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TEXTBOOK QUESTIONS SOLVED

Question 1. Discuss the pattern of variation in the oxidation states of (i) B to Tl (ii) C to Pb.
Answer: (i) B to Tl
Common oxidation states are +1 and +3. The stability of +3 oxidation state decreases from B to Tl. +1 oxidation state increases from B to Tl.
(ii) C to Pb
The common oxidation states are +4 and +2. Stability of +4 oxidation state decreases from C to Pb.
Details can be seen from the text part.

Question 2. How can you explain higher stability of BCl_3 as compared to $TlCl_3$?
Answer: BCl_3 is quite stable. Because there is absence of d- and f-electrons in boron three valence electrons ($2s^2\ 2p_{x1}$) are there for bonding with chlorine atom. In Tl the valence s-electron ($6s^2$) are experiencing maximum inert pair effect. Thus, only $6p^1$ electron is available for bonding. Therefore, BCl_3 is stable but $TlCl_3$ is comparatively unstable.

Question 3. Why does borontrifluori.de behave as a Lewis acid?
Answer: In BF_3, central atom has only six electrons after sharing with the electrons of the F atoms. It is an electron deficient compound and thus behaves as a Lewis acid.

Question 4. Consider the compounds, BCl_3 and CCl_4. How will they'behave with water justify?
Answer: In BCl_3, there is only six electrons in the valence shell of B atom. Thus, the octet is incomplete and it can accept a pair of electrons from water and hence BCl_3 undergoes hydrolysis.
Whereas, in CCl_4, C atom has 8 electrons and its octet is complete. That's why it has no tendency to react with water.
$CCl_4 + H_2O \rightarrow$ No reaction

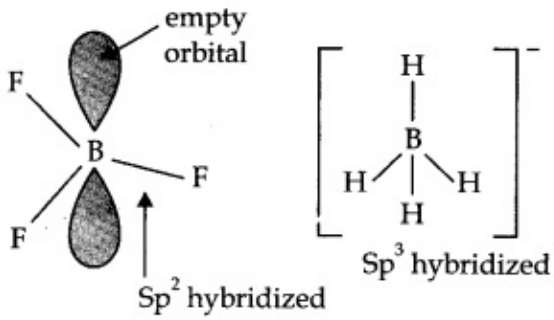
Question 5. Is boric acid a protonic acid? Explain.
Answer: Boric acid is a Lewis acid, it is not a protonic acid.
Boric acid accepts electrons from hydroxyl ion of H_2O molecule.
$B(OH)_3 + 2HOH \rightarrow [B(OH)_4]^- + H_3O^+$

Question 6. Explain what happens when boric acid is heated.
Answer: On heating boric acid above 370 K, it forms metaboric acid, HBO_2 which on further heating yields boric oxide B_2O_3.

$$H_3BO_3 \xrightarrow{\Delta} HBO_2 \xrightarrow{\Delta} B_2O_3$$

Question 7. Describe the shapes of BF_3 and BH_4^-. Assign the hybridisation of boron in these species.

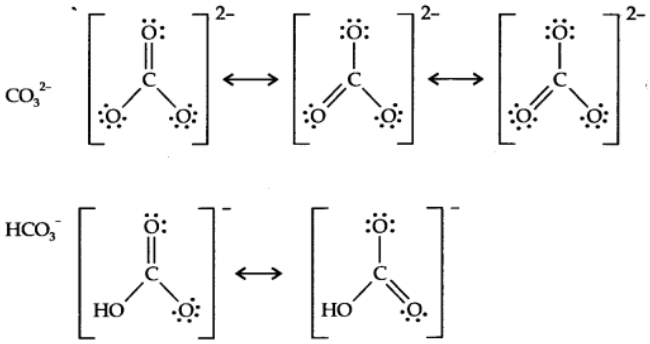
Answer: In BF_3, boron is SP^2 hybridized.
$\therefore$ shape of BF_3 = planar.
In $[BH_4]^-$, boron is sp^3 hybridized, thus the shape is tetrahedral.



Question 8. Write reactions to justify amphoteric nature of aluminium.
Answer: Aluminium reacts with acid as well as base. This shows amphoteric nature of aluminium.
$2Al(s) + 6HCl(dil.) \rightarrow 2AlCl_3(aq) + 3H_2(g)$
$2Al(s) + 2NaOH(aq) + 6H_2O(l) \rightarrow 2Na^+ [Al(OH)_4]^-(aq) + 3H_2(g)$

Question 9. What are electron deficient compounds? Are BCl_3 and $SiCl_4$ electron deficient species? Explain.
Answer: Electron deficient species are those in which the central atom in their molecule has the tendency to accept one or more electron pairs. They are also known as Lewis acid. BCl_3 and $SiCl_4$ both are electron deficient species.
Since, in BCl_3, B atom has only six electrons. Therefore, it is an electron deficient compound.
In $SiCl_4$ the central atom has 8 electrons but it can expand its covalency beyond 4 due to the presence of d-orbitals.
Thus, $SiCl_4$ should also be considered as electron deficient species.

Question 10. Write the resonance structure of CO_3^{2-} and HCO_3^-.
Answer:



Question 11. What is the state of hybridisation of carbon in (a) CO_3^{2-} (b) diamond (c) graphite?
Answer: (a) CO_3^{2-} (sp^2) (b) Diamond (sp^3) (c) Graphite (sp^2)

Question 12. Explain the difference in properties of diamond and graphite on the basis of their structures.
Answer:

- Since diamond exists as a three dimensional network solid, it is the hardest substance known with high density and high melting point.
  Whereas in graphite, any two successive layers are held together by weak forces of attraction. This makes graphite soft.
- In graphite, carbon atom is sp^2 hybridized whereas in

diamond, carbon atom is sp^3 hybridized.
- Unlike diamond, graphite is good conductor of heat and electricity.

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