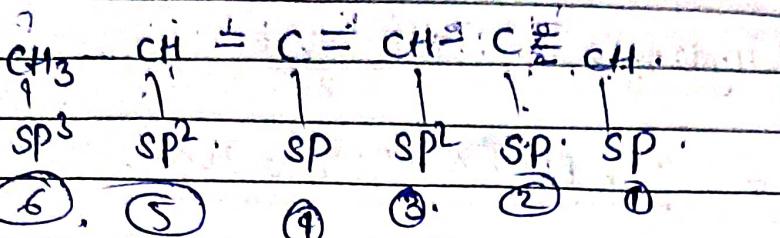


Q1

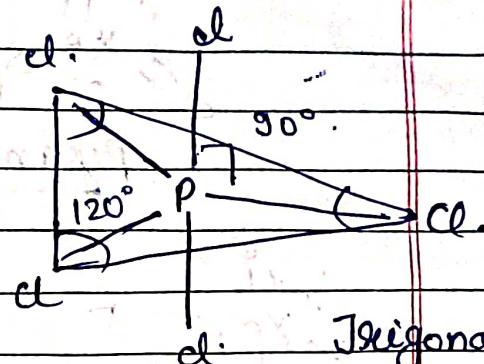
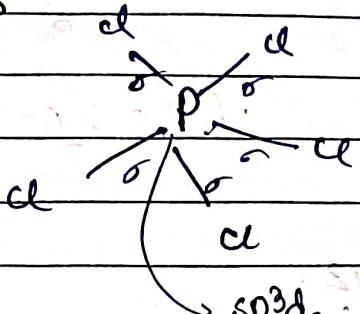
Determine the hybridization.



σ bond = s.l. total.

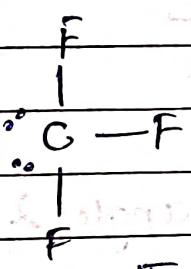
π bond = 4

* PCl_5



Trigonal
Bipyramidal.

* ClF_3 .

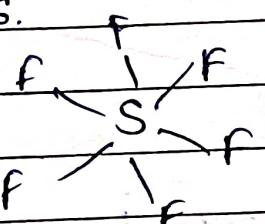


T-shaped

$\text{sp}^3 + 3 \cdot \text{sp}^1 \rightarrow \text{LP} + \sigma \text{ bond} = \text{no. of hybrid orbitals.}$

* Chem Bonding \rightarrow shape.

* SF_6 .



$\text{sp}^3 \text{d}^2$.

Square bipyramidal.

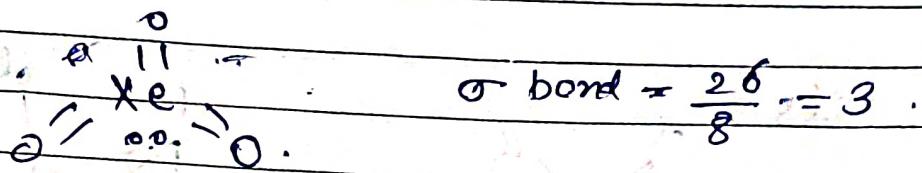
* Maxⁿ bond angle of $90^\circ \Rightarrow \text{sp}^3 \text{d}^2$

* $\text{IF}_7 \rightarrow \text{sp}^3 \text{d}^3 \rightarrow$ pentagonal Bipyramidal.
each angle = 72°

* no. of σ bond = Total valence e⁻
8.

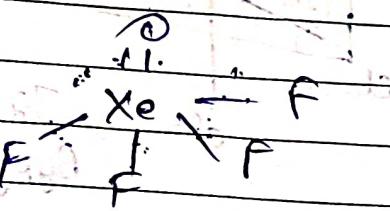
* In case of Hydrogen = Total V.e⁻
 $\frac{2}{2}$.

$$l.p. = \frac{T.V.E - 8 \times \text{no. of } \sigma\text{-bond}}{2}.$$



Pyramidal

$$l.p. = \frac{26 - 8 \times 3}{2} = 1.$$



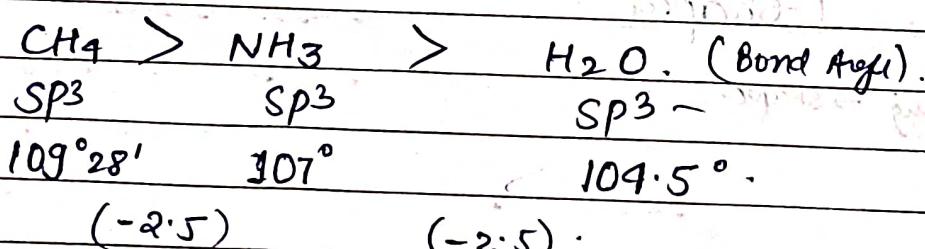
sp^3d^2

Square pyramidal.

$$l.p. = 26 - 8 \times 0$$

$$\sigma\text{-bond} = 0$$

★. VSEPR THEORY \rightarrow det'n of bond angle & shape



ORP 1 LP 2 LP

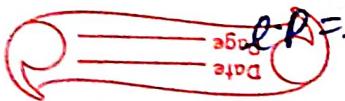
* (i) $l.p. \propto \frac{1}{\text{Bond angle}}$ (C.A containing same hybridization).

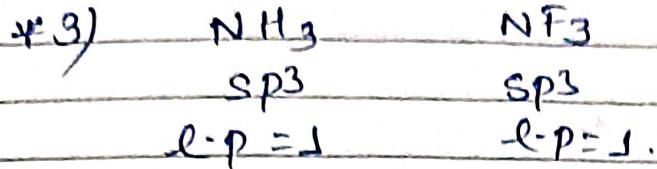
* (ii) $NH_3 > PH_3$ (Bond Angle).

