

Some p -Block Elements

Short Answer Type Questions

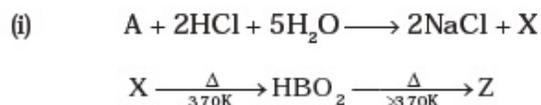
1. Draw the structures of $\text{BCl}_3 \cdot \text{NH}_3$ and AlCl_3 (dimer).
2. Explain the nature of boric acid as a Lewis acid in water.
3. Draw the structure of boric acid showing hydrogen bonding. Which species is present in water? What is the hybridisation of boron in this species?
4. Explain why the following compounds behave as Lewis acids?
 - (i) BCl_3
 - (ii) AlCl_3
5. Give reasons for the following:
 - (i) CCl_4 is immiscible in water, whereas SiCl_4 is easily hydrolysed.
 - (ii) Carbon has a strong tendency for catenation compared to silicon.
6. Explain the following :
 - (i) CO_2 is a gas whereas SiO_2 is a solid.
 - (ii) Silicon forms SiF_6^{2-} ion whereas corresponding fluoro compound of carbon is not known.
7. The +1 oxidation state in group 13 and +2 oxidation state in group 14 becomes more and more stable with increasing atomic number. Explain.
8. Carbon and silicon both belong to the group 14, but inspite of the stoichiometric similarity, the dioxides, (i.e., carbon dioxide and silicon dioxide), differ in their structures. Comment.
9. If a trivalent atom replaces a few silicon atoms in three dimensional network of silicon dioxide, what would be the type of charge on overall structure?
10. When BCl_3 is treated with water, it hydrolyses and forms $[\text{B}(\text{OH})_4]^-$ only whereas AlCl_3 in acidified aqueous solution forms $[\text{Al}(\text{H}_2\text{O})_6]^{3+}$ ion. Explain what is the hybridisation of boron and aluminium in these species?
11. Aluminium dissolves in mineral acids and aqueous alkalies and thus shows amphoteric character. A piece of aluminium foil is treated with dilute

hydrochloric acid or dilute sodium hydroxide solution in a test tube and on bringing a burning matchstick near the mouth of the test tube, a pop sound indicates the evolution of hydrogen gas. The same activity when performed with concentrated nitric acid, reaction doesn't proceed. Explain the reason.

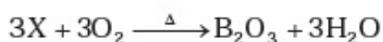
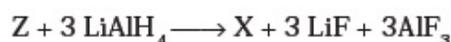
12. Explain the following :

- (i) Gallium has higher ionisation enthalpy than aluminium.
- (ii) Boron does not exist as B^{3+} ion.
- (iii) Aluminium forms $[AlF_6]^{3-}$ ion but boron does not form $[BF_6]^{3-}$ ion.
- (iv) PbX_2 is more stable than PbX_4 .
- (v) Pb^{4+} acts as an oxidising agent but Sn^{2+} acts as a reducing agent.
- (vi) Electron gain enthalpy of chlorine is more negative as compared to fluorine.
- (vii) $Tl(NO_3)_3$ acts as an oxidising agent.
- (viii) Carbon shows catenation property but lead does not.
- (ix) BF_3 does not hydrolyse.
- (x) Why does the element silicon, not form a graphite like structure whereas carbon does.

13. Identify the compounds A, X and Z in the following reactions :



14. Complete the following chemical equations :



Long Answer Type Questions

- Describe the general trends in the following properties of the elements in Groups 13 and 14.
 - Atomic size
 - Ionisation enthalpy
 - Metallic character
 - Oxidation states
 - Nature of halides
- Account for the following observations:
 - AlCl_3 is a Lewis acid
 - Though fluorine is more electronegative than chlorine yet BF_3 is a weaker Lewis acid than BCl_3
 - PbO_2 is a stronger oxidising agent than SnO_2
 - The +1 oxidation state of thallium is more stable than its +3 state.
- When aqueous solution of borax is acidified with hydrochloric acid, a white crystalline solid is formed which is soapy to touch. Is this solid acidic or basic in nature? Explain.
- Three pairs of compounds are given below. Identify that compound in each of the pairs which has group 13 element in more stable oxidation state.
Give reason for your choice. State the nature of bonding also.
 - TlCl_3 , TlCl
 - AlCl_3 , AlCl
 - InCl_3 , InCl
- BCl_3 exists as monomer whereas AlCl_3 is dimerised through halogen bridging. Give reason. Explain the structure of the dimer of AlCl_3 also.
- Boron fluoride exists as BF_3 but boron hydride doesn't exist as BH_3 . Give reason. In which form does it exist? Explain its structure.

7. (i) What are silicones? State the uses of silicones.
(ii) What are boranes? Give chemical equation for the preparation of diborane.
8. A compound (A) of boron reacts with NMe_3 to give an adduct (B) which on hydrolysis gives a compound (C) and hydrogen gas. Compound (C) is an acid. Identify the compounds A, B and C. Give the reactions involved.
9. A nonmetallic element of group 13, used in making bullet proof vests is extremely hard solid of black colour. It can exist in many allotropic forms and has unusually high melting point. Its trifluoride acts as Lewis acid towards ammonia. The element exhibits maximum covalency of four. Identify the element and write the reaction of its trifluoride with ammonia. Explain why does the trifluoride act as a Lewis acid.
10. A tetravalent element forms monoxide and dioxide with oxygen. When air is passed over heated element (1273 K), producer gas is obtained. Monoxide of the element is a powerful reducing agent and reduces ferric oxide to iron. Identify the element and write formulas of its monoxide and dioxide. Write chemical equations for the formation of producer gas and reduction of ferric oxide with the monoxide.