P-Block Elements [$ns^2 np^{1-6}$]

BORON FAMILY

Boron	B	(5)	[He] $2s^2 2p^1$ ⇒
Aluminium	Al	(13)	[Ne] $3s^2 3p^1$ → most abundant metal
Gallium	Ga	(31)	[Ar] $3d^{10} 4s^2 4p^1$
Indium	In	(49)	[Kr] $4d^{10} 5s^2 5p^1$
Thallium	Tl	(81)	[Xe] $4f^{14} 5d^{10} 6s^2 6p^1$

2 isotopes of B
^{10}B (19%) & ^{11}B (81%)

Al is third most abundant element in earth's crust after
① oxygen (45.5%)
② silicon (27.7%)
③ Al (8.3%)

physical Properties :-

① Atomic Radii :-

It increase down the group with ↑ in no of shells.

Atomic radii of Ga ≃ Al

Reason :- poor screening effect of 3d electrons in case of Ga.

Atomic radii of Tl ≃ In

Reason :- Lanthanide Contraction.

Atomic radii
B < Ga < Al < In < Tl
NCERT data base

ionic radii B < Al < Ga < In < Tl

② Ionisation Energy :-

It decrease down the group with ↑ in atomic radii

Exception I :- IE of Gallium ≃ IE of Aluminium

Exception II :- IE of Tl ≃ IE of In

IE : B > Al > Ga > Tl > In
B > Tl > Al > Ga > In
NCERT data based

③ Density :- increases down the group.

B < Al < Ga < In < Tl

④ Electronegativity

B	>	Tl	>	In	>	Ga	>	Al
2.0		1.8		1.7		1.6		1.5

IIT

Q. which of the following statement is correct ?

① Ga^+ salts acts as good reducing agent.

② In^{3+} salt act as good oxidising agent.

③ Tl^{3+} salt act as good oxidising agent.

④ All of these.

Ans ⓐ $Ga^{3+} > Ga^+$

$Ga^+ \longrightarrow Ga^{3+} + 2e^-$

ⓑ $In^+ > In^{3+}$

ⓒ $Tl^+ > Tl^{3+}$

inert pair effect

order of stability

$In^{3+} + 2e^- \longrightarrow In^+$

$Tl^{3+} + 2e^- \longrightarrow Tl^+$

So Ga^+ salt act as good Reducing agent and In^+ & Tl^{3+} act as good oxidising agent.

⑤ Order of m.p. :-

B	Al	Ga	In	Tl
2300°C	660°C	30°C	157°C	303°C

Order of mp

* Boron exist in form of covalent Polymer & thus it possesses exceptionally high mp.

* Ga in form of Ga_2 molecule and its mp is low. It is a liquid metal & it retains its liquid state upto 2000°C.

Chemical Properties :-

① Hydrides :-

hydrides of Boron are known as "Boranes"

Boranes

- Nido boranes — $B_n H_{n+4}$ — eg. B_2H_6 (Diborane)
- Arachno boranes — $B_n H_{n+6}$ — B_4H_{10} (tetraborane)

Diboranes (B_2H_6) :-

$$2NaBH_4 + I_2 \rightarrow B_2H_6 + 2NaI + H_2$$ — NCERT

Preparation :-

① Industrial method :- In industries B_2H_6 is obtained by rxn of BF_3 with LiH (Lithium hydrides)

$$2BF_3 + 6LiH \xrightarrow{\text{high T}} B_2H_6 + 6LiF$$

$2BF_3 + 6NaH \xrightarrow{450K} B_2H_6 + 6NaH$ — NCERT

② by reduction of BCl_3 with $LiAlH_4$.

NCERT

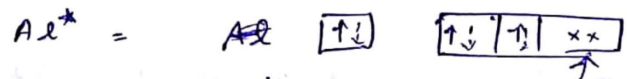
$$BCl_3 + LiAlH_4 \longrightarrow B_2H_6 + LiCl + AlCl_3$$

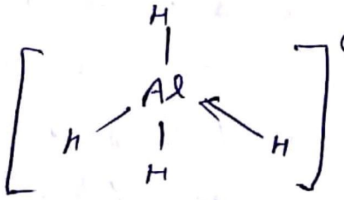
↳ $4BF_3 + 3LiAlH_4 \rightarrow 2B_2H_6 + 3LiF + 3AlF_3$

② By passing a silent electric charge (discharge) through a mix of BCl_3 & Hydrogen.

$$BCl_3 + H_2 \xrightarrow[\text{discharge}]{\text{Silent electric}} B_2H_6 + HCl$$

$Li^{\oplus}[AlH_4]^{\ominus}$

$Al^* =$ 

Li^+  sp^3, tetrahedral

$LiH + AlH_3 \longrightarrow LiAlH_4$

LB LA

Q. which of the following statement is incorrect regarding Diborane ?

(A) There are 12 valence $e^{\ominus}$ in Diborane, 3 $e^{\ominus}$ contributed by each of 2 B atoms & 6 $e^{\ominus}$ each by H-atom.

(B) (2c-2e) bond present b/w B-atom & terminal H.

(C) (3c-2e) bond is present b/w B & bridging H.

(D) B-B bond present in diborane.

Ans (D).

