P - BLOCK

Back BONDING

→ It is an intramolecular concept, when a π type cordinate bond form b/w already covalently bonded atom within a molecule

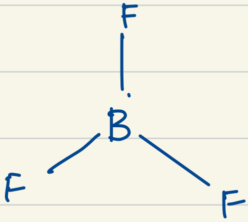
To participate in Back bonding; one atom must contain complete octet along Lone pair & other should have vacant orbital

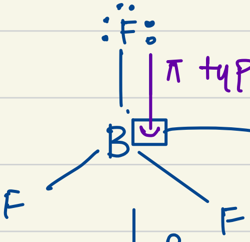
→ To participate B·B one atom should be of 2nd period & other of 2nd or 3rd period.

→ Due to back bonding Hybridizn May or May not change

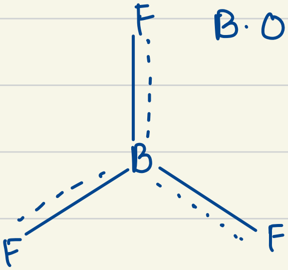
ⓔⓖ $BF_3 \rightarrow 2s^2\ 2p^1$

exc. state → $\boxed{\upharpoonleft}\ \boxed{\upharpoonleft\,|\,\upharpoonleft\,|\ \ }$ — vacant





↓ Reso



$B.O = 1 + \frac{1}{3}$

Due to B.B:

→ Hybⁿ: No change
→ B.A : No change
→ B.O : ↑↑ (Always)
→ B.L : ↓↓ (Always)

② Lewis acidic nature :

	BF_3	BCl_3	BBr_3	BI_3
Shell No. ⇒	2-2	2-3	2-4	2-5

→

Shell No. ↑ , π bond forming tendency ↓ , Lewis Acid char ↑

BF_3 ··· Lewis Acid char ↑ - - BI_3 →

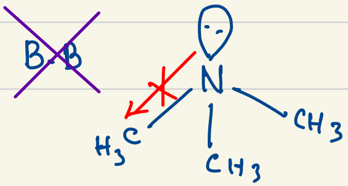
In this case vacant orbital of 'B' is participating in B.B , so it doesn't have vacant orbital to accept e^- pair.

NO. B.B
उसका खाली
can Accept L.P easily.

③ Lewis Base character :

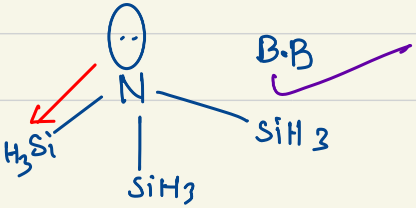
ⓔⓖ Trimethyl amine

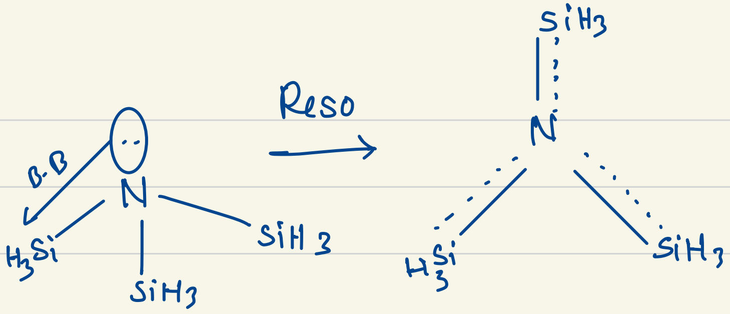
$N(CH_3)_2$



Trysilyl amine

$N(SiH_3)_3$





After B.B in $N(SiH_3)_3$

→ Hyb. = change from sp3 $\xrightarrow{to}$ sp2

→ B.A = ↑ ⇝ sp2 has more B.A than sp3

→ B.O = ↑ ⇝ ↑ in partial bond due to Reso.

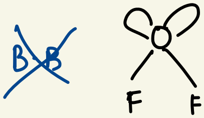
→ B.L = ↓ ⇝ due to ↑ in Bond & B.O.

NOTE $Ni(SiH_3)_3$ is a Non - planar Molecule due to sp3 Hybrid 'Si'

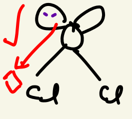
Max atom in same plane in $Ni(SiH_3)_3 = 7$

⇝ B.B is present or not ?

(1) OF_2



OCl_2



★★ negligible B.B due to L.P, L.P Rep^n

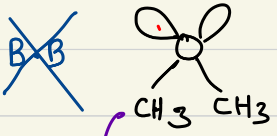
B.B

Reason : Both have complete octet with L.P

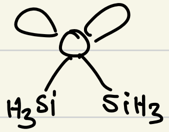
NO B.B

No. one have Vacant orbital

(ii) $O(CH_3)_2$ $O(SiH_3)_2$



dont have vacant orbital



B.B ✓

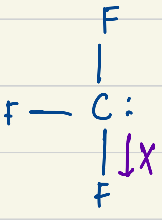
Acidic char ✓

CHF_3 & $CHCl_3$

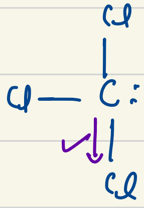
$CHF_3 \xrightarrow{Ka_1} CF_3^- + H^+$

$CHCl_3 \xrightarrow{Ka_2} CCl_3^- + H^+$

B.B. → आसानी से H^+ दे देगा



B.B ✗



B.B ✓

→ $\boxed{Ka_1 < Ka_2}$

Acidic char

R_3-C-OH & $R_3-Si-OH$

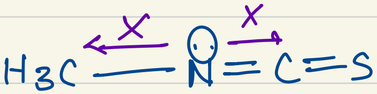
$R_3-C-OH \xrightarrow{Ka_1} R_3-C \overset{\leftarrow \times}{-} O^-$ } BB ✗

$R_3-Si-OH \xrightarrow{Ka_2} R_3-Si \overset{\leftarrow \checkmark}{-} O^-$ } BB ✓

$\boxed{Ka_1 < Ka_2}$

⑦ Compare Geo. w.r.t 'N' ?

CH3NCS

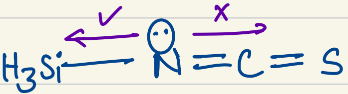


B.B ✗

Hyb remain same

(i.e) sp²

SiH_3NCS



B.B ✓

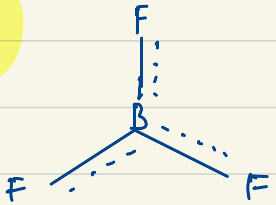
Hyb change

(i.e) sp (Linear)

⑧ Compare (B–F) bond length :-

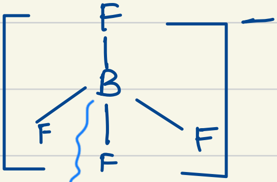
BF_3

✓ B.B



B.O. = 1.33

$(BF_4)^-$



B.B ✗

B पर -ve है तो उतना खाली नहीं है

B.B Not possible

Inert pair effect :-

→ The reluctance of outermost 's' e^- to participate in bond format^n is known as inert pair effect.

→ This effect is observed in havier memb. of grp 13, 14, 15

→ due to this effect the havier Memb. exihibit an Oxd. state which is 2 unit less than the grp OX. stat

→ This effect arises due to lanthenide contr^n

highest oxd. state

grp मे ऊपर जाने पर HOS stable

" " नीचे " " LOS "

Lower ~~Lowest~~ oxd. state.

GOS → grp oxd. state

grp - 13 14 15

O.S → +3 +4 +5 } GOS = HOS

LOS → GOS से 2 unit कम

---

grp : 13

e⁻ config : ns^2np^1

GOS : +3

HOS : +3

LOS : +1

B
Al
Ga
In
Tl ↓

HOS (+3) stability ↓

&

LOS (+1) stability ↑

+3 (stability) ⟹ $B^{+3} > Al^{+3} > Ga^{+3} > In^{+3} > Tl^{+3}$

+1 (") ⟹ $B^{+} < Al^{+} < Ga^{+} < In^{+} < Tl^{+}$

$Tl^{+3} \xrightarrow{Red^n} Tl^{+}$

↳ Act as O.A.

More stable नीचे वाला। LOS stable

grp 14 :

e⁻ config. = ns^2np^2

GOS = +4

HOS = +4

LOS = +2

C
Si
Ge
Sn
Pb ↓

HOS (+4) stab ↓

&

(+2) stab ↑
LOS

$Pb^{+4} \xrightarrow{Red^n} Pb^{+2}$

↳ Act As an O.A.

grp 15 : ns^2np^3

GOS = +5

HOS = +5

LOS = +3

N
P
As
Sb
Bi ↓

HOS (+5) Stab. ↓
&
LOS (+3) Stab. ↑

$Bi^{+5} \longrightarrow Bi^{+3}$

↳ Act as O.A.

⇝ Que on existance & Non-Existance

A^{-} (Anion)

★ Mainly Here in Tl, B, Bi

Weak R.A के साथ +3, +4, +5 stable

Strong R.A के साथ

$+3 \xrightarrow{\text{से}} +1$

$+4 \longrightarrow +2$

$+5 \longrightarrow +3$

✓

Recognition ↓

Oxidising Nature : $F_2 > Cl_2 > Br_2 > I_2$

Reducing nature: $F^- < Cl^- < Br^- < I^-$

weak R.A

strongest R.A

Qu. Which of following does not exist?

a) PbF_4 b) $PbCl_4$ c) PbO_2 ✓ d) $\overset{+4}{Pb}\overset{-}{I_4}$

⇝ Amongst the given Anion I^- is the strongest R.Agent. Hence; it will Reduce $Pb^{+4} \xrightarrow{to} Pb^{+2}$ therefore existance of PbI_4 XX Not possible

Pb^{+4} will get convert to Pb^{+2} by I^-; bcz it is strong R.A

Que: Which of following can exist.

✓ a) $\overset{+5}{Bi}F_5$ b) $\overset{+5}{Bi}Cl_5$ c) $\overset{+5}{Bi}Br_5$ d) $\overset{+5}{Bi}I_5$

NCERT **NOTE** The only pentahalide of 'Bi' that exist is BiF_5.

Q. Which of following does not exist.

a) Boron III Iodide b) Aluminium (III) Iodide

c) Galium III Iodide ~~d)~~ Thallium III Iodide

Q. determine Oxid. state (O.S) of each element in TlI_3

⇝ $Tl^{+} I_3^{-}$

Thllium(I) polyiodide

O·S = +1

O.S. = $-\frac{1}{3}$

~~$Tl^{+3} I^{-}$~~

Not exist

Que. Which is more stable w.r.t dispropo-rtionation in +3 O.S.

⇝ ① N^{+3} ② P^{+3} ③ As^{+3} ~~④~~ Bi^{+3}

Que. determine Correct order of stability b/w given ?

① $C^{+2} < Si^{+2} < Ge^{+2}$

② $Tl^{+3} < B^{+3}$

③ $Tl^{+} > Tl^{+3}$

** ④ $Sn^{+4} > Sn^{+2}$

⑤ $N^{+5} > N^{+3}$

⑥ $N^{+5} > Bi^{+5}$

⑦ $P^{+3} < Bi^{+3}$

Basicity helps draw str. of oxy Ac

→ excepⁿ : H_3PO_2, H_3PO_3, $H_4P_2O_5$, H_3BO_3

Basicity = 1 2 2 1

☆☆☆ Most imp

Trick जितने Hydrogen उतनी Basicity (eg) H_2SO_4 ... ②

Oxyacids :-

$[H_aZ_bO_c]$

Z → Non-Metal P/S/X

X → halogen

① 2 mol Acid $\xrightarrow{-H_2O}$ Pyro-

② 1 mol Acid $\xrightarrow{-H_2O}$ Meta-

③ Peroxo —(O—O)— → Peroxo / peroxy linkage

$+4+2x-16=0$
$2x=12$
$x=+6$

$H_4P_2O_8$ → O.S = +6 ← formulae से

Max O.S of P = +4

अगर O.S Max से ज्यादा आरहा तो it exist in Peroxo / Peroxy

④ HYPO

-ic Acid → form by Higher O.S (eg) H_2SO_4

$\downarrow -[O]$

hypo ....ic acid

-ous Acid → Lower O.S से (eg) H_2SO_3

$\downarrow -[O]$

hypo....ous acid

derivative or daughter Acids

☆ No. of 'H' 3 or More than 3 then that parent Acid carries preffix ortho $\xrightarrow{-H_2O}$ तो Meta daughter Acid form होता

(eg) $H_3PO_3 \xrightarrow{-H_2O} HPO_3$
ortho.... Acid → Meta..... Acid

$H_2SO_3 \xrightarrow{-H_2O} SO_2$
~~ortho~~.... Acid → ~~Meta~~.... Acid

RANGE of oxd^n states

Grp :	15	16	17
max. O.S	+5	+6	+7
	to	to	to
Min O.S	−3	−2	−1
		Except O ↓ −2 to +2	**Except** F only −1

Trick → ignore (Hydrogen).

