Chapter 11. p-Block Elements (Group 13 and14))

1. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that
(a) Sn^{2+} is oxidising while Pb^{4+} is reducing
(b) Sn^{2+} and Pb^{2+} are both oxidising and reducing
(c) Sn^{4+} is reducing while Pb^{4+} is oxidising
(d) Sn^{2+} is reducing while Pb^{4+} is oxidising.
(NEET 2017)

2. Boric acid is an acid because its molecule
(a) contains replaceable H^+ ion
(b) gives up a proton
(c) accepts OH^- from water releasing proton
(d) combines with proton from water molecule.
(NEET-II 2016)

3. AlF_3 is soluble in HF only in presence of KF. It is due to the formation of
(a) $K_3[AlF_3H_3]$ (b) $K_3[AlF_6]$
(c) AlH_3 (d) $K[AlF_3H]$
(NEET-II 2016)

4. The stability of + 1 oxidation state among Al, Ga, In and Tl increases in the sequence
(a) Al < Ga < In < Tl (b) Tl < In < Ga < Al
(c) In < Tl < Ga < Al (d) Ga < In < Al < Tl
(2015, 2009)

5. Which of the following structure is similar to graphite?
(a) B_4C (b) B_2H_6
(c) BN (d) B *(NEET 2013)*

6. Which of these is not a monomer for a high molecular mass silicone polymer?
(a) Me_3SiCl (b) $PhSiCl_3$
(c) $MeSiCl_3$ (d) Me_2SiCl_2
(NEET 2013)

7. The basic structural unit of silicates is
(a) SiO_3^{2-} (b) SiO_4^{2-}
(c) SiO^- (d) SiO_4^{4-}
(NEET 2013)

8. Which statement is wrong?
(a) Beryl is an example of cyclic silicate.
(b) Mg_2SiO_4 is orthosilicate.
(c) Basic structural unit in silicates is the SiO_4 tetrahedron.
(d) Feldspars are not aluminosilicates.
(Karnataka NEET 2013)

9. Name the two type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared?
(a) Linear chain silicate (b) Sheet silicate
(c) Pyrosilicate (d) Three dimensional
(2011)

10. Which of the following statements is incorrect?
(a) Pure sodium metal dissolves in liquid ammonia to give blue solution.
(b) NaOH reacts with glass to give sodium silicate.
(c) Aluminium reacts with excess NaOH to give $Al(OH)_3$.
(d) $NaHCO_3$ on heating gives Na_2CO_3.
(Mains 2011)

11. Which of the following oxide is amphoteric?
(a) SnO_2 (b) CaO
(c) SiO_2 (d) CO_2
(Mains 2011)

12. Which one of the following molecular hydrides acts as a Lewis acid?
(a) NH_3 (b) H_2O
(c) B_2H_6 (d) CH_4 *(2010)*

13. The tendency of BF_3, BCl_3 and BBr_3 to behave as Lewis acid decreases in the sequence
(a) $BCl_3 > BF_3 > BBr_3$ (b) $BBr_3 > BCl_3 > BF_3$
(c) $BBr_3 > BF_3 > BCl_3$ (d) $BF_3 > BCl_3 > BBr_3$
(2010)

14. The straight chain polymer is formed by
(a) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation
(b) hydrolysis of $(CH_3)_4Si$ by addition polymerisation
(c) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation
(d) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation. *(2009)*

15. Which of the following oxidation states are the most characteristic for lead and tin respectively?
(a) +2, +4 (b) +4, +4
(c) +2, +2 (d) +4, +2. *(2007)*

16. Which of the following anions is present in the chain structure of silicates?
(a) $(Si_2O_5^{2-})_n$ (b) $(SiO_3^{2-})_n$
(c) SiO_4^{4-} (d) $Si_2O_7^{6-}$ *(2007)*