*** Only terminal H are replacable and ~~this~~ ~~tetrah~~ tetraalkylated product is from diborane. (B_2H_6)

but Bridging H are not replaceable because they are involved in formation of Banana Bond and thus hexaalkylated product is not obtained from. Diborane (B_2H_6)

$$B_2H_6 \xrightarrow[-BH]{+6CH_3} B_2(CH_3)_6$$ ✗

$$B_2H_6 \longrightarrow B_2H_2(CH_3)_4$$ ✓

*** In presence of Lewis Base, B_2H_6 undergoes homolytic cleavage into BH_3 and form addition compound with Lewis Base

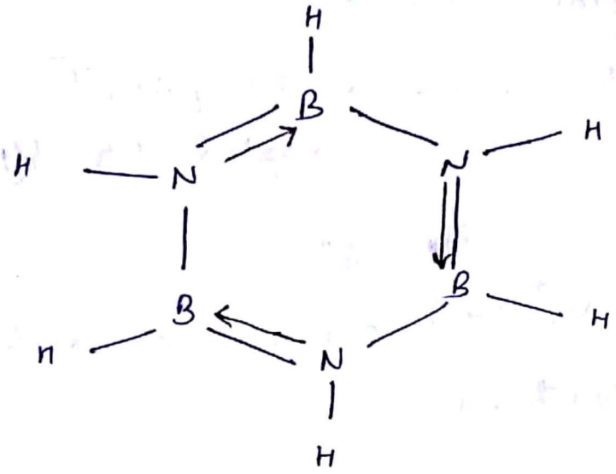
$$B_2H_6 + 2L \longrightarrow 2[L \rightarrow BH_3]$$

L → Lewis Base

addition compound

for eg:. $B_2H_6 + 2CH_3NH_2 \longrightarrow 2[BH_3 \leftarrow NH_2CH_3]$

$B_2H_6 + 2CO \longrightarrow 2[H_3B \leftarrow CO]$



$12\sigma : 3\pi$

$4 : 1$

**

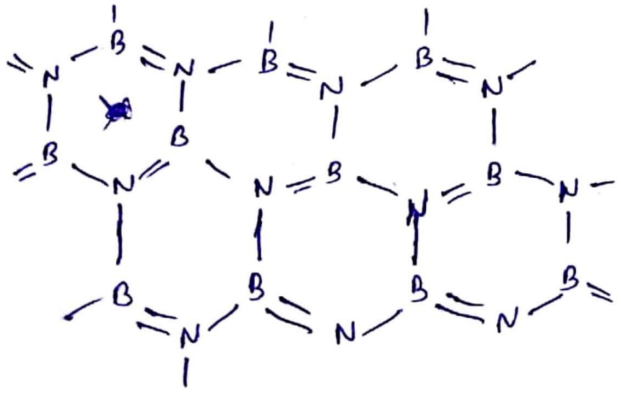
Notes :- "Borazine" is much more reactive than benzene due to presence of polar B-N bond in it while in benzene all the bonds are non-polar

(6) When Diborane is treated with excess of NH_3 at very high temperature then a very hard substance known as "Boron Nitride" is obtained. It is commercially known as "Borazone"

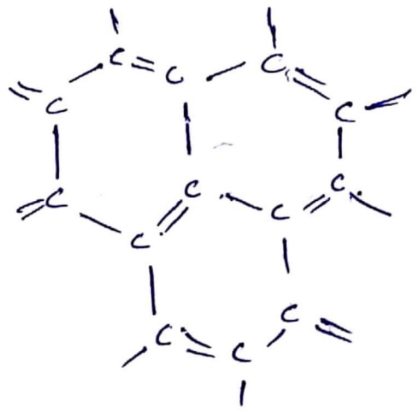
$$B_2H_6 \xrightarrow[\text{very high } T]{\text{excess of } NH_3} BN$$

Boron Nitride

It is also known as "Inorganic graphite" because its structure is like to Graphite.



Boron nitride



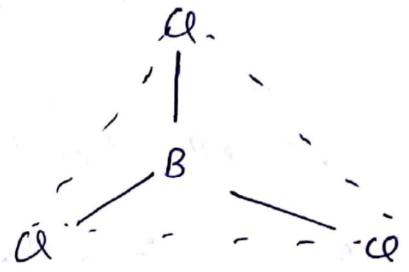
2 Halides :-

Boron halides :-

BF_3 , BCl_3 , BBr_3 , BI_3

G.S $B = 1s^2$ $\boxed{\uparrow\downarrow}$ $2s^2$ $\boxed{\uparrow \; | \; |}$ $2p^1$

Es $B^* = 1s^2$ $\boxed{\uparrow}$ $\boxed{\uparrow\downarrow \; \uparrow\downarrow \; |}$ sp^2



sp^2, Trigonal planar

all Boron halides are electron deficient molecule so they act as lewis acids.

$$BF_3 < BCl_3 < BBr_3 < BI_3$$

Order of Lewis Acid ch^r

** BF_3 is weaker Lewis Acid than other Boron Halides)

Reason :- In case of BF_3 due to small size of B & F atom the filled 2p orbital of F overlap sidewise with the vacant 2p orbital of Boron. forming $p\pi - p\pi$ bond. due to which electron deciency on Boron get compensated and hence Lewis Acid ch'aracter decrease.

But as the size of halogen atom increases tendency to form $p\pi - p\pi$ bond decreases and thus electron deficiency on Boron increases due to which lewis Acid ch^r increases.

Some important compounds of Boron family :-

① **Borax / Tincal / suhaga** :- ($Na_2B_4O_7 \cdot 10H_2O$)

preparation :- ① From colemanite Mineral :-

$$Ca_2B_6O_{11} + Na_2CO_3 \longrightarrow \underset{\text{Borax.}}{Na_2B_4O_7} + \underset{\text{sodium metaborate}}{NaBO_2} + CaCO_3.$$

colemanite

when CO_2 gas is passed through $NaBO_2$, Borax obtained.

$$4NaBO_2 + CO_2 \longrightarrow Na_2B_4O_7 + Na_2CO_3$$

(Borax is found in Puga Valley (Ladakh) & Sambhar Lake (Rajasthan))

② From Boric Acid

NCERT

$$H_3BO_3 + Na_2CO_3 \longrightarrow Na_2B_4O_7 + CO_2 + H_2O$$

properties :-

① The aqueous solution of Borax is alkaline or basic in nature because it is a salt of strong base and weak Acid

$$\underset{\text{Strong Base}}{NaOH} + \underset{\text{weak Acid}}{H_3BO_3} \rightleftharpoons Na_2B_4O_7 + H_2O$$