SP^3 SP^3

$$l.p. = 1$$

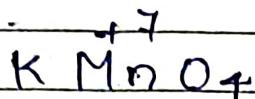
C.A of diff molecules having
(C.A EN ↑) same hybridization
same l.p.
→ Bond Angle ↑.





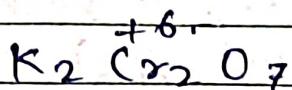
Bonded atoms: N 1

Bond angle 111



$$+1 + x - 8 = 0$$

$$x = +7.$$



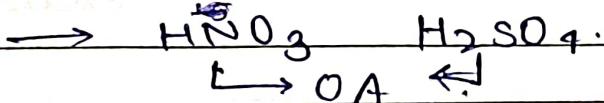
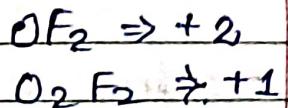
mp.



→ Highest O.S. = Valence e⁻
 ↳ O.A

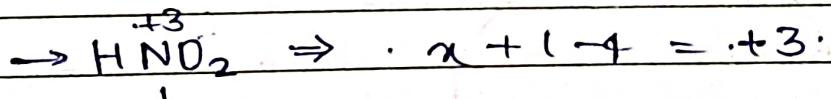
generally = -2
 In case of S.O. = $-\frac{1}{2}$
 Peroxide = -1.

→ Lowest O.S. = $v \cdot e^- - 8$
 ↳ R.A



→ $\text{H}_2\text{S}^{-2} \Rightarrow$ Reducing Agent.

NH_3
 ↓
 Jones O.S.

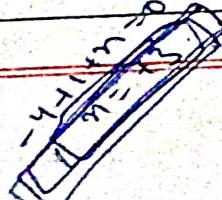
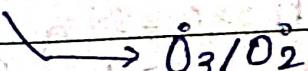
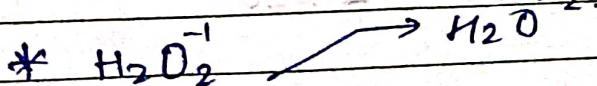


↓
 Reducing Agent.

O.A & R.A both.



Such gets reduced /
 & behaves as
 O.A. substance gets oxidized & behaves as
 $-2 + 2n = 0$ $N_2\text{O}/\text{NO}$ reducing agent
 $n = +1$ HNO_3/NO_2



* Ionisation.

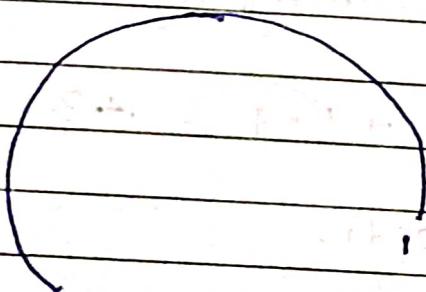
$\text{ENC} \rightarrow$ attractive force.
 $(+)$ screening effect. $V.E.$
 \rightarrow Repulsive force
 $\epsilon^* = Z - S.$

→ Inner shell acts as a screen b/w valence e^- and nucleus. → screening effect.

\uparrow V-shell \uparrow Screen effect \downarrow ENC.

→ force of attr. b/w nucleus & valence $e^- \rightarrow$ effective nuclear charge

* Shielding constant value is determined by Slater's.



In case of Helium.

$\text{He} \rightarrow 1s^2$.

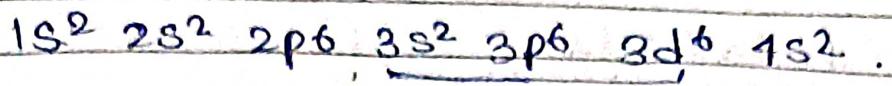
for s electron $\rightarrow 0.30$.

$\text{He} \rightarrow 1 \times 0.30$.

$$\text{ENC} = 2 - 1 \times 0.30.$$

$$\begin{aligned} n &\rightarrow 0.35 \\ (n-1) &\rightarrow 0.85 \\ (n-2) &\rightarrow 1 \\ (n-3) &\rightarrow 1. \end{aligned} \left. \begin{array}{l} \text{for } S_4 \\ \text{P electron} \end{array} \right\}$$

$$\begin{aligned} n &\rightarrow 0.35 \\ (n-1) &\rightarrow 1 \\ (n-2) &\rightarrow 1 \\ n-21 &\rightarrow 1 \end{aligned} \left. \begin{array}{l} \text{diff electrons} \\ \text{P electron} \end{array} \right\}$$



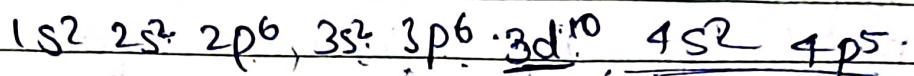
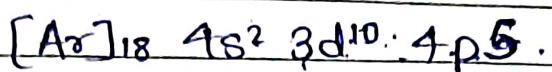
$$4s = 1 \times 0.35 + 18 \times 0.85 + 10 \times 1.00.$$

$$3d = 5 \times 0.35 + 18 \times 1$$

$$3p = 7 \times 0.35 + 8 \times 0.85 + 2 \times 1.$$

Q what is shielding constant experienced by $3d$ electron in boron atom.

$$Br \rightarrow 35.$$



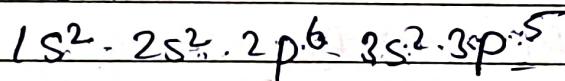
$$\phi g \times 0.35 + 18 \times 1 + \cancel{10 \times 1}$$

~~895 - 188
707~~

$$\begin{array}{r} 35 \\ \times 18 \\ \hline 35 \times \\ 540 \\ \hline 630 \end{array}$$

$$595$$

Cal. the value of effective nuclear charge for last electron of Cl. atom.

