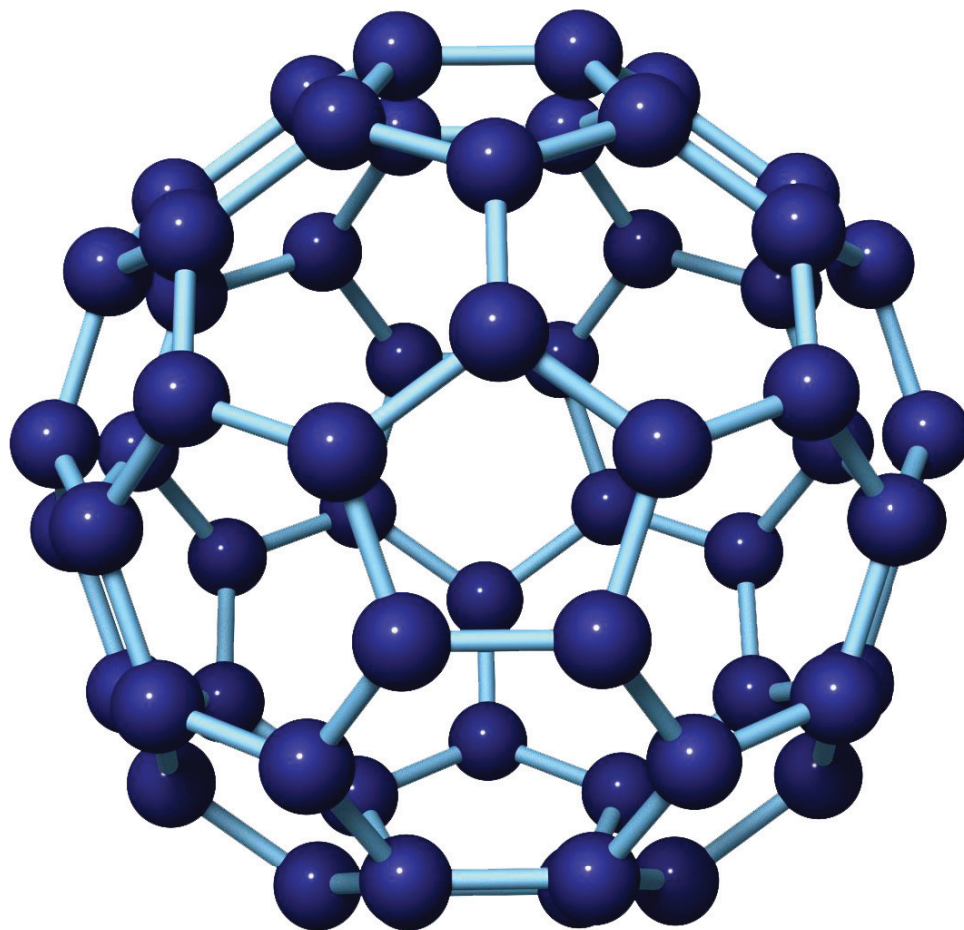


THE p-BLOCK ELEMENTS-1



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THE p-BLOCK ELEMENTS

Introduction

The elements in which last electron enters into p-subshell are called as p-block elements. The number of p-orbitals is three and, therefore, the maximum number of electrons that can be accommodated in a set of p-orbitals is six, hence p-block contains six groups.

Boron Family

Group III A contains six elements: Boron, aluminium, gallium, indium, thallium and ununtrium. The penultimate shell (next to the outermost) contains $1s^2$ in boron, $2s^2 2p^6$ (8 electrons) in aluminium and $(n-1)s^2(n-1)p^6(n-1)d^{10}$ (18 electrons) in other elements.

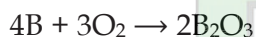
Boron is a non-metal and always forms covalent bonds. Boron family is known as most heterogeneous family as there is no regular trend in all properties, as it comes after d-block, lanthanoid contraction, poor shielding of d-orbital, they have large deviation in properties.

1. Physical Properties

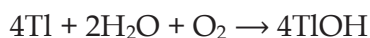
The atomic radius, ionic radius and density increases when one moves from top to bottom in a group in periodic table. While melting point decreases from B to Ga and then increases from (Ga to In). Ionisation energy decreases from B to Al, but shows a reverse trend in going from Al to Ga.

