p-BLOCK ELEMENTS-I

1. **Write a short note on anamolous properties of the first element of p-block.**

- Small size of the first member
- High ionisation enthalpy and high electronegativity
- Absence of d orbitals in their valance shell

2. **What is inert pair effect**

In heavier post-transition metals, the **outer 's' electrons (ns) have a tendency to remain inert** and **show reluctance** to take part in the bonding, which is known as inert pair effect

3. **Define allotropes**

Some elements exist in more than one crystalline or molecular forms in the same physical state. **Ex**: **carbon** exists as diamond and graphite.

4. **Preparation of Borax**

Borax is a **sodium salt of tetraboric acid**. It is obtained from colemanite ore by boiling its solution with sodium carbonate.

$$2Ca_2B_6O_{11} + 2NaCO_3 + H_2O \xrightarrow{\Delta} 3Na_2B_4O_7 + 3CaCO_3 + Ca(OH)_2$$

5. **Uses of Borax**

- For the identification of coloured metal ions
- In the manufacture optical
- A a flux in metallurgy

6. **Prepare boric acid.**

Boric acid can be extracted from borax and colemanite.

$Na_2B_4O_7 + H_2SO_4 + 5H_2O$ -----→$Na_2SO_4 + 4H_3BO_3$

7. **Uses of boric acid**

- It is used in the manufacture of glass, enamels and pigments.
- It is used as an antiseptic
- It is used as a food preservative.
- It is used as an eye lotion.

8. **What is burnt alum?**

On heating potash alum at **475 K** loses water of hydration and swells up. The swollen mass is known as burnt alum.

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9. Write note on Hydroboration

Diborane adds on to alkenes and alkynes in ether solvent at room temperature.

(anti Markovnikov addition)

$$B_2H_6 + 3RCH_2=CH_2R \text{ ------} \rightarrow B(CH_2\text{-}CHR)_3 + 6H_2$$

10. Prepare Inorganic benzene or borozole or borazine

$$3B_2H_6 + 6NH_3 \xrightarrow{-153\ K} 3(B_2H_6.2NH_3)$$

$$3(B_2H_6.2NH_3) \xrightarrow[\text{Clossed vessel}]{\text{High temp}} 2B_3N_3H_6 + 12H_2$$

$2B_3N_3H_6$ (Borazole or Borazine - Inorganic benzene)

11. Write note on McAfee Process:

Aluminium chloride is obtained by heating a mixture of alumina and coke in a current of chlorine.

$$Al_2O_3 + 3C + 3Cl_2 \longrightarrow 2AlCl_3 + 3CO_2$$

12. Prepare Potash alum

- The **alunite** or alum stone is powdered.
- Then alum stone is treated with excess of **sulphuric acid**,
- The **aluminium hydroxide is converted to aluminium sulphate**.
- A calculated quantity of **potassium sulphate is added**
- Potash alum is crystallised. It is purified by recrystallisation.

13. Uses of Alum

- It is used for purification of water
- It is also used for water proofing and textiles
- It is used in dyeing, paper and leather tanning industries
- It is employed to arrest bleeding.

14. What is catenation? Write the Conditions are necessary for catenation

Catenation is an ability of an element to form chain of atoms.

- the valency of element is greater than or equal to two,
- element should have an ability to bond with itself
- the self-bond must be as strong as its bond with other elements
- Kinetic inertness of catenated compound towards other molecules.

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15. Give one example for each of the following

i) icosogens - Boron

ii) tetragen - Carbon

iii) pnictogen - Nitrogen

iv) chalcogen - Oxygen

16. Write note on Fischer Tropsch synthesis

The reaction of carbon monoxide with hydrogen at a pressure of less than 50 atm using metal catalysts at 500 - 700 K yields saturated and unsaturated hydrocarbons.

