CHEMISTRY STUDY MATERIALS FOR CLASS 12
(NCERT Based Reasoning of Chapter -07)
GANESH KUMAR DATE:- 13/01/2021

p – block elements

The p-Block Elements, Important Questions long Answer Type [LA]

Question 7:

(a) Complete the following chemical reaction equations :

(i) $P_4 + SO_2Cl_2 \rightarrow$

(ii) $XeF_4 + H_2O \rightarrow$

(b) Explain the following observations giving appropriate reasons :

(i) The stability of +5 oxidation state decreases down the group in group 15 of the periodic table.

(ii) Solid phosphorus pentachloride behaves as an ionic compound.

(iii) Halogens are strong oxidizing agents. (Delhi 2010)

Answer:

(a)

(*i*) $P_4 + \underset{\text{Sulphuryl chloride}}{10SO_2Cl_2} \longrightarrow \underset{\text{Phosphorus}}{4PCl_5} + \underset{\text{Pentachloride}}{10SO_2}$

(*ii*) $6XeF_4 + 12H_2O \longrightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$

(b) (i) Group 15 first elements are pentavalent, therefore they can show positive oxidation state +3 (due to P-electron) and +5 (due to P and S electrons). In a group the +5 oxidation state stability decreases but +3 oxidation state increases due to inter pair effect which results the 5- orbitals electrons to participate in bonding hence shows +3 oxidation state as their stable oxidation state.

(ii) PCl_5 conducts electricity in the molten state. This means that in solid state it exists as $[PCl_4]^+ [PCl_6]^-$ in which the cation is tetrahedral and the anion is octahedral. $2PCl_5 \rightarrow [PCl_4]^+ [PCl_6]^-$

On melting, these ions become free to move and hence PCl_5 conducts electricity in the molten state.

(iii) As halogens are strong elctron acceptors and change to negative ions and thus undergo reduction, so they are strong oxidising agent.

Question 8:

(a) Explain the following :

(i) NF_3 is an exothermic compound ' whereas NCl_3 is not.

(ii) F_2 is most reactive of all the four common halogens.

(b) Complete the following chemical equations :

(i) $C + H_2SO_4$ (cone) →

(ii) $P_4 + NaOH + H_2O$ →

(iii) $Cl_2 + F_2$ (excess) →

Answer:

(a) (i) F is more electronegative than Cl. The difference in the electronegativity between N and F is much more than the difference between electronegativity of N and Cl. So there is need of much more energy to break the N-F bond.

(ii) Because of the low bond dissociation energy F_2 readily dissociates into atoms and reacts with other substances readily.

(b) (i) $C + 2H_2SO_4$ (cone.) → $CO_2 + 2SO_2 + 2H_2O$

(ii) $P_4 + 3NaOH + 3H_2O \rightarrow PH_2 + 3NaH_2PO_2$

(iii) $Cl_2 + 3F_2$ (excess) → $2ClF_3$

Question 9;

(a) Account for the following :

(i) The acidic strength decreases in the order $HCl > H_2S > PH_3$

(ii) Tendency to form pentahalides
decreases down the group in group 15 of the

(b) Complete the following chemical equations :

(i) $P_4 + SO_2Cl_2$ →

(ii) $XeF_2 + H_2O$ →

(iii) $I_2 + HNO_3$ (conc) →

Answer:

(a) (i) Because of decrease in electronegativity from chlorine to phosphorous, the bond dissociation enthalpy from HCl to H-P increases and their tendency to release H^+ decreases and thus acidic strength decreases.

(ii) Down the group, the tendency of next ‘s’ orbital’s electron to jump to previous’d’ orbital decreases very much due to inert pair effect.

(b) (i) $P_4 + 10SO_2Cl_2 \longrightarrow 4PCl_5 + 10SO_2$
Phosphorus pentachloride

(ii) $XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2$

(iii) $I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$
(conc)
Iodine to Iodic acid

Question 10:

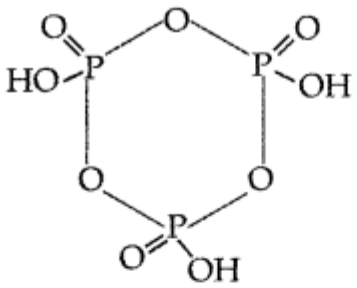
(a) Draw the structures of the following molecules :(i) $(HPO_3)_3$ (ii) BrF_3

(b) Complete the following chemical equations :

(i) $HgCl_2 + PH_3 \rightarrow$ (ii) $SO_3 + H_2SO_4 \rightarrow$ (iii) $XeF_4 + H_2O \rightarrow$

