

8. THE p - BLOCK ELEMENTS

Atomic & Physical Properties

- ✦ **Electronic configuration:** [Noble gas] ns^2np^1
- ✦ **Oxidation state:** +1 & +3
- ✦ **Metallic Character:** B Al, Ga, In, Tl
NonMetal Metals
- ✦ **Atomic radii, ionic radii, density & stability of +1 oxidation state:** Generally increase down the group.
- ✦ **Boiling point & stability of +3 oxidation state:** Decreases down the group.
- ✦ **Electronegativity:** $B > Tl > In > Ga > Al$
- ✦ **Melting point:** Decreases from B to Ga then increases.
 $B > Al > Ga > In > Tl$
- ✦ **Ionisation Energy:** $B > Tl > Ga > Al > In$
- ✦ **Lewis Acid:** BCl_3 , $AlCl_3$ etc behaves as Lewis Acid due to incomplete octet.

GROUP 13 BORON FAMILY

Chemical Properties

- ✦ **Reactivity towards Air** $\rightarrow 4E + 3O_2 \xrightarrow{\Delta} 2E_2O_3$

Al_2O_3
Acidic

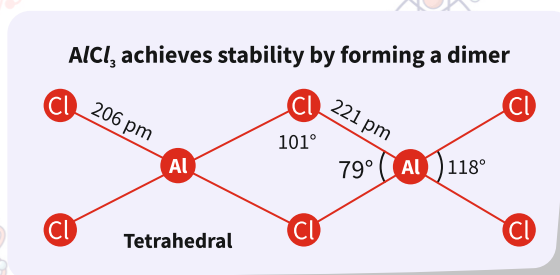
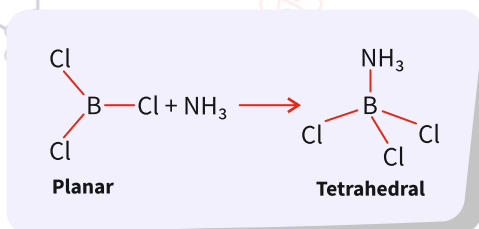
Ga_2O_3
Amphoteric

In_2O_3
Basic

Tl_2O_3
Basic

 $2E + N_2 \xrightarrow{\Delta} 2EN$ {Except Ga, In, Tl}
- ✦ **Reactivity towards halogens:**
 $2E + 3X_2 \rightarrow 2EX_3$ (Except TlI_3)
 (X = F, Cl, Br, I)
- ✦ **Reactivity towards Acids and alkalis**
 $2Al(s) + 6HCl(aq.) \rightarrow 2Al^{3+}(aq.) + 6Cl^-(aq.) + 3H_2(g)$
 $2Al(s) + 2NaOH(aq.) + 6H_2O \rightarrow 2Na^+[Al(OH)_4]^{-}(aq) + 3H_2(g)$

Anomalous Behaviour of Boron Properties



Reasons

- ✦ Small size
- ✦ High ionization enthalpy
- ✦ Non - availability of vacant d - orbital
- ✦ Heating
 $Na_2B_4O_7 \rightarrow 2NaBO_2 + B_2O_3$

- ✦ boron on hydrolysis in water forms tetrahedral $[B(OH)_4]^{-}$
 The hybridisation state of element M is sp^3
- ✦ Aluminium chloride in acidified aqueous solution forms octahedral $[Al(H_2O)_6]^{3+}$ ion. hybridisation state of Al is sp^3d^2 .
- ✦ Its oxides and hydroxides have acidic nature

GROUP 14 CARBON FAMILY



Atomic & Physical Properties

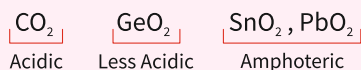
- ✦ **Electronic configuration:** [Noble gas] ns^2np^2
- ✦ **Oxidation state:** +2 & +4
- ✦ **Atomic radii, metallic character & stability of +2 Oxidation state:** Generally increase down the group. $C < Si < Ge < Sn < Pb$
- ✦ **Catenation:** Decreases down the group. Pb does not show catenation. $C \gg Si > Ge \approx Sn$
- ✦ **Ionization enthalpy :** $C > Si > Ge > Pb > Sn$
- ✦ **Electronegativity :** $C > Pb > Si \approx Ge \approx Sn$

Chemical Properties

✦ Reactivity towards Air

They form oxides of the formula EO and EO_2 on heating with air.

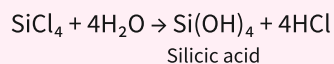
✦ Acidic strength of their oxides decrease down the group.



✦ Reactivity towards water: only Sn reacts with steam.

✦ Reactivity towards halogen: They form halide of formula EX_2 and EX_4 most of the EX_4 are covalent in nature.

✦ Except CCl_4 , Other halides are easily Hydrolysed by water



Anomalous Behaviour of Carbon

- ✦ It has maximum property of catenation.
- ✦ It can form $\pi\pi - \pi\pi$ bonds with itself & other small atom ($C=C$, $C \equiv C$, $C \equiv N$, $C=O$)
- ✦ Carbon dioxide, CO_2 , is a gas while the dioxides of other elements are solids.
- ✦ CCl_4 does not undergo hydrolysis while the tetrahalides, MX_4 , of other elements undergo hydrolysis.

Bond	Bond enthalpy / kJ mol^{-1}
C – C	348
Si – Si	297
Ge – Ge	260
Sn – Sn	240