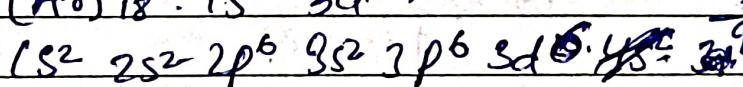
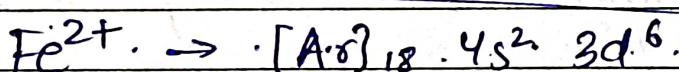


$$7 \times 0.35 + 8 \times 0.85 + 2 \times 1$$

~~21 + 68 + 2~~

~~109 - 10.9 =~~

~~68 - 10.9 =~~

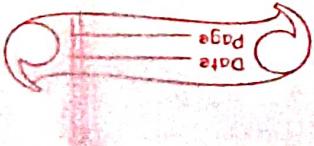


$$5 \times 0.35 + 18 \times 1$$

$$\begin{array}{r} 0.35 \\ \times 5 \\ \hline 17.5 \end{array}$$

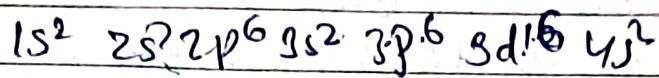
$$17.5 + 18 \rightarrow 19.75$$

$$Z^* = 26 - 19.75 = 6.25$$



* Ionisation Potential.

Fe. [Ar]

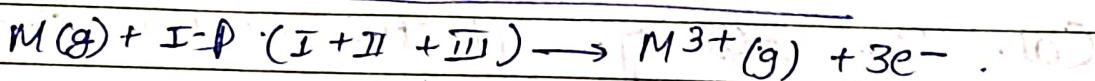
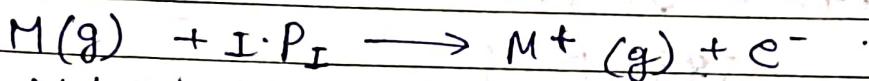


$$1 \times 0.35 + 1 \times 0.85 + 10 \times 1$$

71.2123

$$0.35 +$$

The amount of energy required to remove the valence e^- from an isolated gaseous atom to form cations. It is called ionisation energy/ potential.



$$I.P_I < I.P_{II} < I.P_{III}$$

$$M > M^+ > M^{2+} > M^{3+}$$

* It is the property of metals & it is endothermic process.

* Factors which influence the value of I.P.

(1) Size

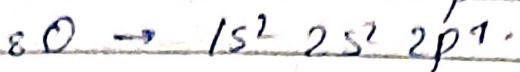
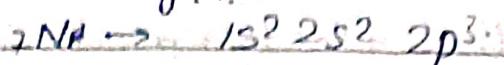
$$I.P \propto \frac{1}{r}$$

(2) At.size

(3) Half filled & completely filled & vacant orbitals are the most strong.

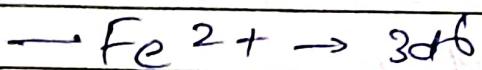


Q The value of IP of Nitrogen is more than Oxygen why??



Half filled orbitals are available in the case of Nitrogen so, it is more stable than Oxygen. Therefore the value of IP of Nitrogen is more than that of Oxygen.

* .



* Screening constant (S.C.) .

$$IP \propto \frac{1}{S.C.} \propto \text{Effective Nuclear Charge}$$

* Penetration effect : (e⁻ attracting power).
 $S > P > d > f$.

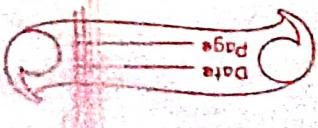
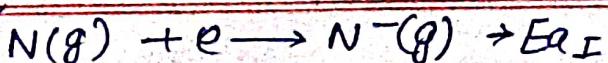
→ Penetration effect decreases in the order.
 $S > P > d > f$.

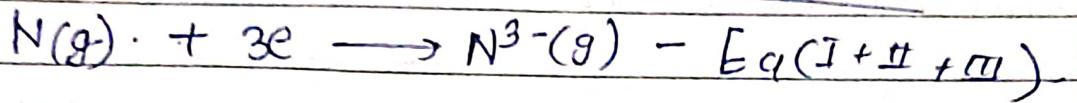
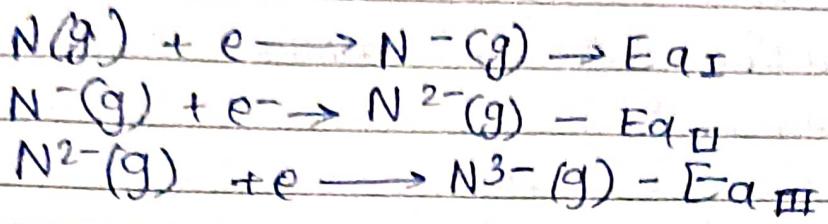
* Electron Affinity :-

The amount of energy released by the addⁿ of e⁻ in the valence shell of an isolated gaseous atom, to form anion.

→ Non-metal property.

→ Exothermic





The value of EA is highest in the case of fluorine in PT.

The value of EA of fluorine is less than chlorine.

→ small size, ~~d-orbital~~
due to absence of d-orbital in the case of fluorine.

EA of Nitrogen < EA of phosphorous.