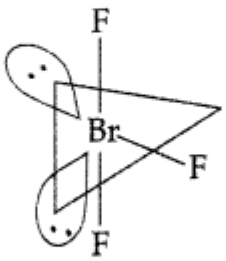
Answer:

(a) (i) $(HPO_3)_3$:



Cyclo Meta-Phosphoric acid
Shape : ring structure

(ii) **BrF_3 :**



Shape : T-shape

(b) (i) $3HgCl_2 + 2PH_3 \longrightarrow Hg_3P_2 + 6HCl$

(ii) $SO_3 + H_2SO_4 \longrightarrow H_2S_2O_7$
Sulphur trioxide — Oleum

(iii) $6XeF_4 + 12H_2O \longrightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$

Question 11:

(a) What happens when

(i) chlorine gas is passed through a hot concentrated solution of NaOH?

(ii) sulphur dioxide gas is passed through an aqueous solution of a Fe (III) salt?

(b) Answer the following :

(i) What is the basicity of H_3PO_3 and why?

(ii) Why does fluorine not play the role of a central atom in interhalogen compounds?

(iii) Why do noble gases have very low boiling points?

Answer:

(a) (i) $3Cl_2 + 6NaOH \xrightarrow{Heat} 5NaCl + NaClO_3 + 3H_2O$

(ii) $SO_2 + Fe_2(SO_4)_3 + 2H_2O \longrightarrow 2FeSO_4 + 2H_2SO_4$

(b) (i) Basicity of $H_3PO_3 = 2$

Because basicity is the number of replaceable H^+ ions in an acid and H_3PO_3 is a Dibasic acid.

(ii) Because F being smaller, it cannot accommodate larger sized other halogen atoms around it. Due to the absence of d-orbitals, F does not show positive oxidation state of +3, +5, +7 needed for the formation of polyatomic interhalogen compounds.

(iii) Because the atoms of these elements are held together by weak van der Waal's forces of attraction.

Question 12.

(a) Complete the following chemical equations :

(i) NaOH (hot and cone.) + Cl_2 →

(ii) $XeF_4 + O_2F_2$ →

(b) Draw the structures of the following molecules :

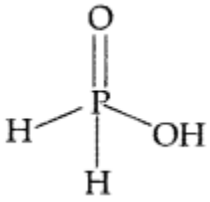
(i) H_3PO_2 (ii) $H_2S_2O_7$ (iii) $XeOF_4$ (Delhi 2012)

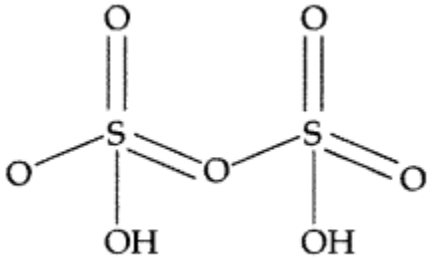
Answer:

(a) (i) $3Cl_2^+$ $6NaOH \rightarrow 5\ NaCl + NaClO_3 + 3H_2O$

(ii) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

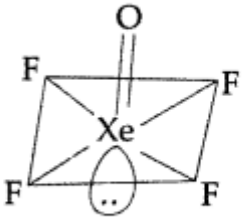
(b) (i) H_3PO_2: (ii) $H_2S_2O_7$:





(iii)

$XeOF_4$



Shape : Square pyramidal

Question 13.

(a) Draw the molecular structure of following compounds : (i) XeF_6 (ii) $H_2S_2O_8$

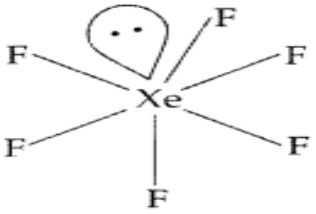
(b) Explain the following observations :

(i) The molecules NH_3 and NF_3 have dipole moments which are of opposite direction.

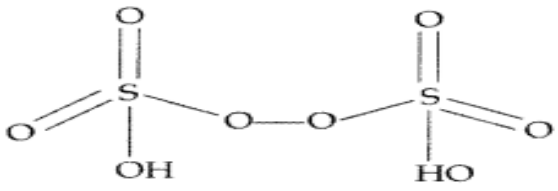
(ii) All the bonds in PCl_5 molecule are not equivalent.

(iii) Sulphur in vapour state exhibits paramagnetism.

Answer: (a) (i) XeF_6:



(*ii*) **$H_2S_2O_8$:**



(b) (i) Because F is more electronegative than N in NF_3 whereas N is more electronegative than H in NH_3.

(ii) Because PCl_5 has a trigonal bipyramidal structure in which the three equatorial P-Cl bonds are equivalent while the two axial bonds are longer than equatorial bonds.

(iii) Because sulphur in vapour state has two unpaired electrons in the antibonding π* orbitals like O_2.

****