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T.D.C. Part-I (Hons)

**UNIT:IV:P-BLOCK ELEMENTS**

**GROUP 13 ELEMENTS**

**COMPARATIVE STUDY**

Group 13 elements of the periodic table contain five element namely Boron,Aluminium,Gallium,Indium and Thailium.The outer most electronic configuration of group 13 elements is ns2np1.The electronic configuration of group 13 elements may be given as below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Atomic no. | Elements | Electronic configuration | Class | Period |
| 5 | B | [He]2s22p1 | III A | 2 |
| 13 | Al | [Ne]3S23P1 | III A | 2 |
| 31 | Ga | [Ar] 3d104s24p1 | III A | 2 |
| 49 | In | [Kr]4d105s25p1 | III A | 2 |
| 81 | Tl | [Xe]4f145d106s26p1 | III A | 2 |

**DIAGONAL RELATIONSHIP**

The first member of a group in the periodic table often behave in a peculiar manner and resemble the 2nd member of the next group diagonally related to it.This is called diagonal relationship .e.g Li resemble Mg,B resemble Si.

**Diagonal relationship of B and Si**

B is the 1st member of group 13 of the periodic table and silicon is 2nd member of group 14 of the periodic table.The main points of similarities may be given as below .

1.Both are typical non-metal,bad conductors and have high melting point.

2.Both dissolve in alkalis giving H2though they are insoluble in dil.acids.

3. Both are obtained by the reduction of their oxides with Mg.

B2O3 + Mg = 2B + 3MgO

SiO2 + 2Mg = Si + 2MgO

4. Both from a number of similar covalent volatile hydrides e.g. B2H6,Si2H6.

5.Their hydroxides viz,B(OH)3 and Si(OH)4 are weak acids.

6.Their carbides are good abrasives viz,B4C and SiC.

**ELEMENTARY IDEA OF HYDRIEDES**

**OXIDES AND HALIDES**

**Hydrides**

Most of components the weather within the element cluster show increasing reactivity because the elements get heavier in mass and better in number. Boron, the primary part within the cluster, is usually unreactive with several components except at high temperatures, though it's capable of forming several compounds with H, typically referred to as boranes. the only borane is diborane, or B2H6 Another example is B10H14.

**Oxides**

All of the boron-group parts ar well-known to create a powerfulness chemical compound, with 2 atoms of the component secure covalently with 3 atoms of O. These parts show a trend of skyrocketing pH scale chemical element chemical compound (B2O3) is slightly acidic, atomic number 13 and metal chemical compound[ (Al2O3) and (Ga2O3) respectively)] ar amphiprotic, indium(III) chemical compound (In2O3) is almost amphiprotic, and Thallium(III) chemical compound (Tl2O3) may be a Lewis base as a result of it dissolves in acids to create salts. every of those compounds ar stable, however metal chemical compound decomposes at temperatures more than 875 °C.

A pulverised sample of chemical element oxide (B2O3), one amongst the oxides of chemical element

.

**Halides**

The elements in cluster thirteen also are capable of forming stable compounds with the halogens, sometimes with the formula MX3 (where M may be a boron-group component and X may be a grouping). Fluorine, the primary grouping, is in a position to create stable compounds with each component that has been tested and also the atomic number 5 cluster isn't any exception. it's even hypothesized that nihonium might type a compound with chemical element, NhF3, before ad lib decaying because of nihonium's radiation. chemical element additionally forms stable compounds with all of the weather within the atomic number 5 cluster, as well as Tl, and is hypothesized to react with nihonium. All of the weather can react with element beneath the proper conditions, like the opposite halogens however less smartly than either chemical element or chemical element. Iodine can react with all natural parts within the table apart from the noble gases, and is notable for its explosive reaction with metal to create 2AlI3 halogen, the heaviest grouping, has solely fashioned a number of compounds, because of its radiation and short half-life, ANd no reports of a compound with an At–B, –Al, –Ga, –In, –Tl, or –Nh bond are seen, though scientists assume that it ought to type salts with metals.

**HYDRIDES OF BORON**

**DIBORANE**

**PREPARATION:**

1. BF3 reacts with NaH and then gives Diborane.

2BF3 + 6NaH → B2H6 + 6 NaF

2. Mg3B2 reacts with and then gives Diborane.

Mg3B2 + 2 H3PO4 → Mg3(PO4)2 + B2H6

**PROPERTIES:**

1.It is air sensitive,volatile and reactive gas with repelling smell.

