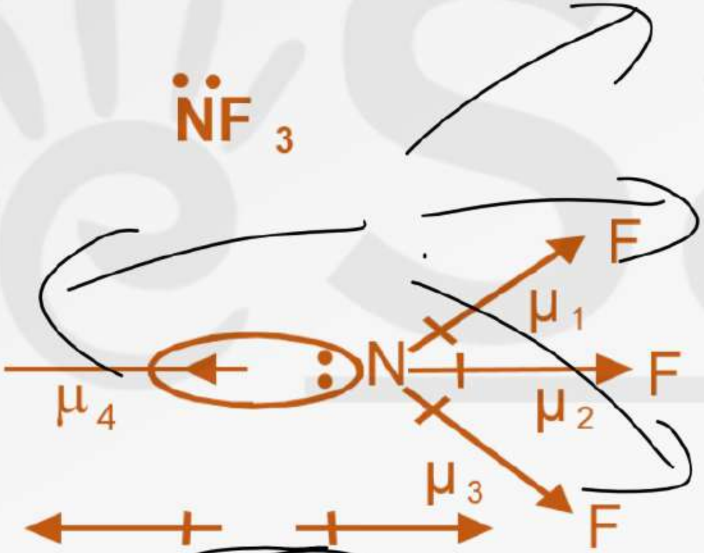
EN↑ μ↑



EN~

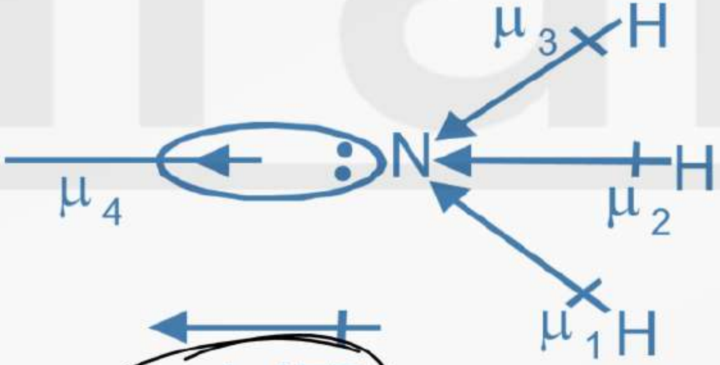


$\ddot{N}F_3$



$\mu = 0.24D$

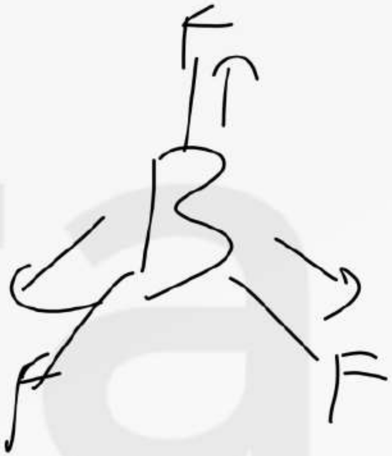
$\ddot{N}H_3$



$\mu = 1.47D$

Q) Compare dipole moment in CH_3F, CH_2F_2, CHF_3 & CF_4

Learn

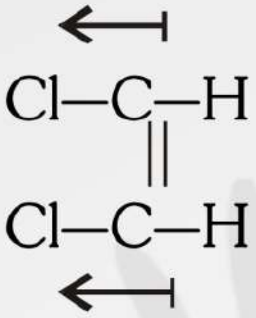


Sol. $CH_3F > CH_2F_2 > CHF_3 > CF_4$

As number of F increases

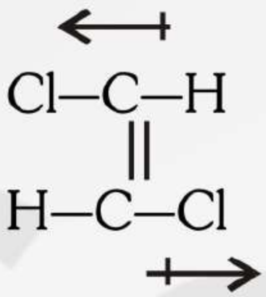
it opposes dipole moment due to other bonds.

To distinguish cis form or trans form



$$\begin{array}{c} \mathrm{Cl-C-H} \\ \| \\ \mathrm{Cl-C-H} \end{array}$$

$\mu \neq 0$
cis-form
Polar ($\mu \neq 0$)



$$\begin{array}{c} \mathrm{Cl-C-H} \\ \| \\ \mathrm{H-C-Cl} \end{array}$$

$\mu = 0$
Trans-form
Non polar

$C_2H_2Cl_2$ polarity
trans $\mu = 0$
cis $\mu \neq 0$

% Ionic character = 16Δ +3.5Δ^2

(Δ is the absolute EN difference)

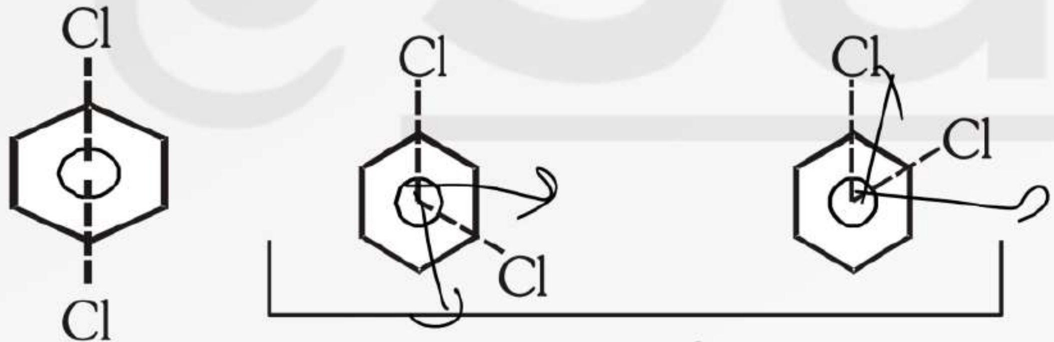
= [$\mu_{observed}$/ $\mu_{calculated}$] x 100

To Locate Position Of Substituents In Compounds.

