P-Block

13th group

B

143pm Al

135pm Ga

In

Tl

① Gen. Conf ⇒ ns^2np^1

B = $1s^2 2s^2 2p^1$

② Atomic size

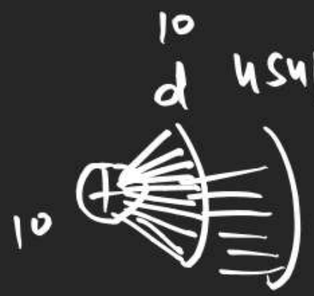
B < Al > Ga < In < Tl

B < Ga < Al < In < Tl

$Al = 1s^2 2s^2 2p^6 3s^2 3p^1$

$Ga = 1s^2 2s^2 2p^6 3s^2 3p^6 \underline{3d^{10}} 4s^2 4p^1$

★



due to poor S.E of 3d Subshell

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I.E ↓ down the group

B
Al
Ga
In
Tl

B > Al < Ga > In < Tl

B > Tl > Ga > Al > In

Tl = [Xe] $4f^{14}$ $5d^{10}$ $6s^2$ $6p^1$

Bl : 4f 5d 6s 6p

Ga =

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B ⇒ non Metallic ch.

⇒ extremly Hard and Black Colour solid.

⇒ B exist in many allotopic form.

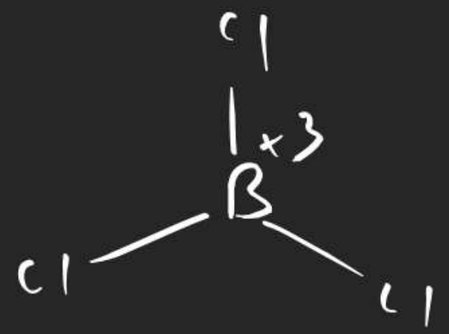
⇒ B_2 solid does not exist

but B solid exist in B_{12} having icosahedral structure made up of Polyhedrons having 20 face and 12 Corner.

→ Al In Tl ⟶ exist in Close packed Structure.

⟶ except B other soft metals having low m.p

— Ga (303 K) — exist as liq. Summer
M.P



Chemical prop.

B ⟶ Sum of first three I.E is very high so B^{+3} cation doesn't form and Boron can not form Ionic Compound.

$B = 1s^2 \boxed{2s^2\ 2p^1}$

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D↑ down group.

B < Al < Ga < In < Te

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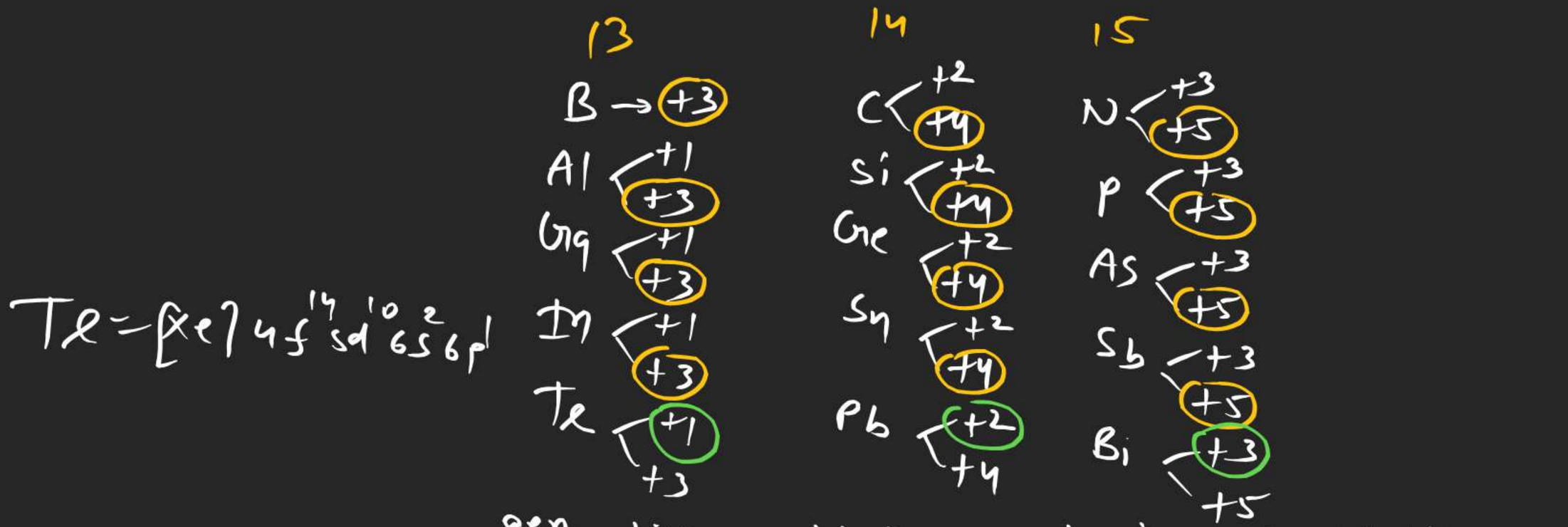
Inert pair effect



