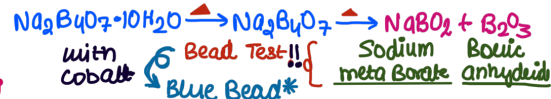




P-BLOCK



Last electron in P-orbital

3 orbital

G13 to G18 $\rightarrow ns^2 np^{1-6}$

OXIDATION STATE

G13	G14	G15	G16	G17	G18
$ns^2 np^1$	$ns^2 np^2$	$ns^2 np^3$	$ns^2 np^4$	$ns^2 np^5$	$ns^2 np^6$
+1	+2	+3	+4	+5	+6
+3	+4	+5	+6	+7	+8

Lower O.S. $\rightarrow$ group oxidation No. $\rightarrow$ Higher oxidation State.

INERT PAIR EFF

G13 $\rightarrow ns^2 np^1$ Down the group, $\Rightarrow Z_{eff} \uparrow$
 force of attraction on ns^2 increases, because of poor screening d-and f orbitals.
 force of attraction $\downarrow$
 electron pair inert.
 $\rightarrow$ does not participate in Rxn.
 G13: $ns^2 np^1$
 stability: - Low OS = $B^+ < Al^+ < Ga^+ < In^+ < Tl^+$
 Increases down group
 stability of high OS = $B^+ > Al^{+3} > Ga^{+3} > In^{+3} > Tl^{+3}$
 decreases down the group

ANOMALOUS BEHAVIOUR OF FIRST:-

Small size, High EN, High Ionisation Energy, Absence of d-orbital.
 $\rightarrow B = 1s^2 2s^2 2p^1$ $Al \rightarrow [Ne] 3s^2 3p^1 3d^0$
 4-Orbital $3s$ $3p$ $3d$
 $\rightarrow$ more covalency 4 $\rightarrow$ more covalency = 6 empty d-orbital.

GROUP 13:

Atomic Size: $B < Ga < Al < In < Tl$
 Poor screening of d-orbitals in Ga.
 $Z_{eff} \uparrow$ Size $\downarrow$
 B $\rightarrow$ Non-metal
 Al, Ga, In $\rightarrow$ metals
 Tl $\rightarrow$ metal
 Ionisation Energy:-
 $B > Tl > Ga > Al > In$

Electronegativity:- NCERT

$B > Tl > In > Ga > Al$

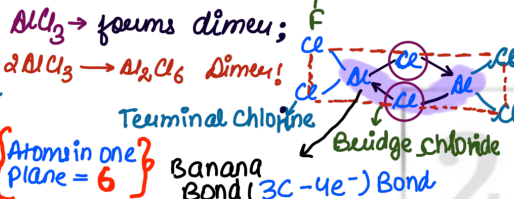
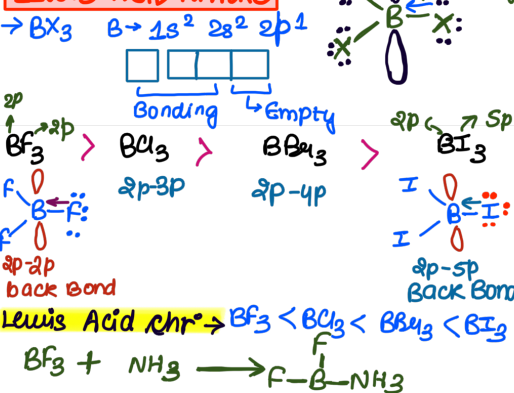
Properties :-

B $\rightarrow$ Non-metals $\rightarrow$ Network solid = high MP/BP.
 Al, Ga $\rightarrow$ Metals
 In, Tl $\rightarrow$ Metals
 Low MP/BP $\Rightarrow$ weak metallic bonding.
 NCERT; Ga $\rightarrow$ low MP
 $\rightarrow$ high BP $\uparrow$ Huge gap
 Temp. Measure help

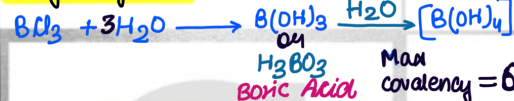
OXIDATION STATE:-

stability: - Low OS = $B^+ < Al^+ < Ga^+ < In^+ < Tl^+$
 Increases down group
 stability of high OS = $B^+ > Al^{+3} > Ga^{+3} > In^{+3} > Tl^{+3}$
 decreases down the group