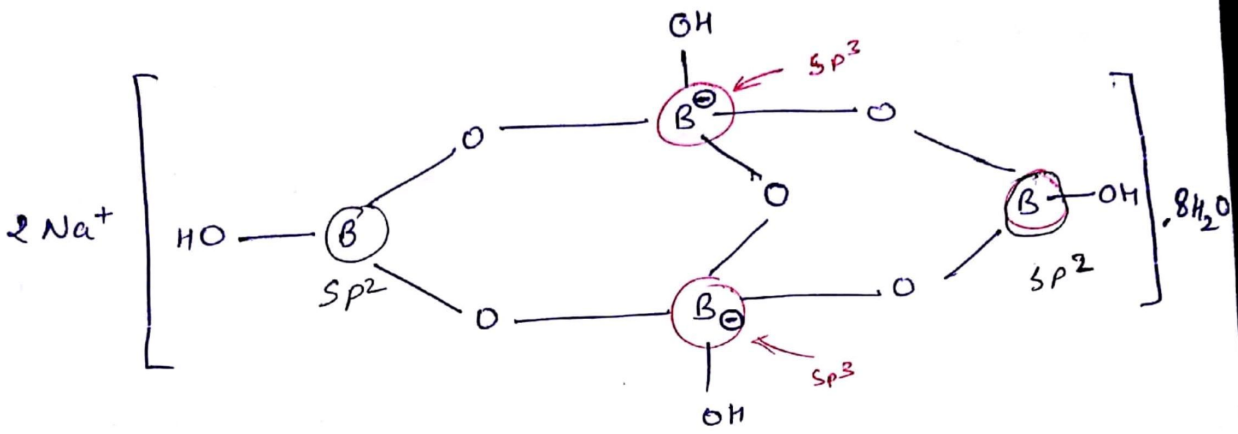
***

② **Borax Bead test** :-

In this test Istly Borax is heated so that its water of crystallisation eliminates & it get converted into anhydrous form $Na_2B_4O_7$.

Structure of Borax :-

It is represented as $Na_2[B_4O_5(OH)_4]\cdot 8H_2O$



***

In Borax 2 B atoms are sp^2 hybridised with a trigonal planar geometry while 2 Boron atoms are sp^3 hybridised with a tetrahedral geometry.

Uses of Borax :-

① It is used as flux as it removes high melting impurities by forming low melting Borates.

flux + Impurity = slag. (M.P) → Borates
M.P

② It is used in softening of water as it removes Mg^{2+} & Ca^{2+} ion from hard water by forming Borates.

i.e. MgB_4O_7 (Magnesium borate) & CaB_4O_7 (Calcium Borates)

③ It is also used as antiseptic.

④ It is also used in manufacture of glass.

Boric Acid / Ortho Boric Acid / H_3BO_3 / $B(OH)_3$ ④

② **Preparation** :- from **Colemanite** Mineral.

When SO_2 Gas is passed through aq. solution of colemanite mineral then crystals of Boric Acid are obtained.

$$Ca_2B_6O_{11} + SO_2 + H_2O \longrightarrow H_3BO_3 + Ca(HSO_3)_2\downarrow$$

(calcium bisulphate)

⑥ from **Borax** :-

$$Na_2B_4O_7 + H_2SO_4 \text{ (conc.)} \longrightarrow H_3BO_3 + Na_2SO_4$$

Properties :-

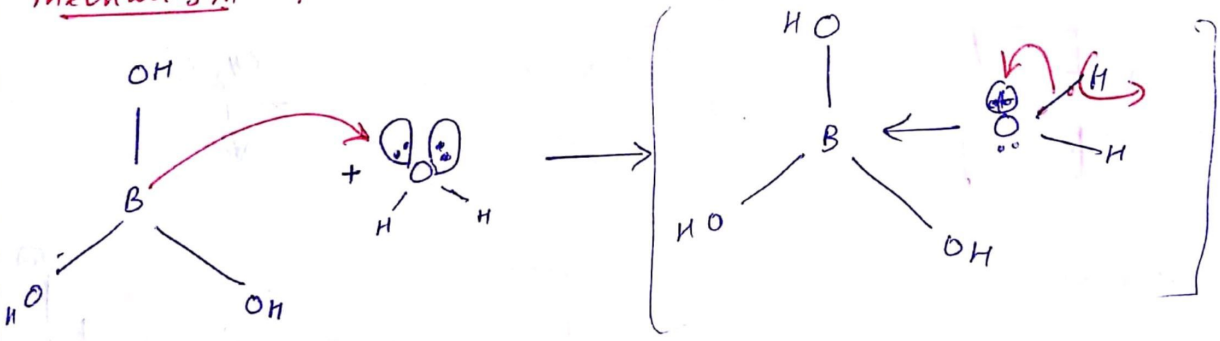
① It is a white coloured powder with soapy touch

IIT ② **Acidic behaviour** :-

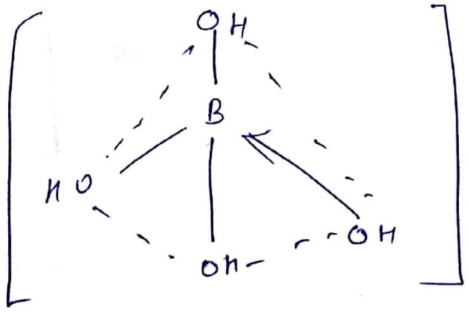
It is a **weak monobasic Acid**. It do **not** act as a **proton donar** rather it act as **Lewis Acid** & it accept $OH^\ominus$ ions from water.