17. Which of the following is the most basic oxide?
(a) SeO_2 (b) Al_2O_3
(c) Sb_2O_3 (d) Bi_2O_3 *(2006)*

18. The correct order regarding the electronegativity of hybrid orbitals of carbon is
(a) $sp < sp^2 < sp^3$ (b) $sp > sp^2 < sp^3$
(c) $sp > sp^2 > sp^3$ (d) $sp < sp^2 > sp^3$
(2006)

19. Which one of the following statements about the zeolite is false?
(a) They are used as cation exchangers.
(b) They have open structure which enables them to take up small molecules.
(c) Zeolites are aluminosilicates having three dimensional network.
(d) Some of the SiO_4^{4-} units are replaced by AlO_4^{5-} and AlO_6^{9-} ions in zeolites. *(2004)*

20. Which one of the following compounds is not a protonic acid?
(a) $B(OH)_3$ (b) $PO(OH)_3$
(c) $SO(OH)_2$ (d) $SO_2(OH)_2$ *(2003)*

21. Which compound is electron deficient?
(a) $BeCl_2$ (b) BCl_3
(c) CCl_4 (d) PCl_5 *(2000)*

22. Which of the following does not show electrical conduction?
(a) Diamond (b) Graphite
(c) Potassium (d) Sodium *(1999)*

23. The type of hybridisation of boron in diborane is
(a) sp^3-hybridisation (b) sp^2-hybridisation
(c) sp-hybridisation (d) sp^3d^2-hybridisation
(1999)

24. Percentage of lead in lead pencil is
(a) 80 (b) 20
(c) zero (d) 70 *(1999)*

25. In graphite, electrons are
(a) localised on each C-atom
(b) localised on every third C-atom
(c) spread out between the structure
(d) present in anti-bonding orbital.
(1997, 1993)

26. Boron compounds behave as Lewis acids, because of their
(a) ionisation property
(b) electron deficient nature
(c) acidic nature
(d) covalent nature. *(1996)*

27. Aluminium (III) chloride forms a dimer because aluminium
(a) belongs to 3rd group
(b) can have higher coordination number
(c) cannot form a trimer
(d) has high ionization energy. *(1995)*

28. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because
(a) nitrogen atom is smaller than boron atom
(b) BCl_3 has no lone pair but NCl_3 has a lone pair of electrons
(c) B—Cl bond is more polar than N—Cl bond
(d) N—Cl bond is more covalent than B—Cl bond. *(1995)*

29. Method used for obtaining highly pure silicon, used as a semiconductor material, is
(a) crystallization (b) zone refining
(c) oxidation (d) electro-chemical.
(1994)

30. Carbon and silicon belong to (IV) group. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to
(a) availability of low lying *d*-orbitals in silicon
(b) large size of silicon
(c) more electropositive nature of silicon
(d) both (b) and (c). *(1994)*

31. Which of the following statements about H_3BO_3 is not correct?
(a) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds.
(b) It does not act as proton donor but acts as a Lewis acid by accepting hydroxyl ion.
(c) It is a strong tribasic acid.
(d) It is prepared by acidifying an aqueous solution of borax. *(1994)*

32. Na^+, Mg^{2+}, Al^{3+} and Si^{4+} are isoelectronic, their ionic size will follow the order
(a) $Na^+ > Mg^{2+} < Al^{3+} < Si^{4+}$
(b) $Na^+ < Mg^{2+} < Al^{3+} < Si^{4+}$
(c) $Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$
(d) $Na^+ < Mg^{2+} > Al^{3+} < Si^{4+}$ *(1993)*

33. Which of the following types of forces bind together the carbon atoms in diamond?
(a) Ionic (b) Covalent
(c) Dipolar (d) van der Waals
(1992)

34. Water gas is produced by
(a) passing steam through a red hot coke bed
(b) saturating hydrogen with moisture
(c) mixing oxygen and hydrogen in the ratio of 1 : 2
(d) heating a mixture of CO_2 and CH_4 in petroleum refineries. *(1992)*

