# UNIT 2-p-Block elements-I

**Choose the correct answer:**

1. An aqueous solution of borax is

a) neutral b) acidic ***c) basic*** d) amphoteric

2. Boric acid is an acid because its molecule (NEET)

a) contains replaceable H+ ion b) gives up a proton

c) combines with proton to form water molecule ***d) accepts OH- from water ,releasing proton.***

3. Which among the following is not a borane?

a) $B_2H_6$ ***b) $B_3H_6$*** c) $B_4H_{10}$ d) none of these

4. Which of the following metals has the largest abundance in the earth's crust?

***a) Aluminium*** b) calcium c) Magnesium d) sodium

5. In diborane, the number of electrons that accounts for banana bonds is

a) six b) two ***c) four*** d) three

6. The element that does not show catenation among the following p-block elements is

a) Carbon b) silicon ***c) Lead*** d) germanium

7. Carbon atoms in fullerene with formula C60 have

a) sp3 hybridised b) sp hybridised

***c) sp2 hybridised*** d) partially sp2 and partially sp3 hybridised

8. Oxidation state of carbon in its hydrides

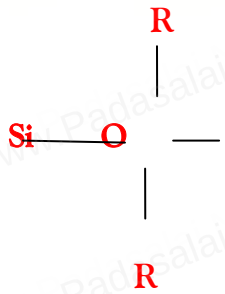
***a) +4*** b) -4 c) +3 d) +2

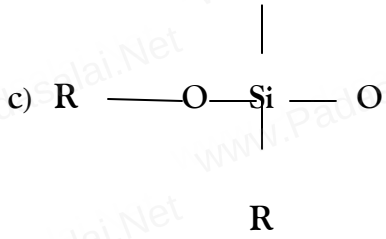
9. The basic structural unit of silicates is (NEET)

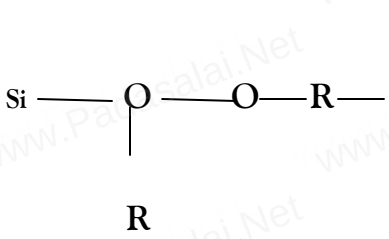
a) $(SiO_3)^{2-}$ b) $(SiO_4)^{2-}$ c) $(SiO)^{-}$ **d) $(SiO_4)^{4-}$**

10. The repeating unit in silicone is

a) $SiO_2$ **b)**



c) 

d) 

11. Which of these is not a monomer for a high molecular mass silicone polymer?

*a) Me3SiCl* b) PhSiCl3 c) MeSiCl3 d) Me2SiCl2

12. Which of the following is not sp2 hybridised?

a) Graphite b) graphene c) Fullerene *d) dry ice*

13. The geometry at which carbon atom in diamond are bonded to each other is

*a) Tetrahedral* b) hexagonal c) Octahedral d) none of these

14. Which of the following statements is not correct?

a) Beryl is a cyclic silicate b) Mg2SiO4 is an orthosilicate

c) $SiO_4^{4-}$ is the basic structural unit of silicates *d) Feldspar is not aluminosilicate*

15. AlF3 is soluble in HF only in the presence of KF. It is due to the formation of (NEET)

a) $K_3(AlF_3H_3)$ *b) $K_3(AlF_3)$* c) $AlH_3$ d) $K(AlF_3H)$

16. Match items in column - I with the items of column – II and assign the correct code.

| Column-I | | Column-II | |
|---|---|---|---|
| A | Borazole | 1 | $B(OH)_3$ |
| B | Boric acid | 2 | $B_3N_3H_6$ |
| C | Quartz | 3 | $Na_2[B_4O_5(OH)_4]8H_2O$ |
| D | Borax | 4 | $SiO_2$ |

| | A | B | C | D |
|---|---|---|---|---|
| (a) | 2 | 1 | 4 | 3 |
| (b) | 1 | 2 | 4 | 3 |
| (c) | 1 | 2 | 4 | 3 |
| (d) | None of these | | | |