2.It is fairly stable in absence of moisture and grease.

3. **Reaction with HCl:** It reacts with dry HCl and then gives B2H5Cl.

B2H6 + HCl = B2H5Cl + H2

4.**Reaction with H2O:** It reacts with water and then gives boric acid.

B2H6 + 6H2O → 2H3BO3 + 6H2

5. Reaction with Cl2: It reacts with Cl2 and then gives borane tri Chloride.

B2H6 + Cl2 = 2BCl3 +6HCl

**Structure Of Diborane**

H

H H

B 97 B 120

H H

H

178 pm

The structure of Diborane molecule consists of 4 H atoms which of 2 atomic number 5 atoms coming near an equivalent plane. In between these planes, there area unit aforementioned to be 2 dividing atoms of H.

The atomic number 5 atom is understood to be sp3 hybridized and has four hybrid orbitals. From these four hybrid orbitals, 3 of the orbitals have one lepton every, ANd of that one is an empty orbital. the {2} electrons of the hybrid orbitals in every of the atomic number 5 atoms kind 2 bonds with the 1s H atoms. the 2 atoms of atomic number 5 left thereupon of every odd lepton orbital and empty orbital forms the 2 bridging (B–H–B) bonds thereupon of the 2 1s H atoms, is additionally referred to as because the banana bond.

**Uses And Applications Of Diborane**

Diborane as a chemical substance has several numbers of applications in varied fields, of that some ar given below:

1. Diborane is employed as a rocket fuel.

2. it's used within the manufacture of borophosphosilicate that could be a style of glass.

3. In most of the chemical reactions, it's used as reducer.

4. Diborane is employed as a catalyst and rubber trained worker within the chemical action reactions.

5. it's even used as a doping agent within the producing of semiconductor devices.

**BORANES,**

Trihydridoboron, also known as borane or borine, is an unstable and highly reactive [molecule](https://en.wikipedia.org/wiki/Molecule) with the [chemical formula](https://en.wikipedia.org/wiki/Chemical_formula) [B](https://en.wikipedia.org/wiki/Boron)H3.

**PREPARATION:**

1. BF3 reacts with NaH and then gives boranes.

2BF3 + 6NaH → 2BH3 + 6 NaF

2. Mg3B2 reacts with and then gives boranes.

Mg3B2 + 2 H3PO4 → Mg3(PO4)2 + 2BH3

**PROPERTIES:**

1.It is air sensitive,volatile and reactive gas with repelling smell.

2.It is fairly stable in absence of moisture and grease.

3.Structure of boranes

BH3

TVE: 3+1X3=6

NB:3

ED: NBX2=3X2=6

LPE===0

TOR=NB+LPE=3+0=3

HYBRIDISATION =SP2

STURCTURE=Triangular

H

B

H H

**BORAZINES,**

**PREPARATION:**

1.Diborane reacts with ammonia and then give borazines.

3 B2H6 + 6 NH3 → 2 B3H6N3 + 12 H2

2.Lithium aluminium hydride reacts with ammonium chloride and then gives borazines.

3 LiBH4 + 3 NH4Cl → B3H6N3 + 3 LiCl + 9 H2

3.Boron trichloride reacts with ammonium chloride and then gives tri chloro borazine .

3 BCl3 + 3 NH4Cl → Cl3B3H3N3 + 9 HCl

The B-Cl bonds are subsequently converted to B-H bonds:

2 Cl3B3H3N3 + 6 NaBH4 → 2 B3H6N3 + 3 B2H6 + 6 NaCl

Properties

1.Borazine is a colourless liquid .

2.**Structure:**

Borazine is isoelectronic with benzine and has similar property, thus it's typically stated as "inorganic benzene". This comparison isn't strictly valid because of the tendency distinction between atomic number 5 and gas. X-ray crystallographic structural determinations show that the bond lengths inside the borazine ring area unit all equivalent at one.429 Å, a property shared by benzine.[4] but, the borazine ring doesn't type an ideal polygonal shape. The bond angle is 117.1° at the atomic number 5 atoms and 122.9° at the nitrogens, giving the molecule distinct symmetry.

The tendency of atomic number 5 (2.04 on the Linus Carl Pauling scale) compared thereto of gas (3.04) and conjointly the lepton deficiency on the atomic number 5 atom and therefore the lone combine on gas favor different mesomer structures for borazine.