EA = 0 (inert gases).

Q) The value of EA for inert gases is zero.

→ The outermost config. of inert gas is $ns^2 np^6$.
that means outermost config. is completely filled. So addⁿ of e^- is very tough or impossible.

Electronegativity :-

→ i) is tendency of atom of an element to attract the shared pair of e^- towards itself.

It depends on two factors :-

i) valence electrons.

ii) size of the atom of an element

H - fluorine is the most E.N. in PT.

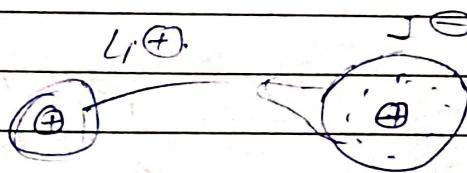
Q) F is more E.N. than Cl why?

Due to absence of 3d orbital in case of F

Pauling scale :-

- (i) EN diff. = 1.7. 50% ionic and 50% covalent
- (ii) EN diff. > 1.7 molecules are ionic.
- (iii) EN diff. < 1.7 molecules are covalent

→ Li⁺ soluble in organic solvent



→ Polarisability - The power of an ion⁽⁺⁾ to distort the other ion is known as its polarising power and the tendency of the ion to distortion is known as polarisability.

Eg- Li⁺I⁻



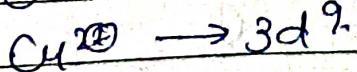
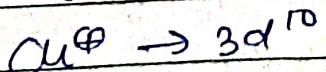
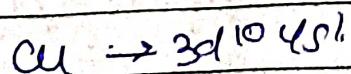
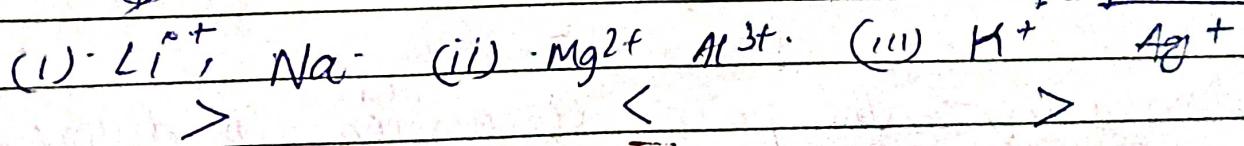
The variation in non-polar character of some compounds can be explained on the basis of polarisation effect.

* Fajan's Rule

- 1) High charge of the cation or anion.
- 2) Small size of the cation.
- 3) Large size of the anion.

- The polarising power of cation & polarisability of an anion will increase in the charge of the ions.
- Small size of cation will have higher charge density & therefore, it will be able to distort (polarise) the e- cloud of the anion more effectively.
- Larger anion: The polarisability (to get distorted) of an anion increases with increase in its size because its e- charge cloud is not firmly held by its own nuclear charge.

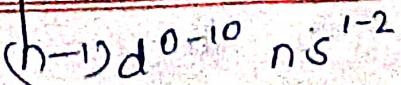
Q: which of the ion have larger tendency of polarisation



d-orbital. k/s size

decreases here

due to lanthanoid contraction



polarity Down

$\text{Cl}^- < \text{F}^-$

d block $\rightarrow (n-1)d^{1-10} ns^2$

f block $\rightarrow (n-2)f^{1-14} (n-1)d^{0-2} ns^2$

58 X

58 Ce $= [\text{Xe}]_{5g} 4f^1 5d^1 6s^2$

$\phi \cdot 57L \rightarrow [\text{Xe}]_{5g} 6s^2 5d^1$

Place \leftarrow { Group - 3
Period - 6. }

(69)

$\rightarrow [\text{Xe}]_{5g} 6s^2 5d^1 4f^{12}$

$\frac{5}{1} \frac{8}{2}$

72
18

90

$[\text{Xe}]_{5g} Rn \rightarrow 12. 5f^1 6d^1 7s^2$

117 $\rightarrow [\text{Rn}]_{8g} 5f^{14} 6d^1 7s^2 7p^5$

75
79

$$VE = 5 + 2 = 7$$

Group no $\Rightarrow 12$

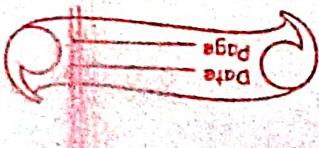
period $= 7^{\text{th}}$.

$(n+l)$ - value
same high
then energy
a value of
 n .

f block \rightarrow inner transition.

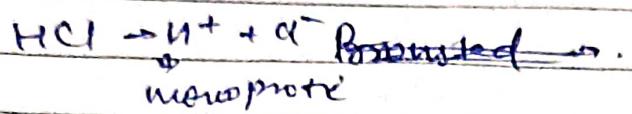
gf \rightarrow lanthanoids

5f \rightarrow Actinoids.

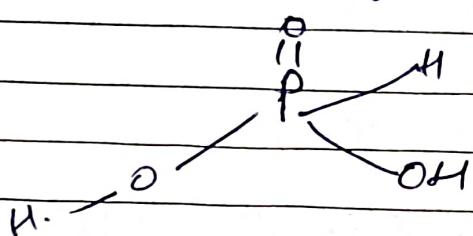


Acids :-

→ Arrhenius → H^+ → acid
 OH^- → base.



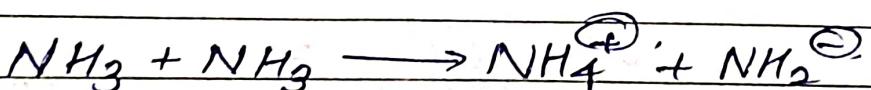
H_3PO_4 → it is a diprotic or dibasic acid.
bcz it gives two ionisable H^+ .