LEWIS ACID NATURE



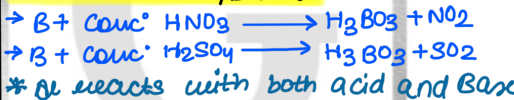
* Hydrolysis :-



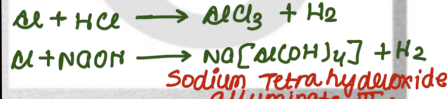
* Rxn with O_2 :-



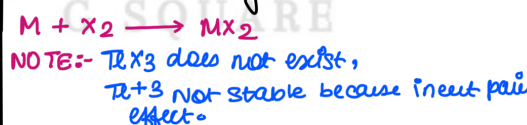
* Rxn with Acid/Base :-



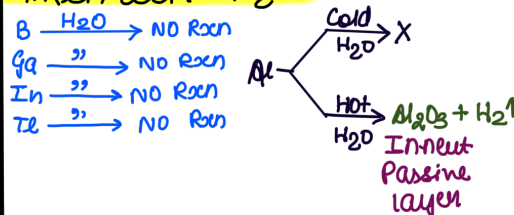
* Al reacts with both acid and Base;



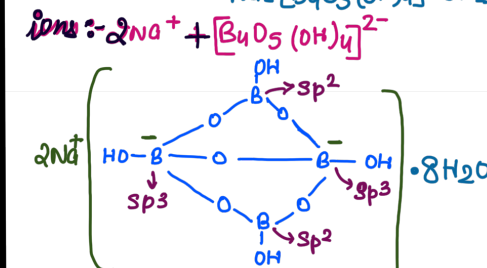
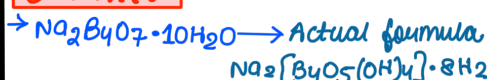
* Rxn with Halogens :-



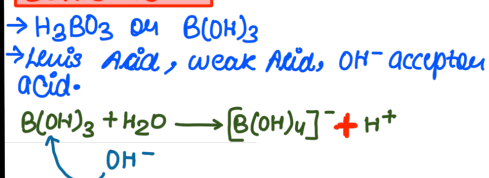
* Rxn with H_2O :-



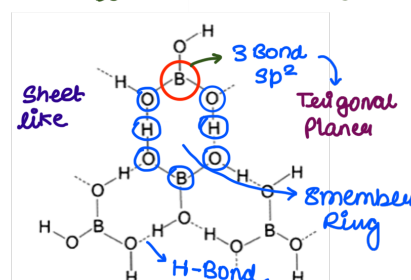
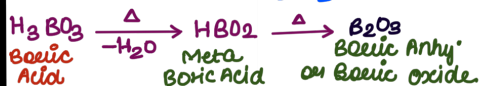
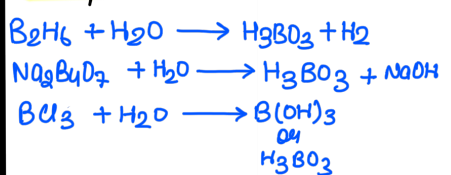
BORAX :-



BORIC ACID:- $n_f = 1$

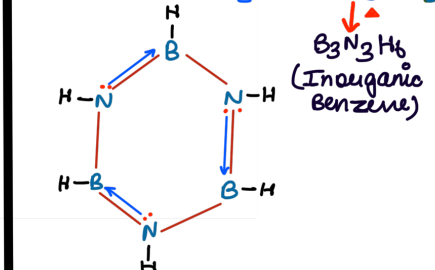
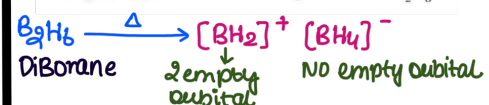
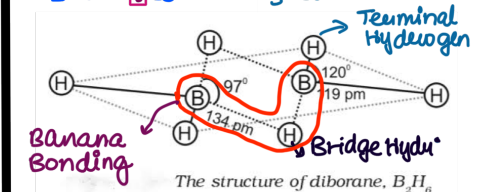
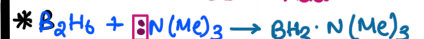
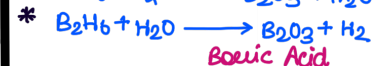
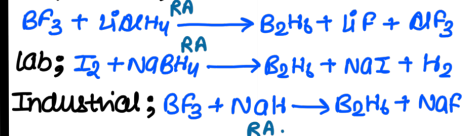