$$B(OH)_3 + H_2O \longrightarrow B(OH)_4^\ominus + H^\oplus$$

mechanism :-

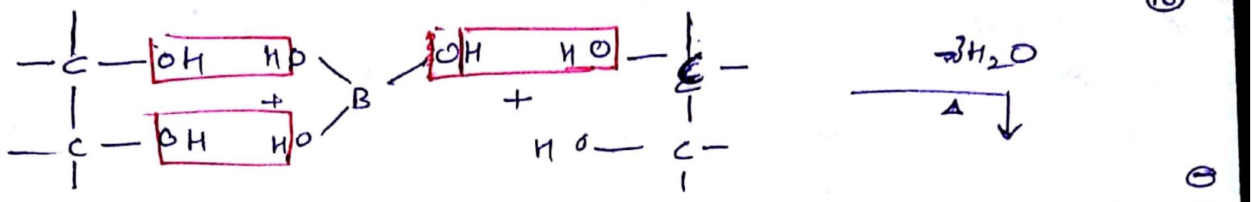


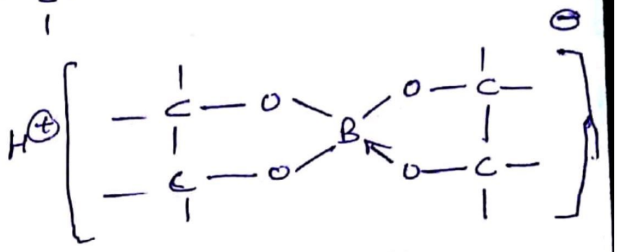
sextet
sp^2



$+ H^\oplus$

sp^3 tetrahedral.





chelate compound.

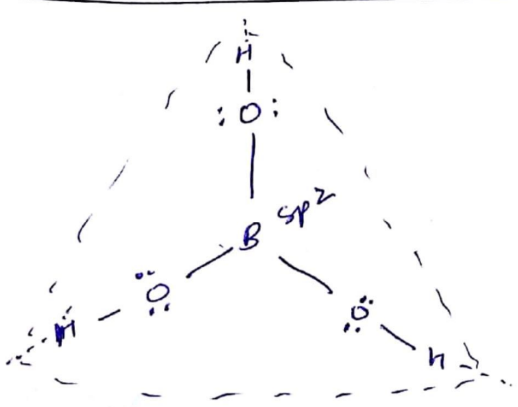
(5) Rxn with ethyl alcohol :-

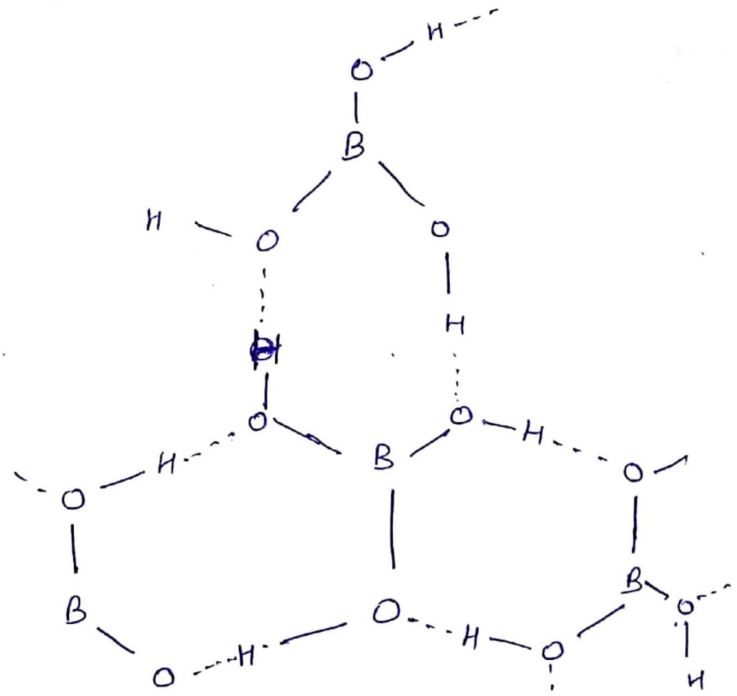
Boric acid reacts with ethyl alcohol forming ethyl borate which burns with green edged flame.

$$B(OH)_3 + C_2H_5OH \longrightarrow B(OC_2H_5)_3 + 3H_2O$$

acid — alcohol — ethyl borate (ester)

Structure of Boric Acid :-





Uses :-

① Used for "eye wash" under the name of "eye lotion"

② used as food preservative.

Compounds of Aluminium :-

Aluminium chloride ($AlCl_3$) :-

Preparation :- dissolution of Al, Al_2O_3 or $Al(OH)_3$ in dil HCl

(i) $2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2\uparrow$

$Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$

$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$

(ii) by heating a mix of Al_2O_3 & coke & passing chlorine over it.

$Al_2O_3 + 3C + 3Cl_2 \longrightarrow \underset{\text{anhydrous}}{2AlCl_3} + 3CO\uparrow$

Properties :-

(1) It is a covalent compound. ~~which is solid~~

(2) It is colourless solid

(3) Anhydrous $AlCl_3$ is deliquescent in nature

Alums :-

alums are double sulphate - $M_2SO_4 \cdot M'_2(SO_4)_3 \cdot 24H_2O$

M :- Monovalent metal ion (eg - Na^+, K^+, NH_4^+ etc)

M' :- Trivalent metal ion (eg - Al^{3+}, Fe^{3+}, Cr^{3+} etc)

Example of Alums are :-

(1) Potash Alum / common Alum - $K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

(2) Soda Alum - $Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$

(3) Ammonium Alum - $(NH_4)_2SO_4 \cdot Al_2(SO_4)_3\, 24H_2O$

(4) Chrome Alum - $K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$

* ~~In Alum each metal ion is surrounded by 6 water molecule.~~

- ~~Li ion do not form alum because~~ Li^+ is ~~too small~~ not able to show coordination number 6.

CARBON FAMILY

Carbon	C	Z=6	[He] $2s^2 2p^2$
Silicon	Si	Z = 14	[Ne] $3s^2 3p^2$
Germanium	Ge	Z = 32	[Ar] $3d^{10} 4s^2 4p^2$
Tin	Sn	Z = 50	[Kr] $4d^{10} 5s^2 5p^2$
Lead	Pb	Z = 82	[Xe] $4f^{14} 5d^{10} 6s^2 6p^2$

Physical properties

① Atomic size :- ↑ down the group.