17. Duralumin is an alloy of

a) Cu,Mn b) Cu,Al,Mg c) Al,Mn *d) Al,Cu,Mn,Mg*

18. Thermodynamically the most stable form of carbon is

a) Diamond ***b) graphite*** c) Fullerene d) none of these

19. The compound that is used in nuclear reactors as protective shields and control rods is

***a) Metal borides*** b) metal oxides c) Metal carbonates d) metal carbide

20. The stability of +1 oxidation state increases in the sequence

***a) Al < Ga < In < Tl*** b) Tl < In < Ga < Al c) In < Tl < Ga < Al d) Ga< In < Al < Tl

**Answer the following questions:**

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

In p-block elements, the first member of each group differs from the other elements of the corresponding group.

1. Small size of the first member
2. High ionisation enthalpy and high electronegativity
3. Absence of d orbitals in their valance shell

| 13th group | 14th group | 15th group | 16th group | 17th group |
|---|---|---|---|---|
| Boron is a metalloid while others are reactive metals | Carbon is strictly a nonmetal while other elements are metalloids (silicon & germanium) or metals (tin & lead) | Nitrogen is a diatomic gas . | Oxygen exists as a diatomic gas in that group. Due to its high electronegativity it forms Hydrogenbonds. . | Fluorine the most electronegative element It shows only -1 oxidation state and also is the strongest oxidising agent and the most reactive element among the halogens. |

2. **Describe briefly allotropism in p- block elements with specific reference to carbon.**

Some elements exist in more than one crystalline or molecular forms in the same physical state. For example, carbon exists as diamond and graphite. This phenomenon is called allotropism (in greek '*allos*' means another and '*trope*' means change) and the different forms of an element are called allotropes.

Carbon : Diamond, Graphite, Graphene, Fullerenes, Carbon nanotube

3. **Boron does not react directly with hydrogen. Suggest one method to prepare diborane from BF3.**

Boron does not react directly with hydrogen. However, it forms a variety of hydrides called boranes. The simplest borane is diborane - B2H6. Other larger boranes can be prepared from diborane. Treatment of gaseous boron trifluoride with sodium hydride around 450 K gives diborane.

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

4. **Give the uses of Borax.**

1. Borax is used for the identification of coloured metal ions
2. In the manufacture optical and borosilicate glass, enamels and glazes for pottery
3. It is also used as a flux in metallurgy and also acts as a good preservative

5. **What is catenation ? describe briefly the catenation property of carbon.**

Catenation is an ability of an element to form chain of atoms. The following conditions are necessary for catenation

(i) the valency of element is greater than or equal to two
(ii) element should have an ability to bond with itself
(iii) the self bond must be as strong as its bond with other elements
(iv) kinetic inertness of catenated compound towards other molecules.

Carbon possesses all the above properties and forms a wide range of compounds with itself and with other elements such as H, O, N, S and halogens.

6. **Write a note on Fisher 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.

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

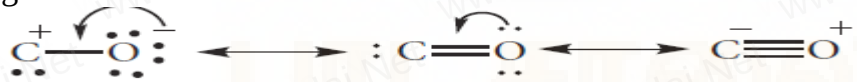
$$nCO + 2nH_2 \longrightarrow C_nH_{2n} + nH_2O$$

Carbon monoxide forms numerous complex compounds with transition metals in which the transition meal is in zero oxidation state. These compounds are obtained by heating the metal with carbon monoxide.

Eg. Nickel tetracarbonyl $[Ni(CO)_4]$, Iron pentacarbonyl $[Fe(CO)_5]$, Chromium hexacarbonyl $[Cr(CO)_6]$.

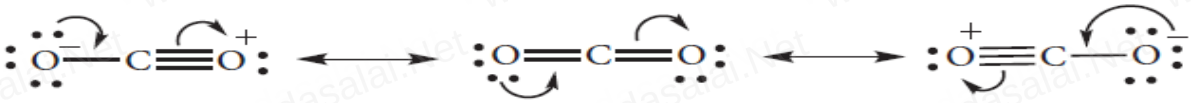
7. **Give the structure of CO and $CO_2$.**

***Carbon monoxide***, has a linear structure.In carbon monoxide, three electron pairs are shared between carbon and oxygen. The bonding can be explained using molecular orbital theory as discussed in XI standard. The C-O bond distance is 1.128Å. The structure can be considered as the resonance hybrid of the following two canonical forms.