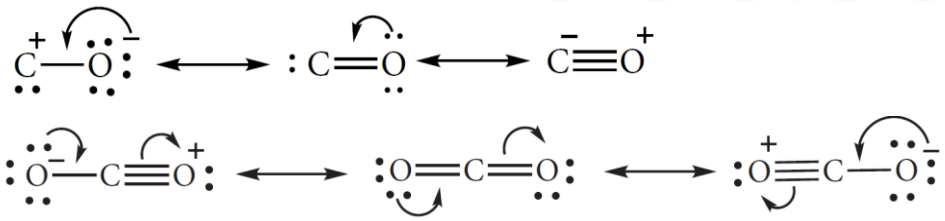
$$nCO + (2n+1)H_2 \longrightarrow C_nH_{(2n+2)} + nH_2O$$

$$nCO + 2nH_2 \longrightarrow C_nH_{2n} + nH_2O$$

17. What are the uses of silicones?

- low temperature lubrication and in vacuum pumps, etc...
- for making water proofing clothes
- as insulating material in electrical motor and other appliances
- mixed with paints to make them resistant

18. Sketch the structures of carbon monoxide & carbon dioxide



19. Write ethyl borate test (or) How will you identify borate radical?

When boric acid or borate salt is heated with ethyl alcohol in presence of conc. sulphuric acid, an ester, triethylborate is formed. The vapour of this ester burns with a green edged flame and this reaction is used to identify the presence of borate.

$$H_3BO_3 + 3C_2H_5OH \xrightarrow[H_2SO_4]{\text{Conc.}} B(OC_2H_5)_3 + 3H_2O$$

20. How will you convert boric acid to boron nitride?

$$B(OH)_3 + NH_3 \xrightarrow{\Delta} BN + 3H_2O$$

21. A hydride of 2nd period alkali metal (A) on reaction with compound of Boron (B) to give a reducing agent (C). Identify A, B and C.

$$B_2H_6 + 2LiH \xrightarrow{\text{Ether}} 2LiBH_4$$

Compound **A**	Compound **B**	Compound **C**
Lithium hydride ***(LiH)***	**Diborane** ***(B_2H_6)***	**Lithium boro hydride** ***($LiBH_4$)***

22. A double salt which contains fourth period alkali metal (A) on heating at 500K gives (B). Aqueous solution of (B) gives white precipitate with $BaCl_2$ and gives a red colour compound with alizarin. Identify A and B.

$$K_2SO_4.Al_2(SO_4)_3.24\,H_2O \xrightarrow{500\ K} K_2SO_4.Al_2(SO_4)_3 + 24\,H_2O$$

(A) **(B)**

$$KAl(SO_4)_{2(aq)} + 2\,BaCl_{2(aq)} \rightarrow 2\,BaSO_{4(s)} + KAlCl_{4(aq)}$$

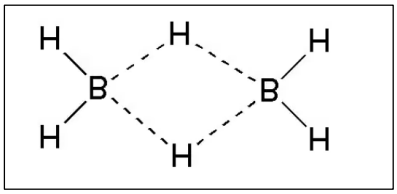
23. CO is a reducing agent. Justify with an example.

CO - relatively high tendency to be oxidised to form carbon dioxide.

Example: In the extraction of iron ore, haematite Fe_2O_3

$$CO + Fe_2O_3 \longrightarrow 2Fe + 3CO_2$$

24. Describe the structure of diborane.



- Two BH_2 units are linked by **two bridged hydrogens**.
- It has eight B-H bonds.
- It has only **12 valance electrons** and are **not sufficient to form normal covalent bonds**.
- The boron is **sp^3 hybridised**.
- **Four** 2c-2e bond (**B-H bond)**
- **Two** 3c-2e bond (**B-H-B bond)**
- The **four terminal B-H bonds** are normal covalent bonds (2c-2e bond).
    - The remaining four electrons have to be used for the bridged bonds. Hence, these bonds are **3c-2e bonds**. The bridging hydrogen atoms are in a plane.