Exception

Atomic size of Pb ≈ Atomic size of Sn

Reason :- Lanthanoid contraction.

② I E :- ↓ down the gp with ↑ in Atomic size

Exception. :- I E of Pb ≥ I E of Sn

③ Oxidation state :-

down the gp due to inert pair effect stability of +2 oxidation state increases.

$Ge^{4+} > Sn^{4+} > Pb^{4+}$

$Ge^{2+} \not< Sn^{2+} < Pb^{2+}$

relative stability of +4 & +2 O.S.

$Ge^{4+} > Ge^{2+}$ order of stability.

Ge^{2+} salt acts as good reducing agent.

$$Ge^{2+}_{(+2)} \longrightarrow Ge^{4+}_{(+4)} + 2e^{\ominus}$$

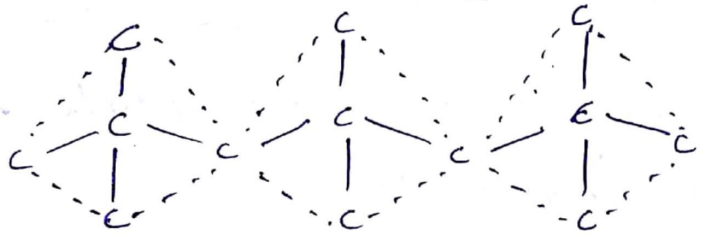
Allotrops of C

Crystalline
- Diamond
- Graphite
- Buck Minister Fullerene C_{60} [Bucky Ball]

Amorphous
- coal
- charcol
- lamp black or Carbon black

Some imp. points regarding Allotropy :-

IIT ① In Diamond state of hybridisation is sp^3 in which large no of tetrahedral units are linked together forming a giant network due to which it is extremely hard.



diamond

AIEEE ② In graphite state of hybridisation carbon is sp^2, ~~in which~~ a large no. of ~~the~~ graphite sheets are held by weak Vander waal force of attraction

The mobile π $e^{\ominus}$ delocalised over the hexagonal sheet of graphite due to which it becomes good conductor of electricity.

Lamp black / carbon black :-

When kerosene, petrol or diesel which have high percentage of carbon in them are heated in limited supply of air then they produce a lot of smoke which is collected over wet blanket. The extract so obtained is known as lamp black or carbon black.

uses :-

- used in making shoe polish.
- used in make ribbon of type writers
- in making printers ink.

②

② Silicon → Crystalline
→ Amorphous.

③ Germanium exist in 2 crystalline form.

④ Tin exist in 3 allotropic form.

Grey tin $\underset{}{\overset{18^\circ C}{\rightleftharpoons}}$ White Tin $\overset{170^\circ C}{\rightleftharpoons}$ Rhombic Tin

density (g/cc) 5.74 7.32 6.55

* White Tin is most stable Allotropic form of Tin.

* In cold countries, white Tin is converted grey Tin which is found in Powder form

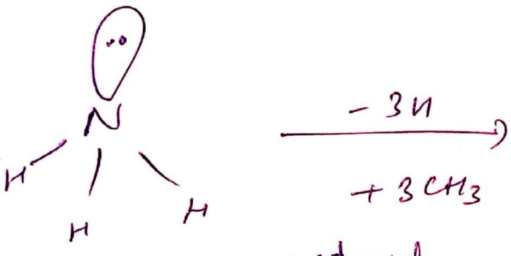
AIEEE * The conversion of white Tin to grey Tin is known as Tin Plague / Tin Pest / Tin Disease.

⑤ lead clo not show allotropy

Q. Explain why Trimethyl Amine $(CH_3)_3N$ is a stronger base than Trisilyl amine $(SiH_3)_3N$?

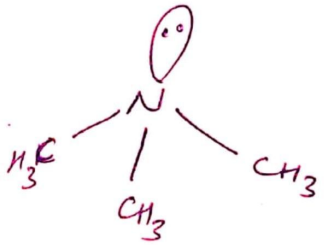
Ans in case of trimethyl amine, carbon do not have 2d orbitals in it thus lone pair on N atom is freely available for donation hence it act as good Lewis Base

But in case of trisilyl amine $(SiH_3)N$ silicon have vacant 3d orbitals thus lone pair of Nitrogen get itself delocalised by forming $d\pi - p\pi$ bonding hence availability of lp on N atom ↓ due to which its basic ch^{r} ↓

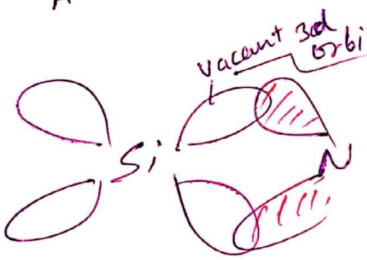


$-3H$

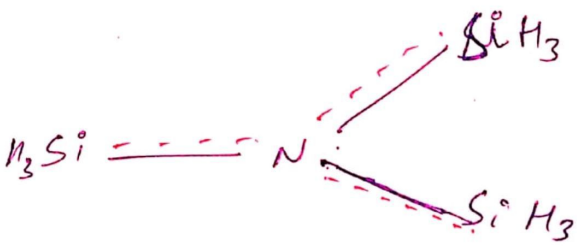
$+3CH_3$



sp^3, pyramidal.



$d\pi - p\pi$ bonding



sp^2, trigonal planar.