gen. higher oxidation state is more stable then the lower but in P-Block 13th to 15th on moving down lower oxidation state becomes more stable due to poor S.E of 4f Sub shell

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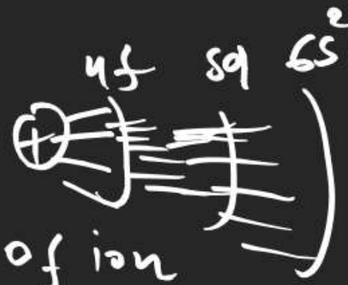
$$_{81}Tl = [Xe]\ 4f^{14}\ 5d^{10}\ 6s^2\ 6p^1$$



Stability of ion

$$Tl^{+} > Tl^{+3}$$

$$Pb^{+2} > Pb^{+4}$$

$$Bi^{+3} > Bi^{+5}$$

$$Hg > Hg^{+2}$$

(O.A) $Tl^{+3} + 2e^- \longrightarrow Tl^{+}$

(O.A) $Pb^{+4} + 2e^- \longrightarrow Pb^{+2}$

(O.A) $Bi^{+5} + 2e^- \longrightarrow Bi^{+3}$

(O.A) $Mg^{+2} + 2e^- \longrightarrow Mg$

TlI_3 does not exist

$$Tl^{+3} + 3I^{\ominus} \longrightarrow Tl^{+} + I_2$$

(O·A) (R·A)

PbI_4 does not exist

$$Pb^{+4} + 4I^{\ominus} \longrightarrow Pb^{+2} + I_2$$

(O·A) (R·A)

BiI_5 does not exist

$$Bi^{+5} + 5I^{\ominus} \longrightarrow Bi^{+3} + I_2$$

(O·A) (R·A)

Prep. of B.

1. from Borax
2. from colemenite
3. from H_3BO_3

1. from Borax

$$Na_2B_4O_7 + Conc.H_2SO_4 \longrightarrow \cancel{H_2B_4O_7} + NaHSO_4$$

$$\cancel{H_2B_4O_7} + Conc.H_2SO_4 \longrightarrow H_3BO_3$$

$$Na_2B_4O_7 + Conc.H_2SO_4 \longrightarrow H_3BO_3 + NaHSO_4$$

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$$H_3BO_3 \xrightarrow{100^\circ C} HBO_2 \text{ (Meta boric acid)}$$

$$HBO_2 \xrightarrow{140^\circ C} H_2B_4O_7 \text{ [tetra boric pyro boric acid)}$$

$$H_2B_4O_7 \xrightarrow[\text{temp.}]{\text{high}} B_2O_3 + H_2O$$

$$B_2O_3 + Li\,|Al|\,K\,|Na \longrightarrow B + Li_2O\,|Al_2O_3\,|K_2O|\,Na_2O$$

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Chemical Reaction of B

B + non oxid. acid → dil HCl: ✗; Conc. HCl: ✗; dil H_2SO_4: ✗; Conc. H_3PO_4: ✗

B + oxid. acid → Conc. HNO_3: $H_3BO_3 + NO_2$; Conc. H_2SO_4: $H_3BO_3 + SO_2$

$B + H\text{-}OH \longrightarrow$ ✗ (hot/cold)

