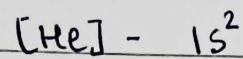




\* Helium is s-block element.

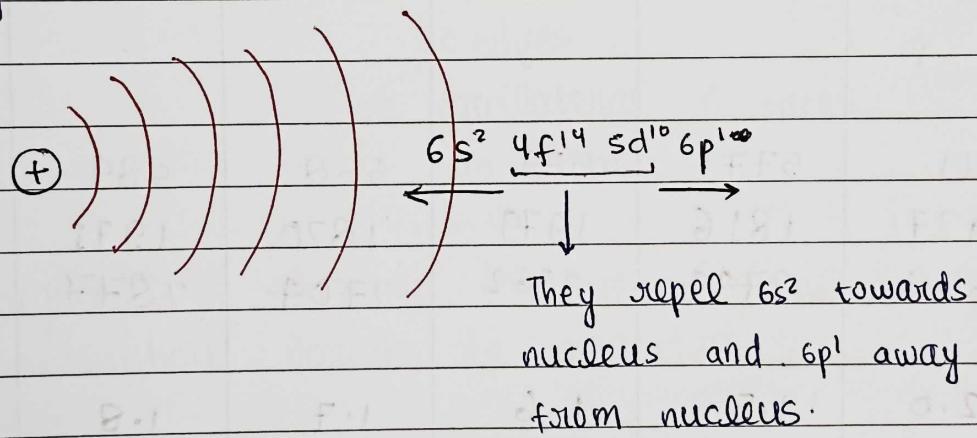


outermost e<sup>-</sup> in s-orbital

\* Inert pair effect:-

Due to introd<sup>n</sup> of f-orbital, f and d together repel s-orbital towards nucleus and  $6p^1$  away from nucleus. Thus, s-orbital becomes inert.

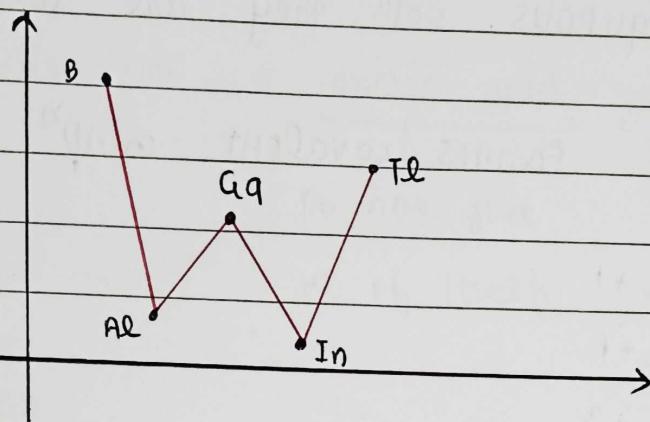
Due to inert pair effect O.S. decreases by 2.



## Boron family :-

	B	Al	Ga	In	Tl
Atomic Radius (in pm)	88	143	135	167	170
Ionic Radius $M^{3+}$ (in pm)	27	53.5	62.0	80	88.5
Ionic Radius $M^+$ (in pm)	-	-	120	140	150
IE <sub>1</sub> (in kJ/mol)	801	577	579	558	589
IE <sub>2</sub> (in kJ/mol)	2427	1816	1979	1820	1971
IE <sub>3</sub> (in kJ/mol)	3659	2744	2962	2704	2877
EN	2.0	1.5	1.6	1.7	1.8
Density (in gm/cc)	2.35	2.70	5.90	7.31	11.85
M.P. (in K)	2453	933	303	430	576
B.P. (in K)	3923	2740	2676	2353	1730

\* W-graph for I-E. (Made for IE<sub>i</sub> values)



\* M.P. of Boron is exceptionally high because it exists in icosahedral crystalline structure ( $B_{12}$ )

• 20 faces

• 30 edges

• 20 equilateral  $\Delta$  faces

• 12 atom.

\* Crystalline Boron is inert while amorphous Boron is reactive.

\* M.P. of Gallium is exceptionally small because it exists in dimer form. Rest all exist in crystalline form.  $b\text{-Ga}_2$ .

\* Due to high temp. difference b/w B.P. and M.P. of Ga, it is used in high temperature thermometers.

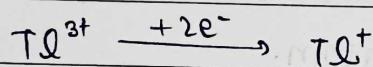
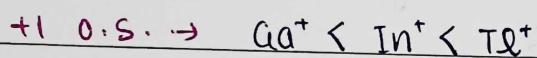
\* Boron compounds are always covalent in nature.

\* Boron is metalloid which shows

\* In gaseous state, Aluminium compn are covalent. In aqueous sol<sup>n</sup>, they are ionic.

*	<del>order</del>	B	+3	Favours covalent compn
		Al	+3	
		Ga	+3, +1	
		In	+3, +1	
		Tl	+1, +3	

order of stability :-



(Good oxidising agent).

	O.S.	Oxides	Chlorides	Hydroxides	Hydrides
B	+3	$\text{B}_2\text{O}_3$ (Acidic)	$\text{BX}_3$ Monomer (back bonding)	$\text{H}_3\text{BO}_3$ Boric Acid	$\text{B}_2\text{H}_6$ Diborane
Al	+3	$\text{Al}_2\text{O}_3$ (Amphoteric)	$\text{AlX}_3$ Dimer	$\text{Al(OH)}_3$ white ppt.	$(\text{AlH}_3)_2$ Polymeric halide
Ga	+3, +1	$\text{Ga}_2\text{O}_3$ (Amphoteric)	$\text{GaX}_3$ Dimer	$\text{Ga(OH)}_3$	$[\text{GaH}_4]^-$ Glance
In	+3, +1	$\text{In}_2\text{O}_3$ (Basic)	$\text{InX}_3$ Dimer	$\text{In(OH)}_3$	$(\text{InH}_3)_2$ Polymeric halide
Tl	+1, +3	$\text{Tl}_2\text{O}_3$ (Basic)	$\text{TlX}$ Ionic crystal	$\text{TlOH}$	No hydride.

## Boronic Acid ( $\text{H}_3\text{BO}_3$ )

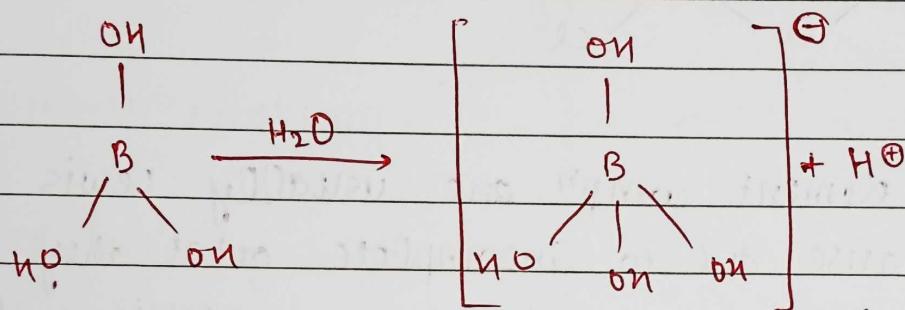
It is not a protic acid, it is a Lewis acid.

Do not give

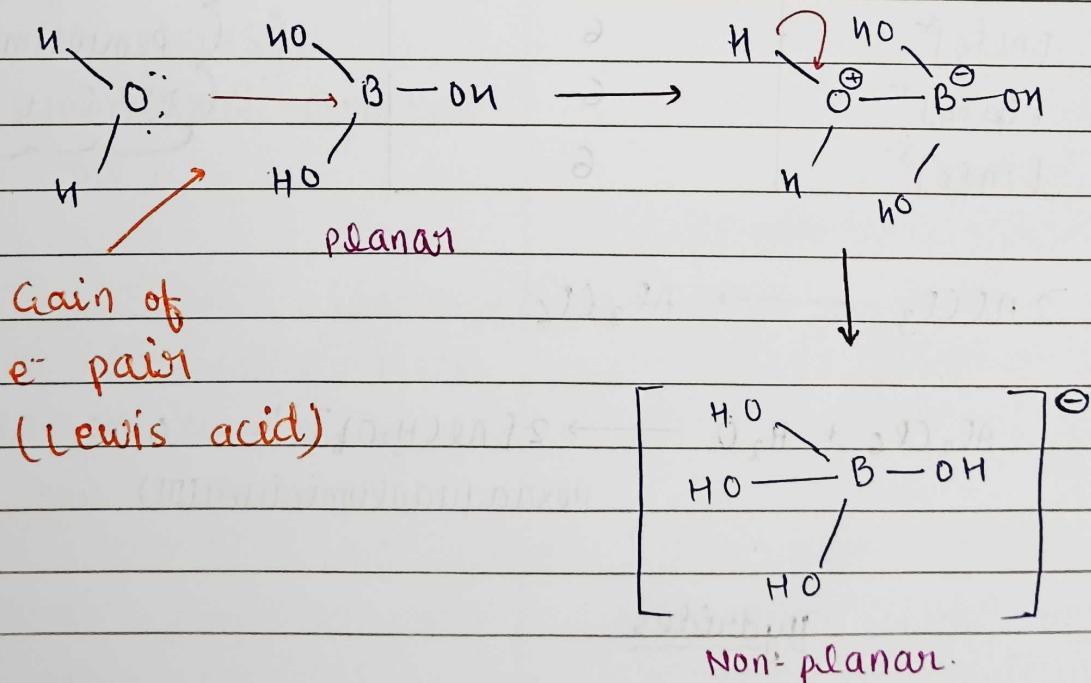
$\text{H}^+$  of itself.

Accept

$\text{sp}$  from water.

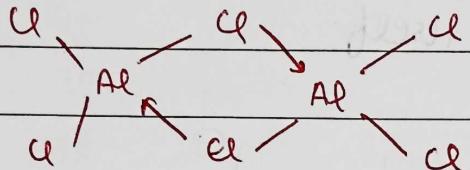


### Mechanism:



\*  $\text{AlCl}_3$  is used as adsorbent in chromatography.

Al, Ga, ~~Ti~~ In form dimer as well as complex halides.



$\text{Pb}_3\text{O}_4 \rightarrow$  Red lead

13<sup>th</sup> group element compn are usually Lewis acid because due to incomplete octet they gain 1 pair of e<sup>-</sup>. gain of e<sup>-</sup> → Lewis acid.