$$\mu \propto \frac{1}{\text{Bond Angle}}$$

$o > m > p$ (general case)

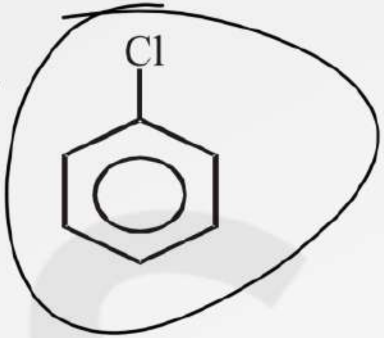
Para **Meta** **Ortho**

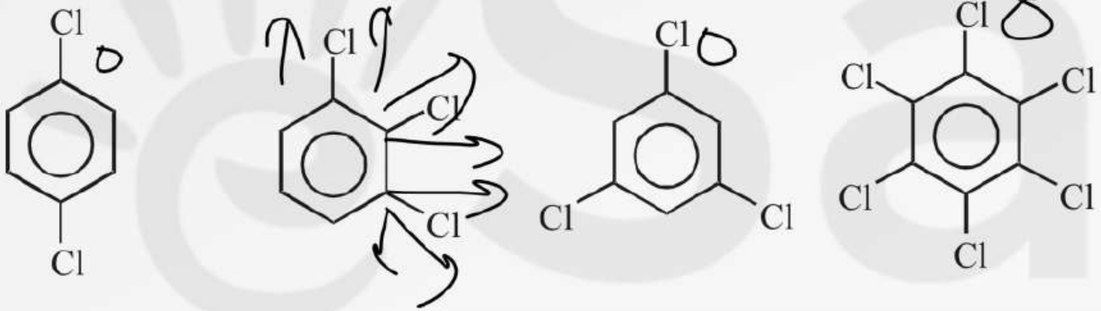


$\mu = 0$

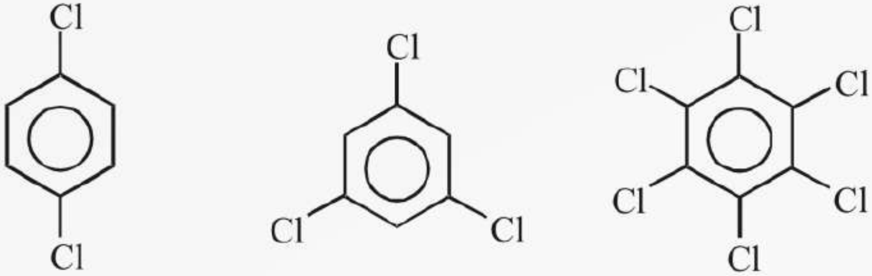
$\mu \neq 0$

Q.2 Find the number of molecule having dipole moment less than the dipole moment of





Ans. (3)