**Structure of carbon dioxide**

Carbon dioxide has a liner structure with equal bond distance for the both C-O bonds. In this molecule there is one C-O sigma bond. In addition there is 3c-4e bond covering all the three atoms.



**8. Give the uses of silicones.**

1. Silicones are used for low temperature lubrication and in vacuum pumps, high temperature oil baths etc...

2. They are used for making water proofing clothes

3. They are used as insulting material in electrical motor and other appliances

4. They are mixed with paints and enamels to make them resistant towards high temperature, sunlight, dampness and chemicals.

**9. $AlCl_3$ behaves like a lewis acid. Substantiate this statement.**

Aluminium chloride behaves like a Lewis acid and forms addition compounds with ammonia, phosphine and carbonylchloride etc... Eg. $AlCl_3.6NH_3$.

$$AlCl_3 + NH_3 \rightarrow [Al(NH_3)Cl_3]$$

**10. Describe the structure of diborane.**

**Structure of diborane:**

In diborane two $BH_2$ units are linked by two bridged hydrogens. Therefore, it has eight B-H bonds. However, diborane has only 12 valance electrons and are not sufficient to form normal covalent bonds. The four terminal B-H bonds are normal covalent bonds (two centre - two electron bond or 2c-2e bond). The remaining four electrons have to used for the bridged bonds. i.e. two three centred B-H-B bonds utilise two electrons each. Hence, these bonds are three centre- two electron bonds. The bridging hydrogen atoms are in a plane as shown in the figure. In diborne, the boron is $sp^3$ hybridised. Three of the four

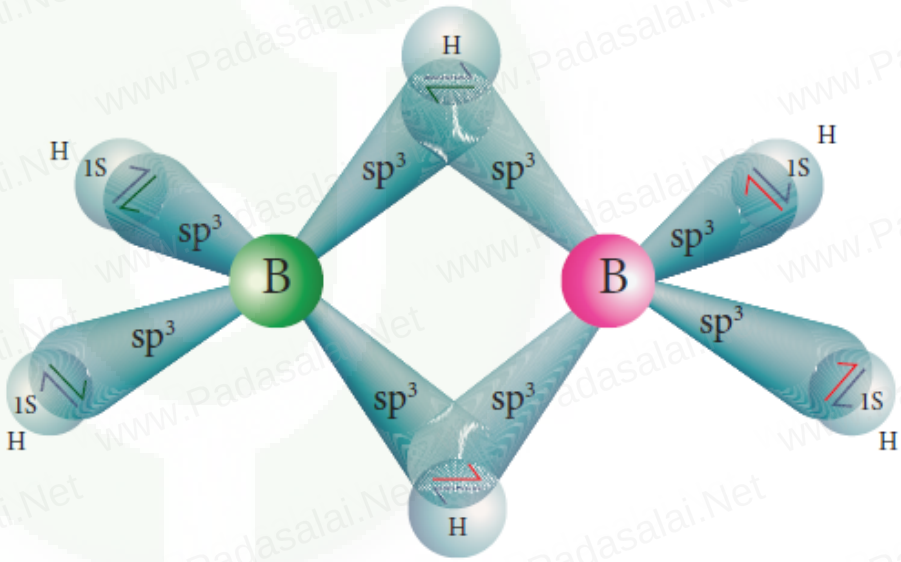



Figure 2. 3 Structure of diborane.

$sp^3$ hybridised orbitals contains single electron and the fourth orbital is empty. Two of the half filled hybridised orbitals of each boron overlap with the two hydrogens to form four terminal 2c-2e bonds, leaving one empty and one half filled hybridised orbitals on each boron. The Three centre - two electron bonds), B-H-B bond formation involves overlapping the half filled hybridised orbital of one boron, the empty hybridised orbital of the other boron and the half filled 1s orbital of hydrogen.