* Preparation:-



DIBORANE B_2H_6

Preparation:



GROUP 14:-

C $\rightarrow$ Non-metal (diamond, graphite)
 Si $\rightarrow$ non-metal (SiO_2 , silicates)
 Ge - metalloids (semi conductor)
 Sn - metals SnO_2 (cassiterite)
 Pb - metals PbS (galena)



OXIDATION STATE

+2 lower OS: $C^{+2} < Si^{+2} < Cu^{+2} < Sn^{+2} < Pb^{+2}$
 +4 higher OS: $C^{+4} > Si^{+4} > Cu^{+4} > Sn^{+4} > Pb^{+4}$
Inert Pair effect.

ATOMIC RADIUS

$C < Si < Ge < Sn < Pb$

IONISATION ENRG

$C > Si > Ge > Pb > Sn^*$

d & f block - poor screening.

ELECTRONEGATI

$C > Si \approx Cu \approx Sn \approx Pb$

CARBON:-

$C \rightarrow 1s^2 2s^2 2p^2$ 4 orbital
 $\rightarrow$ max covalency (4)

Anomalous Behaviour;

- * Small Size
- * NO d-orbital

SILICON:-

$Si \rightarrow [Ne] 3s^2 3p^2 3d^0$

max covalency = 6

HYDROLYSIS:-

$\rightarrow$ Rcn with H_2O
 $\rightarrow$ Requires empty orbitals.

$SiCl_4 + H_2O \rightarrow Si(OH)_4$ Silicic Acid
 empty orbital

$CCl_4 + H_2O \rightarrow$ NO Rcn.
 NO empty orbitals

OXIDES:-

Acidic: CO_2, SiO_2, CuO, GeO_2

Neutral: CO

Amphoteric: SnO, SnO_2

* Rcn with water:-

$Sn + \text{Hot water} \rightarrow SnO_2 + H_2 \uparrow$

$Pb + H_2O \rightarrow PbO$ (Passive due to formation of protective oxide layer)

$\left. \begin{matrix} C \\ Si \\ Cu \end{matrix} \right\}$ NO Rcn

* Rcn with Halogens:-

$\rightarrow E + X_2 \rightarrow E^{+2}X_2$
 $\rightarrow E + X_2 \rightarrow E^{+4}X_4$

NOTE: PbI_4 does not exist.

$\rightarrow Pb^{+4} \rightarrow$ Not stable
 $\rightarrow$ Steric hindrance

CATENATION:-

$\rightarrow$ Self linking property.

Tendency:- $C > Si > Cu > Sn$

Pb does not show catenation

DIAMONDS:-

Crystalline form

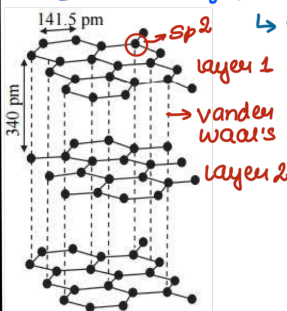
$\rightarrow$ very hard

$\rightarrow$ Network solid (high MP & BP)

$\rightarrow$ good conductor of heat.
 $\rightarrow$ Network solid
 $\rightarrow$ Bad conductor of electricity; absence of e^-

GRAPHITE:-

$\rightarrow$ Crystalline, soft, Network solid.



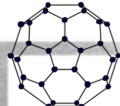
$\rightarrow$ good conductor of heat and electricity due to free e^- .

FULLERENE:-

$\rightarrow$ Football like str; Buckminster fullerene.

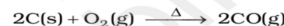
6 member Ring = 20. $\rightarrow sp^2$

5 member Ring = 12. $\rightarrow$ Aromatic

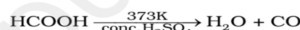


11.8.1 Carbon Monoxide

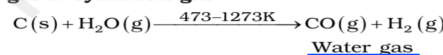
Direct oxidation of C in limited supply of oxygen or air yields carbon monoxide.