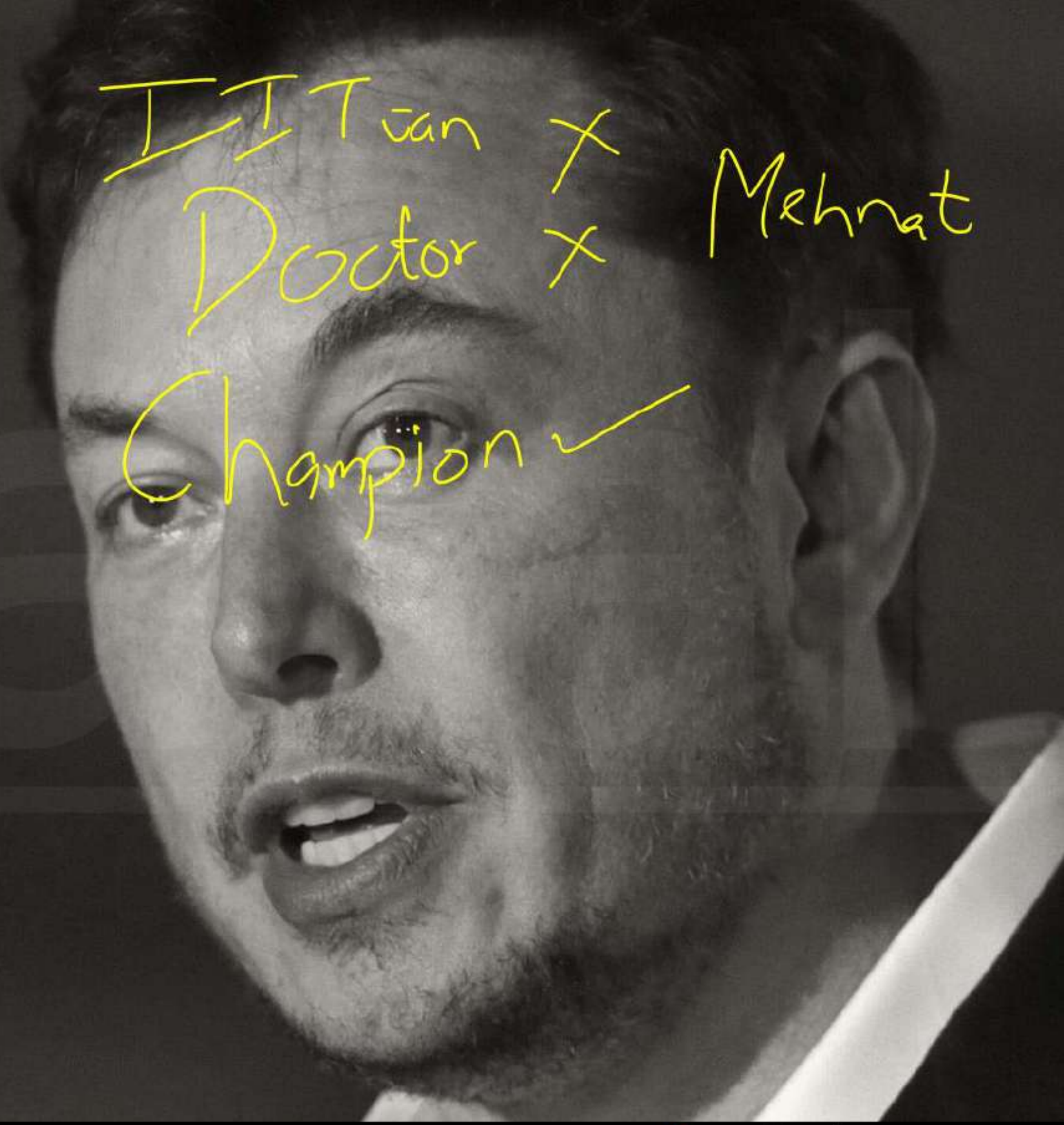


Caution

In chemistry dipole moment direction is from positive to negative, whereas it's opposite is true in Physics!!

"When something is important enough, you do it even if the odds are not in your favor."

Elon Musk



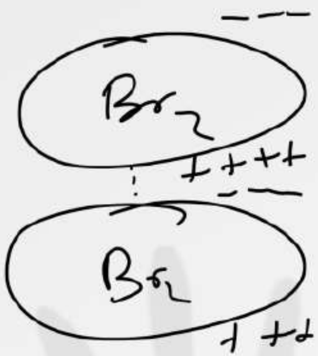
IITian ✗

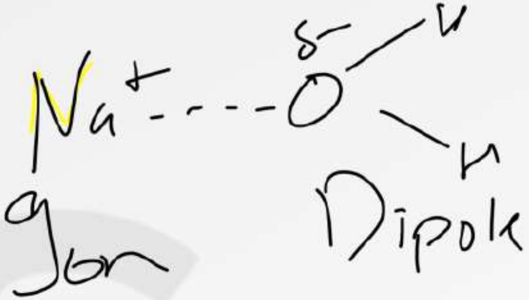
Doctor ✗

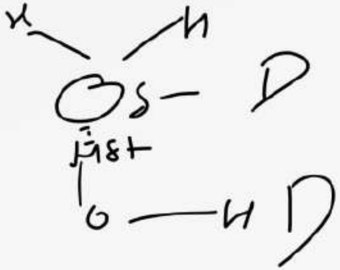
Champion ✓

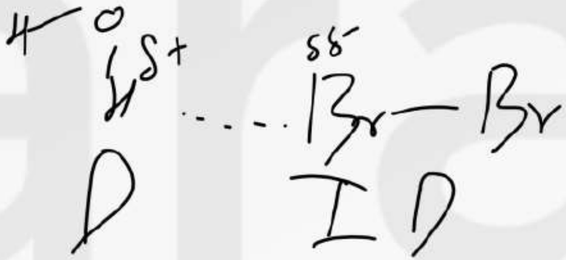
Mehnat

Weak Bonds









(a) Ion-dipole attraction 1

(b) Dipole-dipole attraction 2

(c) Ion-induced dipole attraction 3

(d) Dipole-induced dipole attraction 4

(e) Instantaneous dipole-Induced dipole (Dispersion force or London forces) 5

strength of Weak bonds a > b > c > d > e

Instantaneous dipole- Instantaneous induced dipole attraction (London Forces)

Exists among the non-polar molecules like H_2, O_2, Cl_2 etc. in solid or liquid states. Liquification of noble gases happens by the action of London Force.

instantaneous dipole

instantaneous induced dipole

Q) In which molecule is the London dispersion force likely to be most important in determining melting point and boiling point ?

(A) ICl Polar **(B) Br_2** np

(C) H_2S p **(D)CO** polar

Ans B

Q) Among the following, van derWaals forces are maximum in :

(A) HBr **(B) LiBr** **(C) LiCl** [✓ **(D)AgBr**]

✓ H_2O

VDF $\propto$ Molecular Mass

Ans D
Moleuclar mass is maximum for AgBr

Q) The decreasing solubility order in water of noble gases is

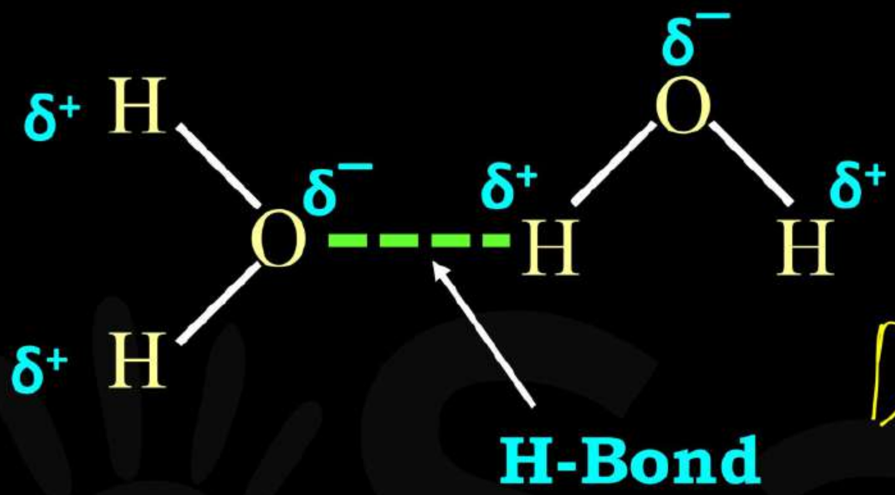
- (A) He > Ne > Ar > Kr > Xe
- (B) He < Ne < Ar < Kr < Xe
- (C) Ar > He > Kr > Xe > Ne
- (D) None of these

Solubility $\propto$ forces

VDF $\propto$ MM

$D \rightarrow ID$

Ans (B)



H-bond

Dipole-Dipole Interaction

1) Happens in the case of high EN elements.
Such as F, O and N.

