P – block elements

Question 99.How would you account for the following :

(i) NCl_3 is an endothermic compound while NF_3 is an exothermic one.

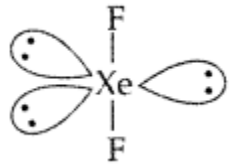
(ii) XeF_2 is a linear molecule without a bend.

(iii) The electron gain enthalpy with negative sign for fluorine is less than that for chlorine, still fluorine is a stronger oxidising agent than chlorine.

Answer:

(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) In XeF_2 there are 2 bond pairs and 3 lone pairs and thus show sp^3 d hybridization. It has linear geometry.



(iii) Because of small size of flourine atom and strong electron-electron repulsions in its compact 2p orbitals.

Question 100.How would you account for the following :

(i) The electron gain enthalpy with negative sign is less for oxygen than that for sulphur.

(ii) Phosphorus shows greater tendency for catenation than nitrogen.

(iii) Fluorine never acts as the central atom in polyatomic interhalogen compounds.

Answer:

(i) The least negative electron gain enthalpy of oxygen is due to small size and more interelectronic repulsion with coming electron.

(ii) The bond strength of P-P is more than N-N, therefore phosphorus shows more tendency for catenation than nitrogen.

(iii) 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.

Question 101. How would you account for the following :

(i) H_2S is more acidic than H_2O.

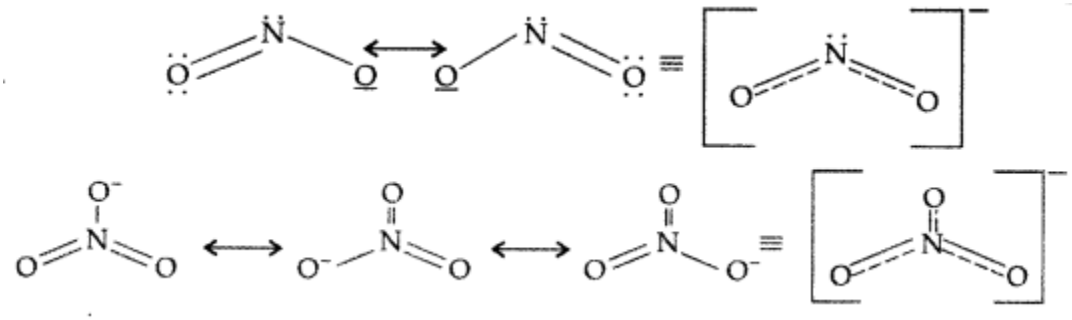
(ii) The N-O bond in NO−2 is shorter than the N-O bond in NO−3.

(iii) Both O_2 and F_2 stabilize high oxidation states but the ability of oxygen to stabilize the higher oxidation state exceeds that of fluorine.

Answer: (i) Since the size of sulphur is more than oxygen, S-H bond length increases and hence bond dissociation energy of S-H is less than O-H. Therefore S-FI easily loses H+ and thus is more acidic than H_2O.

(ii) The resonating structure of NO−2 and NO−3 show that in NO−2 two bonds are sharing a double bond while in NO−3, 3 bonds are sharing a double bond. That's why NO−2 has shorter bond than that of NO−3.

Answer:



(iii) Oxygen stabilizes the highest oxidation state even more than fluorine.

Example : Highest fluoride of Mn is MnF_4 whereas highest oxide is Mn_2O_7. It is due to ability of oxygen to form multiple bonds with the metal atoms.

Question 101. How would you account for the following :

(i) NF_3 is an exothermic compound but NCl_3 is not.

(ii) The acidic strength of compounds increases in the order :$PH_3 < H_2S < HCl$.

(iii) SF_6 is kinetically inert.

Answer:

(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) As the electronegativity increases in the same period from left to right so their electronegativity are in the increasing order, P < S < Cl.

In the same way the acid strength is also in the increasing order i.e. $PH_3 < H_2S < HCl$.

(iii) Because SF_6 is showing steric hindrance due to 6 (six) fluorine atoms which make it unable to react further with any other atom.

Question 102.Give reasons for the following:

(i) Where R is an alkyl group, $R_3P = O$ exists but $R_3N = O$ does not.

(ii) $PbCl_4$ is more covalent than $PbCl_2$.

(iii) At room temperature, N_2 is much less reactive.

Answer:

(i) Due to presence of d-orbitals in P, it can form pπ -dπ bonds and can extend its covalency beyond 4 while N cannot do so due to absence of d-orbitals.

(ii) According to Fajan's rule, highly charged Pb^{4+} can polarize the anion i.e., Cl^- more effectively than Pb^{2+} and hence $PbCl_4$ becomes more covalent than $PbCl_2$.

(iii) Due to presence of triple bonds between 2 N atoms, their bond length decreases and hence bond dissociation energy increases which makes N_2 lesser reactive. While in phosphorus due to presence of single bond, more bond length, bond dissociation energy is low, hence very reactive.

Question 103.Give reasons for the following :

(i) Though nitrogen exhibits +5 oxidation state, it does not form pentahalide.

(ii) Electron gain enthalpy with negative sign of fluorine is less than that of chlorine.

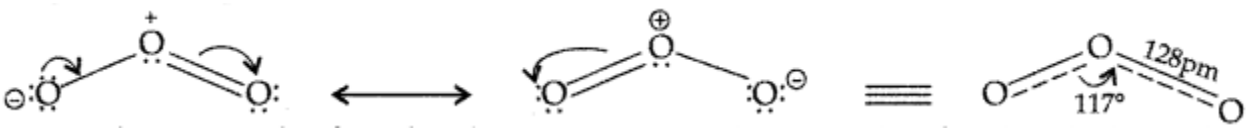
(iii) The two oxygen-oxygen bond lengths in ozone molecule are identical.

Answer:

(i) Due to absence of empty d-orbitals, N_2 does not form pentahalide.

(ii) Because of small size of flourine atom and strong electron-electron repulsions in its compact 2p orbitals.

(iii) Due to resonance the two oxygen atoms have partial double bond character and thus have same bond length i.e. 128 pm



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