B (Red hot) $+ H\text{-}OH \longrightarrow B_2O_3 + H_2O$

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$B + NaOH \longrightarrow NaBO_2 + H_2$

$Al + NaOH \longrightarrow NaAlO_2 + H_2$

B + Metal → Cr → CrB

→ Mg → Mg_3B_2

B + nonMetal → O_2 → B_2O_3

→ N → $\underline{\underline{BN}}$

→ X_2 → BX_3

→ S → B_2S_3

→ C → $\underline{\underline{B_4C}}$ (

$BN \xrightarrow{3000^\circ C} (BN)_x$

Inorganic graphite
2D Sheet like planar structure.

Boron nitride
3D network like structure
Harder and use cutting and polishing of diamond.

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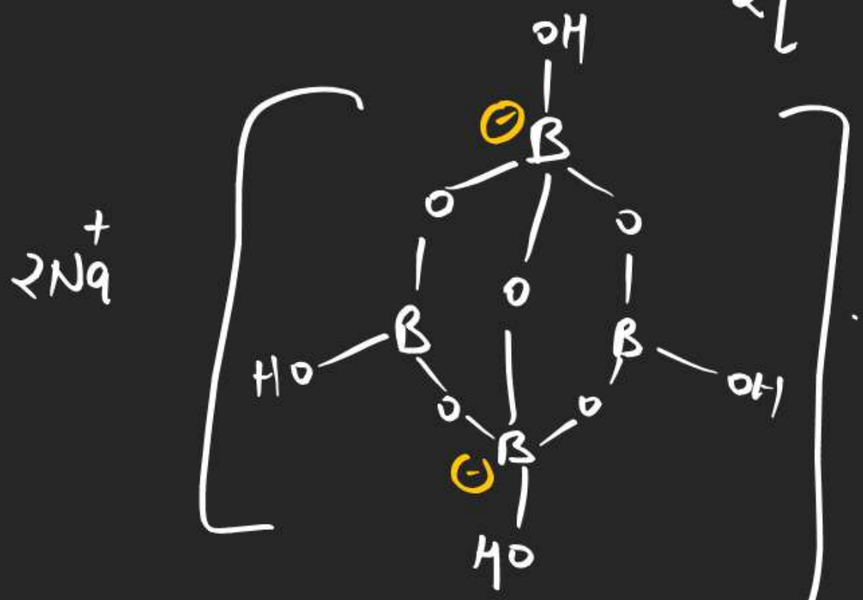
Compounds of B.

Borax

$Na_2B_4O_7 \cdot 10H_2O$

$Na_2[B_4O_5(OH)_4] \cdot 8H_2O$



$2Na^+$ ... $\cdot 8H_2O$

sp^3 two tetrahedral unit

sp^2 two trigonal planar unit

B–O–B linkage = 5

all boron atoms are not in same plane.

Hydrolysis

$Na_2B_4O_7 + 7H_2O \rightleftharpoons \underbrace{2NaOH + 4H_3BO_3}_{2NaBO_2 + 2H_3BO_3}$

Buffer solution

Basic solution

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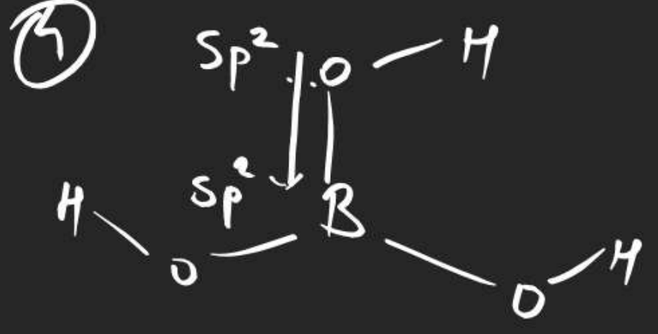
H_3BO_3

(1) White crystalline solid having Sopy touch

(2) mild antiseptic

(3) sparingly soluble in cold water and Complete soluble in hot water

(4)