H-bond can be classified into 3 categories.

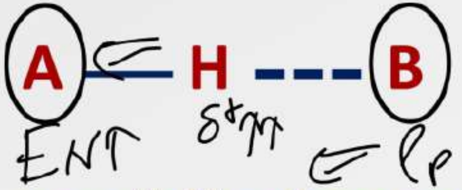
(a) Weak < 25 kJ/mol.

(b) Medium 25-35 kJ/mol

(c) Strong > 35 kJ/mol

ex : $K^+HF_2^-$ or $[HF_2^-]$ ion energy = 220 kJ/mol.

Strong Bonds



$\frac{K \overset{\uparrow}{q_1} q_2}{r^2}$

possibility increases when atom A is more -ve and availability of l.p. on B-atom. (B must be relatively less -ve)

N | O

Q) The correct order of H bond strength is?

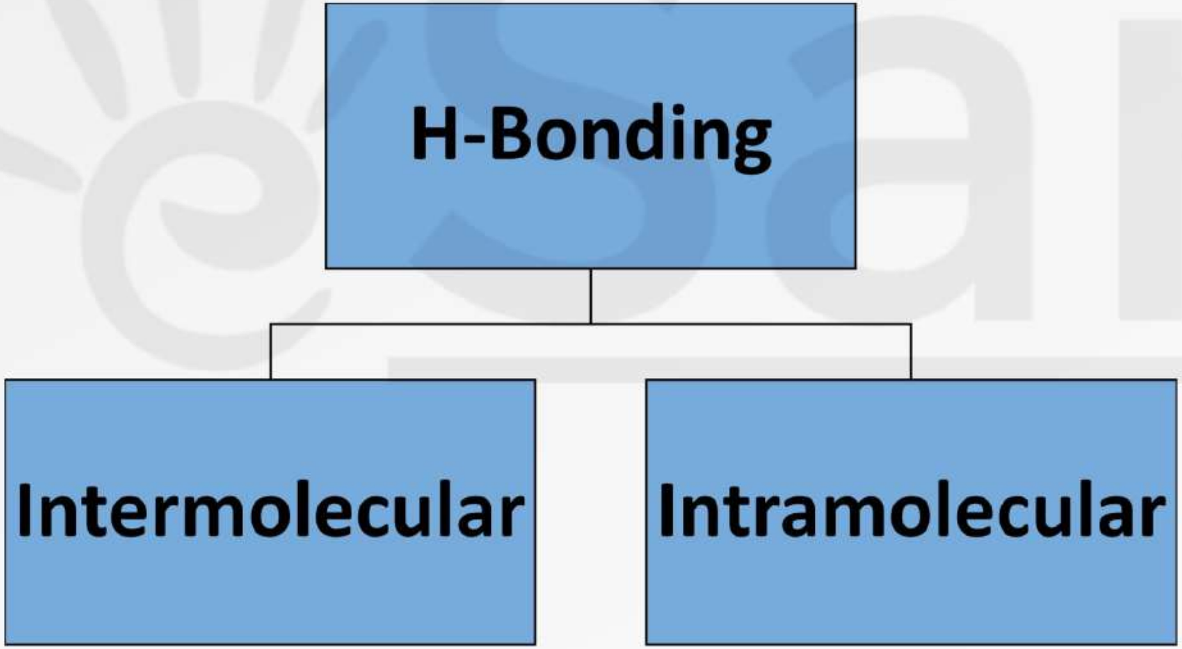
P: $\overset{A}{\text{O}}$-H- - - -$\overset{B}{\text{N}}$ Q: O-H - - - -$\overset{B}{\text{O}}$

