NCERT IN TEXT QUESTIONS

7.1. Why are pentahalides more covalent than trihalidcs ?
Ans: The group 15 elements have 5 e^{-1} s in their valence shell. It is difficult to lose $3e^{-1}$s to form E^{3+} and even more difficult to lose $5e^{-1}$ s to form E^{5+}. Thus, they have very little tendency to form ionic compounds. Further, since the elements in +5 state have less tendency to lose e^{-1}s than in the +3 state, elements in +5 state have more tendency to share e^{-1} s and hence pentahalides are more covalent than trihalides.

7.2. Why is BiH_3 the strongest reducing agent amongst all the hydrides of Group 15 elements?
Ans: This is because as we move down the group, the size increases, as a result, length of E-H bond increases and its strength decreases, so that the bond can be broken easily to release H_2 gas. Hence, BiH_3 is the strongest reducing agent.

7.3. Why is N_2 less reactive at room temperature?
Ans: Due to presence of triple bond between two N-atoms (N = N), the bond dissociation energy of N_2 is very high. As a result, N_2 becomes less reactive at room temperature.

7.4. Mention the conditions required to maximise the yield of ammonia.
Ans: Ammonia is prepared by Haber's process as given below:

$$N_2(g) + 3H_2(g) \underset{\text{Mo (promoter)}}{\overset{\text{700 K, 200 × 10}^5\text{ Pa, Fe}_2\text{O}_3 + \text{K}_2\text{O} + \text{Al}_2\text{O}_3}{\rightleftharpoons}} 2NH_3(g)$$

$\Delta_f H^\circ = -92.4\ kJ\ mol^{-1}$

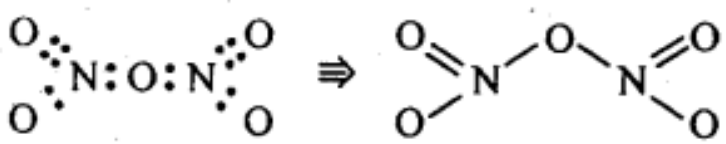
According to Le Chatelier's principle, to maximise the yield of ammonia, high P and T ~ 700 K should be used. The catalyst increases the rate of reaction and Mo promoter increases the efficiency of Fe catalyst.

7.5. How does ammonia react with a solution of Cu^{2+}?
Ans.

$$Cu^{2+}(aq) + 4NH_4OH(aq) \rightarrow \underset{\text{tetrammine copper (II) ion (deep blue)}}{[Cu(NH_3)_4]^{2+}} + 4H_2O$$

7.6. What is the covalence of nitrogen in N_2O_5 ?

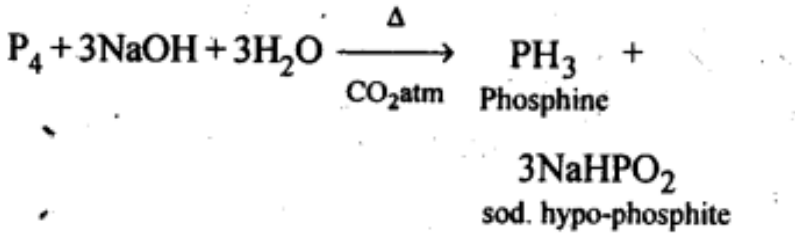
Ans: In N_2O_5 , each N-atom has four shared pairs of e^1 s as shown:



Thus, the covalency of N is 4.

7.7. Bond angle in PH_4^+ is higher than that in PH_3. Why?
Ans: P in PH_3 is sp^3-hybridized with 3 bond pairs and one lone pair around P. Due to stronger lp-bp repulsions than bp-bp repulsions, tetrahedral angle decreases from 109°28′ to 93.6°. As a result, PH_3 is pyramidal. In PH_4^+, there are 4 bp's and no lone pair. As a result, there are only identical bp-bp repulsions so that PH_4^+ assumes tetrahedral geometry and the bond angle is 109°28′.Hence, bond angle of PH_4^+ > bond angle of PH_3.

7.8. What happens when white phosphorus is heated with concentrated NaOH solution in an inert atmosphere of CO_2 ?
Ans:



********** END **********