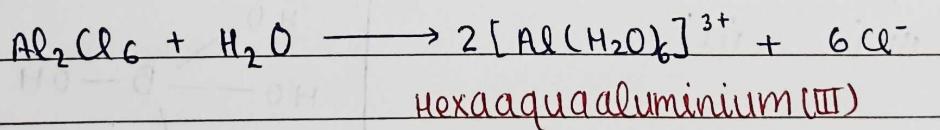
Complexes	Max <sup>m</sup> covalency
$[\text{BF}_4]^-$	4
$[\text{AlF}_6]^{3-}$	6
$[\text{GaF}_6]^{3-}$	6
$[\text{InF}_6]^{3-}$	6

valence e<sup>-</sup>:

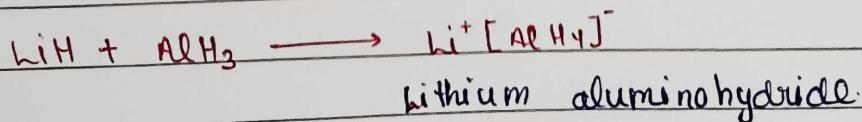
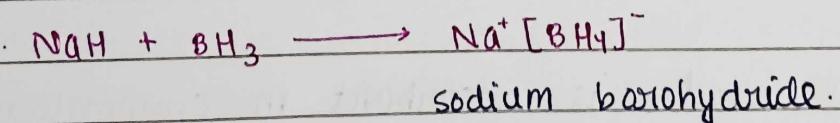
Last shell

Penultimate e<sup>-</sup>:

II<sup>nd</sup> last shell.



### Hydrides

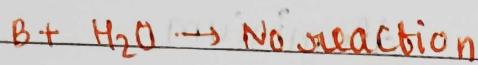


## Boron v/s Aluminium

Boron	Aluminium
1. 2 penultimate e <sup>-</sup>	8 penultimate e <sup>-</sup>
2. Bad conductor of heat and electricity	Good conductor of heat and electricity.
3. Max <sup>m</sup> covalency = 4  Extremely high M.P. (2453 K)	Max <sup>m</sup> covalency = 6  High M.P. (933 K)
4. 2 allotropes - [Crystalline & Amorphous] (Icosahedral structure - $B_{12}$ )	No allotropes.
5. Crystalline allotrope is chemically inert. (2453 K is M.P. of this allotrope)	No allotrope.
6. Boron compounds are only covalent	Aluminium comp <sup>n</sup> are covalent and ionic both.
7. Boron can form large no. of hydride. (Gen. formula $\rightarrow B_nH_{2n+2}$ ) + $B_nH_{2n}$ $B_5H_{10}$	No stable hydride.

8.

Boron does not decompose water or steam



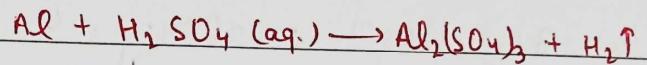
Aluminium can undergo hydrolysis by steam



9.

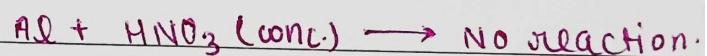
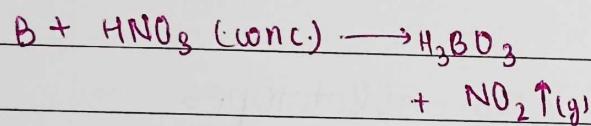
Does not react with dilute acids.

Aluminium can react with dil. acids and releases Hydrogen.



10. Action of conc. Nitric

acid



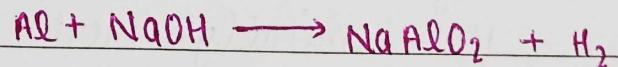
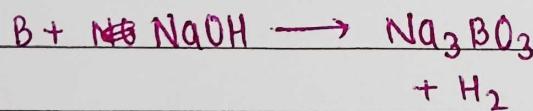
(Due to formation of passive protective layer,  $\text{Al}_2\text{O}_3$ )



Do not further oxidise.  
So, we carry  $\text{HNO}_3$  in Al container.

11. Action of Alkali:-

(sodium borate)



(sodium aluminate)

\* Borates are more stable than aluminates.

$\text{H}_3\text{BO}_3$  /  $\text{B}(\text{OH})_3$  is weak Lewis acid.

$\text{Al}(\text{OH})_3$  is amphoteric.

$\text{BCl}_3$  is fuming liquid.

$\text{AlCl}_3$  is sublimate.

(Vapourise at  $300^\circ\text{C}$ )

Dimer in solid state

Monomer in gaseous state

Boron with metals form borides.

Aluminium forms alloys with metals.

### Diagonal Relationship b/w Boron & silicon

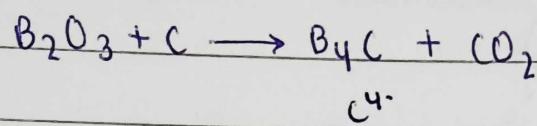
#### Boron

#### Silicon

1. Both are non-metals
2. Oxides are acidic in nature  
 $B_2O_3$
3.  $B_2O_3 + H_2O \rightarrow H_3BO_3$
4.  $B_2O_3 + Mg \rightarrow B + MgO$
5.  $B + NaOH \rightarrow Na_3BO_3 + H_2$
6. Do not react with water / steam
7. Found in combined state  
 $BO_3^{3-} \rightarrow$  Borates
8. Bad conductor
9. ~~Tinyst~~ shows allotropy  
Amorphous  
Crystalline
1. Oxides are acidic in nature  
 $SiO_2$
2.  $SiO_2 + H_2O \rightarrow H_4SiO_4$
3.  $SiO_2 + Mg \rightarrow Si + MgO$
4.  $Si + NaOH \rightarrow Na_2SiO_3 + H_2$
5. Don't react with water / steam
6. Found in combined state.  
 $SiO_4^{4-} \rightarrow$  silicates
7. Bad conductor
8. Shows allotropy.  
Amorphous  
Crystalline.

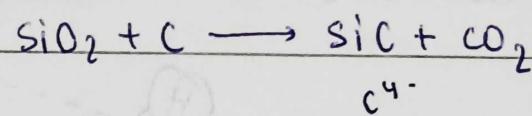
10.	Covalent compounds	Covalent compounds.		
11.	High M.P. (~2300°C)	High M.P. (~1400°C)		
12.	Inert at R.T.	Inert at Room Temperature		
13.	$\text{BO}_3^{3-}$ Borates	<del><math>\text{BO}_2^-</math></del> metaborates	$\text{SiO}_4^{4-}$ Silicate	$\text{SiO}_3^{2-}$ meta-silicate
	$\text{B}_2\text{O}_3 + \text{NaOH} \rightarrow \text{NaBO}_2 + \text{H}_2\text{O}$ (sodium meta borate)		$\text{SiO}_2 + \text{NaOH} \rightarrow \text{Na}_2\text{SiO}_3 + \text{H}_2\text{O}$ (sodium meta silicate)	
14.	Action of HF:-  $\text{B}_2\text{O}_3 + 6\text{HF} \rightarrow 2\text{BF}_3 + 3\text{H}_2\text{O}$ BF <sub>3</sub> is unstable, so it further reacts with HF $2\text{BF}_3 + 2\text{HF} \rightarrow 2\text{HBF}_4$	Action of HF:-  This process is known as Itching of Glass  $\text{SiO}_2 + \text{HF} \rightarrow \text{SiF}_4 + \text{H}_2\text{O}$ $\text{SiF}_4 + \text{HF} \rightarrow \text{H}_2\text{SiF}_6$		
	$\text{B}_2\text{O}_3 + 8\text{HF} \rightarrow 2\text{HBF}_4 + 3\text{H}_2\text{O}$		$\text{SiO}_2 + \text{HF} \rightarrow \text{H}_2\text{SiF}_6 + \text{H}_2\text{O}$	
			Most common glass is $\text{Na}_2\text{SiO}_3 \cdot \text{CaSiO}_3 \cdot 4\text{SiO}_2$	

### 15. Action of coke



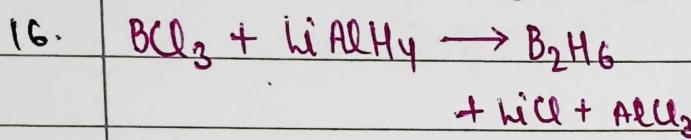
Forms methanide

### Action of coke

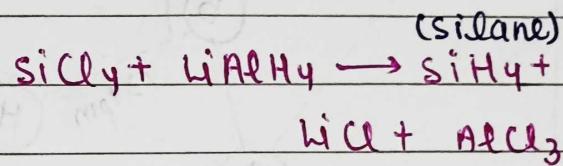


Forms methanide.

(diborane)



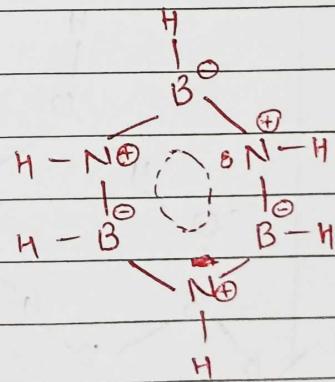
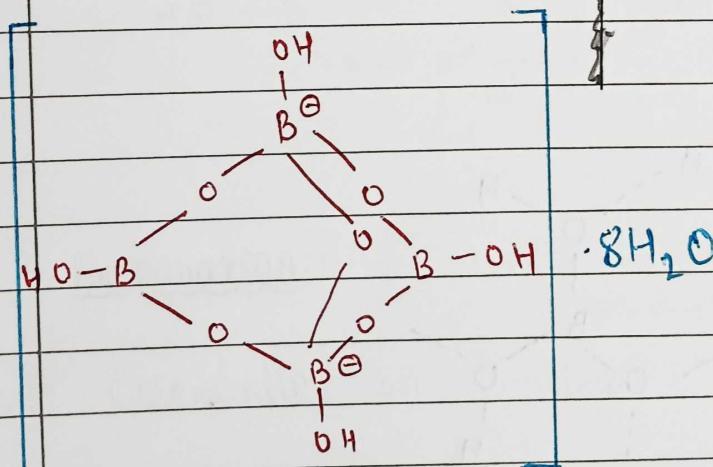
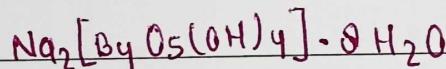
$LiAlH_4 \rightarrow$  source of  $H^-$