35. Which of the following is an insulator?
(a) Graphite (b) Aluminum
(c) Diamond (d) Silicon *(1992)*

36. Glass is a
(a) liquid (b) solid
(c) supercooled liquid
(d) transparent organic polymer. *(1991)*

37. The ability of a substance to assume two or more crystalline structures is called
(a) isomerism (b) polymorphism
(c) isomorphism (d) amorphism. *(1990)*

38. The substance used as a smoke screen in warfare is
(a) $SiCl_4$ (b) PH_3
(c) PCl_5 (d) acetylene. *(1989)*

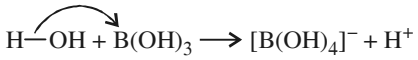
Answer Key

1.	(d)	**2.**	(c)	**3.**	(b)	**4.**	(a)	**5.**	(c)	**6.**	(a)	**7.**	(d)	**8.**	(d)	**9.**	(c)	**10.**	(c)
11.	(a)	**12.**	(c)	**13.**	(b)	**14.**	(c)	**15.**	(a)	**16.**	(b)	**17.**	(d)	**18.**	(c)	**19.**	(d)	**20.**	(a)
21.	(b)	**22.**	(a)	**23.**	(a)	**24.**	(c)	**25.**	(b)	**26.**	(b)	**27.**	(b)	**28.**	(b)	**29.**	(b)	**30.**	(a)
31.	(c)	**32.**	(c)	**33.**	(b)	**34.**	(a)	**35.**	(c)	**36.**	(c)	**37.**	(b)	**38.**	(a)				

EXPLANATIONS

1. (d) : The inertness of *s*-subshell electrons towards bond formation is known as inert pair effect. This effect increases down the group thus, for Sn, +4 oxidation state is more stable, whereas, for Pb, +2 oxidation state is more stable, *i.e.*, Sn^{2+} is reducing while Pb^{4+} is oxidising.

2. (c) : Boric acid behaves as a Lewis acid, by accepting a pair of electrons from OH^- ion of water thereby releasing a proton.



$$H{-}OH + B(OH)_3 \longrightarrow [B(OH)_4]^- + H^+$$

3. (b) : AlF_3 is insoluble in anhydrous HF because the F^- ions are not available in hydrogen bonded HF but, it becomes soluble in presence of little amount of KF due to formation of complex, $K_3[AlF_6]$. $AlF_3 + 3KF \rightarrow K_3[AlF_6]$

4. (a) : In group 13 elements, stability of +3 oxidation state decreases down the group while that of +1 oxidation state increases due to inert pair effect. Hence, stability of +1 oxidation state increases in the sequence : Al < Ga < In < Tl.

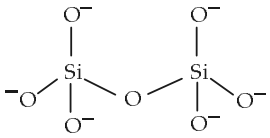
5. (c) : BN is known as inorganic graphite and has structure similar to graphite.

6. (a) : It can form only dimer.

7. (d) : SiO_4^{4-} ortho-silicate is basic unit of silicates.

8. (d) : Feldspars are three dimensional aluminosilicates.

9. (c) : Pyrosilicate contains two units of SiO_4^{4-} joined along a corner containing oxygen atom.



10. (c) : Al reacts with NaOH to give sodium metaaluminate.

11. (a) : SnO_2 reacts with acid as well as base. So SnO_2 is an amphoteric.

$SnO_2 + 4HCl \rightarrow SnCl_2 + 2H_2O$

$SnO_2 + 2NaOH \rightarrow Na_2SnO_3 + H_2O$

CaO is basic in nature while SiO_2 and CO_2 are acidic in nature.

12. (c) : Compounds that are electron deficient act as Lewis acids. Out of the given hydrides B_2H_6 satisfies this condition and is therefore a Lewis acid.