On small scale pure CO is prepared by dehydration of formic acid with concentrated H_2SO_4 at 373 K

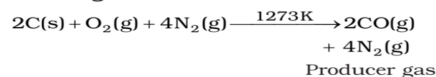


On commercial scale it is prepared by the passage of steam over hot coke. The mixture of CO and H_2 thus produced is known as **water gas** or **synthesis gas**.



Water gas

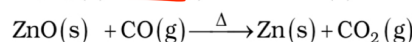
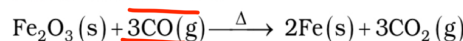
When air is used instead of steam, a mixture of CO and N_2 is produced, which is called **producer gas**.



Producer gas

$\rightarrow$ CO are colourless, odourless, and a powerful reducing agents.

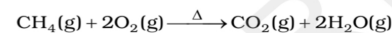
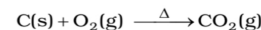
CO is used in the extraction of many metals from their oxides ores.



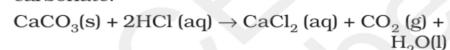
In CO molecule, there are one sigma and two π bonds between carbon and oxygen, $C \equiv O$. Because of the presence of a lone pair on carbon, CO molecule acts as a donor and reacts with certain metals when heated to form **metal carbonyls**. The highly poisonous nature of CO arises because of its ability to form a **complex with haemoglobin**, which is about 300 times more stable than the oxygen-haemoglobin complex. This prevents haemoglobin in the red blood corpuscles from carrying oxygen round the body and ultimately resulting in death.

11.8.2 Carbon Dioxide

It is prepared by complete combustion of carbon and carbon containing fuels in excess of air.



In the laboratory it is conveniently prepared by the action of dilute HCl on calcium carbonate.



On commercial scale it is obtained by heating limestone.

It is a colourless and odourless gas. Its low solubility in water makes it of immense biochemical and geo-chemical importance. With water, it forms carbonic acid, H_2CO_3 which is a weak dibasic acid and dissociates in two steps:

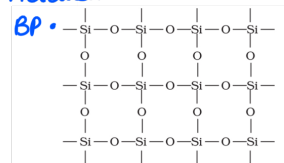


H_2CO_3/HCO_3^- buffer system helps to maintain pH of blood between 7.26 to 7.42. Being acidic in nature, it combines with alkalis to form metal carbonates.

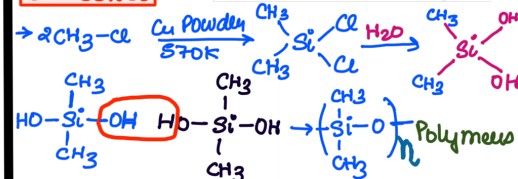
Carbon dioxide, which is normally present to the extent of $\sim 0.03\%$ by volume in the

SiO2

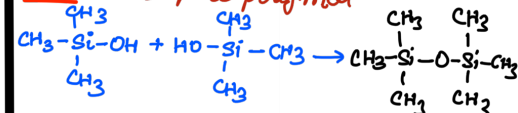
$\rightarrow$ Silicon dioxide
 $\rightarrow$ Covalent 3-D network solid.
 $\rightarrow$ High MP and BP.
 $\rightarrow$ Unreactive.



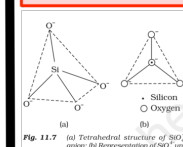
SILICONES



NOTE: To stop a polymer



SILICATES:-



A large number of silicates minerals exist in nature. Some of the examples are feldspar, zeolites, mica and asbestos. The basic structural unit of silicates is SiO_4^{4-} (Fig. 11.7) in which silicon atom is bonded to four oxygen atoms in tetrahedron fashion. In silicates either the discrete unit is present or a number of such units are joined together via corners by sharing 1, 2, 3 or 4 oxygen atoms per silicate units. When silicate units are linked together, they form chain, ring, sheet or three-dimensional structures. Negative charge on silicate structure is

ZEOLITE:-

Zeolites

If aluminium atoms replace few silicon atoms in three-dimensional network of silicon dioxide, overall structure known as aluminosilicate, acquires a negative charge. Cations such as Na^+ , K^+ or Ca^{2+} balance the negative charge. Examples are feldspar and zeolites. Zeolites are widely used as a catalyst in petrochemical industries for cracking of hydrocarbons and isomerisation, e.g., ZSM-5 (A type of zeolite) used to convert alcohols directly into gasoline. Hydrated zeolites are used as ion exchangers in softening of "hard" water.