$LiAlH_4 \rightarrow$  Source of  $H^-$

### Structures of compounds of Boron:-

#### 1. Borax



Borax

Borazine

Diborane

Boric acid

Graphite

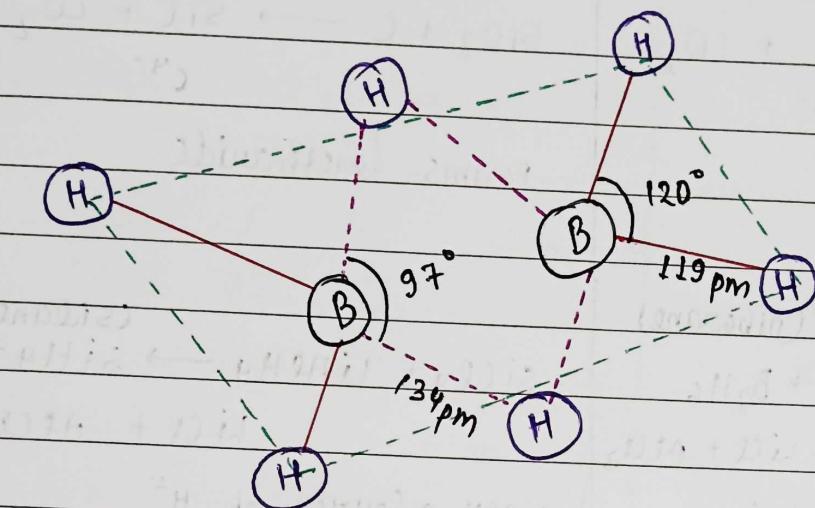
Inorganic

BF3, BCl3, B3

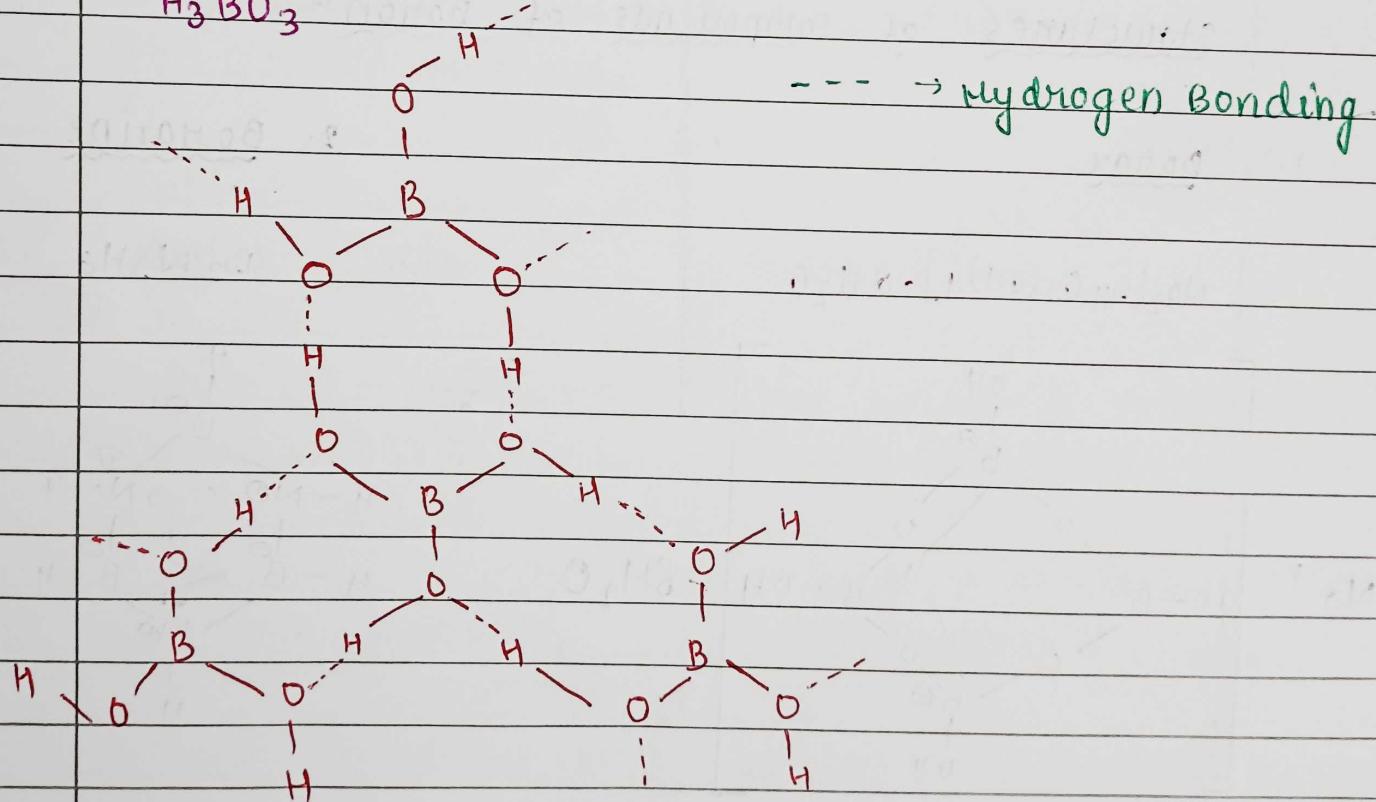
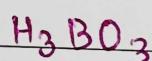
B3N3H6

BBOS, B3

3. Diborane  $B_2H_6$

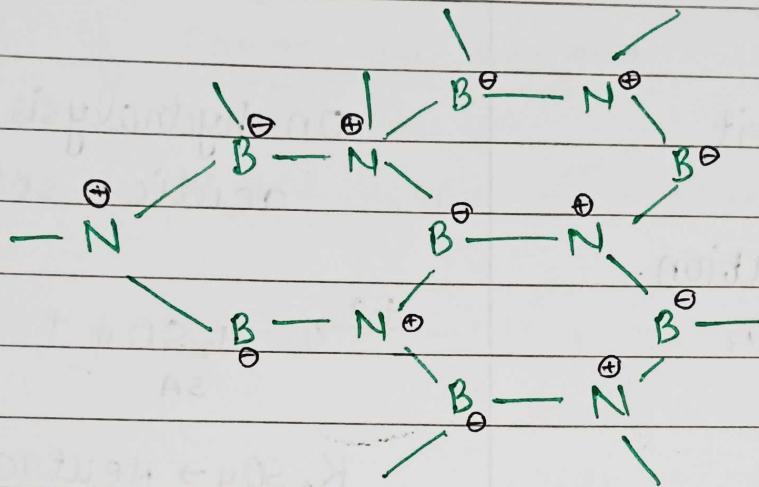


4. Boric acid



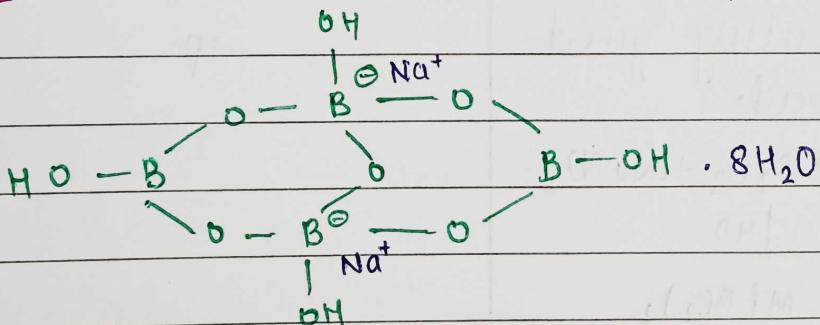
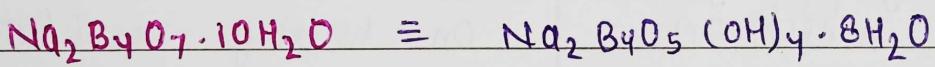
5.

Inorganic graphite  $\text{cBN}_x$



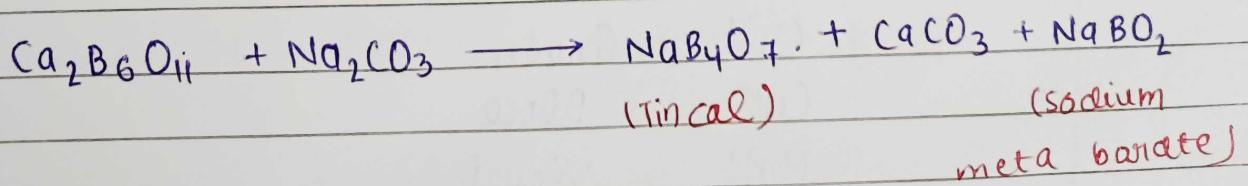
## Compounds of Boron :-

1. Barax



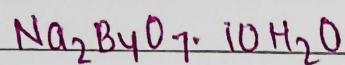
## Preparation :-

1. Colemanite on heating with  $\text{Na}_2\text{CO}_3$ .

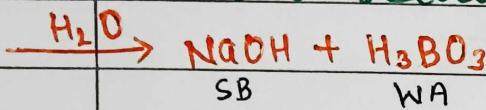


Borax

v/s



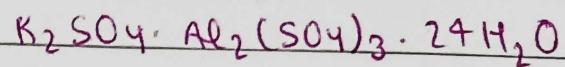
on hydrolysis, it  
make gives  
basic solution.



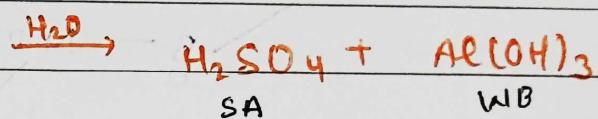
SB

WA

~~Alum~~ Alum



On hydrolysis, it gives  
acidic solution.



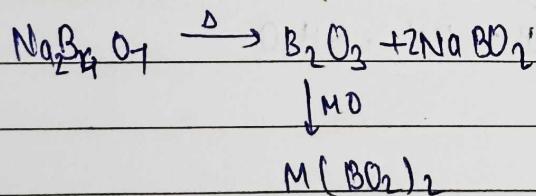
SA

WB

$\text{K}_2\text{SO}_4 \rightarrow$  Neutral salt  
 $(\text{KOH}^{\text{SB}} + \text{H}_2\text{SO}_4^{\text{SA}})$

Action of heating:-

On heating, it gives  
 $\text{Na}_2\text{B}_4\text{O}_7$  which on  
strong heating yield  
Borax bead.



Action of heating:-

On heating swells  
up.

~~$\text{Cu}^{2+}$~~   $\rightarrow$  Green  
 ~~$\text{Cr}^{3+}$~~   $\rightarrow$  Blue

$\text{Cr}^{3+}$  Green

$\text{Cu}^{2+}$  Blue

$\text{Mn}^{2+}$  Violet

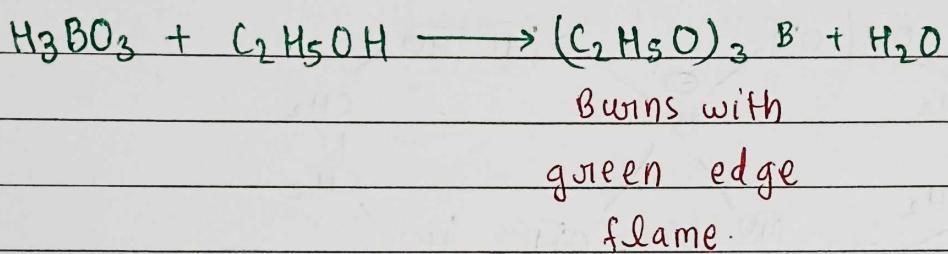
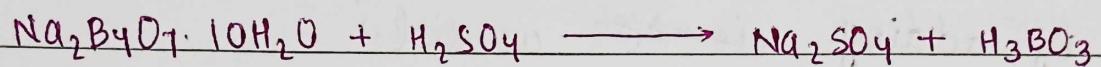
$\text{Ni}^{2+}$  Reddish Brown

$\text{Fe}^{2+}$  Yellowish Brown

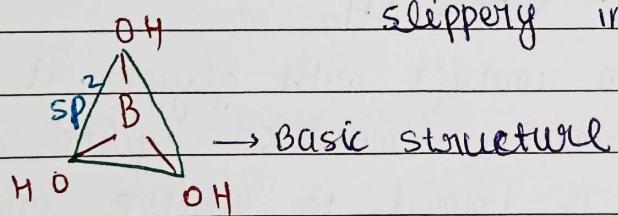
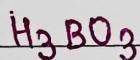
$\text{Co}^{2+}$  Blue

~~On dissolving in ethanol and~~

Test of Borax on borates:-



### Boric Acid



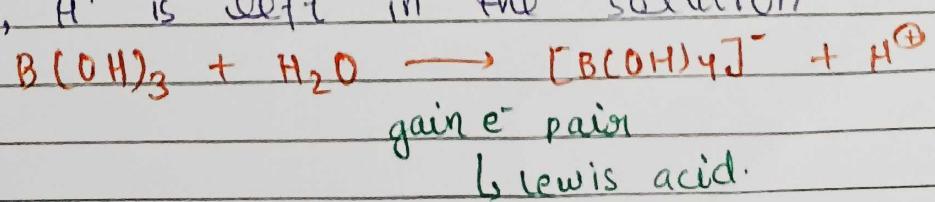
Triangular planar.

why boric acid is not a protic acid?