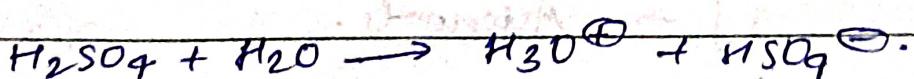
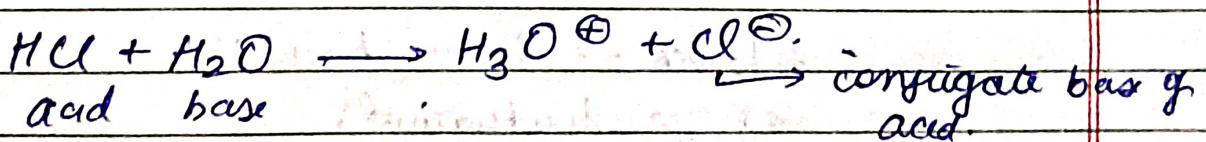
Bronsted .

Proton donor → acid

Proton acceptor → ~~acid.~~ base.

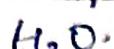


~~Proton acceptor~~
base ; ~~Proton donor~~
acid.

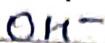


Acc. to Bronsted an acid after donating a proton to give a base called conjugate base of that acid.

Acid



Conjugate base



→ conjugate acid-base pair: A pair of an acid and a base which differ by only one H^+ ion.

Base



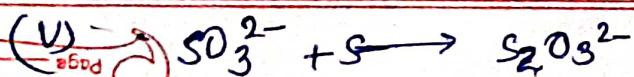
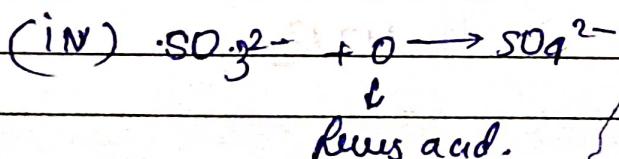
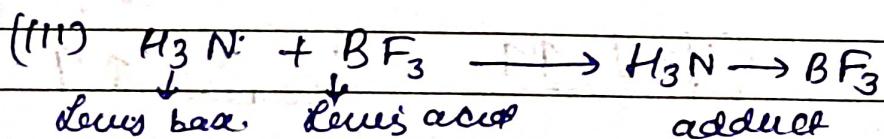
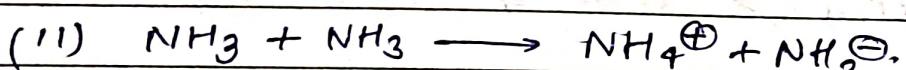
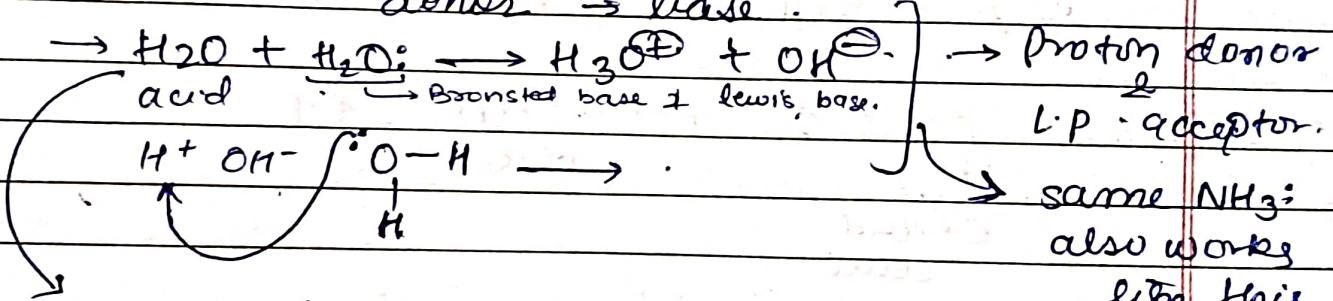
Conjugate acid.



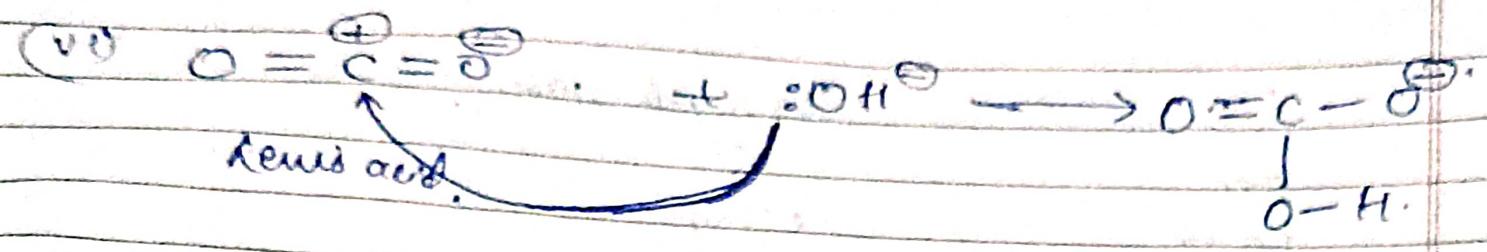
* Lewis concept.