1. upto $[\overset{\text{Non-Metal}}{Z}_2O_6]^{q-} \rightarrow -(Z-Z)-$

   → Except : $H_4P_2O_5$ contains $-(P-O-P)-$ Bond

2. $[Z_2O_7]^{q-} \rightarrow -(Z-O-Z)-$

3. $[Z_2O_8] \rightarrow -(Z-O-O-Z)-$

ⓔⓖ $\underline{H_2P_2O_6}$

$\underline{H_2S_2O_3}$ ∴ 'O' upto 6

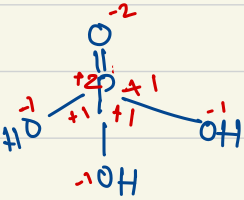
$-(P-P)-$ ✓

$-(S-S)-$ ✓

Oxyacids of phosphorous

1. Phosphoric Acid : ($H_3\overset{+5}{P}O_4$)

a) ortho phosphoric Acid (B = 3)



no. of (P – OH) bond = 3

no. of (P = O) = 1

no. of (P – H) linkage = 0

no. of (P – O) linkge = 4

* Not single bond

2. Pyrophosphoric acid ($H_4\overset{+5}{P_2}O_7$)

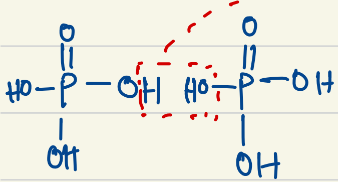
OR

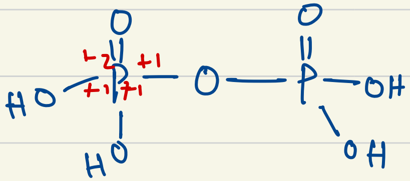
di phosphoric Acid

Basicity → B = 4

↳ (P – O – P)

$2 \times H_3PO_4 \xrightarrow{-H_2O} H_4P_2O_7$

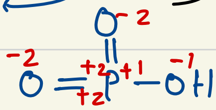




3. Metaphosphoric Acid ($H\overset{+5}{P}O_3$)

B = 1

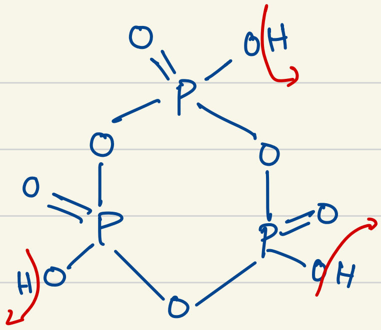
$1 \times H_3PO_4 \xrightarrow{-H_2O} HPO_3$



→ Exist in dimer, trimer or polymer

4. cyclic trimetaphosphoric Acid (HPO_3)

B = 3



no. of POP linkge - 3

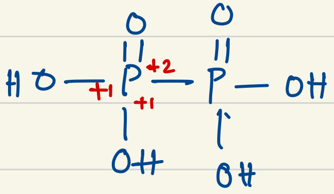
no. of P-OH " - 3

5 Hypophosphoric Acid ($H_4\overset{+4}{P_2}O_6$)

B = 4

$1\times H_3PO_4 \xrightarrow{-[O]} H_3PO_3$ (wrong)

$2\times H_3PO_4 \xrightarrow{-H_2O} H_4P_2O_7 \xrightarrow{-[O]} H_4P_2O_6$ }



no. of (P-H) → 0

" " (P-P) → 1

" " (P-O-P) → 0

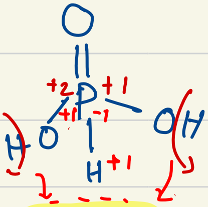
6. Phosphorous Acid ($H_3\overset{+3}{P}O_3$)

(OR)

orthophosphorous

(OR)

phosphonic Acid

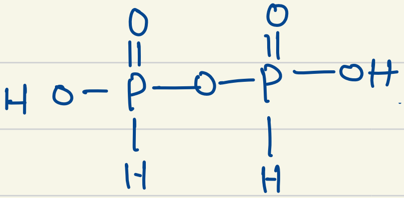


B = 2

Basicity

7. Pyrophosphorous Acid ($H_4P_2O_5$)

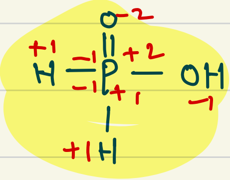
no. of (P–P) link : 0
no. of (P–O–P) " : 1
" " (P–H) " 2



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{P}}-O-\overset{\overset{O}{\|}}{\underset{\underset{H}{|}}{P}}-OH$$

8 Hypophosphorous Acid : ($H_3\overset{+1}{P}O_2$)

1 X $H_3PO_3 \xrightarrow{-[O]} H_3PO_2$



$$\overset{+1}{H}\overset{-1}{-}\overset{\overset{O^{-2}}{\|}}{\underset{\underset{+1\,H}{|}}{P}}\overset{+2}{-}\underset{-1}{OH}$$

no. of (P–H) link = 2

☆ HEATING effect

NCERT

$$H_3\overset{+3}{P}O_3 \xrightarrow[\text{dispn}]{\Delta} H_3\overset{+5}{P}O_4 + \overset{-3}{P}H_3$$

Max O.S   min O.S

Phosphorous when in its intermediate oxd. state shows dispropn ox. Rxn. to give the products of Maxm & Min O.S generally

$$2 \times H_3PO_4 \xrightarrow[-H_2O]{\Delta} H_4P_2O_7 \xrightarrow[\Delta]{-H_2O} H_2P_2O_6 \text{ (or) } (HPO_3)_2$$

$$\begin{tikzcd} (HPO_3)_2 \arrow[d, "-H_2O", "\Delta"'] \\ P_2O_5 \end{tikzcd}$$

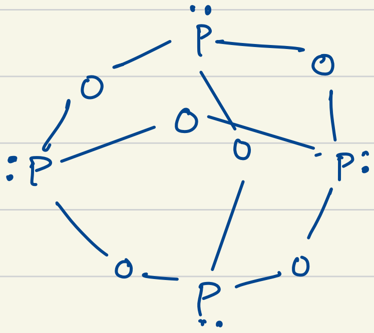
P_2O_5

or

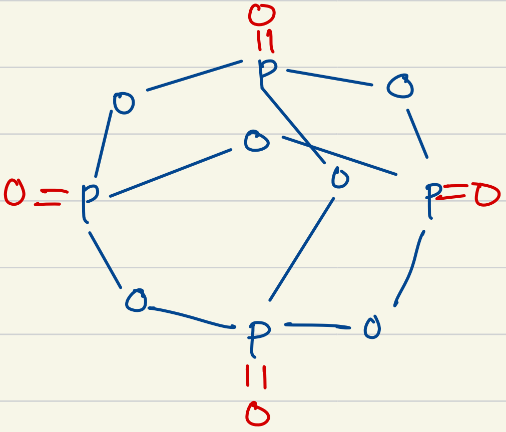
P_4O_{10}

Oxides of phosphorous :

P_4O_6



P_4O_{10}



Hyb. of P =	sp3	sp3
no. of O bonded to each P =	3	4
no. of (P-O-P) link =	6	6

NOTE: in oxyacids of Phosphorous

Reducing nature $\propto$ no. of (P–H) bonds

oxyacids :-	H_3PO_2	H_3PO_3	H_3PO_4
no. of P-H bonds :-	2	1	0

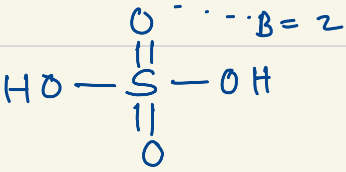
Reducing nature :- $H_3PO_2 > H_3PO_3 > H_3PO_4$

☆ $\overset{+1}{Ag}NO_3 + \underbrace{H_3\overset{+1}{P}O_2}_{R.A} + H_2O \longrightarrow \overset{0}{Ag} + H_3\overset{+5}{P}O_4 + HNO_3$

☆ $\overset{+2}{Cu}SO_4 + \underbrace{H_3PO_2}_{R.A} + H_2O \longrightarrow Cu^0 + H_3PO_4 + H_2SO_4$

Oxyacids of Sulphur

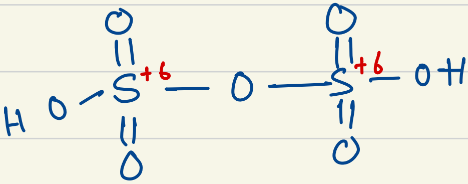
1. shulphuric acid ($H_2\overset{+6}{S}O_4$)



$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$

2. Pyro sulphuric acid ($H_2S_2O_7$)

$2 \times H_2SO_4 \xrightarrow{-H_2O} H_2S_2O_7$ (Oleum)



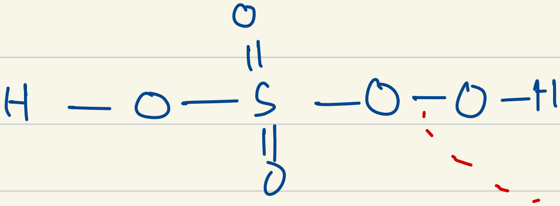
$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S^{+6}}}-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S^{+6}}}-OH$

3. Peroxosulphuric acid (H_2SO_6)

Caro's Acid

$B = 2$

formula से O.S find करने पर → O.S is coming More than Max. More than Possible value so; peroxy linkage present



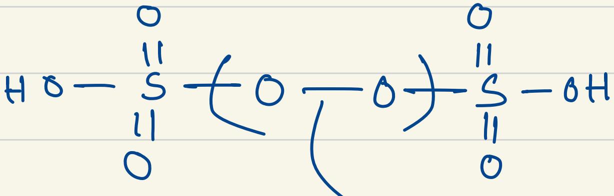
$H-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-H$

Peroxy linkage

4. Peroxodisulphuric Acid ($H_2\overset{+6}{S_2}O_8$)

Marshall's Acid

$B = 2$



$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-(O-O)-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$

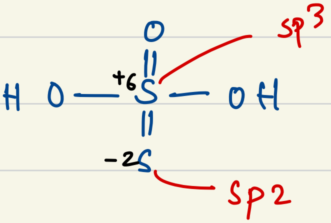
Peroxy

Avg O.S = $\frac{6+6}{2} = 6$

no. of (S-O-O-S) link = 1

5. Thio sulphuric Acid ($H_2\overset{+2}{S}_2O_3$)

(S-S) link = 1

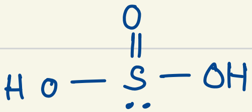


$HO-\overset{\overset{O}{\|}}{\underset{\underset{S}{\|}}{S}}-OH$

Avg os = $\frac{6-2}{2}$

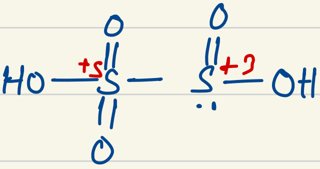
= 2

6. Sulphurous Acid : ($H_2\overset{+4}{S}O_3$)



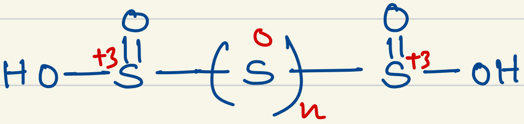
$HO-\overset{\overset{O}{\|}}{\underset{\cdot\cdot}{S}}-OH$

7. Pyro sulphurous Acid ($H_2\overset{+4}{S}_2O_5$)



$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-\overset{\overset{O}{\|}}{\underset{\cdot\cdot}{S}}-OH$

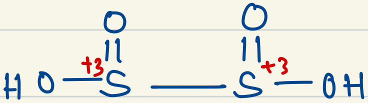
8. <u>Poly</u> thionous Acid : ($H_2S_{\underline{n}}O_4$)



$HO-\overset{\overset{O}{\|}}{S}-(S)_n-\overset{\overset{O}{\|}}{S}-OH$

no. of (S-S) linkage = n-1

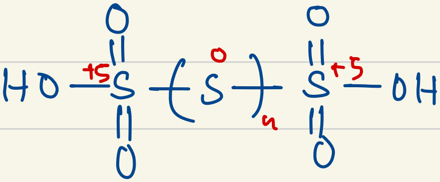
eg dithionous Acid ($H_2S_2O_4$)



$HO-\overset{\overset{O}{\|}}{\overset{+3}{S}}-\overset{\overset{O}{\|}}{\overset{+3}{S}}-OH$

no. of (S-S) link = $n-1$ = $2-1$ = 1

9. Poly thionic Acid ($H_2S_nO_6$)



$HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{\overset{+5}{S}}}-(\overset{0}{S})_n-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{\overset{+5}{S}}}-OH$

☆ Oxyacids of halogen :

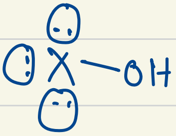
It is not a peroxy Acid

element	hypohalous HOX^{+1} B = 1	halous $H\overset{+3}{X}O_2$ B = 1	halic $H\overset{+5}{X}O_3$ B = 1	Per halic $H\overset{+7}{X}O_4$ B = 1
F	☆ floric Acid HOF	—	—	—
Cl	$HOCl$	$HClO_2$	$HClO_3$	$HClO_4$
Br	$HOBr$	—	$HBrO_3$	$HBrO_4$
I	HOI	—	HIO_3	HIO_4

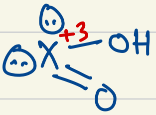
Per iodic Acid

Str :- (oxyacids)

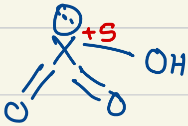
Hypohalous



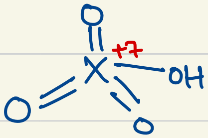
halous



Halic

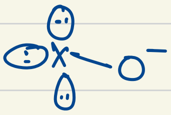


Per halic

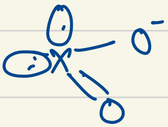


Str. :- (oxyanions)

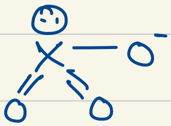
hypohalite



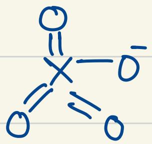
halite



halate

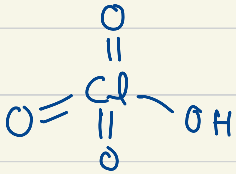


perhalate



Que. Which of the following compd. is not a peroxy compd.

① Carose Acid
② Marshals "
[✓ ③] Perchloric "
④ All are peroxy "



Which contains P-O-P linkg.