Because it takes up from water molecule  
and

Because it does not give  $\text{H}^+$  of itself.

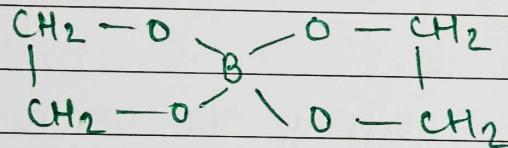
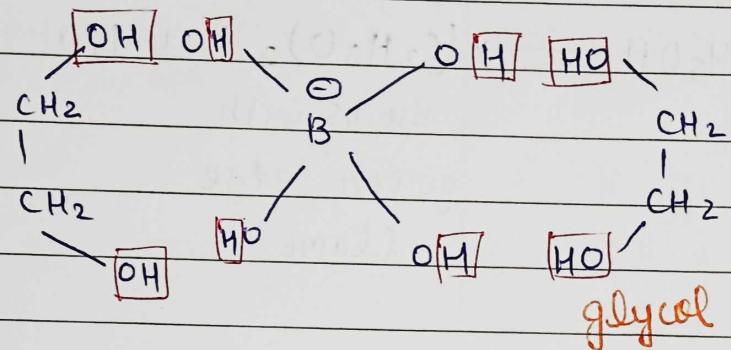
It accepts  $\text{dp(OH^-)}$  from water and thus,  $\text{H}^+$  is left in the solution



Q. Can we enhance acidic strength of boric acid?

Sol<sup>n</sup>:

We can enhance the strength of boric acid by adding ~~isotol~~ cis-diol.



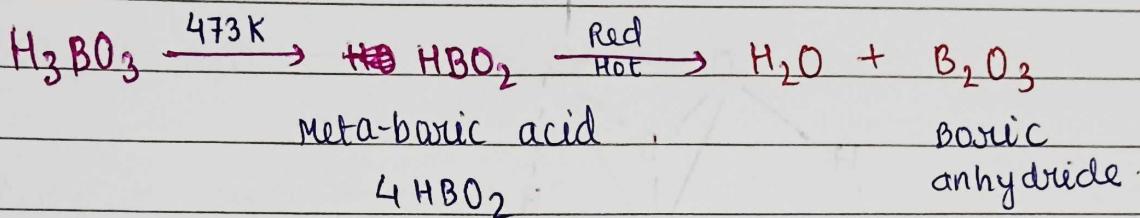
On getting in contact with glycol, it gives its H to form 5 membered cyclic ring complex which is formed to achieve more stability.

No. of  $\text{H}^+$  donate  $\propto$  acidity.

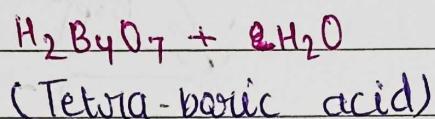
Thus, acidic strength  $\uparrow$ ses.

~~Heating of Boric Acid~~

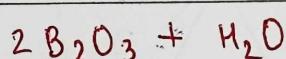
## Heating of Boric Acid



cooled and  
then heated to 410 K



△  
(Red Hot)

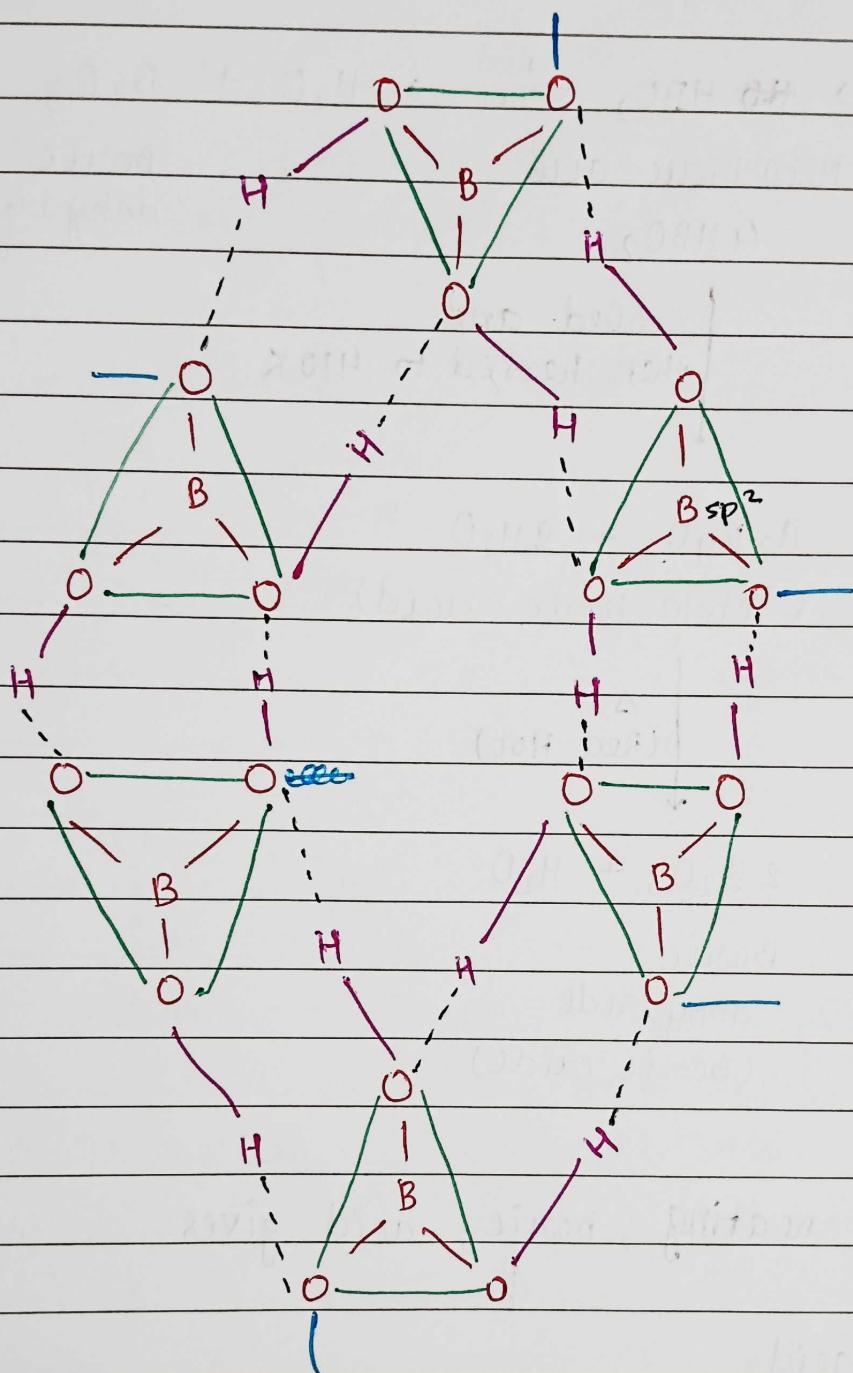


Boric anhydride  
(boric oxide)

Q. On strong heating, boric acid gives

- |     |                  |
|-----|------------------|
| (a) | meta-boric acid  |
| (b) | Tetra-boric acid |
| (c) | Boric            |
| (d) | All of the above |

## Crystalline structure of. Boric Acid



hexagonal 2-D sheet-like structure.

It has layered structure similar to graphite due to which it is used in carrion powder.

Each boron is  $\text{sp}^2$  and each oxygen is  $\text{sp}^3$ . hybridised.

## Preparation of Boric Acid :-



## Diborane

### Boyanne



~~BnHn+4~~

"Nidoborane"

e.g.

$\text{B}_2\text{H}_6$

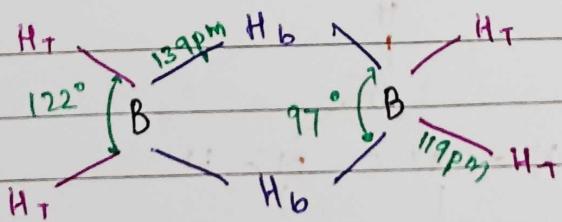
$\text{B}_n\text{H}_{n+6}$

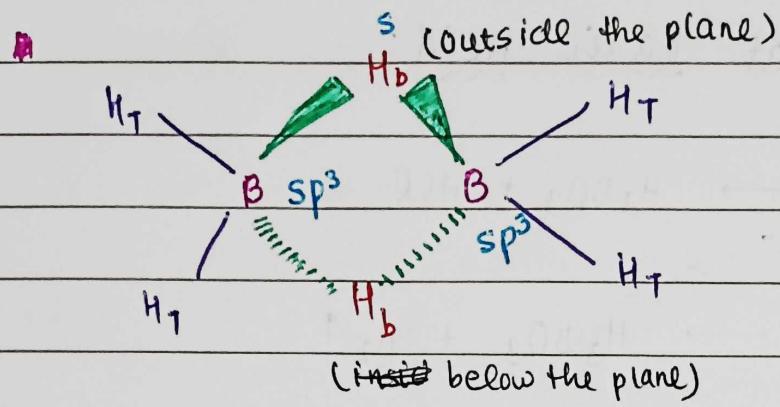
"Aichanoborane"

e.g.