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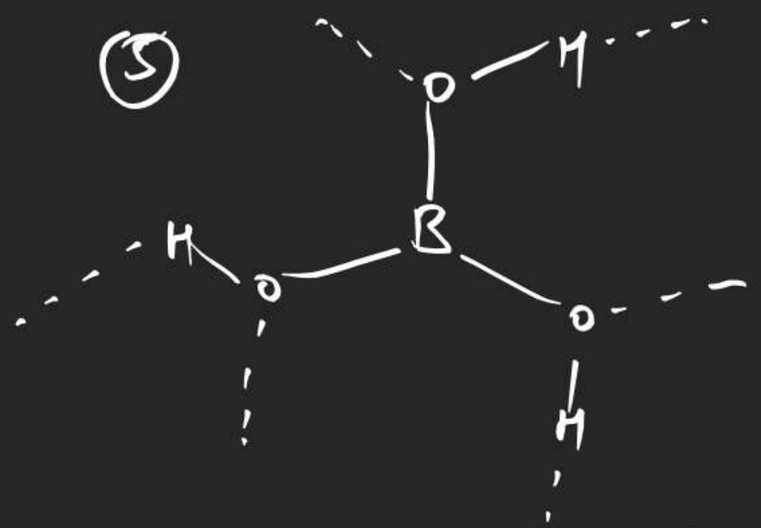
(5)



2D sheet like planar structure
due to Intermolecular H-Bonding

one Ionic acid ⟶ 6 H-Bond

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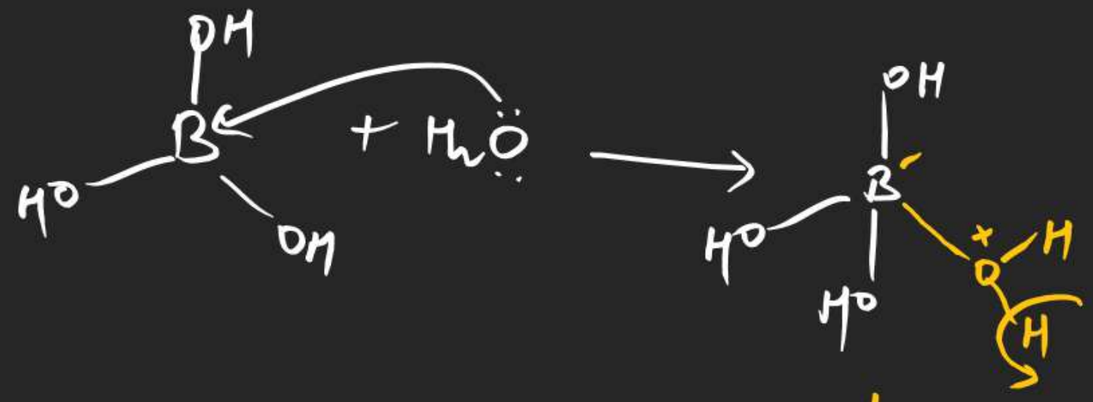

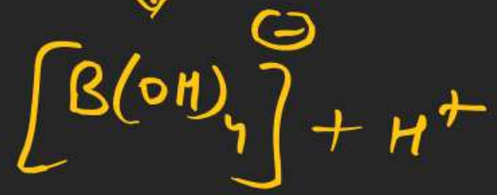

Borate ion

Note ⇒ H_3BO_3 is a week monobasic lewis acid it is not a proton donor acid because it accepts l.p / OH^- from H_2O.

(2) Colemenite

$$\star\ Ca_2B_6O_{11} + Na_2CO_3 \longrightarrow \underset{\text{white ppt}}{CaCO_3} + NaBO_2 + Na_2B_4O_7$$

$CaCO_3 + NaBO_2 + Na_2B_4O_7$ — dissolve in water and filtered

- $CaCO_3$ (residue)
- $NaBO_2 + Na_2B_4O_7$ — Cool and filtered
  - $Na_2B_4O_7$ (crystal)
  - $NaBO_2$ (filtrate) — CO_2 gas pass → $Na_2B_4O_7 + Na_2CO_3$