1) $H_4P_2O_5$
2) $H_4P_2O_6$
3) $H_4P_2O_7$
4) $H_4P_2O_8$
⊛ both 1&2
[✓ ⊛] both 1 & 3
⊛ " 2&3
⊛ " 3&4
1, 2&3
All

Q. Which contains P-H

[✓ 1) $H_4P_2O_5$]
2) $H_4P_2O_6$
3) $H_4P_2O_7$
4) $H_4P_2O_8$

Que: Which of the following compd. Act as strongest R.A

[✓ 1) H_3PO_2] → No. of P-H bond ↑ R.A ↑
2) H_3PO_3
3) H_3PO_4
4) All

(NCERT data)

Que; In polythionic acid range of 'n' can be

→ 2 to 5 , $H_2S_2O_6 \xrightarrow{\text{to}} H_2S_5O_6$

Qu. determine Correct order, Oxidising Nature

i) ClO^- ii) ClO_2^- iii) ClO_3^- iv) ClO_4^-

↓ ↓ ↓ ↓

+1 +3 +5 +7

B·O ⇒ 1 1.5 1.66 1.75

$$\xrightarrow{\hspace{10em}}$$

B.O ↑ (Cl − O) ∴ Bond strength ↑ ; tendency to release 'O' ↓

Oxidising Nature ↓

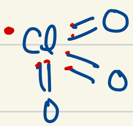
Oxd. Nature: $ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

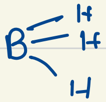
imp → B_2H_6 Al_2Cl_6

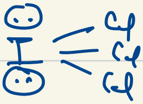
Dimerisation / Polymer

Cl_2O_6 | B_2H_6 | I_2Cl_6

$(ClO_3)_2$ | $(BH_3)_2$ | $(ICl_3)_2$





V.O 

dimerisn by : unpaired e⁻

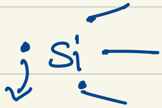
vacant orbital (V.O)

Dimer → V.O ⇒ 1
Polymer → V.O ⇒ 2

V.O
↓
Bridge Bond → 3c-4e⁻ (X)
3c-2e⁻ (H/R)

Que. upaired e⁻ utilised in dimerisn in ?

1) B_2H_6
2) I_2Cl_6
3) Al_2Cl_6
[✓ 4)] Si_2H_6 $(SiH_3)_2$ →



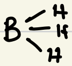
unpaired e⁻

Que. during dimerisn vacant orbital utilised in ?

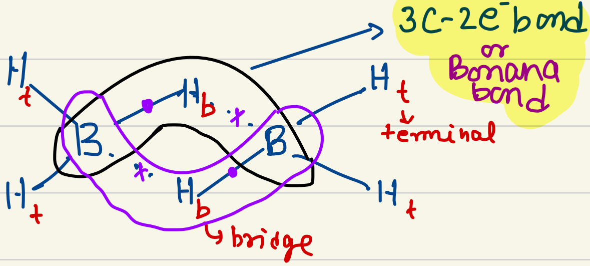
1) C_2H_6 2) Cl_2O_6 [✓ 3)] B_2H_6 4) N_2O_4

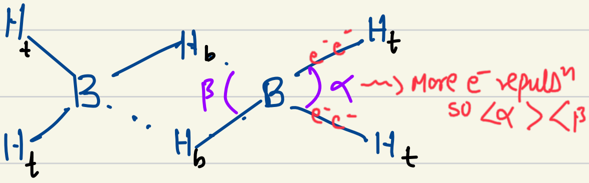
① B_2H_6 (diborane)

$(BH_3)_2$



sp2
$6e^-$





→ More e⁻ repulsⁿ so ∠α > ∠β

- Hybrdⁿ = sp3
- Non-Planar
- no. of 3C-2e bond = 2
- no. of 2C-2e⁻ bond = 4
- Bond Angle: α > β
- Bond length: $B-H_b > B-H_t$
  - partial bond
  - B.O↓ B.L↑
- Octet: Incomplete e⁻ deficien lewis Acid

NOTE In B_2H_6; Max 6 atoms lie in the same plane $\boxed{\text{i.e}}$ Both B atom & all 4 terminal 'H' (H_t)

The bridge 'H' atoms (H_b) lie ⊥ to the plane i.e Above & below the plane.

Property of B_2H_6:

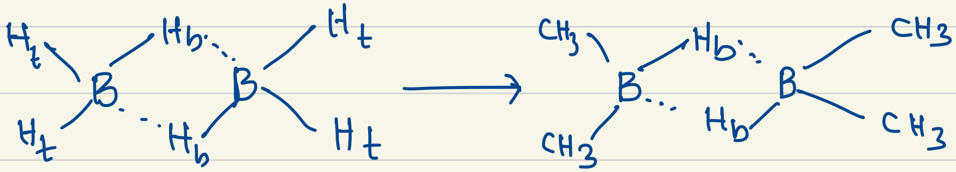
1. Rxn of B_2H_6 with CH_3Cl (sub^n Rxn)

it is easier to replace terminal H (H_t) as compared to H_b (bridge 'H').

* 1 CH_3 will replace 1 terminal H (H_t)

$$B_2H_6 + 4\,CH_3Cl \longrightarrow B_2H_2(CH_3)_4 + 4HCl$$

} max possib subst of B_2H_6



Q. When B_2H_6 reacts with CH_3Cl then which of the following Compd. cannot be form

a) $B_2H_5(CH_3)$

b) $B_2H_4(CH_3)_2$

c) $B_2H_3(CH_3)_3$

d) $B_2H_2(CH_3)_4$

~~e)~~ $B_2H(CH_3)_5$

~~f)~~ $B_2(CH_3)_6$

} we cannot substitut H_b (bridge Hydroge

② Rxn With Nucleophile

In diborane the 3C-2e⁻ bridge / Banana bond acts as a site for Nucleophillic Attac

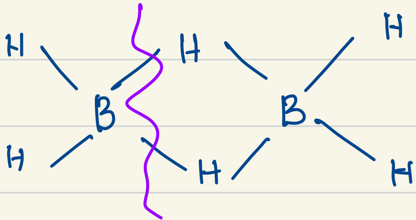
Amines → lower amine, Higher amine

CO Also shows same Rxn.

$\ddot{N}H_3$, R−NH_2

Assym. Cleavage ↓ + B_2H_6

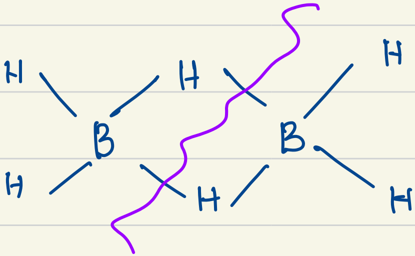
$[BH_2]^+ [BH_4]^-$



Assym. cleavage

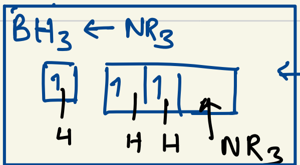
$$B_2H_6 + 2NH_3 \downarrow [BH_2(NH_3)_2]^+ [BH_4]^-$$

$H_3B + BH_3$



Symm. cleavage

$$B_2H_6 + 2\ddot{N}R_3 \downarrow 2[H_3B \leftarrow NR_3]$$



← expl^n

③ Rxn. B/w B_2H_6 & NH_3 :

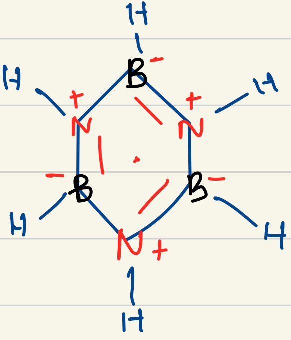
$B_2H_6 + NH_3$ (excess) $\xrightarrow[\text{Assym. Cleavage}]{\text{Low T}}$ $[BH_2(NH_3)_2]^+ [BH_4]^-$

$B_2H_6 + NH_3$ $\xrightarrow{\text{High T}}$ $B_3N_3H_6$ Inorg. benzene / Borazin or Borazole

1 : 2

$B_2H_6 + NH_3$ (excess) $\xrightarrow{\text{High T}}$ $(BN)_n$ Inorganic graphite ⓞⓡ Boron Nitride ⓄⓇ Borazon

☆ Str. of $B_3N_3H_6$ (Inorganic Benzene) :-



- → H - Bond ✓
- → Back bonding ✓
- → Hybridⁿ : Boron → sp^2 , Nitrogen → sp^2
- μ (dipole Moment) = 0 (Non-pola
- Planar
- iso e^- & isostr. with Organic Benzene.

NOTE: Inorgnic Benzene is More reactive than Organic Benzene due to Presence of Polar Bond.

② BeH_2 → $(BeH_2)_2$ → vapour state ---> $\boxed{sp2}$

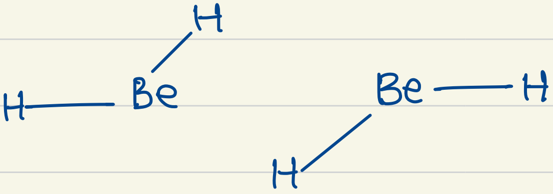
→ $(BeH_2)_n$ → Solid state ---> ⓢⓟ③ sp3

⊙ BeH_2

H — Be — H

ⓢⓟ sp ✓

$(BeH_2)_2$



No. of 3C-2e⁻ bond = 2

no. of 2C-2e " = 2

Hybrid^n = sp2

Planar ✓

Octet ⟿ Incomplet

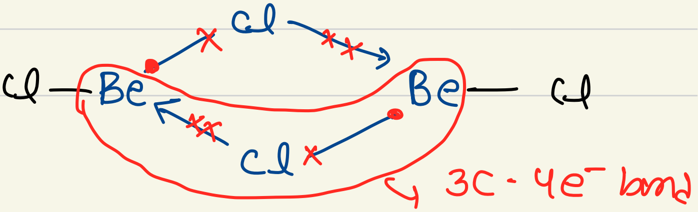
③ $BeCl_2$ → $(BeCl_2)_2$ ⟿ vapour state

→ $(BeCl_2)_n$ ⟿ solid "

▪ $BeCl_2$

Cl — Be — Cl

ⓢⓟ sp ✓



no. of 3c-4e⁻ bond = 2

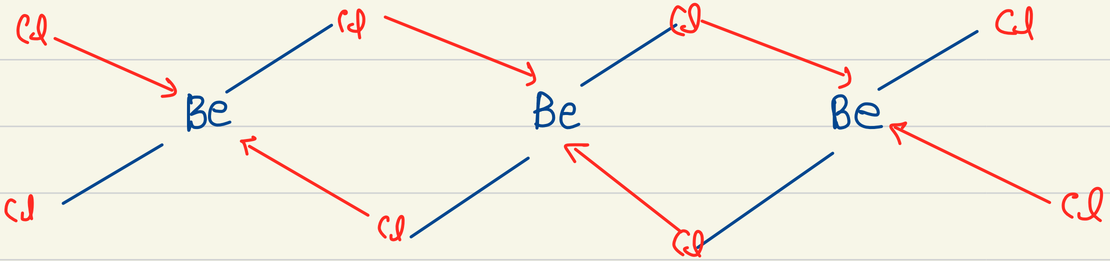
Hyb = sp2

Planar = ✓

octet : Incomplete

---

④ $(BeCl_2)_n$



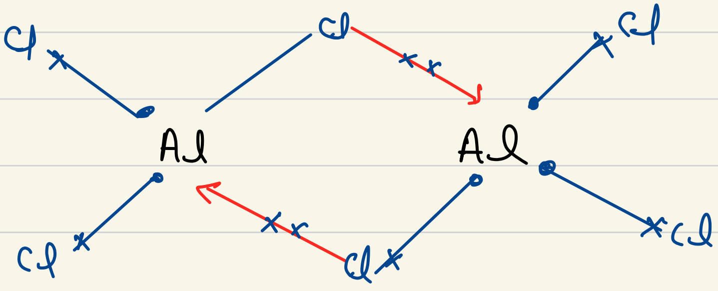
→ 3c-4e bond

→ Hyb. = sp3

→ non-planar ✓

→ octet (complete)

★★★ ⑤



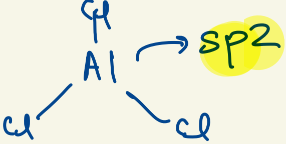
no. of 3c-4e⁻ bond = 2

Hyb = sp3

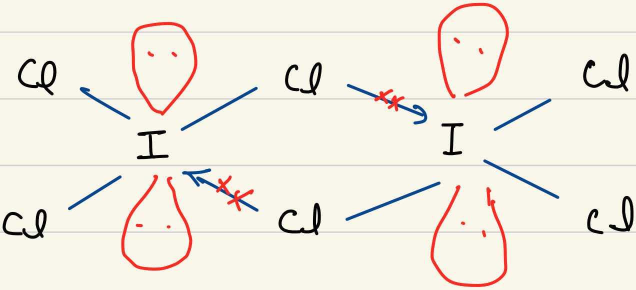
Non Planar

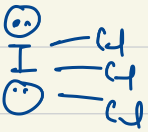
octete : complete

⊙ $AlCl_3$



⑥



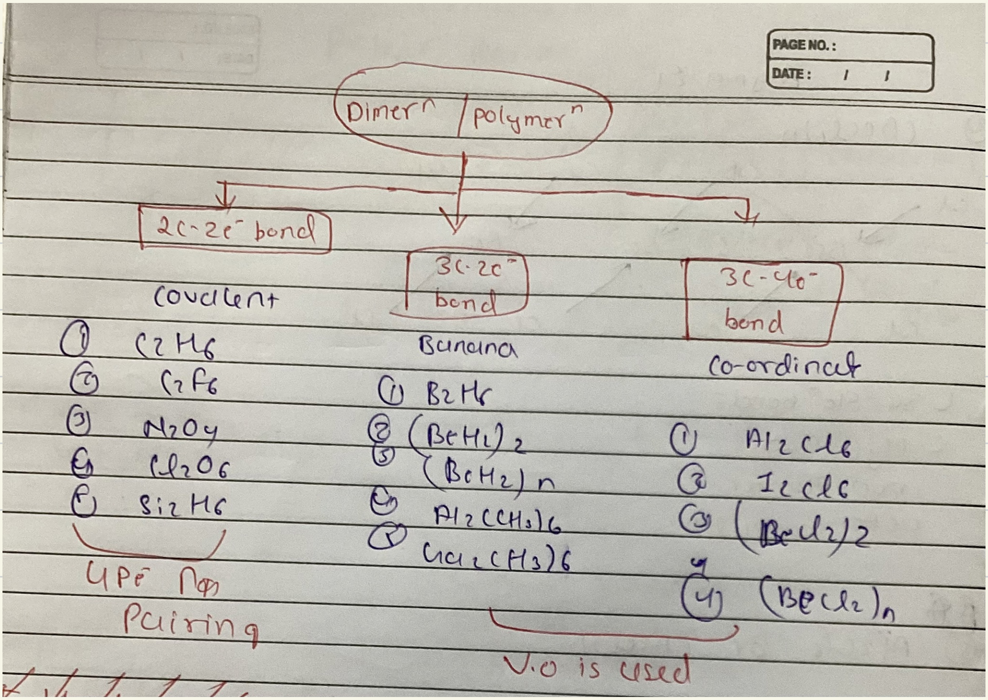


3c–4e⁻ bond = 2

sp^3d^2

Planar

Expanded octet



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Dimerⁿ / polymerⁿ

2c-2e⁻ bond

covalent

① C_2H_6
② C_2F_6
③ N_2O_4
④ Cl_2O_6
⑤ Si_2H_6

UPE no pairing

3c-2e⁻ bond

Banana

① B_2H_6
② $(BeH_2)_2$
③ $(BeH_2)_n$
④ $Al_2(CH_3)_6$
⑤ $Ga_2(CH_3)_6$

3c-4e⁻ bond

co-ordinate

① Al_2Cl_6
② I_2Cl_6
③ $(BeCl_2)_2$
④ $(BeCl_2)_n$

V.O is used

Qu. Which molecule have 3C-2e bond

1) Al_2Cl_6
3) Si_2H_6
2) I_2Cl_6
[✓ 4) B_2H_6]
5) Both 3 & 4

Que- In which of the following Molecule 3c 4e^- bond ?