Tone pair acceptor → acid

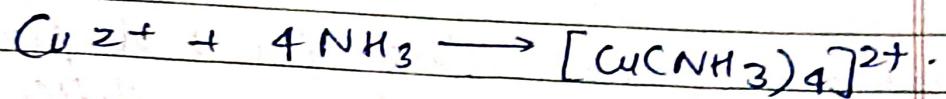
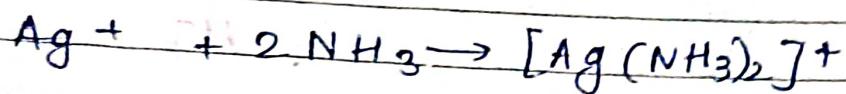
" " donor → base.



Atoms of an element containing 6 electrons in their valence shell behave as Lewis acid

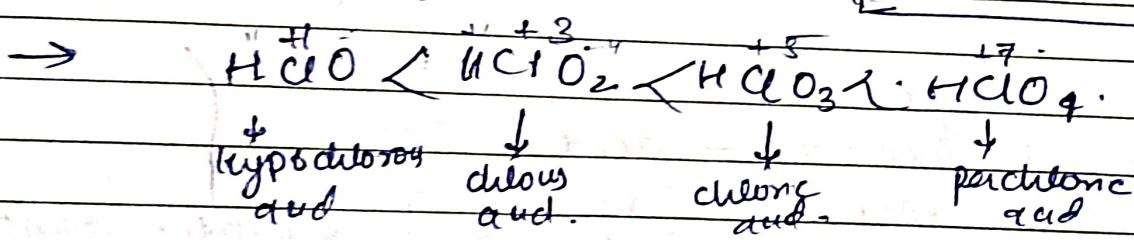
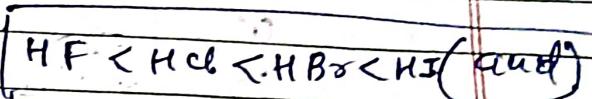


(VI) Simple cations Ag^+ ; Cu^{2+} .

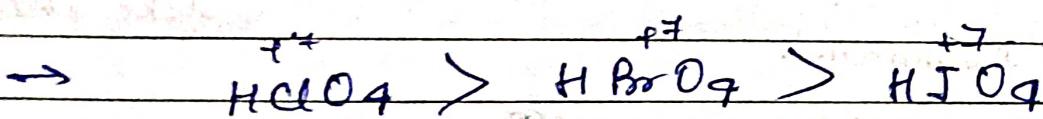


Alkali & alkaline earth metal \rightarrow hard acids.
Heavy metal \rightarrow soft acids.

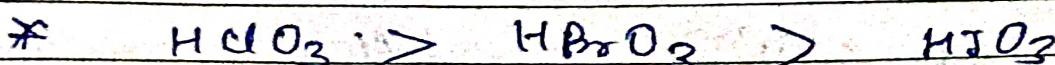
* Strength of acid.



$O/S \uparrow \uparrow \rightarrow$ acidic pp.
of same central element



E.N of 11
C.N acidic char. ↑↑



* Metal. Ions or acids are classified as
class(A) : metal ions & H^+
class(B) : metal ions)

class A : These include alkali & alkaline earth metal ions, lighter transition elements (first row 3d metal ions).

e.g.: Li^{+} , Be^{2+} , Al^{3+} , Ca^{2+} , Fe^{3+} , Ti^{4+} , Co^{2+} , H^{+} ,

: Behaves as hard acids.

class B : characteristics of Hard acids:-

- Cations of smaller size & lighter elements.
- Cations of higher charge, not easily polarizable
- molecules or ions, with lesser no. of valence e⁻'s

class B : These include heavy transition metal ions

(soft acid) (II & III row transition elements. 4d & 5d metal ions). as: Hg^{2+} , Pd^{2+} , Pt^{2+} , Cd^{2+} , Ag^{+} , & lower oxidation state ion.: Ag^0 , Cu^{\oplus} , Hg^0

* characteristics

- cations of larger size & heavier elements
- cations of larger size or heavier elements
- cations of low charge
- easily polarizable
- molecules or ions with large no. of valence e⁻'s.



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* Bases are categorised in two categories

Class A: bases are hard bases.

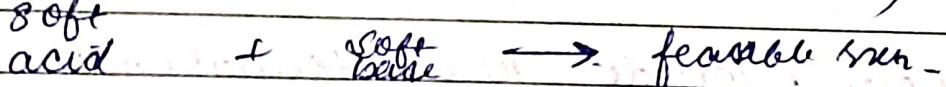
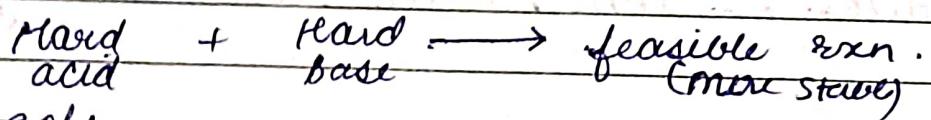
Ligands or bases include those molecules or ions where donor atom is N, O, F, Cl, i.e. donor atom is of high electronegativity.

e.g.: H_2O , NH_3 , R-OH , F^- , $\text{R}-\text{OR}'$

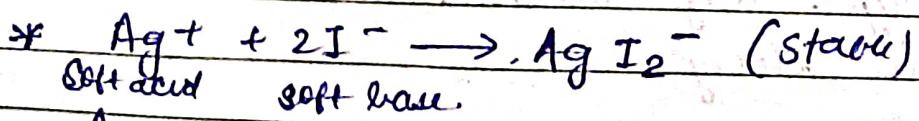
→ soft bases.

Class B: ligands include those molecules or ions where donor atom is phosphorous, arsenic, sulphur, selenium, iodine, R_3P^- , R_2S , HCN^- , SCN^- behaves as soft bases.