R: $\underset{X}{\text{N}}$-H- - - -N   S: $\underset{X}{\text{N}}$-H- - - -O

(A) Q > P > S > R   (B) R > Q > S > P   (C) R > S > P > Q   (D) P > Q > R > S

Ans. D

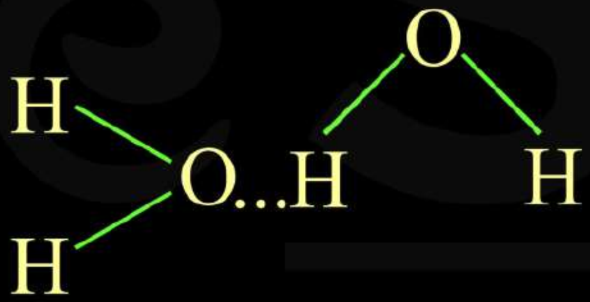
$A \cdots B$



H-Bonding

Intermolecular

Intramolecular



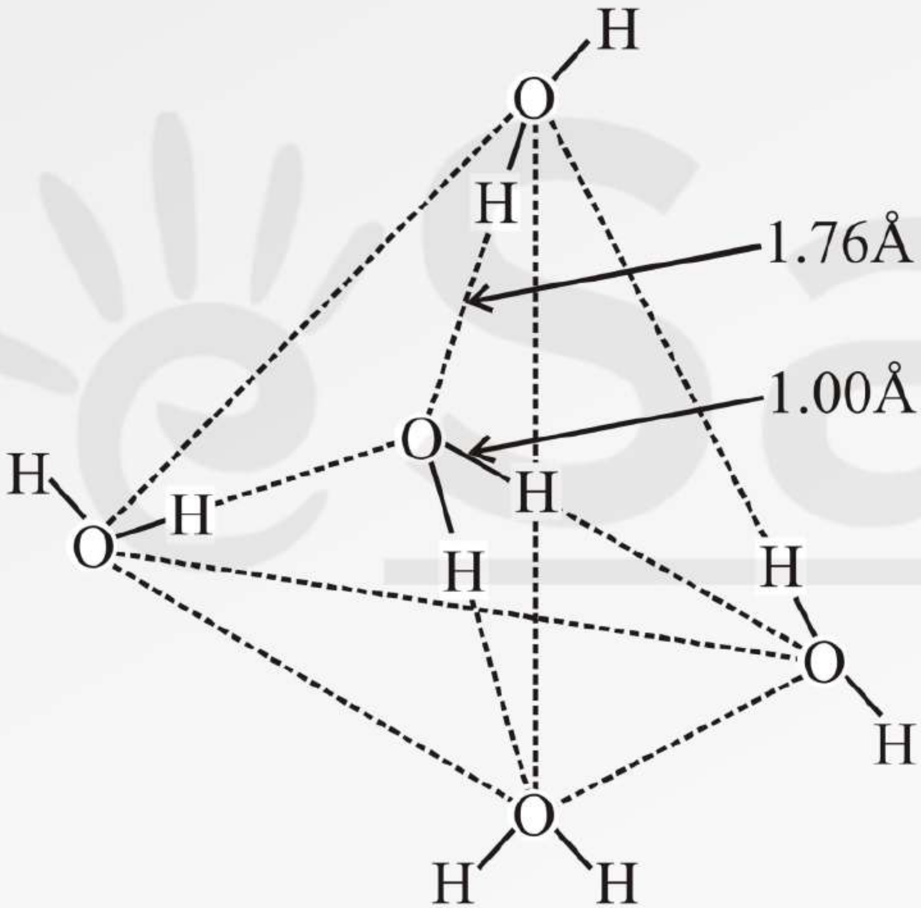
Intermolecular

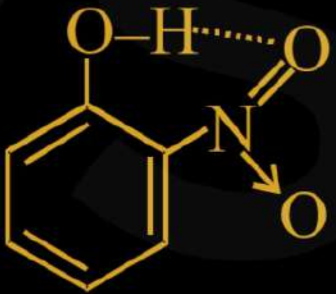
Q) Explain Anomalous behavior of Water and crystal structure of Ice.

0°C

Special

tetrahedral



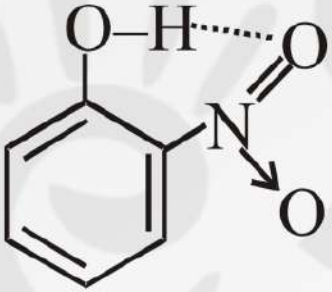


Intramolecular

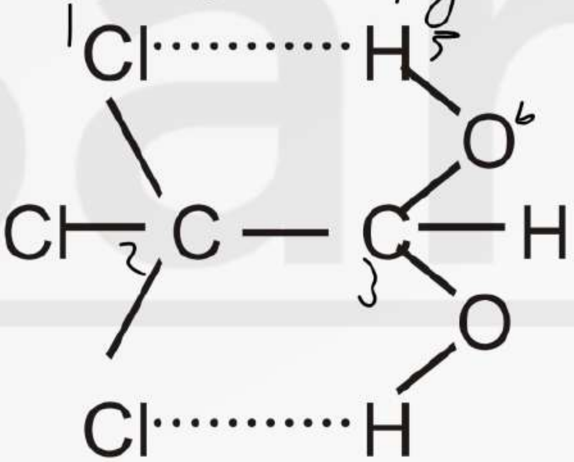
vv Imp

5, 6 membered ring ✓

Butterfly Structure



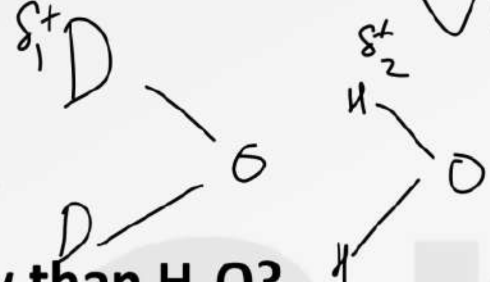
o-nitrophenol
less soluble in water



Chloral hydrate

Viscosity: The substances which can give more extensive hydrogen bonding will have higher viscosity.

$\delta_1^+ > \delta_2^+$



Viscosity $\propto$ Intermolecular Bonding $\propto \frac{1}{\text{Intra-molecular Bonding}}$

Q) Why D_2O has higher viscosity than H_2O?

Sol. D is more electropositive than H, so partial positive charge on D is more than on H, hence the extent of H-bonding is more in D_2O

Dipole induced dipole interactions are present in which of the following pairs :-

(1) $\overset{np}{SiF_4}$ and $\overset{np}{He}$ atoms (2) $\overset{p}{H_2O}$ and $\overset{p}{\text{alcohol}}$ **[NEET-UG 2013]**

(3) $\underset{np}{Cl_2}$ and $\underset{np}{CCl_4}$ (4) $\underset{p}{HCl}$ and $\underset{np}{He}$ atoms

Ans 4

Which of the following is a polar molecule ? **[NEET-UG 2013]**

(1) XeF_4	(2) BF_3	(3) SF_4 ✓	(4) SiF_4
Sq planar	TP	see saw	Tetrahedral

Ans 3

Electrovalent or Ionic bond

One should be electropositive & other should be electronegative

High EN difference

Cation forming element should possess 1,2 or 3 valence electrons

Group 1,2,13

Anion forming element must possess 5,6 or 7 valence electrons

15,16,17

NaCl Viscosity $\propto$ MM $\propto$ Force

A bond is formed when Energy is released

Ionisation enthalpy of Na = 496 KJ/mole

Electron gain enthalpy of Cl = -349 KJ/mole

147KJ/mol

Ionisation enthalpy of **Na = 496 KJ/mole**

Na^+ Cl^-

Electron gain enthalpy of **Cl = -349 KJ/mole**

Lattice Energy of **NaCl = - 787 KJ/mol**

-640 KJ/mol

1st

Cs

Cl

CsCl

Low I.E. ✓

High EA ✓

High LE ✓

(a) Lattice energy (L.E.) $\propto \frac{1}{r}$

$r = r_+ + r_-$ = interionic distance

Ex: NaCl > KCl

(b) L.E. $\propto Z^+, Z^-$

Z^+ = charge on cation

Z^- = charge on anion

Ex MgO > NaCl

s-block electrovalency

1 **H**	
3 **Li**	4 **Be**
11 **Na**	12 **Mg**
19 **K**	20 **Ca**
37 **Rb**	38 **Sr**
55 **Cs**	56 **Ba**
87 **Fr**	88 **Ra**

Alkali Metals

+ 1

Alkali Earth Metals

+ 2

d-block electrovalency

Na $IE_1 >>> IE_2$

Variable Electrovalency

(a) Instability of the core: Do not attain inert gas configuration, hence unstable core.