1) B_2H_6
[✓ 2) Al_2Cl_6]
3) Cl_2O_6
4) C_2F_6

Que. What is the hyb. of $BeCl_2$ in solid state

1) sp
2) sp^2
[✓ 3) sp3]
4) sp^3d

Hydrolysis

- Halides
- oxides
- carbides, Nitride
- Phosphide
- oxyacids

→ it is a type of lewis acid & lewis base Rxn

→ In these Rxns, H2O acts as lewis Base. where as the other compd. must act as lewis acid.

→ generally, in these Rxn's Oxd. state does not change.

→ Hydrolysis can occur through SN1, SN2, Redox (or) push-pull Mechan

☆ generally we will use → SN2 Mech.

⇝ $\boxed{\text{Grp : 2}}$

1. $\overset{+2}{Be}\overset{-}{Cl_2} + \underset{H^+\ OH^-}{H_2O} \longrightarrow \overset{+2}{Be}(OH)_2 + \overset{-1}{HCl}\uparrow$

white fume

Grp : 13

① $\overset{+3}{B}Cl_3 + H_2O \longrightarrow H_3\overset{+3}{B}O_3 + H\overset{-1}{Cl}\uparrow$

② $\overset{+3}{Al}Cl_3 + 3H_2O \longrightarrow \overset{+3}{Al}(OH)_3 + HCl\uparrow$

gelatinous white ppt

③ $AlCl_3 + \underset{\text{excess}}{6H_2O} \longrightarrow [Al(H_2O)_6]^{3+} + 3Cl^-$

↳ sp^3d^2 (octahedral)

Grp - 14

NCERT

S_N2

1. $\overset{+4}{C}\overset{-1}{Cl_4} + H_2O \longrightarrow$ No Rxn

$\downarrow$ S_N1

$COCl_2 + 2HCl$

Phosgene

Poisonous.

Reason: 'C' do not have vacant orbital

$C \xleftarrow{\times} \ddot{O}H$

2. $SiCl_4 + H_2O \longrightarrow \overset{+4}{Si}(OH)_4 + HCl$

or $H_2\overset{+4}{Si}O_3$

or $\overset{+4}{Si}O_2$

Grp - 15

★ ★ ★1. $\overset{-3}{N}\overset{+3}{Cl_3} + H_2O \longrightarrow NH_3 + HOCl$

↳(quite diff. way to React)

2. $\overset{+3}{P}Cl_3 + H_2O \longrightarrow H_3PO_3 + HCl\uparrow$

↳ white fume

Grp - 16

$\overset{+6}{S}F_6 + H_2O \longrightarrow$ No hydrolysis

Reason: In SF_6, 'S' is sterically symmetrically surrounded by 6 fluorine Atom in such a way that attack of H_2O is not possible

Grp-17

Inert halogen compound :- when two diff. halogen atom combined with each other then, IHC form.

☆ **Types of Interhallogen compd.**

$X \rightarrow$ C.A
$X' \rightarrow$ S.A

S.NO	Type	Examples
1.	$x^{+} x'$	IF, ICl, IBr, BrF, BrCl, ClF
2.	$\overset{+}{X} X'_3$	IF_3, ICl_3, IBr_3, ~~BrF_3~~, ~~$BrCl_3$~~, ClF_3
3.	$\overset{+}{X} X'_5$	IF_5, BrF_5, ClF_5
4.	$\overset{+}{X} X'_7$	IF_7

$IF_7 \rightarrow$ Large Anion

Hydrolysis of I.H.C

1. $\overset{+1}{X}X' + H_2O \longrightarrow HOX$

eg. $\overset{+1}{Cl}F + '' \longrightarrow HO\overset{+1}{Cl} + HF$

hypohalous

2. $\overset{+3}{X}\overset{-1}{X'_3} + H_2O \longrightarrow H\overset{+3}{X}O_2 + HX'$

halous

eg. $\overset{+3}{Cl}\overset{-1}{F_3} + H_2O \longrightarrow HClO_2 + HF$

4. $\overset{+5}{X}\overset{-1}{X'_5} + H_2O \longrightarrow H\overset{+5}{X}O_3 + HX'$

halic

eg. $ClF_5 + H_2O \longrightarrow H\overset{+5}{Cl}O_3 + HCl$

5. $\overset{+7}{X}\overset{-1}{X'_7} + H_2O \longrightarrow HXO_4 + HX$

Per halic

eg. $\overset{+7}{I}\overset{-1}{F_7} + H_2O \longrightarrow HIO_4 + HF$

$\cancel{XeO_2} \xrightarrow{\text{unstable}} Xe + O_2$

Grp-18

diff. way of Rxn.

★1 $\overset{+2}{Xe}F_2 + H_2O \xrightarrow{\text{Redox}} \overset{0}{Xe} + O_2 + HF$

★2. $\overset{+4}{Xe}F_4 + H_2O \xrightarrow{\text{disproport}^n} \overset{0}{Xe} + O_2 + \overset{+6}{Xe}O_3 + HF$

★3. $\overset{+6}{Xe}F_6 + H_2O \longrightarrow \overset{+6}{Xe}O_3 + HF$ (complete hydrolysis)

⦿ Step by step hydrolysis of XeF_6 (Partial Hydrolysi

i) $XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

ii) $XeOF_4 + H_2O \longrightarrow XeO_2F_2 + 2HF$

iii) $XeO_2F_2 + H_2O \longrightarrow XeO_3 + 2HF$

$\boxed{\text{Net Rxn : } XeF_6 + 3H_2O \longrightarrow XeO_3 + 6HF}$

Rxn. of Oxides with Water

1. $\overset{+2}{Ca}O + H_2O \longrightarrow Ca(OH)_2$

2. $\overset{+3}{N_2}O_3 + H_2O \longrightarrow HNO_2$

3. $\overset{+5}{N_2}O_5 + H_2O \longrightarrow HNO_3$

4. $\overset{+3}{P_4}O_6 + H_2O \longrightarrow H_3PO_3$

5. $\overset{+5}{P_4}O_{10} + H_2O \longrightarrow H_3PO_4$

6. $\overset{+4}{C}O_2 + H_2O \longrightarrow H_2CO_3$

7. $\overset{+6}{S}O_3 + H_2O \longrightarrow H_2SO_4$

8. $\overset{+4}{S}O_2 + H_2O \longrightarrow H_2CO_3$

★ 9. $\overset{+4}{S}O_2 + 2H_2O \longrightarrow H_2\overset{+6}{S}O_4 + 2[H]$ → nescent hydrogn.

Bleaching Action of SO_2

10. $\overset{+5}{Cl_2O_5} + H_2O \longrightarrow HClO_3$

11. $\overset{+7}{Cl_2O_7} + H_2O \longrightarrow HClO_4$

NO Any Acid possible exist in → +4 → SO; disproph^n होगा

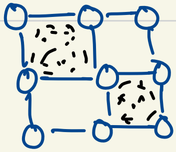
★ 12. $\overset{+4}{N_2O_4} + H_2O \xrightarrow{disp^n} H\overset{+3}{N}O_2 + H\overset{+5}{N}O_3$

★ 13. $\overset{+6}{Cl_2O_6} + H_2O \xrightarrow{disp^n} \overset{+5}{HClO_3} + \overset{+7}{HClO_4}$

14. $\overset{+5}{PCl_5} + H_2O \longrightarrow \overset{+5}{POCl_3} + 2HCl$

$POCl_3 + H_2O \longrightarrow H_3\overset{+5}{P}O_4 + 3HCl$

Carbides :

★★ **Ionic Carbide** Gen: S-block	**Covalent Carbide** Gen: P-block	**Interstitial** Gen: d & f block
eg Be_2C, Mg_2C_3 CaC_2, Al_4C_3	eg B_4C, SiC very High M.pt ↳ due to Giant & Cov. Polymeric Str.	eg V, Nb, Ta etc. 

Non Stoichiometric Compd.

No formula

BCZ

Ionic oxides

- Methanide (C^{4-}) $\xrightarrow{+H_2O}$ CH_4 (Methane)
- Acetylide (C_2^{2-}) $\xrightarrow{+H_2O}$ C_2H_2 (Acetylene)
- Allylide OR Propylide (C_3^{4-}) $\xrightarrow{+H_2O}$ C_3H_4 (Allylyne/ propyne)

Rxn. of Carbides / Nitrides / Phosphide

1. $\overset{+2}{Be}{}_2C + H_2O \longrightarrow Be(OH)_2 + CH_4\uparrow$

2. $\overset{+2}{Mg}{}_2C$ + ,, $\longrightarrow Mg(OH)_2 + C_3H_4\uparrow$

3. $\overset{+2}{Ca}C_2$ + ,, $\longrightarrow Ca(OH)_2 + C_2H_2\uparrow$

4. $\overset{+3}{Al}{}_4C_3$ + ,, $\longrightarrow Al(OH)_3 + CH_4\uparrow$

5. $\overset{+2}{Mg_3}N_2 + {}^{\prime\prime} \longrightarrow Mg(OH)_2 + \dot{N}H_3\uparrow$

6. $\overset{+2}{Ca_3}P_2 + {}^{\prime\prime} \longrightarrow Ca(OH)_2 + PH_3\uparrow$

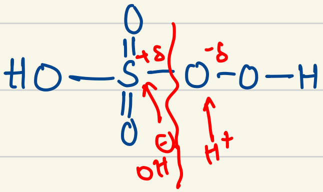
{M.O.P of PH_3}

Rxn. of Oxyacids with H_2O :-

- O.S of parent = O.S of daughter acid

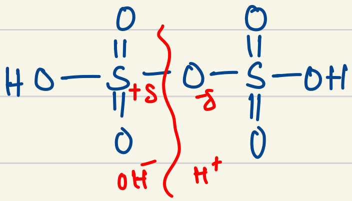
1. $H_2SO_5 + H_2O \longrightarrow H_2SO_4 + H_2O_2$

Caro's Acid

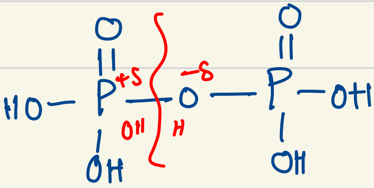


2. $H_2\overset{+6}{S_2}O_7 + H_2O \longrightarrow H_2SO_4 + H_2SO_4$ OR $2H_2\overset{+6}{S}O_4$

(contact process)

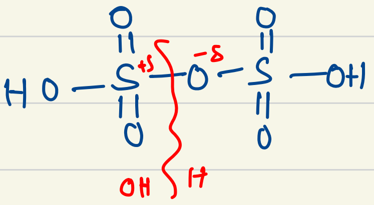


3. $H_4\overset{+5}{P_2}O_7 + H_2O \longrightarrow H_3\overset{+5}{P}O_4$



4. $\overset{+6}{H_2S_2O_6} + H_2O \longrightarrow \overset{+6}{H_2SO_4} + H_2SO_5$

$$H_2SO_5 \xrightarrow{H_2O} H_2SO_4 + H_2O_2$$



$$HO-\overset{O}{\underset{O}{S}}-O-\overset{O}{\underset{O}{S}}-OH$$

OR

$H_2S_2O_6 + 2H_2O$ $\boxed{OR}$ excess H_2O $\longrightarrow 2H_2SO_4 + H_2O_2$

NOTE:

✪ BF₃ & SiF₄ undergo partial hydrolysis

① partial

$BF_3 + H_2O \longrightarrow H_3BO + HF$

$BF_3 + HF \longrightarrow H^+ BF_4^-$ ✓

complete hydrolysis

$BCl_3 + H_2O \longrightarrow H_3BO_3 + HCl$

$BCl_3 + HCl \cancel{\longrightarrow}$

$\boxed{\text{extent of hydrolysis}}$ Extent $\propto$ Cov. char.

↳ Polarisn ↑ C.C ↑

$C^{\oplus}$ small

$A^{\ominus}$ Large

extent of hydrolysis $BF_3 < BCl_3 < BBr_3 < BI_3$

- SF₆ & CCl₄ does not hydrolyse

Q. The hyb. state of Boron in transn state during hydrolysis of BCl_3 will be

1) sp [✓ 2) sp^3] 3) sp^3d sp^2

Qu- How many moles of water required for Complete hydrolysis of 1 Mole XeF_6

1) 1 2) 2 [✓ 3) 3] 4) 4

Qu- which of following on hydrolyesis produces A basic & Acidic. product.

