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1.(C) The negatively charged colloidal particles of impurities get neutralised by the Al^{3+} ions and settle down and pure water can be decanted off.

2.(B) Glass is a transparent or translucent amorphous supercooled solid solution (supercooled liquid) of silicates and borates, having a general formula $R_2O \cdot MO \cdot 6SiO_2$ where R = Na or K and M = Ca, Ba, Zn or Pb.

3.(D) Graphite has a two-dimensional sheet like structure and each carbon atom makes a use of sp^2 hybridisation. The layer structure of graphite is less compact than that of diamond. Further, since the bonding between the layers involving only weak van der Waals forces, these layers can slide over each other. This gives softness, greasiness and lubricating character to graphite.

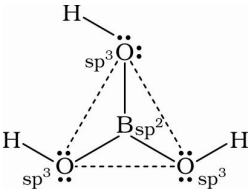
4.(B) Grey tin is very brittle and easily crumbles down to powder in very cold climates.

$$\underset{\text{(tetragonal)}}{\text{White tin}} \rightleftharpoons \underset{\text{(cubic)}}{\text{grey tin}}$$

The change of white tin to grey tin is accompanied by increase in volume. This is called tin disease or tin plague.

5.(B) $Al_2Cl_6 + 12H_2O \rightleftharpoons 2[Al(H_2O)_6]^{3+} + 6Cl^-$

6.(B)



7.(B) Aluminium chloride in aqueous solution exists as ion pair.

$$2AlCl_3 + aq. \longrightarrow [AlCl_2(H_2O)_4]^+_{(aq)} + [AlCl_4(H_2O)_2]^-_{(aq)}$$

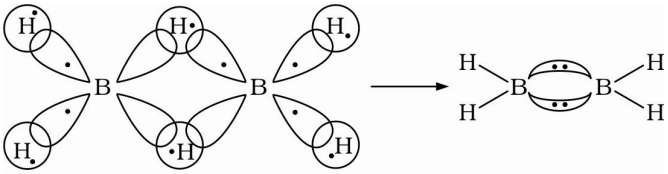
The crystallization of $AlCl_3$ from aqueous solution, therefore, yields an ionic solid of composition $[AlCl_2(H_2O)_4]^+[AlCl_4(H_2O)_2]^- \cdot xH_2O$. This compound decomposes at about 190°C to give the non-ionic dimer Al_2Cl_6.

$$[AlCl_2(H_2O)_4]^+[AlCl_4(H_2O)_2]^- \cdot xH_2O \xrightarrow[190°C]{\text{heat}} Al_2Cl_6 + H_2O$$

8.(B) Calcium carbide is ionic carbide having $[:C \equiv C:]^{2-}$.

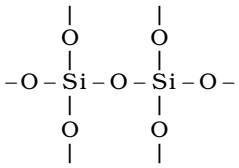
$Ca^{2+}[:C \equiv C:]^{2-}$

9.(A) According to molecular orbital theory, each of the two boron atoms is in sp^3 hybrid state. Of the four hybrid orbitals, three atoms have one electron each while the fourth is empty. Two of the four orbitals of each of the boron atom overlap with two terminal hydrogen atoms forming two normal $B-H$ σ-bond. One of the remaining hybrid orbital (either filled or empty) of one of the boron atoms, 1s orbital of hydrogen atoms (bridge atom) and one of hybrid orbitals of the other boron atom overlap to form a delocalised orbital covering the three nuclei with a pair of electrons. Such a bond is known as three centre two electron (3c – 2e) bonds.



Structure of diborane

10.(A) Silicon dioxide exhibits polymorphism. It is a network solid in which each Si atom is surrounded tetrahedrally by four oxygen atoms.



11.(D) CaO-basic, CO_2 and SiO_2 -acidic, SnO_2 -amphoteric, as it reacts with both acids and bases.

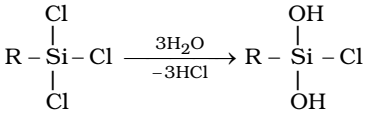
$SnO_2 + 4HCl \rightarrow SnCl_4 + 2H_2O$

$SnO_2 + 2NaOH \rightarrow Na_2SnO_3 + H_2O$

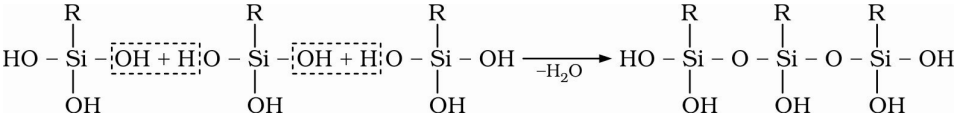
12.(D) Due to inert pair effect (the reluctance of ns^2 electrons of outermost shell to participate in bonding) the stability of M^{2+} ions (of group IV elements) increases as we go down the group.

13.(C) $RSiCl_3$ on hydrolysis gives a cross linked silicone. The formation can be explained in three steps :

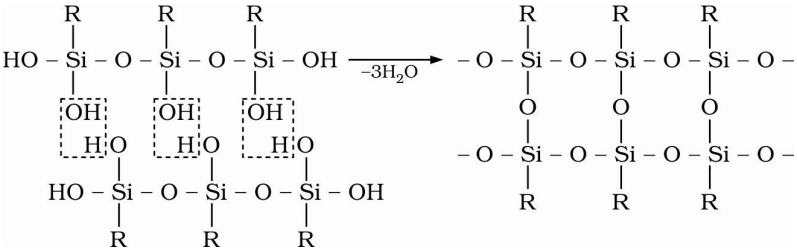
(i)



(ii)



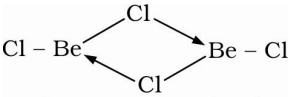
(iii)



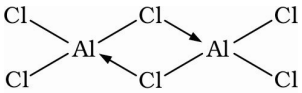
14.(D) Boric acid is a weak monobasic acid ($K_a = 1.0 \times 10^{-9}$). It is a notable part that boric acid does not act as a protonic acid (i.e., proton donor) but behaves as a Lewis acid by accepting a pair of electrons from OH^- ions.

$B(OH)_3 + 2H_2O \rightarrow [B(OH)_4]^- + H_3O^+$

$BeCl_2$ like Al_2Cl_6 has a bridged polymeric structure in solid phase generally as shown below.



Polymeric structure of $BeCl_2$



Polymeric structure of Al_2Cl_6

Beryllium exhibits coordination number of four as it has only four available orbitals in its valence shell. Also,

$$3B_2H_6 + 6NH_3 \longrightarrow 3[BH_2(NH_3)_2]^+BH_4^- \quad \text{or} \quad B_2H_6 \cdot 2NH_3 \xrightarrow{\text{Heat, } 450\,K} \underset{\text{Borazine}}{2B_3N_3H_6} + 12H_2$$

or

$B_2H_6 \cdot 2NH_3$

Borazine has structure similar to benzene and therefore, it is called inorganic benzene. Hence option (D) is correct.

15.(C) In BF_3, B is sp^2 hybridised and has a vacant 2p-orbital which overlaps laterally with a filled 2p-orbital of F forming strong $p\pi - p\pi$ bonds. However in CF_4, C does not have any vacant p-orbitals to undergo π-bonding. Thus $B.E._{B-F} > B.E._{C-F}$.