25. **Write a note on zeolites.**

- Zeolites are **three-dimensional crystalline solids** containing aluminium, silicon, and oxygen in their regular 3D framework.
- They are **hydrated sodium alumino silicates** with general formula $NaO.(Al_2O_3).x(SiO_2).yH_2O$ (x=2 to 10; y=2 to 6).
- Zeolites have **porous structure** & Si and Al atoms are tetrahedrally coordinated
- Zeolites are similar to clay minerals but they **differ in their crystalline structure**.
- Zeolites have a **3D crystalline structure looks like a honeycomb** consisting of a network of interconnected tunnels and cages.
- **Use:** In **the removal of permanent hardness of water**

26. **Write a note on metallic nature of p-block elements.**

The **tendency of an element to form a cation by losing electrons** is known as metallic character.

This character depends on the ionisation energy. Generally on descending a group the ionisation energy decreases and hence the metallic character increases.

In p-block, the elements present in **lower left part are metals** while the elements in the **upper right part are non-metals**.

27. **Boron does not react directly with hydrogen. Suggest one method to prepare diborane from BF_3.**

Boron does not react directly with hydrogen. However, it forms a variety of hydrides called boranes. The simplest borane is diborane - B_2H_6. Other larger boranes can be prepared from diborane. Treatment of gaseous boron trifluoride with sodium hydride around 450 K gives diborane. To prevent subsequent pyrolysis, the product diborane is trapped immediately.

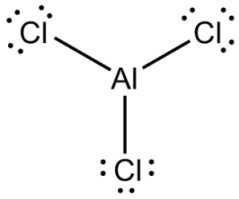
$$2BF_3 + 6NaH \xrightarrow{450\ K} B_2H_6 + 6NaF$$

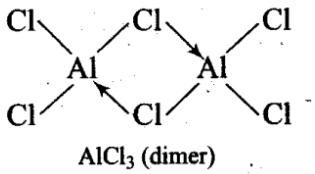
28. **$AlCl_3$ behaves like a Lewis acid. Substantiate this statement.**

- $AlCl_3$ being electron deficient **due to** incomplete octet of central metal atom behave as Lewis acids.
- In **$AlCl_3$** it forms three bonds and hence outer shell has 6 electrons.
- **Al** needs **two** more electrons to complete its octet. So, it needs electron from outside and it exist in dimer form and form bond with Cl atom and complete its octet.

- Furthermore, Al must access both its 2s and its three 2p orbitals to bond, so it uses sp^3 hybridization (**one** 2s and **three** 2p orbitals), giving it **four bonding orbitals** (one of which is empty as $AlCl_3$). This allows it to form a fourth bond and acquire a tetrahedral structure as $AlCl^{-4}$.
- With one ***empty*** orbital and three ***electron-withdrawing*** Cl atoms attached, the compound is thus an **electron-acceptor** at the Al center.

By definition those which accepts electrons are called **Lewis acids**. So **$AlCl_3$** is a **Lewis acid**.





$AlCl_3$ (dimer)

- **Example**: Friedel-Crafts Acylation reaction shows the Lewis Acid behaviour of Al in $AlCl_3$

29. Differences between **Graphite** and **Diamond**

Diamond	Graphite
1. less stable	most stable
2. It is very hard and do not conducts electricity	It is soft and conducts electricity
3. The carbon atoms in diamond are sp^3 hybridised	The carbon atoms in diamond are sp^2 hybridised
4. The carbon atoms are bonded to four neighbouring carbon atoms	The carbon atoms are bonded to three neighbouring carbon atoms
5.Use: cutting glasses	**Use:** as a lubricant

30. Write note on Fullerenes

- discrete molecules such as C_{32}, C_{50}, C_{60}, C_{70}, etc..
- **cage like** structures
- The C_{60} molecules have a soccer ball like structure and is called buckminster fullerene or **buckyballs.**
- It has a fused ring structure consists of **20 six membered** rings and **12 five membered** rings.
- Each carbon atom is sp^2 hybridised