[✓ 1) NCl_3] 2) PCl_3 3) $AsCl_3$ 4) $SbCl_3$

which of the following compd gives 2 oxyacids on hydrolysis.

1) PCl_3 2) $AlCl_3$ [✓ 3) N_2O_4] 5) N_2O_5

Which of th following Not show hydrolysis - with H_2O.

CCl_4 SF_6 NF_3

1) both 1 & 2
2) both 2 & 3
3) both 3 & 1
[✓ 4) All]

Bleaching Agent

$$\text{Coloured Substance} \xrightarrow{\text{Bleaching}} \text{Colourless}$$

Permanent

$$\text{Coloured} \xrightarrow[+[O]]{\text{by oxd}^n} \text{Courless}$$

Temporary

$$\text{Coloured} \xrightarrow[+[H]]{\text{by Red}^n} \text{Colourle}$$

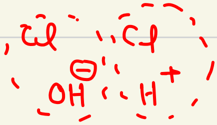
Reverse in presence of Atm. O_2

S.NO.	by oxd.ⁿ	by red.ⁿ
1.	O_3 (dry)	SO_2 (Moist)
2.	H_2O_2 (Moist)	
3.	Cl_2 (Moist)	

eg 1) $$\overset{0}{O_3} \longrightarrow O_2 + [O]$$

nescent oxygen

eg 2) $$Cl_2 + H_2O \xrightarrow{\text{disprop}^n} H\overset{-1}{Cl} + HO\overset{+1}{Cl}$$



3) $$SO_2 + 2H_2O \longrightarrow H_2SO_4 + 2[H]$$

nescent 'H'

Que. Which acts as temporary bleaching Agent

i) O_3 ii) H_2O_2 iii) Cl_2 [✓ iv) SO_4]

Qu. Which is dry bleaching Agent

[✓ i) O_3] ii) H_2O_2 iii) Cl_2 iv) SO_4

Qn. Which of the following shows bleaching by oxd^n Method.

i) O_3 ii) H_2O_2 iii) Cl_2 [✓ iv) All]

Q. O_3, H_2O_2, Cl_2 & SO_2 can act as?

O.A R.A Bleaching Agent

i) 1 & 3 ii) 1 & 2 [✓ iii) 1, 2 & 3] iv) None

☆ Dehydrating Agent/ Drying Agent

Acid को dehydrate करने के लिए → Acid का use

Base को " " " " → Base का use

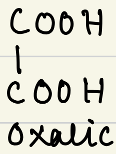
ⓔⓖ conc. H_2SO_4, CaO, P_4O_{10}, $CaCl_2$ etc.

1) $C_2H_5OH \xrightarrow{conc.\ H_2SO_4} C_2H_5 + H_2O$

ethanol

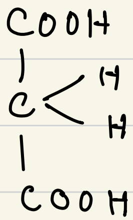
2) $HCOOH \xrightarrow{''} CO + H_2O$ Method of prep of CO

formic Acid

3) 

$\begin{matrix} COOH \\ | \\ COOH \end{matrix} \xrightarrow{''} CO\uparrow + CO_2 + H_2O$

oxalic

4) 

$\begin{matrix} COOH \\ | \\ C\begin{matrix} H \\ H \end{matrix} \\ | \\ COOH \end{matrix} \xrightarrow{''} C_3O_2 + 2H_2O$

malonic acid

5) CaO ..... NH_3

CaO is used to dry Ammonia (NH_3)

**6) Charring of sugar.

$$C_{12}H_{22}O_{11} \xrightarrow[H_2SO_4]{conc.} 12C + 11H_2O\uparrow$$

12C ↓ (Black residue)

**7) $2\times H\overset{\textcircled{+5}}{N}O_3 \xrightarrow{P_4O_{10}} N_2O_5$

Method of Prep. of
of N_2O_5

Anhydride

Anhyd. oxd. बनाना है

$$\text{N.M.O} \underset{-H_2O}{\overset{+H_2O}{\rightleftharpoons}} \text{Oxyacid}$$

Normal
metal
oxd.

Anhydride

Basic

Acidic (Non-metal

1) $Ca(OH)_2 \xrightarrow{-H_2O} \overset{+2}{Ca}O$

2) $2\times H_3PO_4 \xrightarrow{-3H_2O} \overset{+5}{P_2}O_5 \,/\, \overset{+5}{P_4}O_{10}$

3) $H_2SO_4 \xrightarrow{-H_2O} SO_3$

4) $2\times H\overset{+5}{Cl}O_3 \xrightarrow{-H_2O} \overset{+5}{Cl_2}O_5$

5) $2\times H\overset{+7}{Cl}O_4 \xrightarrow{-H_2O} \overset{+7}{Cl_2}O_7$

6) $H\overset{+5}{Cl}O_3 + H\overset{+7}{Cl}O_4 \xrightarrow{-H_2O} \overset{+6}{Cl_2}O_6$
(Mix Anhydride)

Silicones

→ Basic unit ⟹ R_2SiO

- organo Silicon polymer having R_2SiO as its Basic unit.

- They Are chemically inert due to presence of strong σ bond.

- They act as insulator due to Absence of free e^-s

- due to presence of Alkyl grp they are Hydrophobic in nature

Prep^n

$$\text{Alkyl chloro Silane} \xrightarrow[-HCl]{+H_2O} \text{Intermediate} \xrightarrow[\text{polymers}^n]{+\text{condens}^n} \text{Silicones}$$

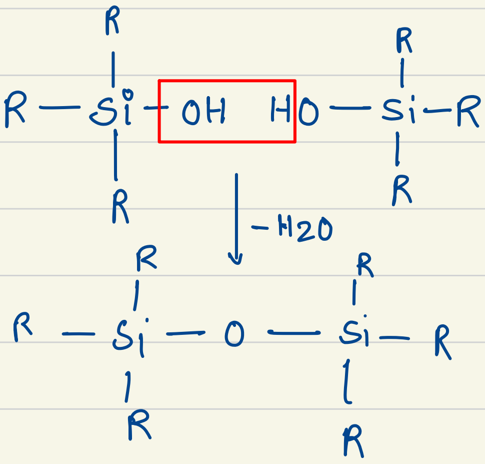
S.No.	Alkyl chloro silane	Silicones
1.	R_3SiCl	chain terminating
2.	R_2SiCl_2	linear chain
3.	$RSiCl_3$	Cross linked

★ जितने 'Cl' है उतने H_2O से Rxn कराओ उतने ही HCl बाहर

chain terminating

1 ⟶ $R_3SiCl \xrightarrow[-HCl]{+H_2O} R_3Si(OH)$

↓ condens^n polymrs^n

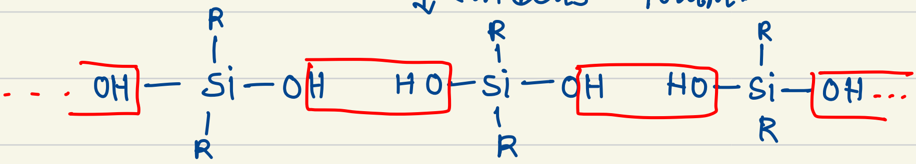


linear chain

2.

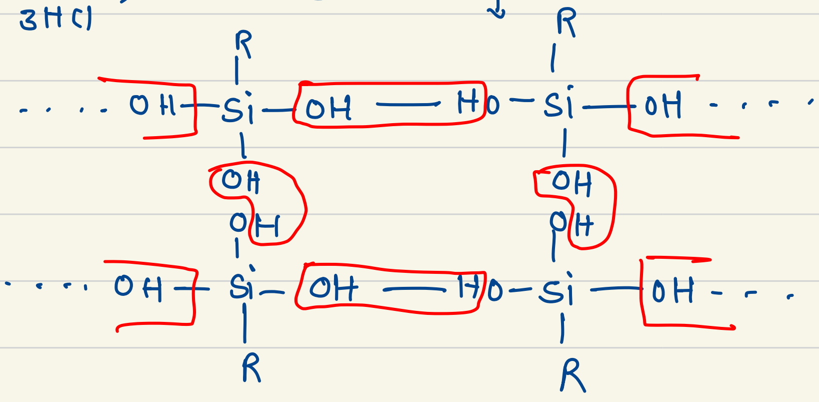
$R_2SiCl_2 \xrightarrow[-2HCl]{+2H_2O} R_2Si(OH)_2$

↓ condens^n Polym.



Cross linked

3. $RSiCl_3 \xrightarrow[3HCl]{3H_2O} RSi(OH)_3 \xrightarrow{\text{condsⁿ polym.}}$



1) cross linked silicon formed from

1) R_3SiCl 2) R_2SiCl_2 [✓ 3) $RSiCl_3$] 4) None

2) which of the following Alkyl chloro silane result in high molecular mass of silicon

1) R_3SiCl 2) R_2SiCl_2 [✓ 3) $RSiCl_3$] 4) None

3) In the process of obtaining silicon from Alkyl chloro silane the following process performed respectively?

1) Hydrolysis Addⁿ Polymersⁿ

2) Addⁿ Polymersⁿ, Hydrolysis

✓ 3) Hydrolysis, Condensⁿ polymerisⁿ

4) condsⁿ polymrsⁿ, Hydrolysis

Silicates

Way to Remember{

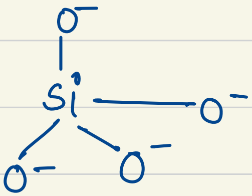
Oxygen और Si मे single Bond ही बनाते हैं so we have two way

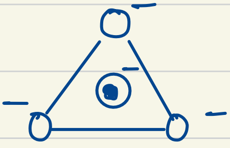
$Si-O^-$ OR $-Si-O-Si$

★ Monovalent

★ Shared Oxygen

basic unit $(SiO_4)^{4-}$





• → 'Si' atom

O → Oxygen atom

→ Neutral 'O' atom will considered as shared Oxygen atom.

→ Mono-vely charged O atom will be considered as Monovalent O atom.

और प्यारी single cycle sheet 3-D
0 1 2 2 3 4

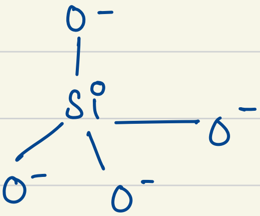
→ Trick for table below

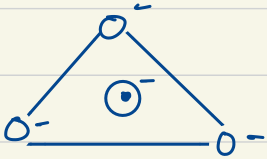
SNo.	Type	formula	No. of shared 'O' per 'Si'	example
	Ortho	$(SiO_4)^{4-}$	0	Zircon
	pyro	$(SiO_{\cancel{3.5}}7)^{-6}$	1	
	-single chain	$(SiO_{\underline{3}})_n^{-2}$	2	
	cycle	$(SiO_{\underline{3}})^{-2}$	2	*Beryl
	sheet	$(SiO_{\cancel{2.5}}5)^{-2}$	3	
	3-D	(SiO_2)	4	** Zeolite / silica

No. of reacting 'O' ↓sing

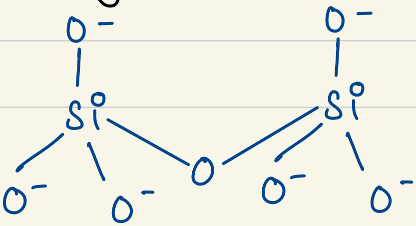
way to Remember: from 0.5 trend, odd species of 'O' will get double

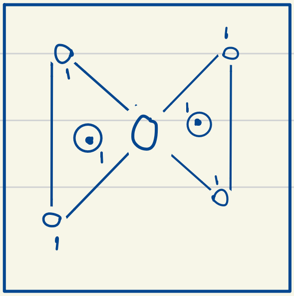
1. Ortho silicate



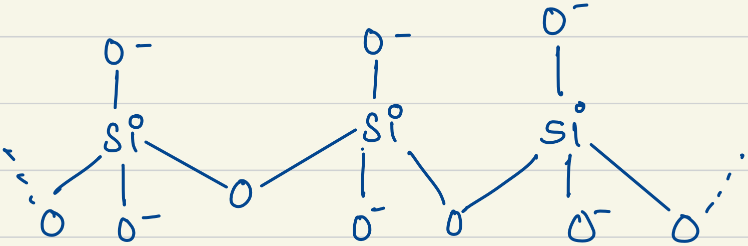


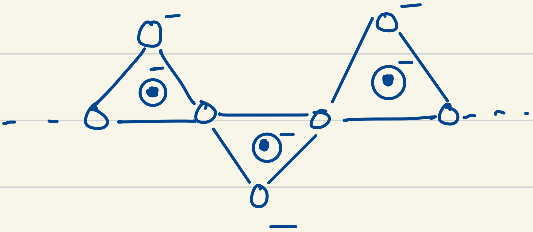
2. Pyro silicate



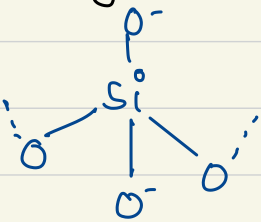


3. Single chain

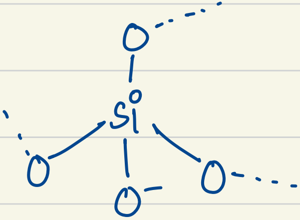




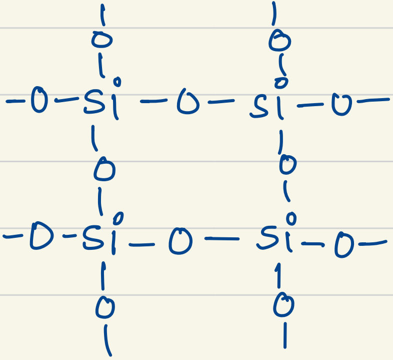
4. Cyclic



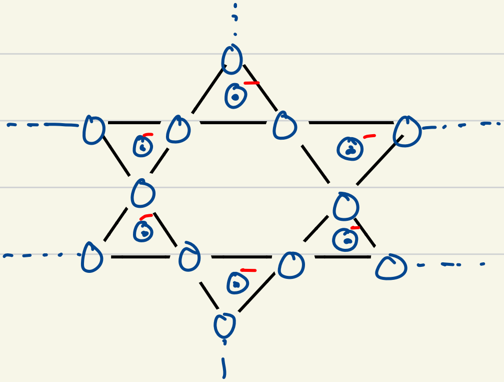
5. sheet



6. 3-D



Q.



determine silicate & formula.

sheet silicate

⤳ Q. In which of the following silicate one mono valent O atom is +nt per unit

1) ortho silicate
2) pyro "
[✓ 3) sheet "]
4) cyclic "

Q. Beryl is an example of ?
→ cyclic silicate

Q. In which of the following silicate all oxygen atom are shared

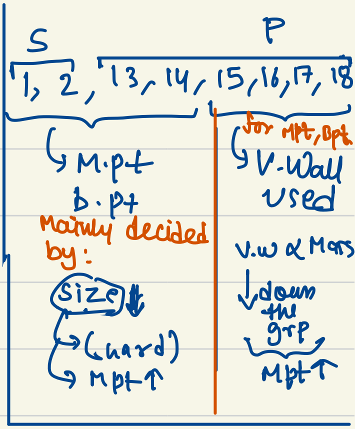
1) ortho 2) sheet

3) cyclic [✓ 4) 3-D]

Q Zircon $(ZrSiO_4)$ is an Example of which silicate ?