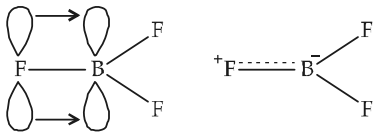
13. (b) : The relative Lewis acid character of boron trihalides is found to follow the following order,

$BBr_3 > BCl_3 > BF_3$

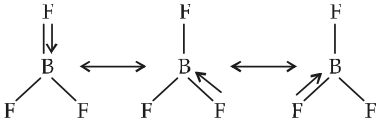
but the expected order on the basis of electronegativity of the halogens (electronegativity of halogens decreases from F to I) should be,

$BF_3 > BCl_3 > BBr_3$

This anomaly is explained on the basis of the relative tendency of the halogen atom to back donate its unutilised electrons to vacant *p*-orbital of boron atom. In BF_3, boron has a vacant 2*p*-orbital and each flourine has fully filled unutilised 2*p*-orbitals. Fluorine transfers two electrons to vacant 2*p*-orbital of boron, thus forming $p\pi$-$p\pi$ bond.



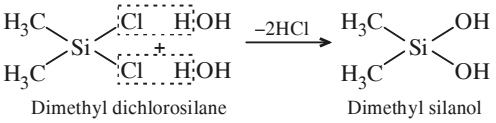
This type of bond has some double bond character and is known as dative or back bonding. All the three bond lengths are same. It is possible when double bond is delocalized. The delocalization may be represented as :



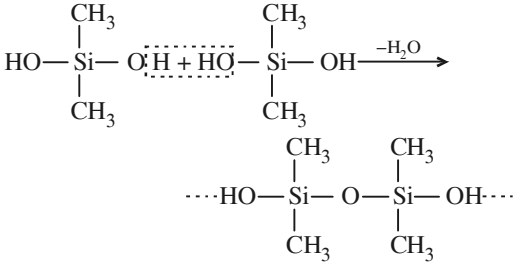
The tendency to back donate decreases from F to I as energy level difference between B and halogen atom increases from F to I. So, the order is

$BF_3 < BCl_3 < BBr_3$.

14. (c) : Hydrolysis of substituted chlorosilanes yields corresponding silanols which undergo polymerisation. Out of the given chlorosilanes, only $(CH_3)_2SiCl_2$ will give linear polymer on hydrolysis followed by polymerisation.



Dimethyl dichlorosilane — Dimethyl silanol



15. (a) : When ns^2 electrons of outermost shell do not participate in bonding then these ns^2 electrons are called inert pair and the effect is called inert pair effect. Due to this inert pair effect Ge, Sn and Pb of group IV have a tendency to form both +4 and +2 ions. Now the inert pair effect increases down the group, hence the stability of M^{2+} ions increases and M^{4+} ions decreases down the group. For this reason, Pb^{2+} is more stable than Pb^{4+} and Sn^{4+} is more stable than Sn^{2+}.

16. (b) : Chain silicates are formed by sharing two oxygen atoms by each tetrahedra. Anions of chain silicate have two general formula :

(i) $(SiO_3)_n^{2n-}$ (ii) $(Si_4O_{11})_n^{6n-}$

17. (d) : $SeO_2 \rightarrow$ acidic oxide

$Al_2O_3 \rightarrow$ amphoteric, $Sb_2O_3 \rightarrow$ amphoteric

$Bi_2O_3 \rightarrow$ basic oxide.

18. (c) : Electronegativity of carbon atom is not fixed. It varies with the state of hybridisation. Electronegativity of carbon increases as the *s*-character of the hybrid orbital increases.

C (sp) > C (sp^2) > C (sp^3)

19. (d) : Zeolites have SiO_4 and AlO_4 tetrahedrons, linked together in a three dimensional open structure in which four or six membered rings predominate. Due to open chain structure, they have cavities and can take up water and other small molecules.