Fe = [Ar] $4s^2\ 3d^6$

(b) Comparatively less difference between successive ionisation energies.

Ex: Fe (+2, +3), Mn (+2, +3, +4, +7)

p-block electrovalency

Variable Electrovalency

Inert pair effect

Tendency of the s subshell electrons of p block to become inert to bonding in the elements at the bottom of the groups.

Increased effective nuclear charge at the bottom of the groups.

Tl

$s^2 p^1$

$\boxed{s^2}$ nuclear force ↑↑↑

tough

4d series Thalium

⇓

poor shielding

+1 oxidation state of Tl is more stable than it's +3 oxidation state. Similarly +2 for Pb > +4 and +3 for Bi > +5

Q) $PbCl_4$ is stable at room temperature, whereas PbI_4 doesn't exist. Explain.

$Pb^{+4} \rightarrow Pb^{+2}$ $\quad$ $I^- \rightarrow$ redox

unst $\quad$ stable

Sol. Due to inert pair effect Pb(+4) is less stable than Pb(+2). Hence it is very good oxidant.

$Cl^- \rightarrow$ redox

$Pb(+4) + 2e^- \longrightarrow Pb(+2)$

Reducing abilities of halides follows the sequence

$I^- > Br^- > Cl^-$

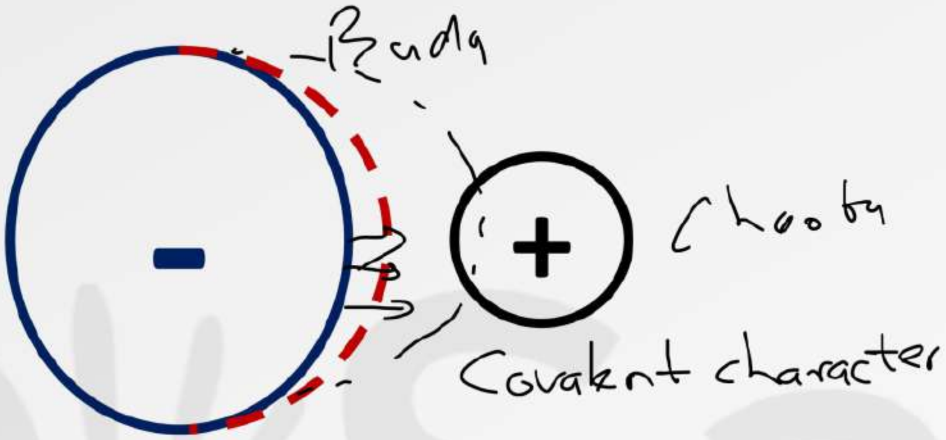
$$Pb(+4) + 4Cl^- \longrightarrow PbCl_4 \xrightarrow{\Delta} PbCl_2 + Cl_2$$

$$Pb(+4) + 4I^- \longrightarrow PbI_2 + I_2$$

AgCl → White

AgBr → Pale Yellow

AgI → Dark Yellow



Fajan

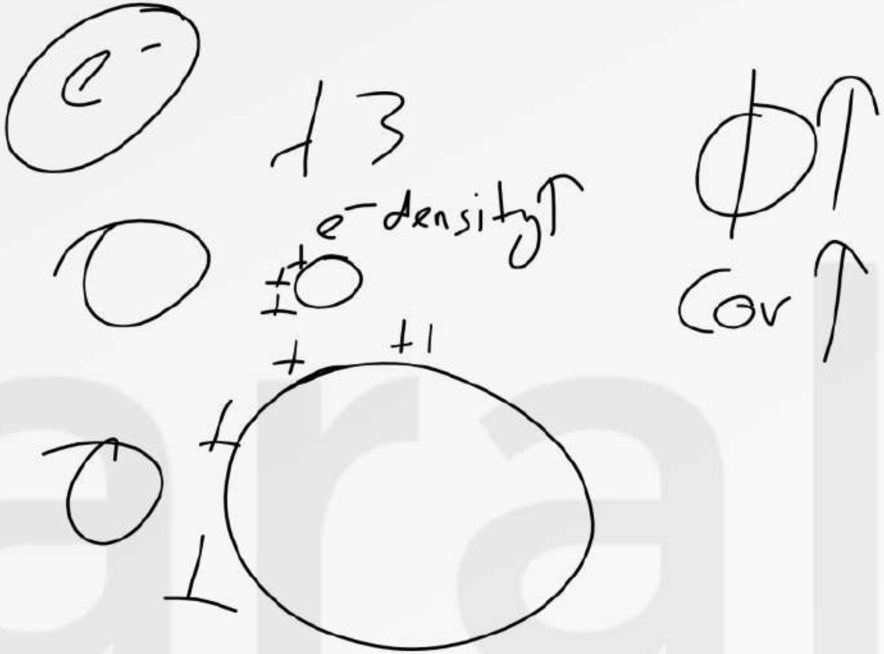
Ionic Bond

Covalent Bond

With increasing polarization, the charge clouds of neighboring cations and anions would ultimately tend to mix or merge with one another as is observed in a covalent compound.