[✓ 1) ortho] 2) cyclic 3) sheet 4) 3-D

GROUP - 18



Inert gases / Noble gases.

GEC : $ns^2 np^6$ (Except: He)

He
Ne
Ar
Kr
Xe
Rn
↓

M.pt ↑
b.pt ↑
density ↑
} As go down Mass ↑ ⇝ Van der waal force ↑ ⇝ Mpt ↑ Bpt ↑

$\boxed{\text{Solubility in } H_2O}$ ↑ ⇒ due to polarisability
(OR)
due to ↑ in dipole-induced dipole Attr^n

1st compound of Inert gas :-

first ever compd. of inert gas $\underline{Xe^+[PtF_6]^-}$ &
Red compd.

it was covered by Neil Bartlett

idea came into mind from the compound
$\underline{O_2^+[PtF_6]^-}$
Red compd

IE_1 of O_2 ≈ IE_1 of Xe

Molecular oxygen

Prep^n of Xenon fluorides

1. $Xe + F_2 \longrightarrow XeF_2$

Ratio: 2 : 1

2. $Xe + F_2 \longrightarrow XeF_4$

1 : 5

3. $Xe + F_2 \longrightarrow XeF_6$

1 : 20

4. $XeF_2 + O_2F_2 \longrightarrow$

Fluorinating Agent

Should have idea of ratio mentioned

NOTE Xe fluoride can act as fluoride ion donor or Acceptor, when they react with other fluorides.

$$\overset{+}{M}\overset{-}{F} + XeF_6 \longrightarrow M^+[XeF_7]^-$$

Ionic

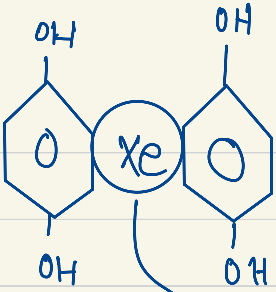
M = Na, K, Rb, Cs

$$\underbrace{PF_5 / SbF_5}_{\text{Covalent}} + XeF_4 \longrightarrow [XeF_3]^+[SbF_6]^-$$

Trick: जीसके पास ज्यादा halogen है वो Accept करेगा

(out of NCERT)

→ Clatherate compd:



Xenon diquinol
(dipole-induced dipole Att^n)

only Large size inert gas form. this

NOTE

→ XeO_3 is Explosive

→ 'He' & sometimes 'Ne' are found in Minerals of Radioactive Origin like; pitch blend, clevite, Monazite
(P) (C) (M)

→ Commercial source of He is natural gas.

→ He gets easily diffused through laboratory Materials like; glass, plastic rubber etc.

GROUP-13
BORON FAMILY

GEC : $ns^2 np^1$

Common O.S : +3 (HOS), +1 (LOS)

Members: B Al Ga In Tl Nh

M.pt : B > Al > Tl > In > Ga ⇝ (Trick: उल्टी Ingarden)

B.pt : B > Al > Ga > In > Tl

density : B < Al < Ga < In < Tl

⇝ Base on size

⇝ Ga is used in High Temp Thermometer

⇝ In Acidified Aq. solⁿ $AlCl_3$ exist As;

$$\boxed{[Al(H_2O)_6]^{+3} + 3Cl^-}$$

↳ sp^3d^2

↳ octahedral

⇝ on moving down the grp as size ↑ Lewis Acidic char. ↓ses.

$$\underrightarrow{BCl_3 > AlCl_3 > GaCl_3}_{\text{lewis Acid.}}$$

} don't confuse with B.B

Chemical Property

1. Rxn with Oxygen:

$E + O_2 \longrightarrow E_2O_3$ (sesque oxide)

2 : 3

E : O

Acidic (B_2O_3 — Non-Metal Acc. to NCERT

Ampho (Al_2O_3, Ga_2O_3

Basic (InO_3, TlO_3

2. Rxn. with Nitrogen

$E + N_2$

$B + N_2 \longrightarrow BN$ or $(BN)_x$ $\xrightarrow{\text{known}}$ Inorganic graphite

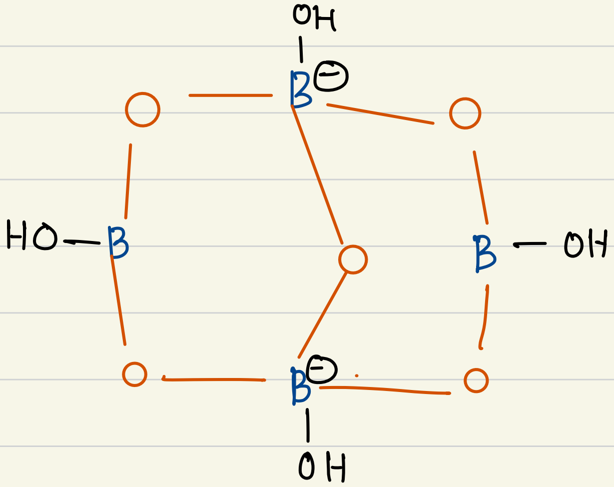
$Al + N_2 \longrightarrow AlN \xrightarrow{+H_2O} Al(OH)_3 + NH_3\uparrow$

Borax
H_3BO_3
diborane

Some important Compounds :

1. Borax : $Na_2B_4O_7 \cdot 10H_2O$ (OR) $Na_2[B_4O_5(OH)_4]\ \underbrace{8H_2O}_{\text{Actual water of Crystallisn}}$

Structure :



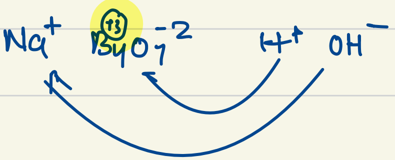
NO. of sp^2 'B' → 2
" " sp^3 'B' → 2

NO. of B-O-B → 5
NO. of B—O link → 14

Property :

① Rxn with Water :

$$Na_2B_4O_7 + H_2O \xrightarrow{\text{hydrolysis}} \underset{S.B}{NaOH} + \underset{(W.A)}{H_3\overset{+3}{B}O_3}$$



Aqous solⁿ of borax is alkaline (basic) in Nature

② Action of heat:

Borax when heated, it swells up first on further heating it becomes liq. which on cooling down settles into glassy transparent mass known as **Borax Bead**.

$$Na_2B_4O_7\cdot10H_2O \xrightarrow{\Delta} Na_2B_4O_7$$

$$\downarrow \Delta$$

$$\underbrace{\underset{\text{Sodium Metaborate}}{NaBO_2} + \overset{\text{Boric Anhydride}}{B_2O_3}}_{\text{Borax Bead}}$$

glassy transparent Mass.

2. Add unknown Metal oxygenated salt

BORAX Bead Test

1st. both container made of ⇒ $\boxed{NaBO_2 + B_2O_3}$ Borax bead

2nd. on Addⁿ of - Metal oxygenated salt then two possibility:-

→ NO Test Absence Transitⁿ Cation

①

Then → d block Cation tnt

②

eg Cobalt

give blue colour

$Co(BO_2)_2$

Cobalt Metaborate

This test is shown by transition Metal salt when Aq. sol of transition Metal oxygenated salt are poured in Borax Bead then due to formation of Metal Metaborate colour is obtained.

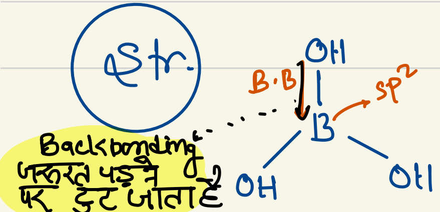
2. H_3BO_3 OR $B(OH)_3$ (ortho boric Acid)

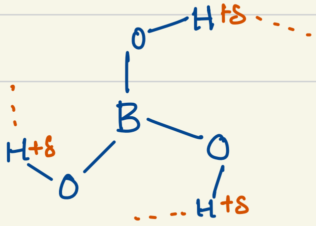
When Borax react with Mineral Acid like HCl / H_2SO_4 then ortho boric acid is form.

$$Na_2B_4O_7 + HCl \longrightarrow NaCl + H_3BO_3$$

$$Na_2B_4O_7 + H_2SO_4 \longrightarrow Na_2SO_4 + H_3BO_3$$

Str.





- B.B ✓
- H-Bonding ✓

↳ when; some Metal Approaching Boron to form bond, so bond form will be σ (i.e) More Stabl than B-B.

In Orthoboric acid due to presence of H-bonding hexagonal str. are obtained.

it is less soluble in water But its solubility ↑ses in HOT water.

☆ **NOTE** :

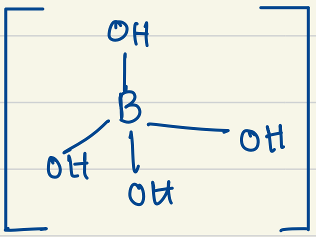
☆ ☆

⇝ Boric Acid is not A triprotic Arrhenius Acid.

⇝ it is a Weak Monobasic lewis Acid.
When Boric Acid is dissolved in water it Accept 1 Hydroxyl ion to form $[B(OH)_4]^{-1}$

$$B(OH)_3 + H_2O \longrightarrow [B(OH)_4]^- + H^+$$

from water



Property :

1. Heating effect:

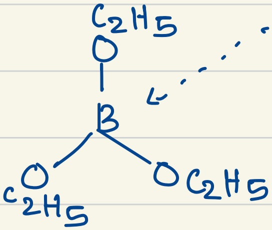
$$\underset{\text{orthoboric}}{H_3BO_3} \xrightarrow[-H_2O]{\Delta} \underset{\text{Metaboric}}{H^+BO_2^-} \xrightarrow{\Delta} \underset{\text{Boric Anhydride}}{B_2O_3}$$

2. Test for Borate (BO_3^{2-}) Radical:

$$\underset{\text{orthoboric Acid}}{B(OH)_3} + \underset{\text{ethyl Alcohol}}{3C_2H_5OH} \xrightarrow{\text{ether}} B(OC_2H_5)_3$$

green edged flame
(Ethyl Borate)

Volatile



Not in NCERT

3. When boric acid is titrated with strong base like: NaOH, then No sharp end point is obtained, to obtained sharp end point cis-1,2 diol type compd must be added.

NOTE: Crystalline Boron (B) is unreactive always. Boron exist As B_{12} units and has Icosahedral str.

3. Diborane (B_2H_6)

Prepⁿ: i) $BCl_2 + LiAlH_4 \longrightarrow B_2H_6 + LiCl + AlCl_3$

ii) $BCl_3 + NaH \longrightarrow B_2H_6 + NaCl$

iii) $I_2 + NaBH_4 \longrightarrow B_2H_6 + H_2\uparrow + NaI$

Lab Method

Property:

1) Rxn with O_2 :- B_2H_6 is Highly reactive & it catches fires spontenously

$B_2H_6 + O_2 \longrightarrow B_2O_3 + H_2O$ ✓ highly Exotherm

$B_2H_6 + H_2O \longrightarrow B(OH)_3 + H_2\uparrow$

GROUP-14

CARBON FAMILY

Lowest O.S — Max O.S

$\boxed{-4 \text{ to } +4}$

GEC: $ns^2 np^2$

Common O.S : $\overset{(HOS)}{+4}, \overset{(LOS)}{+2}$

Members: C, Si, Ge, Sn, Pb

M.pt : C > Si > Ge > Sn > Pb

B.pt : Si > Ge > Sn > Pb

density: $\underset{\text{graphite}}{\boxed{C}} < Si < Ge < Sn < Pb$

$Si < \underset{\text{dimond}}{\boxed{C}} < Ge < Sn < Pb$

Catination: C > Si > Ge > Sn

Chemical Property

① Rxn. with Oxygen

$E + O_2 \longrightarrow \overset{+2}{E}O$ (mono oxide)

$E + O_2 \longrightarrow \overset{+4}{E}O_2$ (di oxide)

unknown Nature, exist only at High T ★★
$\boxed{\text{NCERT}}$

Neutral (CO
$\boxed{SiO}$ ★
Acidic → GeO
Ampho. { SnO
PbO

Acidic { CO_2
SiO_2
GeO_2
Ampho { SnO_2
PbO_2

Basic Char ↑

② Rxn With Water :-

- C, Si, Ge do not react with water
- Sn reacts with steam to decompose it.

$$\boxed{Sn + H_2O(\text{Steam}) \longrightarrow SnO_2 + H_2}$$

H → will unable to react here. so escape.