2. Chemical Properties

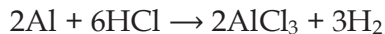
i. **Reaction with air:** Impure boron in air forms oxide while pure boron is less reactive.



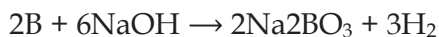
ii. **Reaction with water:** Boron is not affected by water or steam under ordinary conditions. However, Aluminium reacts with cold water if oxide layer is not present on its surface.



iii. **Reaction with acids:** Boron is not affected by non-oxidising acids like HCl and dilute H_2SO_4 while other elements dissolve and liberate H_2 gas.



iv. **Reaction with alkalis:** Boron, Aluminium, Gallium react with alkali solutions whereas Indium and Thallium are not affected by alkalis.



Anomalous Properties of Boron

Boron, the first member of group 13 elements, shows anomalous behaviour and differ from rest of the members of its family. The main reason for this difference are:

- Exceptionally small atomic and ionic size.
- High ionization enthalpy.
- Absence of d orbital in its valence shell.
- It has higher melting and boiling point than those of the other members of its group.

Compounds of Boron

1. Borax/ Sodium Tetraborate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$)

It is the most important compound of boron. It is a white crystalline solid. Borax dissolves in water to give an alkaline solution.

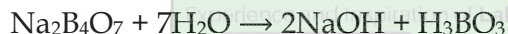
Preparation:

From Boric acid: Boric acid is neutralised with sodium carbonate and the resulting solution is cooled to get crystals of borax.

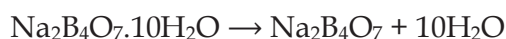


Properties:

- i. It gets hydrolysed with water to form an alkaline solution



- ii. **Borax bead test:** On heating borax first swells up due to elimination of water molecules. On further heating it melts to a liquid which then solidifies to a transparent glassy mass.



- iii. It is a useful primary standard for titration against acids.



2. Diborane: B_2H_6

The simplest boron hydride known, is diborane. It is prepared by treating boron trifluoride with LiAlH_4 in diethyl ether.

Preparation



Properties

- i. Stable at low temperature only, colourless and highly toxic.
- ii. $B_2H_6 + 6H_2O \rightarrow 2H_3BO_3 + 6H_2$
- iii. $B_2H_6 + 6Cl_2 \rightarrow 2BCl_3 + 6HCl$
- iv. $B_3H_6 + 2Me_3N \rightarrow 2[Me_3N.BH_3]$

Uses of Boron and Aluminium and Their Compounds

Boron Compounds

Boron is a hard solid having high melting point low density and very low electrical conductivity. Some important boron compounds are:

1. **Boron fibers:** It is mixed with plastic to form a material which is lighter than aluminium but tougher and stiffer than steel hence it is used in body armour, missiles and aircrafts.
2. **Boron-10 (^{10}B) isotope:** Boron carbide rods or boron steel are used to control nuclear reactions as neutron absorbers.



3. **Borax:** It is used in manufacture of enamels and glazes for pottery and tiles. It is also used in making optical glasses and also borosilicate glasses which is very resistant to heat and shock. It is used as an antiseptic.
4. **Boric acid:** It is used in glass industry, in food industry as preservative. It is also used as an antiseptic and eye wash under the name 'boric lotion'. It is also used in manufacture of enamels and glazes for pottery.
5. **Boron carbide:** Hardest boron compound.

Aluminium Compounds

Aluminium and its alloy are used in packing industry, utensil industry, aeroplane and transportation industry etc.

1. **Alumina (Al_2O_3):**
 - a) Used in chromatography.
 - b) Used in making bauxite bricks which are used for lining furnaces.
2. **Aluminium chloride ($AlCl_3$):** Used in manufacture of dyes, drugs and perfumes and also in manufacture of gasoline. It is also used as catalyst in Friedel Craft reaction.
3. **Potash Alum. [$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24 H_2O$]:** Used in purification of water, leather tanning, as antiseptic and as a mordant.

Group 14 Elements : The Carbon Family

Group IV A contains six elements: carbon, silicon, germanium, tin, lead and ununquadium. The penultimate shell (prior to outermost) contains $1s^2$ -grouping in



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