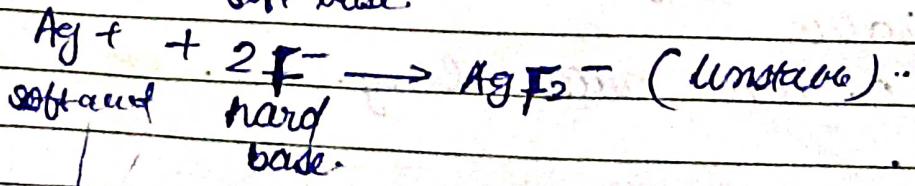
* Hard soft acid base principle :- (Pearson).



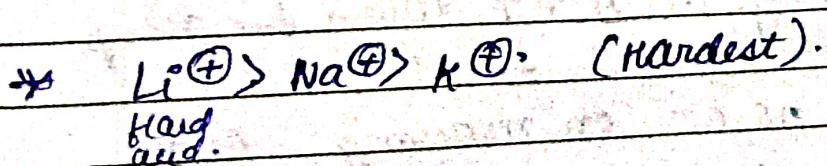
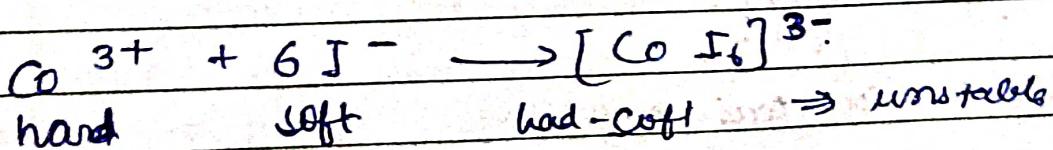
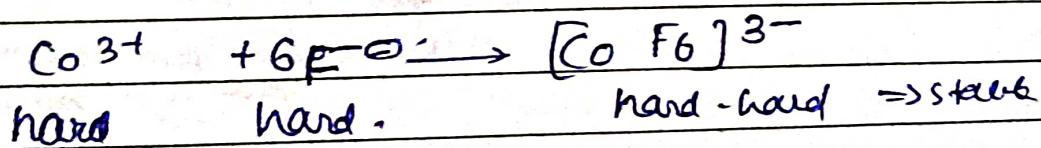
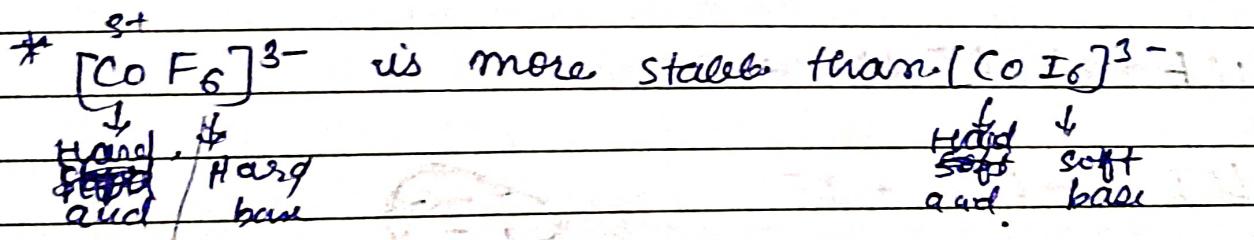
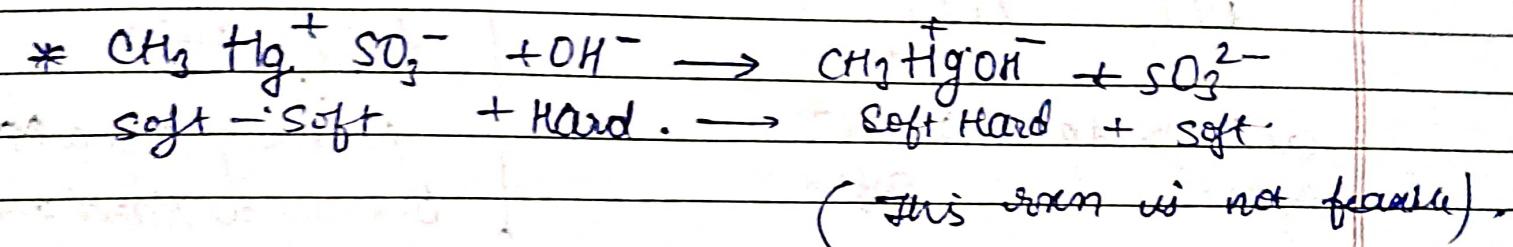
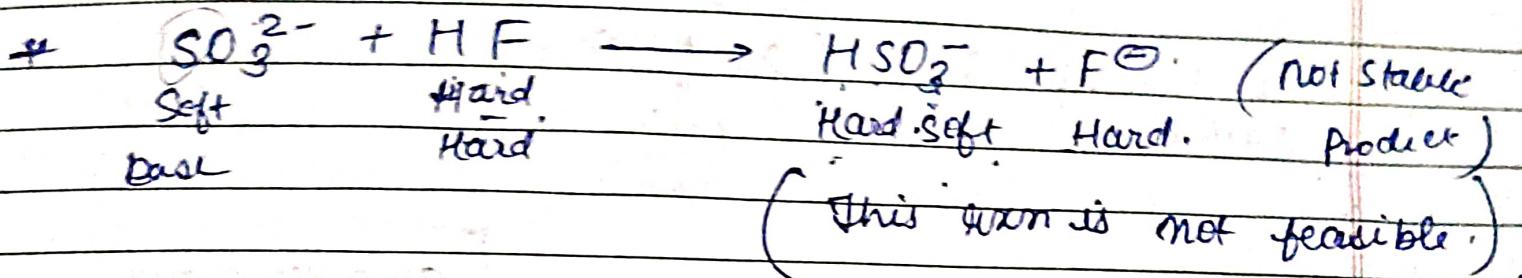
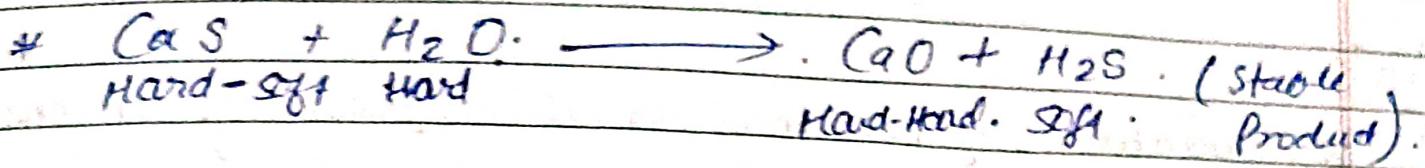
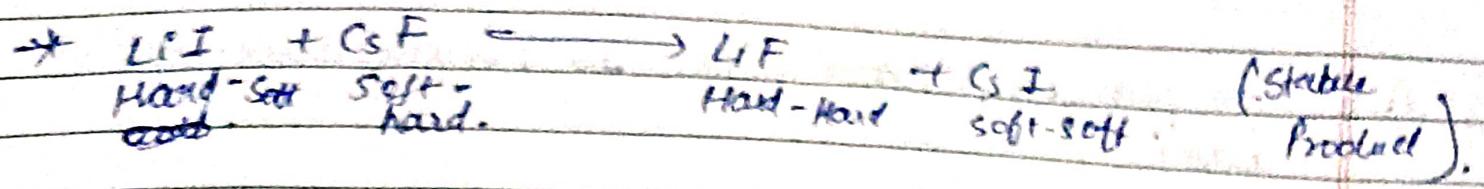
Acc. to Pearson hard acids prefers to bond to hard bases & soft acids prefers to combine with soft bases. i.e. hard-hard & soft-soft combination are more stable.



