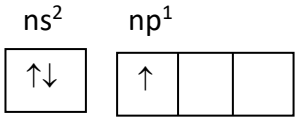
Group 13

Valence shell configuration

B	5	$2s^2sp^1$
Al	13	$3s^23p^1$
Ga	31	$4s^24p^1$
In	49	$5s^25p^1$
Tl	81	$6s^26p^1$

General valence shell configuration :



Penultimate shell configuration ;

B : $(n-1)s^2$

Al : $(n-1)s^2p^6$

Ga,In,Tl: $(n-1)s^2p^6d^{10}$

Screening effect :

- In. Al, screening is caused by s and p electrons
- In Ga & in, screening is caused by s, p & d electrons.
- In Tl, screening is caused by s, p, d, f electrons.
- Almost all properties will show a normal trend from B to Al & slows down thereafter. It is due to ineffective screening caused by d & f electrons beyond aluminium.

Abundance:

- Most abundant metal of all 106 elements is aluminium.
- Density : Increases down the group due to increase in atomic mass from B to Tl.
- M.Ps and B.Ps decrease down the group due to decrease in the strength of metallic bond.
- B has highest MPs & BPs due to its giant polymeric structure.
- Ga is liquid metal with least MP & BP due to its simple structure.
- Atomic radius : Increases normally from B to Al but, increases slightly beyond Al due to ineffective screening of d or d & f electrons.
- The difference in the atomic radii between Al & Ga is very small when compared to B & Al. It is due to ineffective screening effect of d electrons in Ga.

Ionization potential :

- In general, they have low IP values.
- B to Al IP_1 value normally decreases but beyond Aluminum, it slightly decreases.

Metallic nature :

B to Tl increases. B$\rightarrow$ non – metal.

Al, Ga, In Tl $\rightarrow$ metal

- Electronegativity: B to Al normally decreases but beyond Aluminum slightly increases.

Electro positivity :

- B to Al normally increases but thereafter slightly increases.

Oxidation states:

Most common oxidation state is +3.

- B also exhibits – 3 as it is a non – metal.
  Eg : Mg_3B_2, B_2O_3
- Al and Ga + 3, Tl + 1
- Due to inert pair effect, Tl always exhibits +1 oxidation state while all elements of the group exhibit +3 oxidation state.
- Reluctance of s – electron pair to take part in bonding is called inert pair effect. Inert pair effect becomes significant in heavier elements of group due to ineffective screening effect.

Covalency:

Normal covalency of these elements is 3. Maximum covalency of B is 4 while Al & others can exhibit a maximum valency of 6 due to absence of vacant d –orbitals in B and presence of vacant d-orbitals in Al & other.

$BF_3 \rightarrow 3$ $[AlF_6]^{3-} \rightarrow 6$

$AlCl_3 \rightarrow 3$

$BF_4^- \rightarrow 4$

Nature of compounds :

- B forms only covalent , Al forms both covalent and ionic while others predominantly form ionic compounds.
- In anhydrous state, they are covalent & in hydrated state, they are ionic.
  Eg : Anhydrous $AlCl_3$ is covalent.
  Hydrated $AlCl_3$ is ionic.

SOP values : It increases from Boron to Aluminium but decreases from Aluminium to Thalium. Aluminium has highest SOP value and Thalium has least SOP value.