H H H

H N H H N+ H H N+ H

B B B- B- B- B-

N N N+ N+ N+ N+

H B H H B- H H B- H

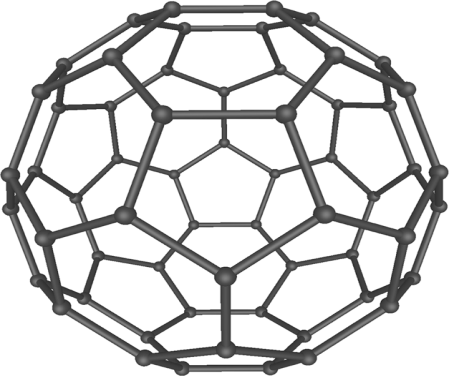
H H H

**FULLERENES**

A C is an element of carbon whose molecule consists of carbon atoms connected by single and double bonds therefore on kind a closed or partly closed mesh, with consolidated rings of 5 to seven atoms. The molecule is also a hollow sphere, ellipsoid, tube, or several alternative shapes and sizes. Graphene , that may be a flat mesh of standard polygon rings, will be seen as an extreme member of the family.

Fullerenes with a closed topology square measure informally denoted by their formula Cn, usually written Cn, wherever n is that the range of carbon atoms. However, for a few values of n there perhaps over one chemical compound.

The family is known as when fullerene (C60), the foremost renowned member, that successively is known as when architect. The closed fullerenes, particularly C60, are informally referred to as buckyballs for his or her likeness to the quality ball of football ("soccer"). Nested closed fullerenes are named bucky onions.



**TETRA SULPHUR TETRENITRIDES**

Tetrasulfur tetranitride is an chemical compound with the formula S4N4. This gold-poppy colored solid is that the most significant binary sulfur chemical compound, that ar compounds that contain solely the weather sulfur and chemical element. it's a precursor to several S-N compounds and has attracted wide interest for its uncommon structure and bonding.

Nitrogen and sulfur have similar electronegativities. once the properties of atoms ar therefore extremely similar, they usually type intensive families of covalently secure structures and compounds. Indeed, an oversized variety of S-N and S-NH compounds ar famous with S4N4 as their parent.

2.58A S

S 1.62 A

105

N N 113 N

N

S S

**PROPERTIES OF HALOGENS**

Halogens show physical and chemical properties typical of nonmetals. they need comparatively low melting and boiling points that increase steady down the cluster. close to temperature, the halogens span all of the physical states: F and Cl area unit gases, halogen may be a liquid, and iodine may be a solid.

Elements: Fluorine; Iodine; Bromine; halogen

**INTERHALOGENS AND POLYHALIEDS**

An interhalogen compound could be a molecule that contains 2 or a lot of totally different grouping atoms (fluorine, chlorine, bromine, iodine, or astatine) and no atoms of components from the other cluster.

Most interhalogen compounds known are binary. Their formulae ar usually XYn, wherever n = one, 3, 5 or 7, and X is that the less negative of the 2 halogens. They're all at risk of chemical reaction, and ionize to offer rise to polyhalogen ions. Those shaped with At have a really short half-life because of at being intensely radioactive .

**EXTRACTION OF B AND Sn**

**Position of Boron in the periodic table**

The atomic number of boron is 5.The electronic configuration of boron may be given as below.

1S22S22P1

Class: III A

Period: 2

The ore’s of boron may be given below.

1.Borax [Na2B4O7.10H2O]

2.Colemanite [Ca2B6O11.5H2O]

3.Panderinite [Ca2B6O11.3H2O]

4.Boracite [2Mg3B8O15.MgCl2]

**Extraction of Boron:**

Boron is extracted from colemanite.The powdered colemanite is boiled with excess of conc Na2CO3 solution and filtered. The filtrate on crystalisation gives borax crystal.

2Ca2B6O11 + 3Na2CO3 + H2O = 3Na2B4O7 + 3CaCO3 +Ca(OH)2

Na2B4O7 react with H2SO4 and then give boric acid.

Na2B4O7 + H2SO4 + 5H2O = Na2SO4 + 4H3BO3

Boric acid heated on 110 then give m-boric acid,then heating 140 and givepyroboric acid,then red hot then give B2O3.

H3BO3 HBO2 H2B4O7 2B2O3

B2O3 reacts with Mg and then gives boron.

B2O3 + 3Mg → 3MgO + 2B