Pb → does not React with water probably due to formation of oxide layer.

Some imp Compound

1. Carbon Monooxide : ($\overset{+2}{CO}$)

Property :-

a) $HCOOH \xrightarrow{conc.\ H_2SO_4} CO + H_2O$

b) $\underset{\text{(coke)}}{C} + \underset{\text{(steam)}}{H_2O} \xrightarrow{473K\ to\ 1273K} \underbrace{CO + H_2}_{\text{water gas / syn gas}}$

when steam is passed over coke then water gas is produced.

c) $\underset{\text{coke}}{C} + \underset{\text{Air}}{\boxed{O_2 + N_2}} \xrightarrow{1273K} \underbrace{CO + N_2}_{\text{producer gas}}$

When Air is passed over coke then producer gas is obtained

About 'CO' Carbon monoxide:

→ its a Neutral oxide

→ Act as OA & RA

→ poisonous in Nature

→ Carboxy hoemoglobin complex is 300 times more stable than oxy Hb

2. CO_2 : $(\overset{+4}{C}O_2)$

(Read from NCERT)

3. Silicon dioxide (SiO_2)

Crystalline

Amorphous → Kieselguhr

*
- → Silica
- → Cristoballite
- → Trydymite
- → Quartz (Piezoelectric Material)
  - ↳ Pressure लगा के electricity conduct ✓

→ Due to present of strong (Si–O) bonds silica is unreactive but it shows Rxn towards HF & NaOH

a) $SiO_2 + HF \longrightarrow SiF_4 + H_2O$

glass
(etching of glass)

$\downarrow + 2HF$

$H_2[SiF_6]$ hexafluoro silicic Acid

b) $SiO_2 + NaOH \longrightarrow$

grp15 double displacement Rxn
↳

GROUP - 15

Nitrogen family

VEC : ns^2np^3

O.S : $\underset{\text{Lowest}}{\underline{-3}}$ to $\underset{\text{highest}}{\underline{+5}}$

Memberes : N P As Sb Bi Mc

→ Except 'N' all other element show Allotropy.

→ At Room 'T' N_2 is unreactive, but becomes reactive At elivated T

→ when in +1 to +4 O.S, 'N' shows disproportionatⁿ in Acidic Medium.

i.e $\overset{+3}{HNO_2} \xrightarrow{dispp^n} \overset{+5}{HNO_3} + \overset{+2}{NO}$

Chemical Property

1) Rxn with hydrogen:

$E + H_2 \longrightarrow EH_3$

NH_3
PH_3
AsH_3
SbH_3
BiH_3 ↓

Acidic chart

Reducing Nature ↑

2) Rxn with Oxygen:

$$E + O_2 \longrightarrow \begin{cases} \overset{+3}{E_2O_3} \\ \overset{+5}{E_2O_5} \end{cases}$$

cov. char ↑↑

due to charge ↑ Polarisn ↑

$$\text{Acidic}\begin{cases} N_2O_3 \\ P_2O_3 \end{cases}$$

$$\text{Ampho}\begin{cases} As_2O_3 \\ Sb_2O_3 \end{cases}$$

$$\text{Basic}\begin{cases} Bi_2O_3 \end{cases}$$

↓ Basic char ↑

$\boxed{\text{due to} \uparrow \text{ Metallic char.}}$

3) Rxn with halogens:

$$E + X_2 \longrightarrow \begin{cases} \overset{+3}{EX_3} \\ \overset{+5}{EX_5} \end{cases}$$

→ 'N' cannot form pentahalide.

→ NF_3 is the only stable trihalide of Nitrogen

→ Bi forms only one pentahalide i.e BIF_5

→ only $\underbrace{BiF_3}$ is predominantly ionic in natur

↳ in Nitrogen family.

(due to very low polarisn) ⇒ cov. char ↓ ⇒ ionic char ↑

↳ Large ⊕ small Anion

grp15 → Type of Max^m Rxn
↳ double displacement
↳ heating

Some imp Compounds

1. Nitrogen (N_2)

preph: a) Rxn b/w $NaNO_2$ & NH_4Cl

$$Na^+NO_2^- + NH_4^+Cl^- \longrightarrow NaCl + NH_4^+NO_2^-$$

$$\downarrow \Delta$$

$$^{\circ}N_2 + 2H_2O$$

b) Heating of $(NH_4)_2CrO_7$

$$(NH_4)Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + \underset{\text{green}}{Cr_2O_3}$$

c) Heating of Metal Azide → [Methode for purest Nitrogen

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + N_2\uparrow$$

$$Na(N_3) \xrightarrow{\Delta} Na + N_2\uparrow$$

d) when Air is 1st Liquify & then distilled then we get Nitrogen & Oxygen is left behind.

2. Ammonia (NH_3)

Prep^n: (a) Hydrolysis of urea:

$$H_2N-CO-NH_2 + 2H_2O \longrightarrow 2NH_3 + H_2CO_3$$

(b) Rxn with Ammonium salt & Alkali's
कोई भी

$$(NH_4)_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + NH_3 + H_2O$$

$$(NH_4)_2CO_3 + KOH \longrightarrow K_2CO_3 + NH_3 + H_2O$$

(c) Haber's Process :

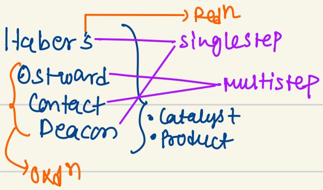
$$N_2 + 3H_2 \xrightarrow{\text{Iron Oxide}} 2NH_3$$

→ iron oxide used as a Catalyst

→ In this Rxn K_2O & Al_2O_3 used for fast Attenment of eql^m

→ In Earlier times Mo (Molibdemum) used as a promoter.

→ Acc. to lechat high pressure will be favourable condn for large productn of NH_3.



Oxd. Agent used : Oxygen

→ NH_3 Act as lewis base (Ligand)

→ Aq. soln of NH_3 is alkaline

d block ions / Salts React with NH_3 to form their Respective Complex:

$$\overset{+2}{Cu}\overset{-2}{SO_4} + 4NH_3 \longrightarrow [Cu(NH_3)_4]^{+2}SO_4^{-2}$$

Blue   Blue

$$\overset{+}{Ag}\overset{-}{Cl} + 2NH_3 \longrightarrow [Ag(NH_3)_2]^{+}Cl^{-}$$

✓ colourless

✓ soluble

Property of N_2

1) Rxn. with Oxygen:

$$N_2 + O_2 \xrightarrow{200K} 2NO$$

Nitric oxide

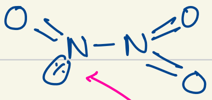
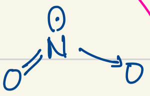
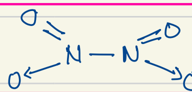
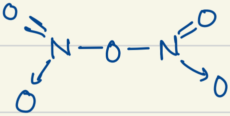
2) $CaC_2 + N_2 \longrightarrow CaCN_2$ Calcium Cyanide

Ca^{2+} CN_2^{2-} CO_2

$$\downarrow$$

$$^{-}N=C=N^{-}$$

3) Oxides of Nitrogen

S.NO.	formula	Name	prepn	Str.
1	$\overset{+1}{N_2O}$ (Laughing gas)	Dinitrogen Monoxide (OR) Nitrous oxide	$\overset{+}{NH_4}\overset{-}{NO_3} \xrightarrow{\Delta} N_2O + 2H_2O$ Neutral, colourless (gas)	$N\equiv N\rightarrow O$
2	$\overset{+2}{NO}$	Nitrogen monoxide (OR) Nitric oxide	$N_2 + O_2 \xrightarrow{200K} 2NO$ Neutral, colourless (gas)	$N=O$ 2c-3ē bond
3	$\overset{+3}{N_2O_3}$	Dinitrogen dioxide	$2NO + N_2O_4 \rightarrow 2N_2O_3$ acidic, Blue solid	
4	$\overset{+4}{NO_2}$	Nitrogen dioxide	$Pb(NO_3)_2 \xrightarrow{\Delta} PbO + NO_2\uparrow + O_2\uparrow$ acidic, Brown gas	 Just remo 1 C.B.
5	$\overset{+4}{N_2O_4}$	dinitrogen tetraoxide	$2NO_2 \underset{warm}{\overset{cool}{\rightleftharpoons}} N_2O_4$ acidic, Colourless Solid or Liq.	
6	$\overset{+5}{N_2O_5}$	dinitrogen pentaoxide	$2HNO_3 \xrightarrow{P_4O_{10}} N_2O_5 + HPO_3$ acidic, Colourless Solid	

- gas, solid Natures depends on Mass
  ↓
  Vanderwaal

★★ imp

④ HNO_3 (Nitric Acid)

When $NaNO_3$ / KNO_3 reacts with H_2SO_4 then Nitric Acid is form.

Prepn

a) Lab method [Glass retort Method]

$$Na^{+}NO_3^{-} + H_2SO_4 \longrightarrow Na^{+}HSO_4^{-} + HNO_3$$

b) Ostward process:

oxdn.

[illegible]

$$\overset{-3}{N}H_3 + O_2 \xrightarrow{Pt/Rh} \overset{+2}{N}O + H_2O$$

$$\overset{+2}{N}O + O_2 \longrightarrow \overset{+4}{N}O_2$$

$$\overset{+4}{N}O_2 + H_2O \xrightarrow{despn} H\overset{+5}{N}O_3 + \underline{\overset{+2}{N}O}$$

Re-use

Neutral.

68% by mass

H_2SO_4 (to dehydrate)

HNO_3 (98% by Mass)

Remember.

property of HNO_3

→ planar Molecule

→ A strong Oxd. agent whos Oxidising Nature depends on conc. & Temp.

Element	conc. $\overset{+5}{HNO_3}$	Dil $\overset{+5}{HNO_3}$
−ve SRP metal	Metal Nitrate + $\overset{+4}{NO_2}\uparrow$	metal nitrate + $\overset{+1}{N_2O}\uparrow$
+ve SRP Metal	metal nitrate + $\overset{+4}{NO_2}\uparrow$	Metal nitrate + $\overset{+2}{NO}\uparrow$
Metalloids	−ic acid + $\overset{+4}{NO_2}\uparrow$	X

Conc. HNO_3 में alway NO_2 (Brown)

$Zn + \text{conc. } HNO_3 \longrightarrow Zn(NO_3)_2 + \overset{+4}{NO_2}\uparrow + H_2O$

$Cu + \text{〃 〃} \longrightarrow Cu(NO_3)_2 + \overset{+4}{NO_2}\uparrow + H_2O$

$Zn + \text{dil. } HNO_3 \rightarrow Zn(NO_3)_2 + \overset{+1}{N_2O}\uparrow + H_2O$

$Cu + \text{〃 〃} \rightarrow Cu(NO_3)_2 + \overset{+2}{NO}\uparrow + H_2O$

Acid

Non Ox. Acid

$H^+ A^-$

↳ Act As O.A

शुद्ध $H^+ \xrightarrow{\text{Reduc}} \overset{0}{H_2}\uparrow$

A^- ⇒ will Remain same

eg Conc. HCl
dil HCl
dil H_2SO_4
Conc. H_3PO_4
dil 〃

v. very dil HNO_3

Oxd. Acid

$H^+ A^-$

Act as O.A

eg Conc. HNO_3
dil HNO_3
Conc. H_2SO_4

Reduced gaseous oxide product

O·A

$$\overset{0}{B} \xrightarrow{\text{conc.-}\overset{+5}{HNO_3}} \overset{+3}{H_3BO_3}$$

$$P_4 \xrightarrow{''} H_3\overset{+5}{P}O_4$$

$$S_8 \xrightarrow{''} H_2\overset{+6}{S}O_4$$

$$\bigstar\ I_2 \xrightarrow{''} H\overset{+5}{I}O_3$$

$$C \xrightarrow{''} \overset{+4}{C}O_2 + H_2O$$

$$\downarrow$$

$$\overset{+4}{N_2O}\uparrow$$

NOTE :

NOT IN NCERT

1) Mn & Mg release 'H' or Rxn with very v.v dil HNO_3

NCERT ✓

2) Al, Fe, Be, Cr (आलु फीर बेकार) Are rendered Passive on Rxn HNO_3 (formation of Protective oxide layer)

3) Noble Metals like Au, Pt do not dissolve in HNO_3. Au, Pt show Reactivity toward Aqua Regia :-

4) Aqua regia (A.R) → $\boxed{HCl + HNO_3}$

$\boxed{HCl + HNO_3 \rightarrow NO^+Cl^-}$

Hexachloro platinic Acid

$$\bigstar\ \overset{0}{Pt} + A.R \longrightarrow \overset{+4}{Pt}Cl_4 \xrightarrow{+2HCl} H_2[PtCl_6]$$

$$\bigstar\ \overset{0}{Au} + A.R \longrightarrow \overset{+3}{Au}Cl_3 \xrightarrow{+HCl} H^+[AuCl_4]^-$$

Tetrachloro Auric Acid

⑤ Phosphine ($\overset{-3}{P}H_3$)

a) $P_4 + NaOH \xrightarrow{disp^n} \overset{-3}{P}H_3 + NaH_2\overset{+1}{P}O_2$

Rxn take place in inert Atmosphere of CO_2.
bcz of its very reactive.

b) $\overset{+2}{Ca_3}\overset{-3}{P_2} + H_2O \xrightarrow{hydrolysis} \overset{+2}{Ca}(OH)_2 + \overset{-3}{P}H_3$

Prop.:

1) Rotten fish like smell.

2) It explodes when comes in contact of O.A. like HNO_3, Cl_2, Br_2 etc.