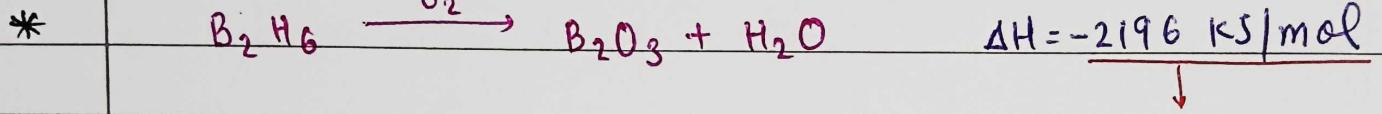
$\text{B}_2\text{H}_8$

## Diborane,



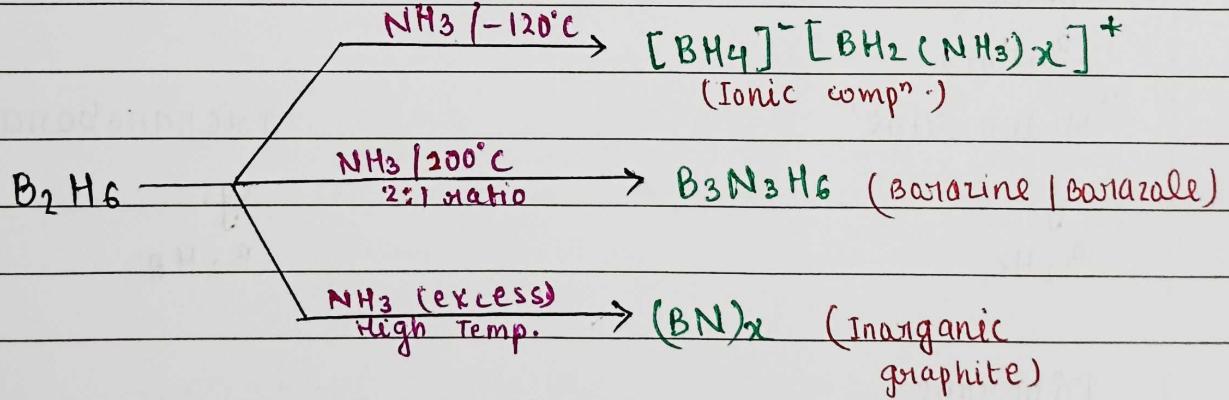


"Hybrid" of Banana bond:-  $sp^3 - s - sp^3$

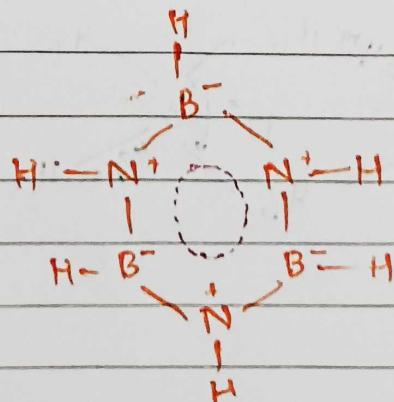


cave very high  
~~calorific~~ energy.

That's why used in  
rocket fuel.



$$B^- \& N^+ \equiv C$$



(Barazine)

Inorganic Diamond  
Borazon  
 $(BN)_x$

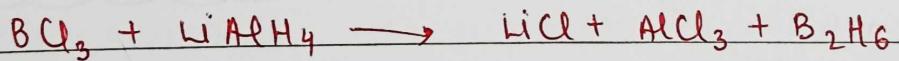
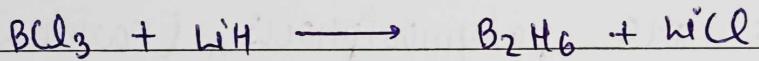
SIC - Corborundum  
Artificial gem

C-C bond of graphite ( $sp^2$ )  
is much stronger  
than diamond ( $sp^3$ ) but due to  
layered structure, it  
can slide over the  
other.

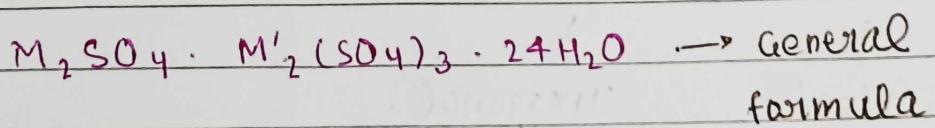
$p \cdot l \propto 1$

Bond strength

Preparation of Diborane :-



Alum



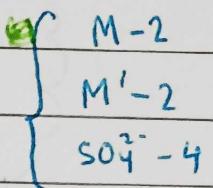
Alum is a double salt.

$M \rightarrow$  Univalent (+1)

$M' \rightarrow$  Trivalent (+3)

Type of ions present in alum = 3

Total no. of ions present in alum = 8



M	M'	Name
K	Al	Potash Alum
K	Cr	Chrome Alum
NH <sub>4</sub> <sup>+</sup>	Fe	Ferric Alum

### Pseudo Alums

to ~~alum~~ alum.

Pseudo Alums are polymorphous, (Formula same, structure different)

polymorphous

Formula same,  
structures

Different.

Isomorphous

Structure same,  
Formula different

eg, Zns

Zinc blende

wurtzite

Cubical

Hexagonal.

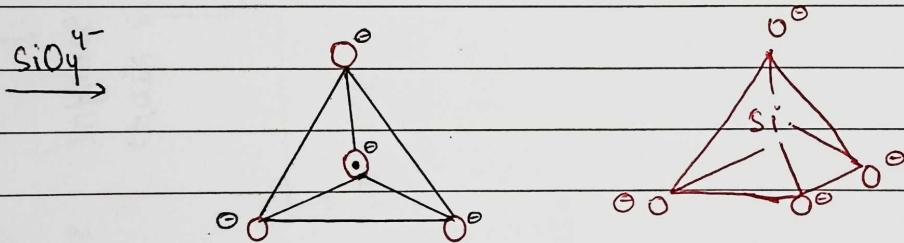
# Carbon family :-

## Silicates

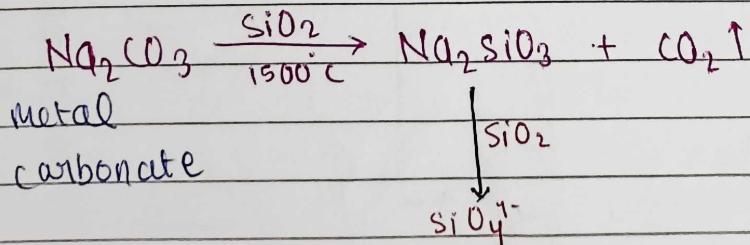
General formula  $\rightarrow \text{SiO}_4^{4-}$

Each unit is  $sp^3$  hybridised tetrahedral unit in Si is represented by dot ( $\cdot$ ) and oxygen is represented by circle ( $\circ$ ).

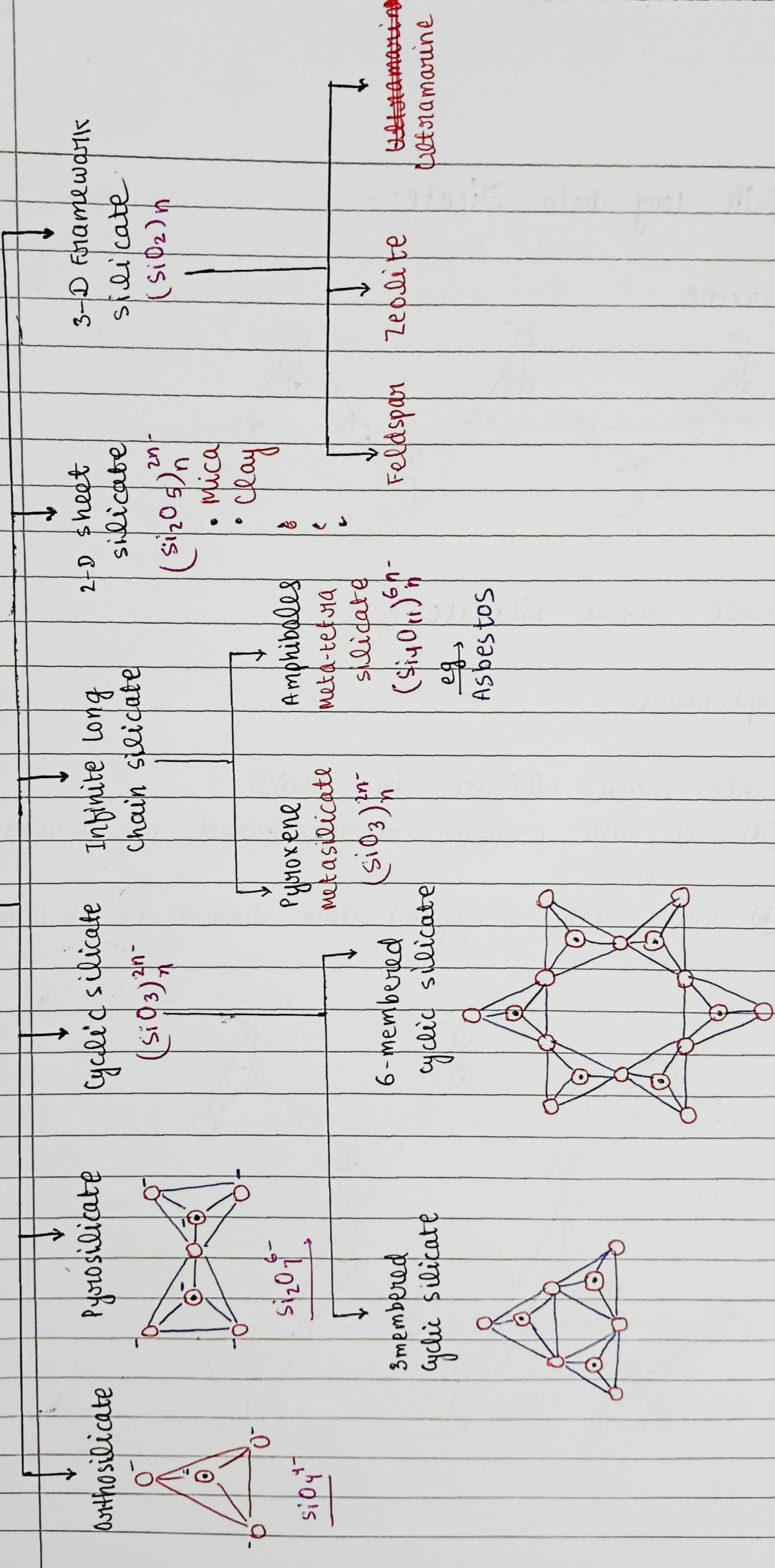
In silicates, covalency of silicon = 4



The large of earth crust is composed of silicates or aluminosilicates which can be formed by the fusion of silica in metal carbonates.