No bond is 100% covalent or Ionic

Polarizing power of a cation is usually called Ionic Potential or Charge Density



$$\text{Ionic Potential } \phi \text{ (phi)} \propto \frac{\text{Charge on cation}}{\text{Size of Cation}}$$

Fajan’s Rules

$$\text{Ionic Potential } \phi \text{ (phi)} \propto \frac{\text{Charge on cation}}{\text{Size of Cation}}$$

$r_a < r_b$ $k \frac{Q_1 Q_2}{r^2}$

Size of cation↑ ϕ ↓ Covalent character↓

AgF gc↑

$\overset{+}{A}gBr$ gc↓

Size of anion↑ ϕ ↑ Covalent character↑

$\Longrightarrow$ Cov↑

Cation↓ ϕ↑

Anion↑ ϕ↑

Q) The most covalent halide is:-

(1) $\overset{+3}{Al}F_3$ (2) $\overset{+3}{Al}Cl_3$

(3) $\overset{+3}{Al}Br_3$ (4) $\overset{+3}{Al}I_3$

Anion size ↑

$\phi \uparrow$

Cov↑

Ans 4

Charge on ion ↑ ϕ ↑ **Covalent character** ↑

4) A cation with 18 electrons in its outermost shell (non-inert gas or pseudo inert gas configurations, ns^2 np^6 nd^{10}) has greater polarization power to polarize an anion than a cation with s-electrons in its outermost shell (inert gas configuration ns^2 np^6) even if both the cations have same size and charge.

Which is more covalent, CuCl or NaCl?

Ans) Cu^+ and Na^+ both the cation (Pseudo-inert & inert) have same charge but polarising power of Cu^+ is more than Na^+ because –

d – block
pseudo ϕ
↓
inert configuration

Z_{eff} of ns^2p^6 (inert) < Z_{eff} of $\underline{ns^2}\underline{np^6}\underline{d^{10}}$ (pseudo-inert)

Na^+ < Cu^+

(Ionic) (Covalent)

So, CuCl has more covalent character than NaCl.

Li^+

1. Colour in Ionic compounds $\phi\uparrow$ colour $\uparrow$
2. Thermal Stability Ionic character $\uparrow$ TS $\uparrow$ $\phi\downarrow$
3. Melting point $\phi\downarrow$ MP $\uparrow$
4. Solubility in water $\phi\uparrow$ solubility $\downarrow$
5. Ionic Mobility

The bigger anions are more polarised and hence their electrons get excited by absorption of visible light

$\phi \uparrow$ color $\uparrow$

Q) In $SnCl_2$ and SnI_2, which compound is more probable to show color?

Ans) $SnCl_2$ is white but SnI_2 is red

- Thermal Stability
  - Polyatomic Anion
    - Ionic Character(Fajan's Rule)
  - Monoatomic Anion
    - Lattice Energy

Alkali Metal Carbonates: Ionic character order

$Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$

Alkali Earth Metal Carbonates: Ionic character order

$BeCO_3 < MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

$$MCO_3 \xrightarrow{\Delta} \underline{MO} + \underline{CO_2}$$

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

Carbonates of alkali metals other than Li_2CO_3 do not decompose on heating, they melt on heating.

Thermal Stability of Metal Sulphates

$$MSO_4 \xrightarrow{\Delta} MO + SO_3 \ (T > 800^0 \text{ C then } SO_3 \longrightarrow SO_2 + \tfrac{1}{2}O_2)$$

Thermal Stability of Metal Nitrates

$$2MNO_3 \xrightarrow{\Delta} M_2O + 2NO_2 + \frac{1}{2}O_2$$

Ag_2S is less soluble than Ag_2O in H_2O

$Fe(OH)_3$ is less soluble than $Fe(OH)_2$ in water

$\phi\uparrow$ solubility$\downarrow$

M.P. of covalent < M.P. of ionic

$\underrightarrow{BeCl_2\ ,\ MgCl_2\ ,\ CaCl_2,\ SrCl_2,\ BaCl_2}$

ionic charater $\uparrow$ MP $\uparrow$

$\phi\uparrow$ MP$\downarrow$

$\phi\uparrow$ MP$\downarrow$

Learn

Exception

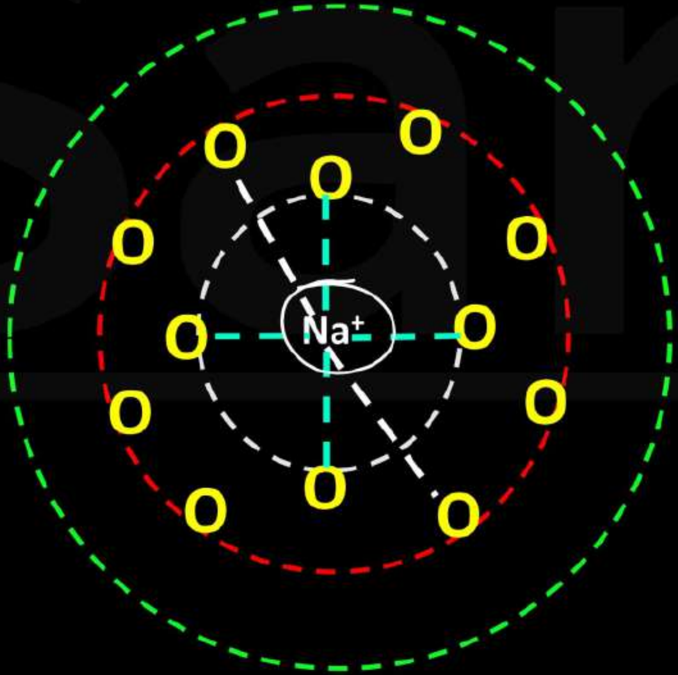
NaCl>KCl>RbCl>CsCl>LiCL

$O^{\delta-}$ Na^+ 1Cr

$H^{\delta+}$ 10Rs

Hydrated

$\phi \uparrow$ Size $\uparrow$



$\phi \uparrow$ IM $\downarrow$

Q) What is the correct order of hydrated size for alkali metal cations?