3) It react with $CuSO_4$ & $HgCl_2$ to form their respective phosphides

$$\overset{+2}{Cu}S\overset{-2}{O_4} + \overset{-3}{P}\overset{+1}{H_3} \longrightarrow Cu_3P_2 + H_2SO_3$$

$$\overset{+2}{Hg}\overset{-1}{Cl_2} + \overset{-3}{P}\overset{+1}{H_3} \longrightarrow Hg_3P_2 + HCl$$

4) $PH_3 + HI \longrightarrow PH_4I \xrightarrow{+KOH} PH_3 + H_2O + KI$

(pure)

PH_3 ↓ impure

Containing P_4 & P_2H_4

Pure phosphene is Non-flamaable but becomes flamable due to trace of impurities like; P_4 , P_2H_4 , to purify it is Made to react with HI Which on further Rxn With KOH gives pure phosphene.

Uses:

⊙ Holmes Signal :

Sponteneous Combution of phosphene(impur Serves as a signal know as Holme signal, when Containers filled with Ca Carbide & Ca phosphide are peared & thrown in sea water the gases evolve which produce smoke screen due to cumbution in Air.

⑥ $\overset{+3}{PCl_3}$

Prepn

a) $\overset{0}{P_4} + 6\overset{0}{Cl_2} \longrightarrow \overset{+3}{P}\overset{-1}{Cl_3}$

b) $\overset{0}{P_4} + \overset{+4}{S}OCl_2 \longrightarrow \overset{+3}{P}Cl_3 + \overset{+4}{SO_2} + S_2Cl_2$

Thionyl chloride

Prop

i) $\overset{+3}{PCl_3} + H_2O \longrightarrow H_3\overset{+3}{P}O_3 + HCl$

⑦ $\overset{+5}{PCl_5}$

a) $\overset{0}{P_4} + 10\overset{0}{Cl_2} \longrightarrow \overset{+5}{P}\overset{-1}{Cl_5}$

b) $\overset{0}{P_4} + \overset{+6}{S}O_2Cl_2 \longrightarrow \overset{+5}{P}Cl_5 + \overset{+4}{SO_2}$

Sulphuryl chloride

O more → more oxidise

i) $\overset{+5}{PCl_5} + H_2O \longrightarrow H_3\overset{+5}{P}O_4 + HCl$

ii) $PCl_5 \xrightarrow{\Delta} \overset{+3}{PCl_3} + \overset{0}{Cl_2}\uparrow$

iii) PCl5 react with powdered Metals Ag / sn to form their respective Chlorides.

$\overset{0}{Ag} + \overset{+5}{PCl_5} \longrightarrow \overset{+1}{AgCl} + \overset{+3}{PCl_3}$

$\overset{0}{Sn} + \underbrace{\overset{+5}{PCl_5}}_{\text{acting as O.A}} \longrightarrow \overset{+4}{SnCl} + \overset{+3}{PCl_3}$

GROUP-16

chalcogens

GEC : $ns^2 np^4$

O.S : -2 to $+6$ except : O

for sulphur : $-2, 0, +4, +6$

Members: O, S, Se, Te, Po

Physical Property :

M.pt : $O < S < Se < Te$

B.pt : $O < S < Se < Te$

density : $O < S < Se < Te$

chemical property :

1) Rxn. with hydrogen :

$$E + H_2 \longrightarrow H_2E$$

H_2O
H_2S
H_2Se
H_2Te
H_2Po ↓

Acidic char ↑

3) Rxn with halogens:

$$E + X_2 \longrightarrow \overset{+2}{EX_2} / \overset{+4}{EX_4} / \overset{+6}{EX_6}$$

→ SF_6 does not show hydrolysis

→ Their monohalide exist in dimeric form Se_2Cl_2, O_2F_2, S_2F_2 } Half open book structure

→ except ; 'Se' all other elements form dichloride & dibromide

→ Their dimeric monohalide undergo disprop^n

4) Rxn with oxygen:

$$E + O_2 \longrightarrow \overset{+4}{EO_2}, \quad \overset{+6}{EO_3}$$

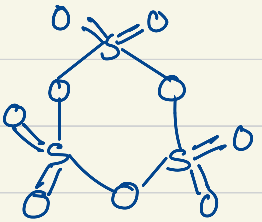
SO_2
SeO_2
TeO_2 ↓

Basic char. ↑

Oxidising Nature ↑

SO_3 (solid)

i.e $(SO_3)_3 \approx S_3O_9$



Some imp compound

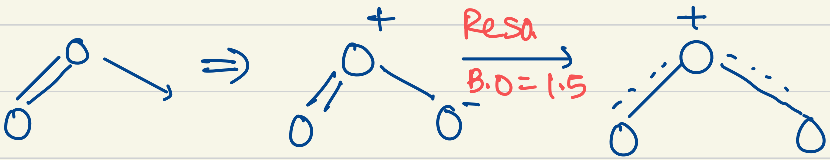
1. Dioxygen (O_2)

Prepn:
$KClO_3 \xrightarrow{\Delta} KCl + O_2$
$KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2\uparrow$
$K_2Cr_2O_7 \xrightarrow{\Delta} K_2CrO_4 + Cr_2O_3 + O_2\uparrow$
$\underset{(2PbO + PbO_2)}{Pb_3O_4} \xrightarrow{\Delta} PbO + O_2\uparrow$

$PbO_2 \xrightarrow{\Delta} PbO + O_2\uparrow$
$2H_2O \xrightarrow{\text{electrolysis}} 2H_2\uparrow + O_2\uparrow$

2. Ozone [O_3]

Str.



★★★ Colour :

solid → Violet black
liquid → Dark blue
gases → Pale blue
(light)

darkness ↑

Prepn silent electric discharge

silent electric discharge

$$3O_2 \xrightarrow{SED} 2O_3 \uparrow\uparrow$$

- endo (energy↑)
- highly unstable

→ When silent electric discharge is passed through a container filled with a pure oxygen then About 10% of ozone is produced.

→ The formation of ozone is endothermic process hence; it is Highly unstable so, decomposes to give [O] nescent oxygen. hence acts as a good O.A. (oxydising Agent)

→ The Mixture of ozone & oxygen is known as ozonised oxygen.

O_3 (O.A)
SO_2 <
H_2SO_4 similar Rxn →
Cl_2
$KMnO_4$
$K_2Cr_2O_7$
H_2O_2 <

$\overset{0}{O_3}$ (O.A) → itself Reduce

ite → ate

$\overset{+3}{NO_2^-} \rightarrow \overset{+5}{NO_3^-}$

$\overset{+4}{SO_3^{2-}} \rightarrow \overset{+6}{SO_4^{2-}}$

$X^- \rightarrow \overset{0}{X_2}$

$Pb\overset{-2}{S} \rightarrow Pb\overset{+6}{S}O_4$

Moist $\overset{0}{I_2} \rightarrow H\overset{+5}{I}O_3$

$\overset{0}{O_2}$

Estimation of ozone

ozone is quantitatively estimated by passing Exc. KI sol^n to produce violet coloured I_2 which on further Rxn with sod. thiosulphate produces colourless NaI.

This Rxn occurs in presence of borate buffer pH Approx. ≃ 9.2.

$$2KI + H_2O + O_3 \longrightarrow \underset{}{2KOH + O_2 + \underset{\text{(violet)}}{I_2}}$$

$$I_2 + Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + \underset{\text{(Colourless)}}{NaI}$$

③ SO_2 (sulphur dioxide)

$\boxed{S \rightarrow -2, 0, +4, +6}$

O.S of sulphur

Prep^n:

i) $S + O_2 \longrightarrow SO_2$

ii) $ZnS \xrightarrow[+O_2]{Rosting} ZnO + SO_2 \uparrow$

Property: Colourless gas with pungent smell.

It can act as R.A & O.A

SO2 As O.A :-

SO_2 (O.A)

X^- (i.e) (Br^-, I^-) → $\overset{0}{X_2}$

H_2S → S (Milky sulphur)

↓

$\overset{0}{S}$ (Milky sulphur)

SO2 As R.A :-

Max O.S

$\overset{+4}{SO_2}$ (R.A)

orange $\overset{+6}{Cr_2O_7^{-2}}$ → Cr^{+3} (green)

purple $\overset{+7}{MnO_4^-}$ → Mn^{+2} → colourless

yellow Fe^{+3} → Fe^{+2} (green)

Higher state

↓

$\underset{+6}{SO_4^{-2}}$

grp: 16,17, d & f → Redox

Test to distinguish b/w $\overset{+4}{CO_2}$ & $\overset{+4}{SO_2}$

only Red. ← Max

Intermediate → Redox ✓

When CO_2 or SO_2 is passed through lime water it turns to Milky.

When exc. CO_2 & Exc. SO_2 passed through lime water Milkyness disappear.

$$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 \text{ Milky ✓}$$

$$Ca(OH)_2 + \underset{(excess)}{CO_2} \rightarrow Ca(HCO_3)_2 \text{ Milky ✗}$$

above Rxn; same for SO_2 also.

- CO_2 केवल O.A की तरह काम कर सकती है

But SO_2 Both O.A & R.A की तरह work करता है

↳ Rxn's जहा SO_2 (R.A) की तरह work कर रहा था they can give test b/w CO_2 & SO_2

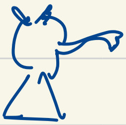
⑨ $\underset{\text{purple}}{KMnO_4} \xrightarrow{+\,CO_2\,\cancel{(R\cdot A)}} \text{purple (No Rxn)}$

$\underset{\text{purple}}{KMnO_4} \xrightarrow{+\,SO_2\,(R\cdot A)\checkmark} \text{Colourless} + SO_2\uparrow$

H_2S (Hydrogen sulphide)

Prep: $FeS + H_2SO_4 \longrightarrow FeSO_4 + H_2S\uparrow$

it is prepared in Kipps Apparatus



Property:
- colourless gas
- rotten egg like smell
- black ppt with led acetate

$(CH_3COO)_2Pb + H_2S \longrightarrow \underset{\text{(Black ppt)}}{PbS} + 2CH_3COOH$

Reducing Behaviour :-

H_2S Act Strong R-A as decomposes evolving hydrogen

$$\underset{(R\cdot A)}{\overset{-2}{H_2S}} + \underset{(O\cdot A)}{\overset{+4}{SO_2}} \longrightarrow H_2O + \underset{\text{milky sulphur}}{\overset{0}{S}}$$

$$H_2\overset{+6}{S}O_4$$

sulphuric acid / oil of vitriol / King of chemicals

Prep. Contact Process

a) Burning of sulphur or sulphide ore in presence of O_2

$$\overset{0}{S}+O_2 \longrightarrow \overset{+4}{S}O_2$$

b) $$2\overset{+4}{S}O_2+O_2 \xrightarrow{V_2O_5} 2\overset{+6}{S}O_3$$

c) Absorpⁿ of SO_3 in H_2SO_4 to give oleum.

$SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7$

oleum/pyrosulphuric acid / Disulphuric acid

Dilution of oleum:

$H_2S_2O_7 + H_2O \longrightarrow \underset{\sim\sim\sim}{2H_2\overset{+6}{S}O_4}$

96 to 98 %
pure

NOTE: In contact process impurity of As_2O_3 absorbed by $\underline{Fe_2O_3 \cdot xH_2O}$.
hydrated ferric oxid

Prop:

→ Act as dehydrating Agent
→ Hot & conc. H_2SO_4 Act as Moderate O.A
→ its oxidising power lies b/w
Nitric acid (HNO_3) > H_2SO_4 > H_3PO_4 (Phosphoric)

$$\rightarrow H_2SO_4 \xrightarrow[Ka_1]{-H^+} HSO_4^- \xrightarrow{-H^+} SO_4^{2-}$$

Salt-1 (Bisulphate) — Salt-2 (sulphate)

Ka_1 — ka_2

Acidic ✓ — ~~Acidic~~

$$Ka_1 >>> Ka_2$$

Sulphuric Acid forms two types of salts

$$\rightarrow \overset{0}{Cu} + \text{conc. } H_2\overset{+6}{S}O_4 \longrightarrow \overset{+2}{Cu}SO_4 + \overset{+4}{S}O_2\uparrow + H_2O$$

$$\overset{0}{C} + \text{conc. } H_2\overset{+6}{S}O_4 \longrightarrow \underbrace{\overset{+4}{C}O_2\uparrow + \overset{+4}{S}O_2\uparrow}_{\boxed{\text{2 gaseous product}}} + H_2O$$

$$\overset{0}{S} + \text{conc. } H_2\overset{+6}{S}O_4 \longrightarrow \overset{+4}{S}O_2 + H_2O$$

Halogens grp 17

- GEC: $ns^2 np^5$
- Memb. : F, Cl, Br, I, At, Ts
  ↳ (Tennessine)

F_2 Cl_2 Br_2 I_2

F_2 → yellow
Cl_2 → greenish yellow
Br_2 → Red
I_2 → violet

- Oxd. state : +7 to -1

- do not show allotropy
- do not " Catination
- F_2, Cl_2 → gaseous
  Br_2 → liq.
  I_2 → solid

M.pt : F < Cl < Br < I

B.pt : F < Cl < Br < I

density : F < Cl < Br < I

Property :

1. Rxn. with hydrogen : $E + H_2 \longrightarrow HE$

HF
HCl
HBr
HI ↓

Acidic Nature ↑

2. Rxn With Oxygen :

halogen forms diff. oxides in diff. O.S

$E + O_2 \longrightarrow E_2O, E_2O_3, E_2O_5, E_2O_7$ etc.

fluorine :

→ 'F' forms only 2 type of fluoride i.e. OF_2, O_2F_2

→ Both OF_2 & O_2F_2 are unstable at room 'T', but OF_2 is comperatively more stable, both act as good fluorinating Agent.

→ In which O_2F_2 is unstable & used in removing 'Pu' as PuF_6 from spent Nuclear fuel.

*
* → Stability of oxides forms by Halogens I > Cl > Br, called Middle row Anamoly.

↓

Reason: due to thermodynamic & kinetic factors

: In oxides of iodine due to greater change seperatⁿ stability is very high.

In oxides of chlorine (Cl), stability ↑ due to Multiple Bond character.

In oxides of bromin Neither of the properties are present.