soft acid soft base.



soft acid hard base.

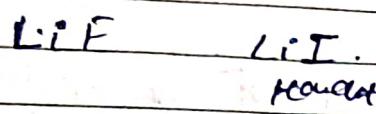
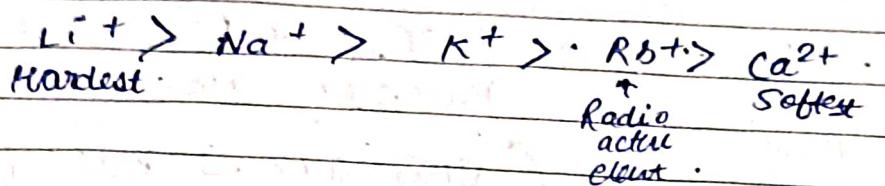


Q) Acc to perrson, hard soft sol., define hard-soft base.

Next pair eff.

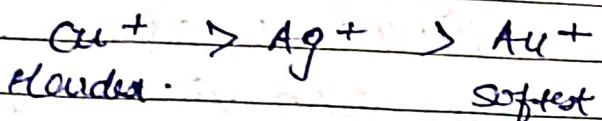
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* Variation of Hardness and softness of cations.



Li^+

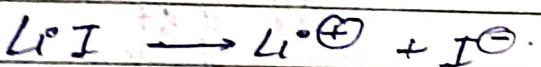
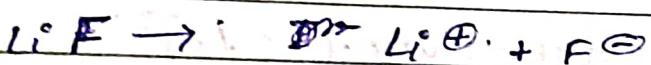
Hardest



smaller cation
larger anion

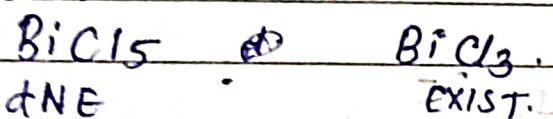
\downarrow
Polarising Power
Behaves as Hard and

* Polarising Power :-



F^- - weak force of attraction with nucleus.

The power



due to next pair effect

Stability of L.O.A ↑↑ down the group
 $\text{H O S} \downarrow \downarrow \downarrow$

→ The inertness of ns e- on moving from top to bottom in a group. This effect is called next pair effect.



→ The stability of lower O.S. T.T. down the group whereas the stability of higher O.S. T.T. is lower. This is b/c of inert pair effect.

- Q. BiCl_3 exists or more stable whereas BiCl_5 (Bi^{+5}) doesn't exist why?
 ↳ This is due to inert pair effect.

* Lanthanoid Contraction.

4 f - Series.

$$(n-2) f^{1-14} \underset{\text{4f}}{(n-1)d} \underset{\text{5d}}{ns^2}.$$

with ↑↑ in At no intervening e- entering
Shielding ↓↓ of f subshell

Effective Nuclear

charge ↑↑

→ They at^{+3} O.S. atoms of an element of lanthanoid series decrease ... → this phenomenon is known as lanthanoid contraction.

- Q. what is lanthanoid contraction?
 → with ↑↑ in At no. intervening e- enters in $(n-2)f$ subshell whereas $(n-1)d$ subshell remains vacant.

due to this shielding of f - subshell & ↓ & Effective nuclear charge ↑↑ & hence size decreases
 this is known as lanthanoid contract

→ Zr & Hf → size same
 → due to lanthanoids contraction.

- Q. what are the consequences of lanthanoid contract?
 Q. what is the diff b/w lanthanoids and actinoids (9-5).

Test

↳ Standardization
 ↳ Periodic table