Chemical Properties

① Hydrides :-

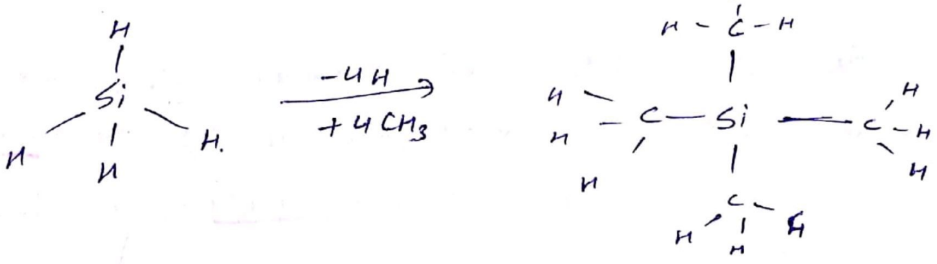
ⓐ Hydrides of Carbon

- Alkane (C_nH_{2n+2}) — eg :- CH_4, C_2H_6
- Alkene (C_nH_{2n}) — C_2H_4, C_4H_8
- Alkyne (C_nH_{2n-2}) — C_2H_2, C_3H_4.

ⓑ hydrides of Silicon & Ge are known as Silanes & Germanes respectively.

SiH_4	Si_2H_6	Si_3H_8 etc.
Silane	Disilane	trisilane
GeH_4	Ge_2H_6	Ge_3H_8 etc.
Germane	(Digermane)	(trigermane)

Q. Calculate no of σ & π bonds in tetramethyl silane?



16 σ & 0 π

ⓒ Tin forms two hydrides :

SnH_4 → stannane.

Sn_2H_6 ⇒ Distannane.

ⓓ Lead form only one hydride

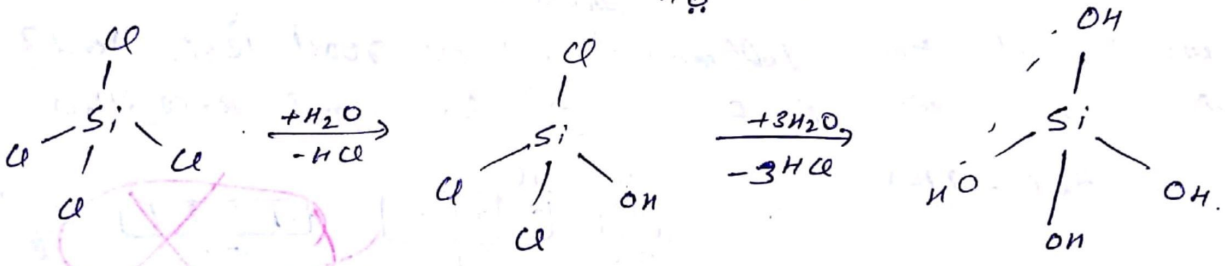
PbH_4 ⇒ Plumbane

III ➡ Except carbon tetrahalides, all other tetrahalide undergoes hydrolysis due to presence of vacant d orbitals in them.

Q. Explain why CCl_4 is not hydrolysed but $SiCl_4$ is hydrolysed ?

G.S. Si ⇒ $3s^2$ $3p^2$ $3d^0$

E.S. Si^* ⇒ sp^3



➡ Except carbon tetrahalides, all other tetrahalide act as good Lewis Acid because they accept lp donated by ligand & extend their C.N. beyond 4. d hydrolysis

eg:- $SiF_4 + 2F^\ominus \longrightarrow [SiF_6]^{2-}$ 3d ✓

$CF_4 + 2F^\ominus \longrightarrow [CF_6]^{2}$ $2d_x$ ✗

$GeF_4 + 2F^\ominus \longrightarrow [GeF_6]^{2-}$ 4d ✓

$SnCl_4 + 2Cl^\ominus \longrightarrow [SnCl_6]^{2-}$ 5d ✓

$PbCl_4 + 2Cl^\ominus \longrightarrow [PbCl_6]^{2-}$ 6d ✓

③ Oxides :-

① Members of carbon family form two type of oxides.

Monoxide (MO)		Dioxide (MO_2)
CO, SiO, GeO, SnO, PbO	&	CO_2, SiO_2, GeO_2 & SnO_2, PbO_2
*neutral, unstable, Basic, Amphoteric		acidic, Amphoteric

Carbon Monoxide (CO) :-

preparation :-

① by heating formic acid :-

$$HCOOH \xrightarrow[373\ K]{conc.\ H_2SO_4} CO + H_2O$$

② by heating oxalic acid :-

$$\begin{matrix} COOH \\ | \\ COOH \end{matrix} \xrightarrow[-H_2O]{conc.\ H_2SO_4} CO + CO_2$$

③ By ~~direct~~ rxn of $K_4[Fe(CN)_6]$ with conc. H_2SO_4

$$K_4[Fe(CN)_6] + H_2SO_4\ (conc.) + H_2O \longrightarrow K_2SO_4 + FeSO_4 + (NH_4)_2SO_4 + CO$$

④ by passing steam of water over hot coke

$$C(s) + H_2O(g) \xrightarrow{473-1273\ K} \underbrace{CO(g) + H_2(g)}_{\text{water gas}}$$

When air is used instead of steam, a mixture of CO & N_2 is produced, which is called producer gas.

$$2C(s) + O_2(g) + 4N_2(g) \xrightarrow{1273(K)} \underbrace{2CO(g) + 4N_2(g)}_{\text{producer gas.}}$$

Uses:-

① CO is a powerful reducing agent and reduces all metal oxides ~~except~~ other than those of alkali and alkaline earth metals, aluminium etc.

CO is used in extraction of many metals from their oxides ores.

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$Fe_2O_3(s) + CO(g) \xrightarrow{\Delta} 2Fe(s) + 3CO_2(g)$

$ZnO(s) + CO(s) \xrightarrow{\Delta} Zn(s) + CO_2(g)$

$PbO(s) + CO(g) \xrightarrow{\Delta} Pb(s) + CO_2$

② Used in purification of metals.

In Mond's Process for purification of Nickel CO is used

$Ni + CO \longrightarrow Ni(CO)_4$

metal carbonyl.

~~volatile~~ (volatile compound)

while impurities are non-volatile & seperates out.