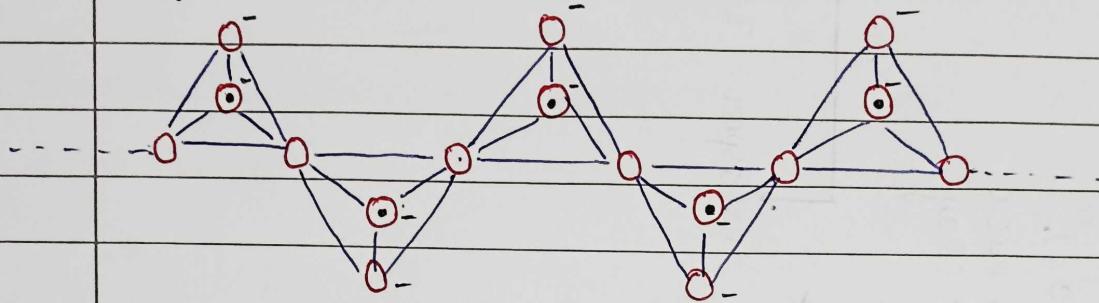


## Silicates



\* Infinite long chain silicate:-

1. Pyroxene



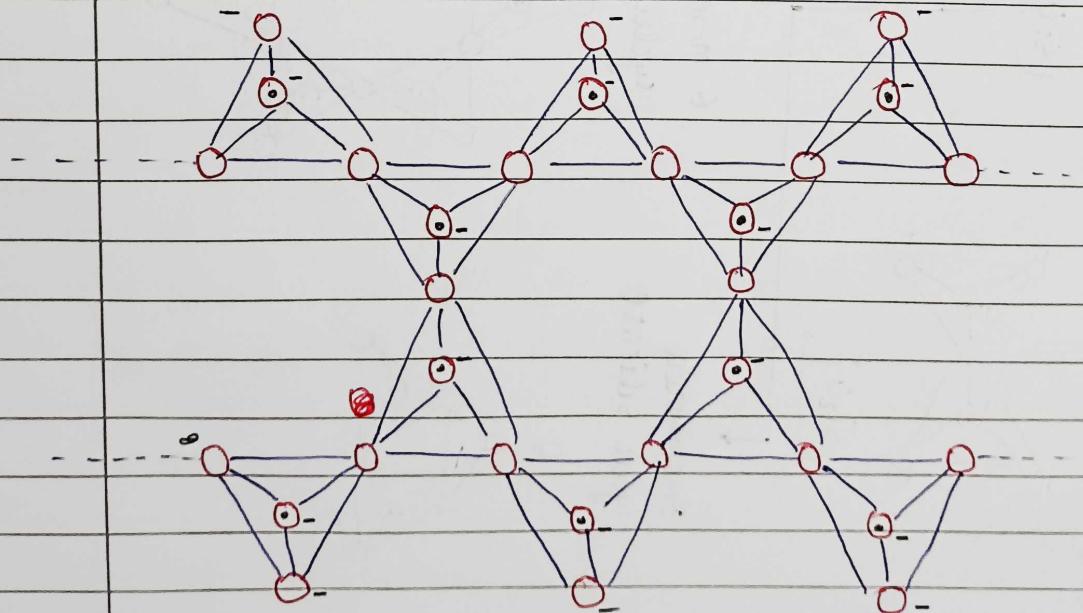
single chain silicate.

2. Amphiboles

Double chain silicate in which

(a) Unit with 2 oxygen atoms shared i.e. linear chain.

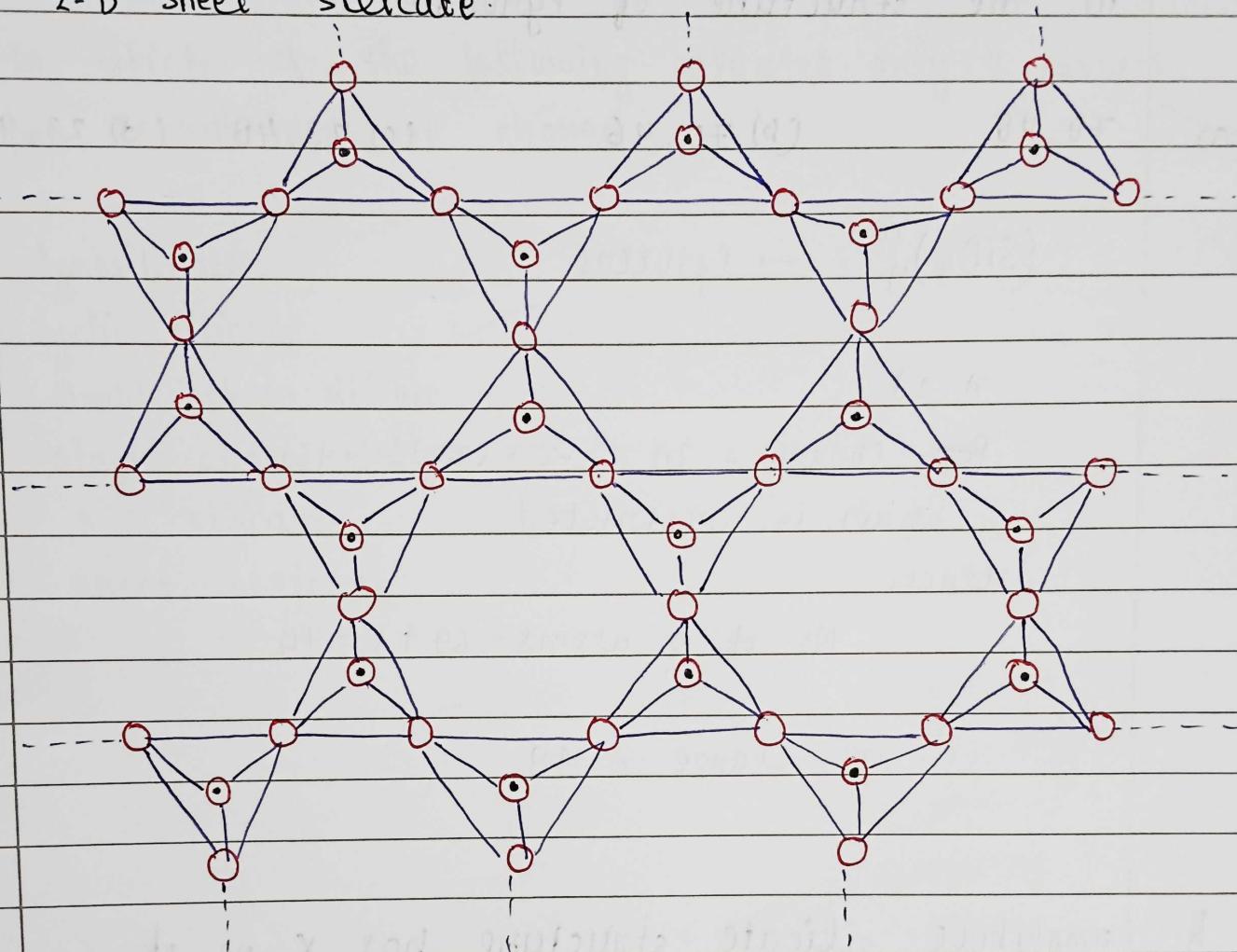
(b) Unit with 3 oxygen atom shared i.e. bridge unit.



half of the units are sharing 2 oxygen  
and rest half 3 oxygen atoms.

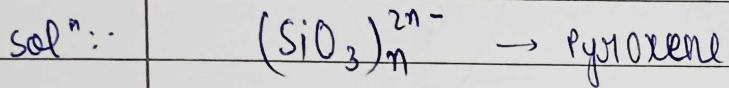
\*

2-D sheet silicate



Q. If the no. of silicon atoms restricted to 23 only - what would be the no. of oxygen atoms and magnitude of -ve charge respectively in the structure of Pyroxene?

- (a) 70, 48      (b) 70, 46      (c) 23, 48      (d) 23, 46



$$n = 23$$

$$\text{charge} = 2n = -2 \times (23) = -46$$

chain is restricted

Hence,

$$\text{No. of O-atoms} = 69 + 1 = 70$$

$$-\text{ve Charge} = 48$$

Q. Amphibole silicate structure has x no. of corners shared per tetrahedron. The value of x is -

$$\begin{aligned} \text{Ans} &= 1 + \frac{1}{2} + \frac{1}{2} + \frac{1}{2} \\ &= \frac{5}{2} \end{aligned}$$

Q. No. of corner oxygen atoms shared per tetrahedron in pyroxene and sheet silicates are :-

- (a) 2.5, 3      (b) 2, 3      (c) 3, 2      (d) 2, 2

No. of O-atoms shared -

Pyroxene = 2

Sheet silicate = 3

Q. In which of the following silicates only 2 corners per tetrahedron are shared:-

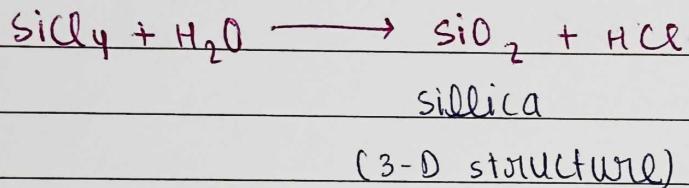
- (a) Pyrosilicate
- (b) Cyclic silicate ✓
- (c) Double chain silicate
- (d) Single chain silicate ✓
- (e) 3-D silicate
- (f) Sheet silicate

## Silicones

The general formula of silicones is  $(R_2SiO)_n$

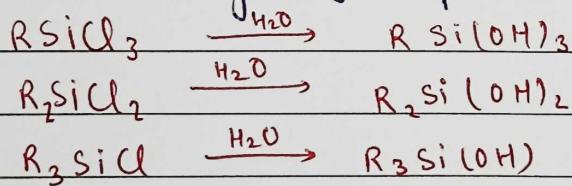
The repeated unit of silicone is  $\text{--- Si-O-Si ---}$   
(R = Alkyl group)

Also known as organosilicon polymer



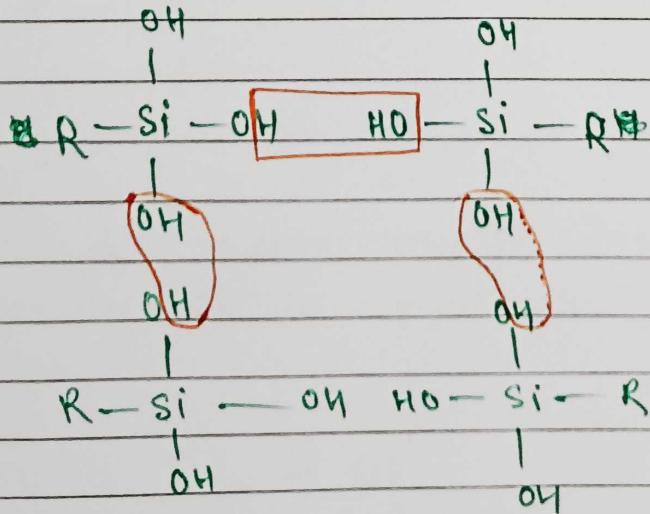
silicones have  
~~O-Si-O~~ linkage  
Si-O-Si

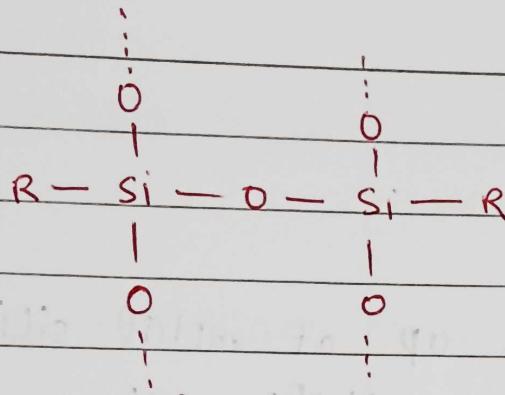
To form silicones, doping of silica is done with alkyl group.