20. (a) : $B(OH)_3$ in aqueous medium coordinates a molecule of water to form the hydrated species $\begin{matrix}H\\H\end{matrix}\!\!>\!O\rightarrow B(OH)_3$. In this species, B^{3+} ion, because of its small size, exercises a high polarizing power thereby pulling the sigma electron charge of the coordinated O atom towards itself. The coordinated oxygen, in turn, pulls the sigma electron charge of the OH bond of the attached water molecule towards itself. This facilitates the removal of H^+ ion from the O – H bond.

$$\begin{matrix}H\\H\end{matrix}\!\!>\!O\rightarrow B(OH)_3 \rightleftharpoons [B(OH)_4]^- + H^+$$

Thus, the solution of $B(OH)_3$ in water acts as a weak acid, and it is not a protonic acid.

21. (b) : In BCl_3 the central atom 'B' is sp^2 hybridised and contains only 'six' electrons in its valence shell. Therefore it is electron deficient.

22. (a) : Except diamond other three conduct electricity. Potassium and sodium are metallic conductors, while graphite is a non-metallic conductor.

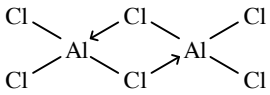
23. (a) : Each 'B' atom in diborane (B_2H_6) is sp^3-hybridised. Of the 4-hybrid orbitals, three have one electron each, while the 4th is empty. Two orbitals of each form σ bonds with two 'H'-atoms, while one of the remaining hybrid orbital (either filled or empty), 1s orbital of 'H' atom and one of the hybrid orbitals of other 'B' atom overlap to form three centered two electron bond. So there exists two such type of three centered bonds.

24. (c) : Lead pencil contains graphite and clay. It does not contain lead.

25. (b) : In graphite each carbon atom undergoes sp^2-hybridisation and is covalently bonded to three other carbon atoms by single bonds. The fourth electron forms π bond. A graphite consists of two layers which are separated by a distance of 340 pm.

26. (b) : Lewis acids are those substances which can accept a pair of electrons and boron compounds usually are deficient in electrons.

27. (b) : $AlCl_3$ forms a dimer as there is unsaturation in coordination. Also it enables Al atoms to complete their octets.



28. (b) : There is no lone pair on boron in BCl_3 hence no repulsion takes place. There is a lone pair on nitrogen in NCl_3 hence repulsion takes place. Therefore BCl_3 is planar molecule but NCl_3 is pyramidal molecule.

29. (b) : Pure silicon is made by the reduction of highly purified silicon tetrachloride ($SiCl_4$) with dihydrogen.

$SiCl_4 + 2H_2 \rightarrow Si + 4HCl$. The silicon obtained is purified further by the zone refining process. A method of refining metals some inorganic and organic compounds depending on the difference in solubility of impurities in the liquid and solid states is called zone-refining process.

30. (a) : Carbon has no *d*-orbitals, while silicon contains *d*-orbitals in its valence shell which can be used for bonding purposes.

31. (c) : H_3BO_3 is a weak monobasic acid. We know that $B(OH)_3 + H_2O \rightarrow [B(OH)_4]^- + H^+$. Therefore it is a weak monobasic acid.

32. (c) : In isoelectronic species as the charge on cations increases, their sizes decrease in that order. Thus the ionic sizes of the given cation (isoelectronic) decrease in the order

$Na^{+} > Mg^{2+} > Al^{3+} > Si^{4+}$

33. (b) : In diamond each carbon atom is sp^3 hybridized and thus forms covalent bonds with four other carbon atoms lying at the corners of a regular tetrahedron.

34. (a) : $\underset{\text{Steam}}{H_2O} + \underset{\text{Red hot}}{C} \rightarrow \underset{\text{water gas}}{H_2 + CO}$

35. (c) : All the above are conductors except diamond. Hence diamond is an insulator.

36. (c) : Glass is a super cooled liquid which forms a non-crystalline solid without a regular lattice.

37. (b) : The phenomenon of existence of a substance in two or more crystalline structures is called polymorphism. Polymorphism of elements is known as allotropy.

38. (a) : $SiCl_4$ gets hydrolysed in moist air and gives white fumes which are used as a smoke screen in warfare.