Li > Na > K > Rb > Cs

AO_2 B
Am
A/

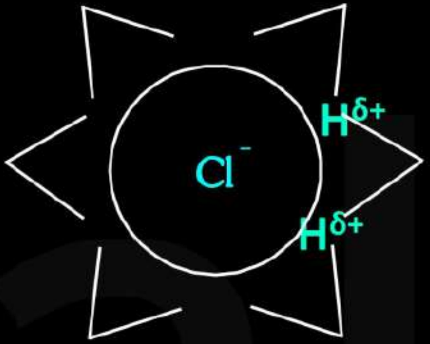
Oxide

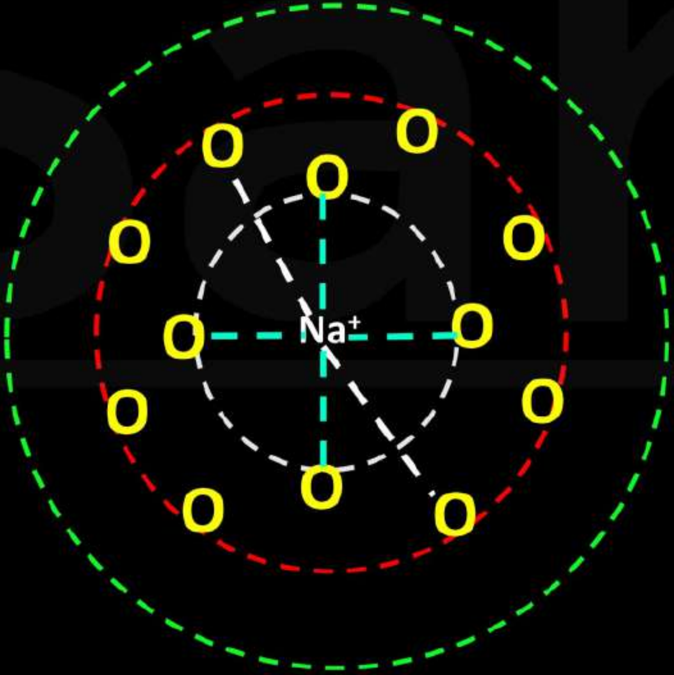
$\sqrt{\Phi} < 2.2$ **Basic**

$2.2 < \sqrt{\Phi} < 3.2$ **Amphoteric**

$\sqrt{\Phi} > 3.2$ **Acidic**


δ-
O
δ+
H
δ+
H


Cl⁻
Hδ+
Hδ+


Na⁺
O
O
O
O
O
O
O
O
O
O
O
O
O
O

Lattice ✓ Solubility

$AB \xrightarrow{H_2O} A^+ + B^-$ Break

$AB \xrightarrow{H_2O} AB$ X

Whenever any compound, generally ionic or polar covalent is dissolved in a polar solvent then different ions of the compound will get separated and will get surrounded by polar solvent molecules. This process is known as solvation. Energy released in this process is known as solvation energy.

Condition for Solvation

gm↓ Conductivity↓

Warning → There is no explanation of Solubility

It is purely Experimental

$\Delta H_{hydration} > \Delta H_{Lattice\ energy}$

(i)Water has maximum dielectric constant ($\varepsilon = 80$)

(CH_3OH $\varepsilon = 35$), (Acetone $\varepsilon = 21$)
(C_2H_5OH $\varepsilon = 27$), (Ether $\varepsilon = 4.1$)
(Benzene $\varepsilon = 2.3$)

$H_2O > CH_3OH > CH_3CH_2OH > CH_3COCH_3 > CH_3OCH_3 > C_6H_6$

↓ Poly anion ≥ Cation

sol ↓

↓ sol ↑

Generally solubility increases down the group, but in case of polyatomic anion it decreases down the group when number of anion is ≥ number of cations.

General observation

Poly

Big Ions

- SO_4^{2-}
- CO_3^{2-}
- Br^-
- I^-
- ClO_4^-

↓ > cation sol ↓

mono atomic

Small Ions

- OH^-
- F^-
- O^{2-}
- S^{2-}

↓ sol ↑

1. $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
2. $BeX_2 > MgX_2 > CaX_2 > SrX_2 > BaX_2$ where (X = Cl, Br, I)

Polyatomic anion. With Anion $\geq$ Cation

3. $Li_2CO_3 < Na_2CO_3 < K_2CO_3 < Rb_2CO_3 < Cs_2CO_3$
4. $NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$

Polyatomic anion. With Anion < Cation

5. $Be(OH)_2 < Mg(OH)_2 < Ca(OH)_2 < Sr(OH)_2 < Ba(OH)_2$
6. $LiF < NaF < KF < RbF < CsF$

Monoatomic anion.

Exceptions

1) $BaF_2 > BeF_2 > SrF_2 > CaF_2 > MgF_2$

Above happens because BeX_2 forms a soluble complex in water, leading to increased solubility.

2) $NaCl > KCl > RbCl > CsCl > LiCl$

3) $NaF > KF > LiF > RbF > CsF$

4) $MgC_2O_4 < CaC_2O_4 < SrC_2O_4 < BaC_2O_4 < BeC_2O_4$

Amongst LiCl, RbCl, $BeCl_2$ and $MgCl_2$ the compounds with the greatest and the least ionic character, respectively are : **[JEE-MAINS(Online) 2014]**

(1) RbCl and $MgCl_2$
(2) LiCl and RbCl
(3) $MgCl_2$ and $BeCl_2$
(4) RbCl and $BeCl_2$

Ans 4