R group is hydrophobic

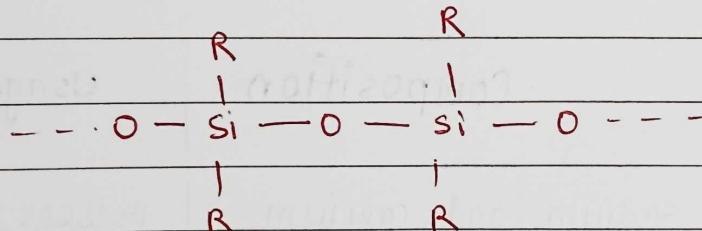
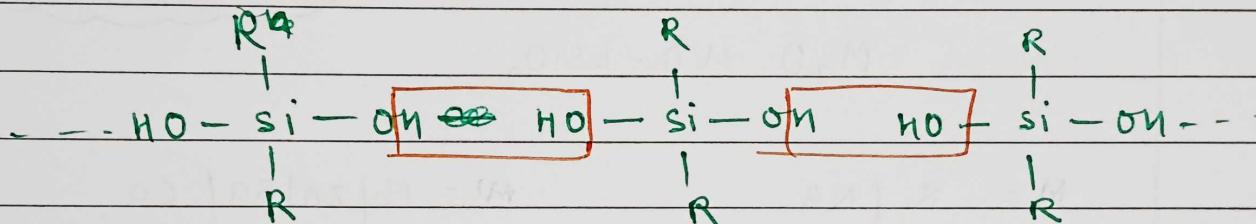
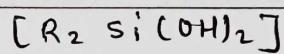
\* Sheet silicone formation from  $[\text{RSiCl}_3]$  or  $[\text{RSi(OH)}_3]$ .





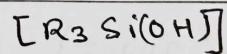
\* ~~chain~~ silicone formation from  $[\text{R}_2\text{SiCl}_2]$

or

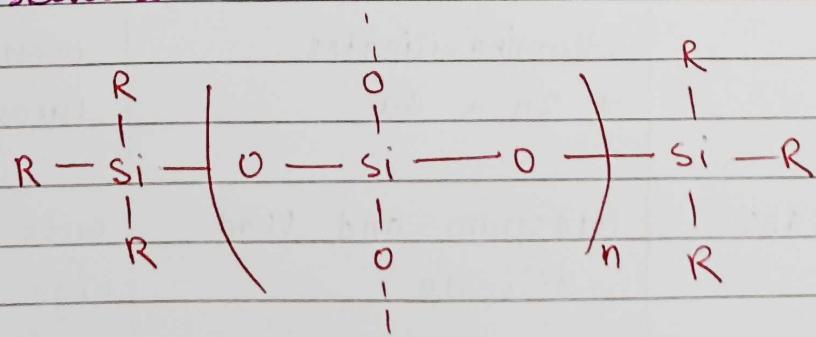


\* Terminal silicone formation  $[\text{R}_3\text{SiCl}]$

or



$\text{R}$  group being hydrophobic terminates silicone.

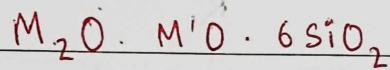


# Glass :-

Glass is mainly made up of metal silicates in which most common metals are Potassium, Calcium and Lead.

General formula:-

Glasses are amorphous



$M = K / Na$

$M' = Pb / Zn / Ba / Ca$

Glass	Composition	Usage
1. Soft Glass (soda glass)	sodium and calcium silicate	Bottles, window pane, tubes
2. Hard Glass (potash glass)	Potassium and lead silicate	resistant towards water and acids
3. <del>Pyrex</del> Pyrex Glass	Borosilicates and Alumino silicates + Zn + Ba	Laboratory, oven (heat resistant)
4. Flint Glass	Potassium and lead silicate	Bulbs due to high refractive index

5.	Jena Glass	Zn + Ba + Borosilicate	costly glassware
6.	Quartz Glass	purest form of silica	very low coefficient of heat expansion
7.	Crook's Glass	cerium oxide	Used to make eye lens

### Important gases of Carbon

CO (carbon monoxide)

CO<sub>2</sub> (carbon dioxide)

C<sub>3</sub>O<sub>2</sub> (Carbon bisuboxide)

Syn gas

Producer gas

CNG

LPG (Liquified Petroleum Gas)

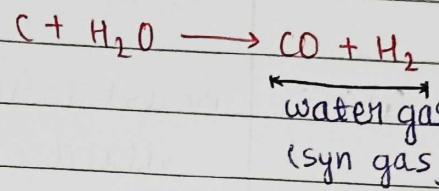
Coal gas

Bio gas

## Gas

## Composition

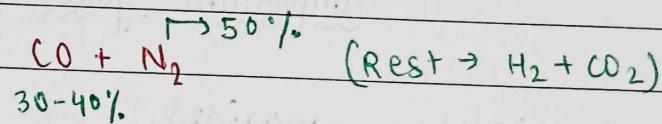
1. Syn gas  
 (water gas)  
 (synthetic gas)



50% CO, 50% H<sub>2</sub> → Approx.  
 1% (CO<sub>2</sub> + H<sub>2</sub>O)

Used for manufacturing  
 of Hydrogen.

2. Producer gas



Poisonous

Heavier than air

Used in  
 (i) steel making.  
 (ii) glass industry.

3. CNG

CH<sub>4</sub> - 85% (Rest → ethane, butane,  
 propane, nitrogen)

4. LPG

C<sub>4</sub>H<sub>10</sub> (n-butane + iso-butane  
 (Butane) + propane)

↓  
 major component

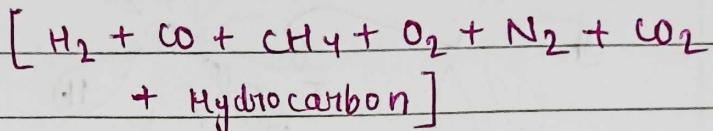
Colourless, odourless, tasteless

↓  
 Odour on leaking is due to  
 C<sub>2</sub>H<sub>5</sub>SH (ethyl mercaptan).

Coal Gas

56.1. Hydrogen

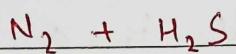
+ Methane



Used in metallurgy  
In smelting

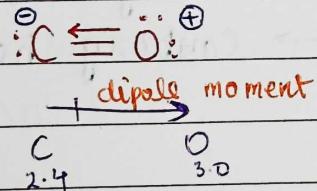
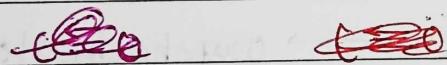
Bio Gas

By the degradation of organic waste -  $CH_4$  (major) +  $CO + H_2 +$



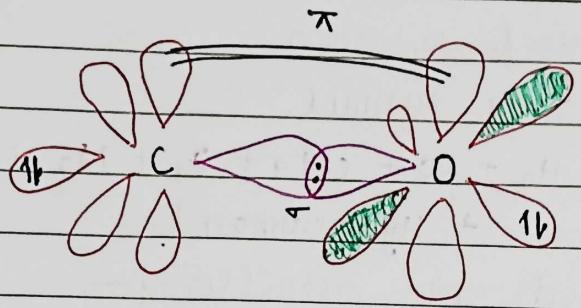
↳ cause of bad odour.

### \* Carbon monoxide ( $CO$ ):-



Bond moment is from O to C and dipole from C to O. That's why  $CO$  is almost non-polar ( $\mu = 0.03 \text{ D}$ )

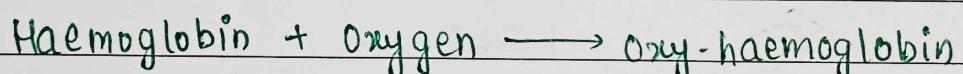
Carbon is having -ve charge even though it is Electropositive so, it will donate lp. That's why  $\text{CO}$  is Lewis Base.



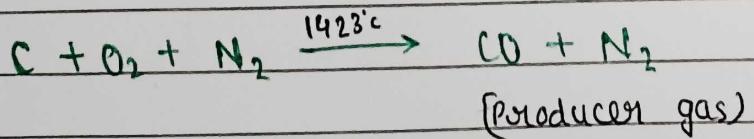
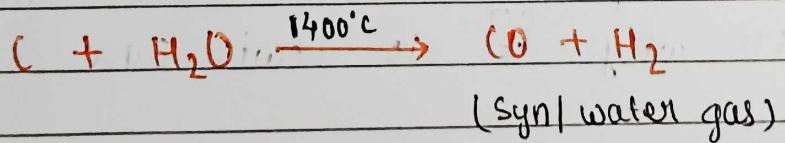
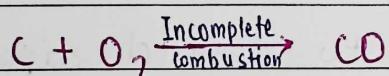
Carbon monoxide is a poisonous gas which has 300 times more stable comp<sup>n</sup> formation tendency with haemoglobin than oxygen.



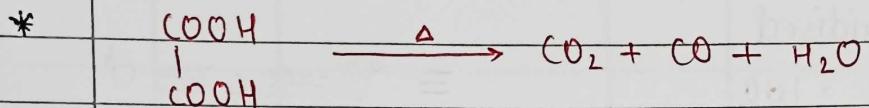
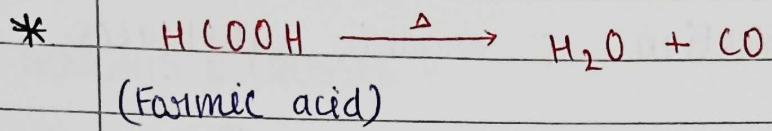
Every haemoglobin atom contains 4 iron atoms.



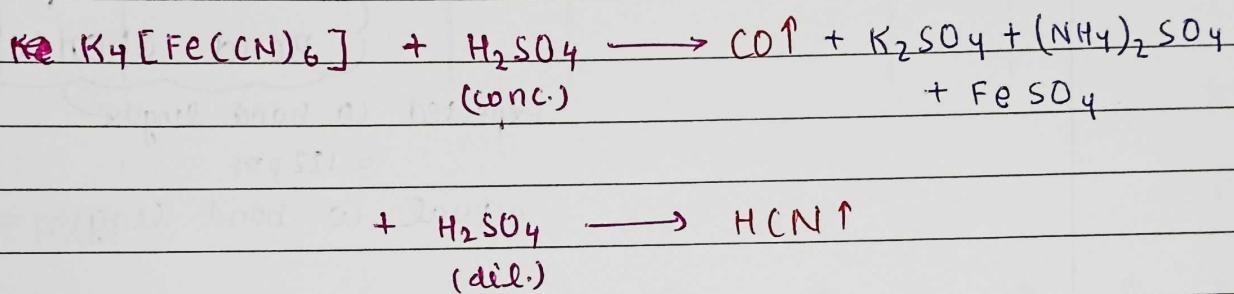
Preparation of CO :-



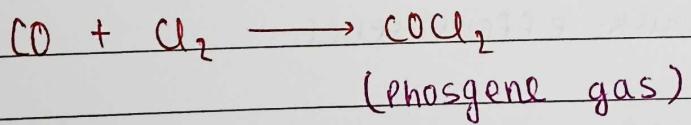
Identification test for CO : It burns with blue edged flame



\* Advanced :-



carbon monoxide is thermally stable even above 1000°C. That's why used in metal extraction.