② Used in manufacture of: producer gas. $(CO + N_2)$

$\xrightarrow{\Delta}$

water gas $(CO + H_2)$

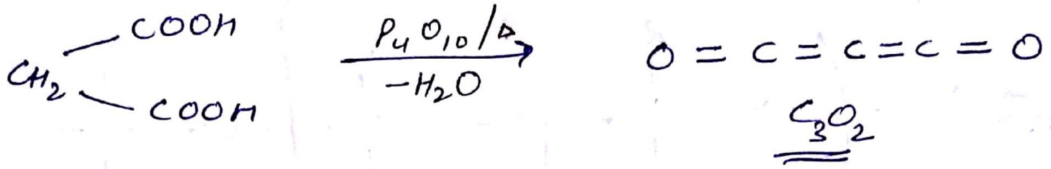
Note:-

In formation of metal carbonyls, like $Ni(CO)_4$, $Fe(CO)_5$ etc. it is carbon which donates its lp in vacant orbital of metal.

In metal carbonyl O.S. of metal is zero.

Carbon suboxide (C_3O_2)

It is obtained by heating malonic Acid in presence of P_4O_{10} which act as dehydrating agent.



- C_3O_2 is foul smelling gas.
- ~~C_3O_2~~

(4) **Silicones** :- Silicones are organo silicon polymers forming R_2SiO as main structural unit

R = alkyl gp

2 type → Linear chain Silicones
→ Cross linked Silicones.

Linear chain silicones :-

Step I :- formation of R_2SiCl_2

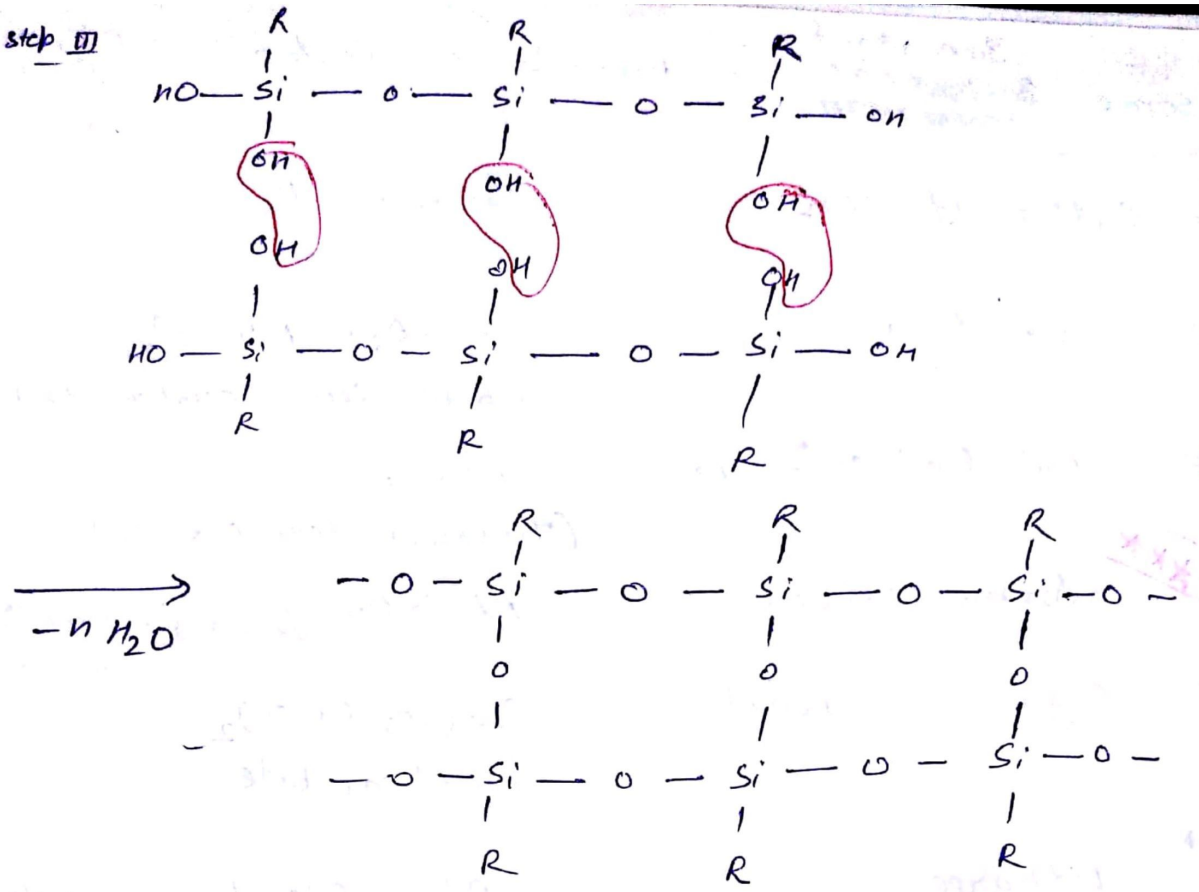
$$2RCl + Si \xrightarrow[570\,K]{Cu\ Powder} R_2SiCl_2$$

Step II :- hydrolysis of R_2SiCl_2.

$$R_2SiCl_2 + 2H_2O \longrightarrow R_2Si(OH)_2 + 2HCl.$$

Step III :- condensation.

Step III



one Ring :- 4 Silicon + 4 O ⇒ 8 atoms.

Hydrolysis of R_3SiCl (trialkyl chloro silicone) give a dimer.

$$R_3Si\boxed{OH + HO}-SiR_3 \longrightarrow \underbrace{R_3Si-O-SiR_3}_{\text{dimer}}$$

R_2SiCl_2	⇒	linear chain silicones
$RSiCl_3$	⇒	cross linked silicones
R_3SiCl	⇒	Dimer

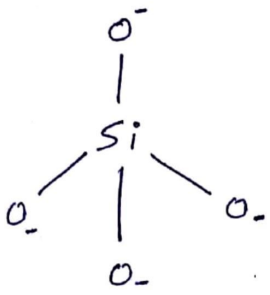
AIEEE-08

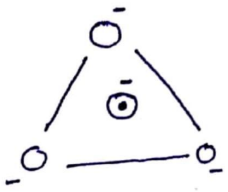
Properties :-

1. Silicones are water repellent in nature
2. chemically inert.
3. poor conductor of electricity.
4. very high thermal stability.

