UG1 PART I

Some Important Compounds of Group 13 Elements

Boron

- Symbol - B
- Atomic no - 5
- Valence electron - 3
- Electronic configuration - $1s^2 2s^2 2p^1$
- It is lustrous metalloid.
- It forms covalent bonds resulting many compounds such as boric acid, the mineral borax and the ultra hard crystal boron carbide.

Q. What are the chemical formula for boric acid, borax and boron carbide?

- Boron is similar to carbon in its capability to form stable covalently bonded molecular networks.
- Crystalline Boron is very hard black material with a melting point of above 2000°C.
- Elemental Boron is rare and poorly studied because the pure material is extremely difficult to prepare.

BORON HYDRIDES / BORANES

- Boron does not combine directly with hydrogen to form hydrides, but a number of interesting boron hydrides are known.
- These hydrides of Boron are called Boranes. on analogy with alkanes.
- Classification of Boranes

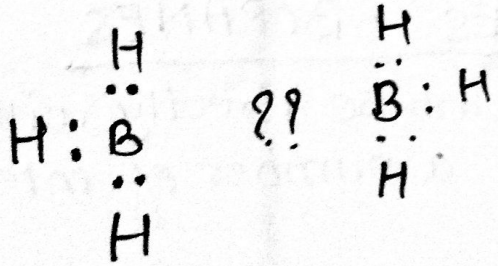
Boranes can be divided into two series depending upon their general formulae

General formula for Boranes are
$B_m H_{m+4}$ and $B_n H_{m+6}$
Some examples are

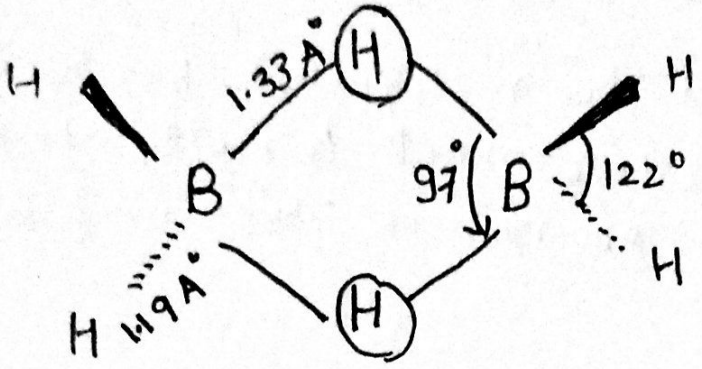
$B_m H_{m+4}$ series		$B_n H_{m+6}$ Series	
B_2H_6	Diborane	B_4H_{10}	Tetraborane
B_5H_9	Pentaborane (9)	B_5H_{11}	Pentaborane (11)
B_6H_{10}	Hexaborane	B_6H_{12}	Hexaborane (12)
$B_{10}H_{14}$	Decaborane	$B_{10}H_{16}$	Decaborane (16)

Structure of Diborane

- Boranes are interesting examples of electron deficient compounds.
- Since boron atom in excited state has three half filled orbitals, it has three electrons available for sharing. Therefore it can link to itself three hydrogen atoms.
- Thus while each boron atom in diborane can link to itself three hydrogen atoms there are no electrons left in diborane to form a bond between the two Boron atoms. as shown below.



From diffraction and infrared spectroscopic experiment it has been shown that structure of diborane is



Structure of diborane

- In structure of borane four hydrogen atom, two on the left and two on the right known as <u>terminal hydrogen</u> are in different environment from the other two hydrogen atoms which are known as <u>bridging atoms.</u>
- The two Boron atoms and the four terminal hydrogen atoms lie in the same plane while the other below lie in a plane perpendicular to this plane perpendicular to this plane.

<u>Facts that support the above structure are:</u>

i) Heat capacity measurements have shown that the rotation of the two ends of the molecule against each other is very much hindered. This indicates that the bridging hydrogen atoms lie in a plane at right angles to the plane in which the rest of the molecule lies. In a molecule like ethane in which there are no bridging hydrogen atoms. the hindrance to this type of rotation is very low

2. Nuclear magnetic resonance and Raman Spectra have Shown that four hydrogens are of one type and two hydrogens are of another type. In ethane all the six hydrogens are known to be equivalent.

3. Diborane cannot be methylated beyond $(CH_3)_4B_2H_2$. The hydrogens which cannot be methylated evidently are in a different environment. These are bridging hydrogen atoms.