**11. Write a short note on hydroboration.**

Diborane adds on to alkenes and alkynes in ether solvent at room temperature. This reaction is called hydroboration and is highly used in synthetic organic chemistry, especially for anti Markovnikov addition.

$$B_2H_6 + 3RCH_2=CH_2R \longrightarrow 2B(CH_2\text{-}CH_2R)_3 + 6H_2$$

**12. Give one example for each of the following**

(i) Icosogens--Boron

(ii) Tetragen---Carbon

(iii) Prictogen --Nitrogen

(iv) Chalcogen --Oxygen

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

The tendency of an element to form a cation by loosing electrons is known as electropositive or 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. Elements of group 13 have metallic character except the first element boron which is a metalloid, having properties intermediate between the metal and nonmetals. The atomic radius of boron is very small and it has relatively high nuclear charge and these properties are responsible for its nonmetallic character. In the subsequent groups the non-metallic character increases. In group 14 elements, carbon is a nonmetal while silicon and germanium are metalloids. In group 15, nitrogen and phosphorus are non metals and arsenic & antimony are metalloids. In group 16, oxygen, sulphur and selenium are non metals and tellurium is a metalloid. All the elements of group 17 and 18 are non metals.

**14. Complete the following reactions**

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

b) $Na_2B_4O_7 + H_2SO_4 + 5H_2O \longrightarrow Na_2SO_4 + 4H_3BO_3$

c. $B_2H_6 + 2NaOH + 6H_2O \longrightarrow 2Na[B(OH)_4] + 6H_2$

d. $B_2H_6 + CH_3OH \longrightarrow 2B(OCH_3)_3 + 6H_2O$

e. $BF_3 + 3H_2O \longrightarrow H_3BO_3 + 3HF$

f. $HCOOH + H_2SO_4 \longrightarrow CO + H_2O + H_2SO_4$

g. $SiCl_4 + NH_3 \xrightarrow[\text{ETHER}]{330K}$ Cl--- Si—NH---SiCl3-

h. $SiCl_4 + 6C_2H_5OH \longrightarrow Si(OC_2H_5)_4 + 4HCl$

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i $2B + 6NaOH \longrightarrow 2Na_3BO_3 + 3H_2$

j. $H_4B_2O_7 \xrightarrow{\text{red hot}} 2B_2O_3 + H_2O$

**15. 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, trialkylborate is formed. The vapour of this ester burns with a green edged flame and this reaction is used to identify the presence of borate.

$$4H_3BO_3 + 3C_2H_5OH \xrightarrow{\text{con } H_2SO_4} B(OC_2H_5)_3 + 3H_2O$$

**16. Write a note on zeolites.**

Zeolites are three-dimensional crystalline solids containing aluminium, silicon, and oxygen in their regular three dimensional 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 in which the monovalent sodium ions and water molecules are looselyheld.

**17. How will you convert boric acid to boron nitride?**

Fusion of urea with $B(OH)_3$, in an atmosphere of ammonia at 800 - 1200 K gives boron nitride.

$$B(OH)_3 + NH_3 \longrightarrow BN + 3H_2O$$

**18. 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.**

**(A)** is NaH. It reacts with $BF_3$ to give $B_2H_6$

$$\underset{\textbf{(B)}}{2BF_3} + 6NaH \xrightarrow{450\ K} \underset{\textbf{(C)}}{B_2H_6} + 6NaF$$

$B_2H_6$ is used as a reducing agent in organic chemistry

**19. 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.**

$$\underset{(A)}{K_2SO_4.Al_2(SO_4)_3.24\,H_2O} \xrightarrow{5ook} \underset{(B)}{K_2SO_4.Al_2(SO_4)_3} + 24\,H_2O$$

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

**20. CO is a reducing agent . justify with an example.**

Carbon monoxide acts as a strong reducing agent.

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