Silicates :-

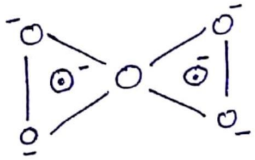
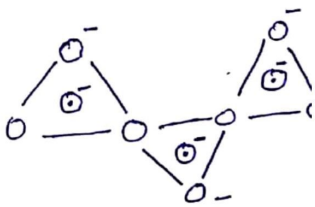
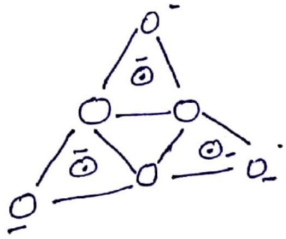
Basic / structural unit :- SiO_4^{-4}





• → Si
O → O-atom

- SiO_4^{-4} have a tendency of polymerisation.

Silicate	no. of oxygen atom shared per unit	general formula	Structure
1. Ortho silicate	0	SiO_4^{-4}	
2. pyro silicate	1	$Si_2O_7^{-6}$	
3. single chain silicate	2	$(SiO_3^{-2})_n$	
4. cyclic silicate	2	$(SiO_3^{-2})_n$	

Some Important points Regarding Carbon family :-

① Plumbosolvancy :-

The dissolution of lead in water in presence of oxygen known as "Plumbo solvancy".

$$Pb + H_2O + O_2 \longrightarrow Pb(OH)_2$$

In presence of sulphates, carbonates & phosphates decrease plumbosolvancy due to formation of salts while in presence of nitrates, organic acids and ammonium salts increase plumbosolvancy.

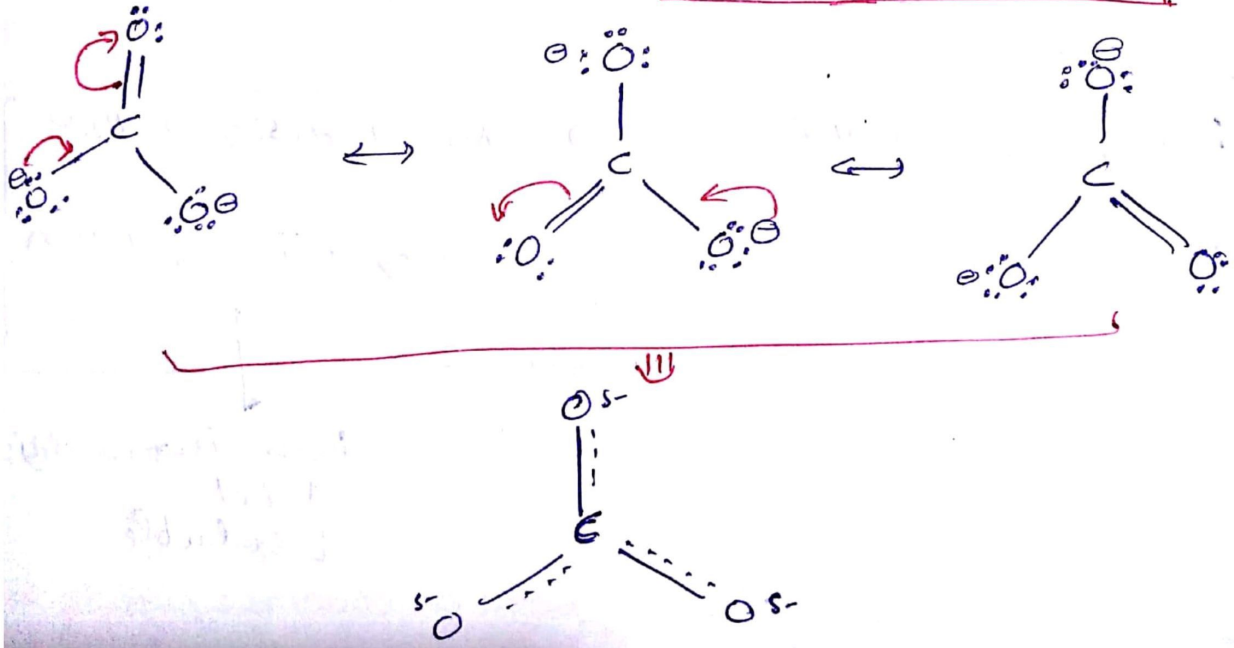
To minimize plumbosolvancy hard water is firstly passed through lead pipes to form insoluble $PbSO_4$ & then treated with $CaCO_3$ to form insoluble $PbCO_3$.

② $Sn + HNO_3 \longrightarrow H_2SnO_3 + NO_2 + H_2O$

(HNO_3 : Conc.) ; H_2SnO_3 : meta stannic Acid

③ order of B.L. :=)

$$CO < CO_2 < CO_3^{2-}$$



⑥ Crooke's glass contain CeO_2 [cerium oxide] it protect eyes from harmful UV rays coming from sun.

⑦ ⓐ Coal gas :- H_2 = 56 %
CH_4 = 22.4 %
CO = 10.9 %
N_2 = 5 %

ⓑ ~~Alcohol~~ Natural gas :-

CH_4	C_2H_6	C_3H_8	C_4H_{10}	N_2
85 %	9 %	3 %	1 %	2 %

ⓒ Gobar gas :-
The main component is CH_4 (80-85 %)

⑧ $SnCl_2$ is an ionic solid due to its ionic nature & $SnCl_4$ is fuming liquid due to its covalent nature.

⑨ Tin Cry :-
When tin is bent it produces a peculiar sound which is known as tin cry.
It is due to rubbing of crystals of tin with each other