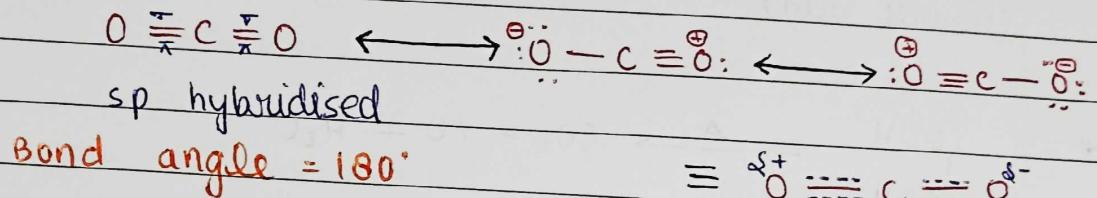
CO, H<sub>2</sub>O, N<sub>2</sub>O, NO, OF<sub>2</sub> are neutral  
Nitrous oxide  $\leftarrow$        $\downarrow$  Nitric oxide.  
(Laughing gas)

carbogen

~~Cyanogen~~ (95% Oxygen + 5% CO<sub>2</sub>) is used to provide artificial respiration when CO is inhaled.

## Carbon Dioxide ( $\text{CO}_2$ )

Obtained by complete combustion of organic substances



Partial Triple Bond character (PTBC)

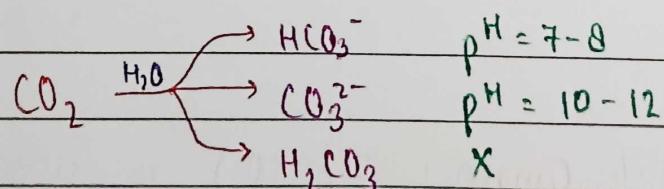
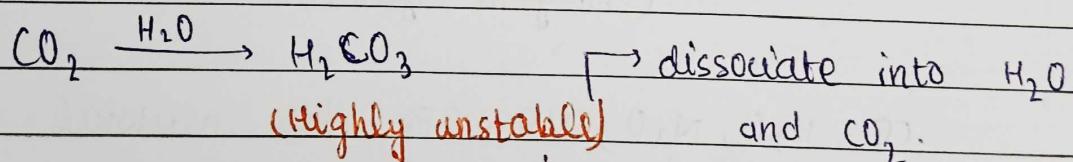
Expected CO bond length  
= 122 pm

Actual CO bond length = 115 pm

$\text{CO}_2$  is colourless, odourless, tasteless and 1.5 times heavier than air.

Non-combustible and non-supporter of combustion.

Evolved with brisk effervescence.



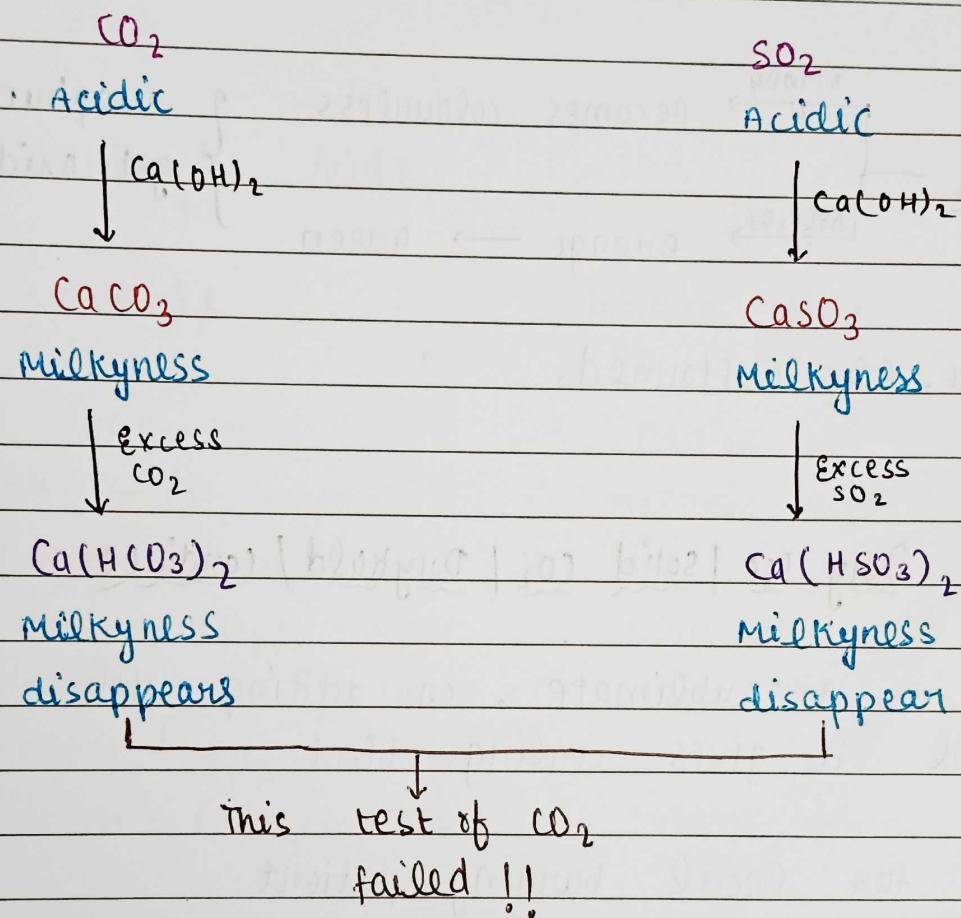
$\text{HCO}_3^- / \text{CO}_3^{2-} \rightarrow$  Buffer solution  $\rightarrow$  "Blood"

Blood is a buffer soln.  $\longleftrightarrow$

That's why pH is maintained (b/w 7.2-7.4).

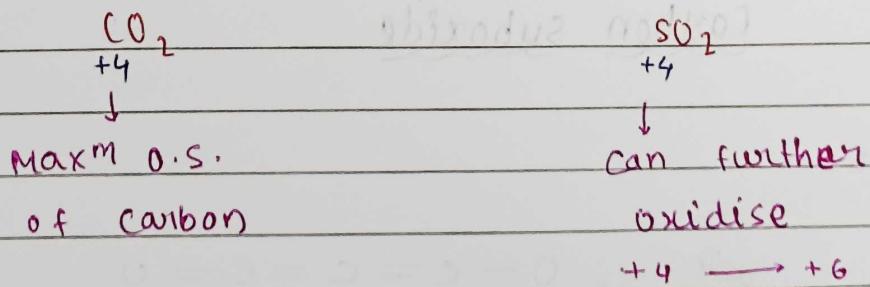
## Detection of $\text{CO}_2$ :

$\text{CO}_2$  v/s  $\text{SO}_2$

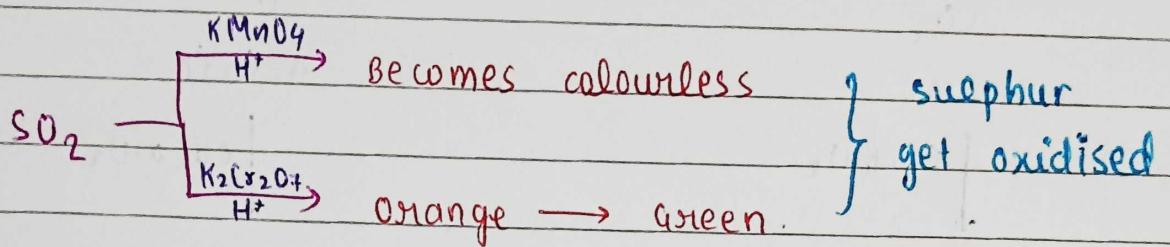
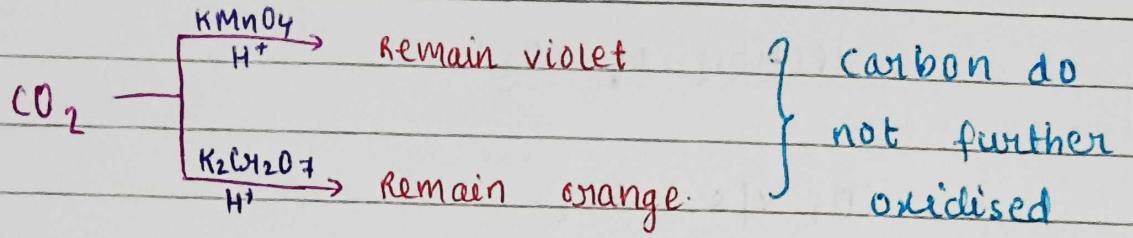


Now,

To differentiate b/w  $\text{CO}_2$  and  $\text{SO}_2$  we use another test.



Hence, to differentiate b/w these two oxidising agents are used.



Hence,  $\text{CO}_2$  confirmed.

### Dry ice | solid $\text{CO}_2$ | Drycold / carbonice

It is a sublimate, on adding with alcohol it gives cooling effect.

Used for local burning patient.

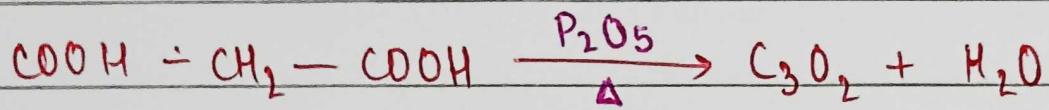
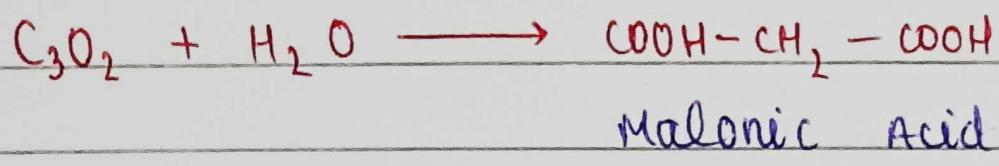
Used for cooling of frozen dessert.

### Carbon suboxide



Foul smelling gas:

Linear molecule.



Carboxylic Acids:-

Aids	Common Name
$\text{COOH}-\text{COOH}$	Oxalic Acid
$\text{COOH}-\text{CH}_2-\text{COOH}$	Malonic Acid
$\text{COOH}-\text{CH}_2-\text{CH}_2-\text{COOH}$	Succinic Acid
$\text{COOH}-\text{(CH}_2)_3-\text{COOH}$	Glutamic Acid
$\text{COOH}-\text{(CH}_2)_4-\text{COOH}$	Adipic Acid
$\text{COOH}-\text{(CH}_2)_5-\text{COOH}$	
$\text{COOH}-\text{(CH}_2)_6-\text{COOH}$	Suberic Acid.