Chemistry Study Materials for Class 12

(NCERT Intext Questions –Answers)

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The p-Block Elements

Question 1: Why are pentahalides more covalent than trihalides?

Solution 1: In pentahalides, the oxidation state is +5 and +3oxidation state in trihalides. Since the metal ion with a high charge has more polarizing power, pentahalides are more covalent than trihalides.

Question 2: Why is BiH3 the strongest reducing agent amongst all the hydrides of Group 15 elements?

Solution 2: As we move down a group. the atomic size increases and the stability of the hydrides of group 15 elements decreases Since the stability of hydrides decreases on moving from NH3 to BiH3, the reducing character of the hydrides increases on moving from NH3 to BiH3.

Question 3: Why is N2 less reactive at room temperature?

Solution 3: The two N atoms in N2 are bonded to each other by very strong triple covalent bonds. The bond dissociation energy of this bond is very high. As a result, N2 is less reactive at room temperature.

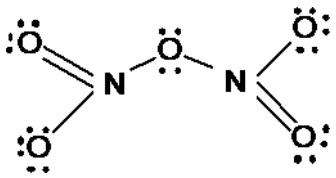
Question 4: Mention the conditions required to maximize the yield of ammonia.

Solution 4: Ammonia is prepared using the Haber s process. The yield of ammonia can be maximized under the following conditions:

(i) High pressure (200*atm*) (ii) A temperature (700 K)

Question 6: What is the covalence of nitrogen in N_2O_5?

Solution 6:



From the structure of N_2O_5 , it is evident that the covalence of nitrogen is 4.

Question 7: Bond angle in PH_4^{+1} is higher than that in PH_3 . Why?

Solution 7: In PH_3,P is sp^3 hybridized. Three orbitals are involved in bonding with three hydrogen atoms and the fourth one contains a lone pair. As lone pair- bond pair repulsion is stronger than bond pair-bond pair repulsion, the tetrahedral shape associated with sp^3 bonding is changed to pyramidal. PH_3 combines with a proton to form in which the lone pair PH_4^{+1} is absent. Due to the absence of lone pair in PH_4^{+1} there is no lone pair-bond pair repulsion. Hence, the bond angle in PH_4^{+1} is higher than that in PH_3.

Question 8: What happens when white phosphorus is heated with concentrated *NaOH* solution in an inert atmosphere of CO_2 ?

Solution 8: White phosphorous dissolves in boiling *NaOH* solution (in a CO_2 atmosphere) to give Phosphine, PH_3

$$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$$

Phosphine *Sodium hypophosphine*

Question 9: What happens when PCl_5 is heated?

Solution 9: $\xrightarrow{heat} PCl_3$ All ten bonds that are present in PCl_5 , are not similar. It has three equatorial and two axial bonds. The equatorial bonds are stronger than the axial ones. Therefore, when PCl_5 , is heated strongly, it decomposes to form PCl_3

Question 10: Write a balanced equation for the hydrolytic reaction of PCl_5 , in heavy water

Solution 10: $$PCl_5 + D_2O \longrightarrow POCl_3 + 2DCl_2$$

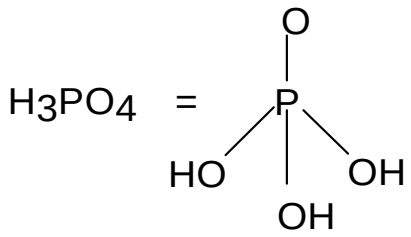
$$Cl_3 + 3D_3O \longrightarrow D_3PO_4 + 3DCl$$

Therefore, the net reaction can be written as

$$POCl_5 + 4D_3O \longrightarrow D_3PO_4 + 5DCl$$

Question 11: What is the basicity of H_3PO_4?

Solution 11: H_3PO_4



Since there are three replaceable OH groups present in, H_3PO_4 its basicity is three i.e., it is a tribasic acid.

Question 12: What happens when H_3PO_3 is heated?

Solution 12: H_3PO_3 , on heating, undergoes disproportionation reaction to form PH_3 and H_3PO_4 . The oxidation numbers of P in H_3PO_3, PH_3 and H_3PO_4 are +3, -3, and +5 respectively. As the oxidation number of the same element is decreasing and increasing during a particular reaction, the reaction is a disproportionation reaction

$$4\,H_3PO_3 \xrightarrow{\Delta} 3\,H_3PO_4 + PH_3$$

Orthophosphorous acid *Orthophosphoric acid* *Phosphine*

(+3) (+5) (-3)

Question 13: List the important sources of sulphur.

Solution 13: Sulphur mainly exists in combined form in the earth's Crust primarily as sulphates [gypsum ($CaSO_4, 2H_2O$) , Epsom salt ($MgSO_4, 7H_2O$), baryte blends (ZnS) copper pyrites ($CuFeS_2$) $BaSO_4$ and sulphides (galena (PbS) , zinc.

Question 14: Write the order of thermal stability of the hydrides of Group 16 elements.

Solution 14: The thermal stability of hydrides decreases on moving down the group. This is due to a decrease in the bond dissociation enthalpy (H-E) of hydrides on moving down the group.

Therefore, Thermal stability decreases $H_2O > H_2S > H_2Se > H_2Te > H_2Po$

Question 15: Why H_2O is a liquid and H_2S a gas?

Solution 15: H_2O has oxygen as the central atom. Oxygen has smaller size and electronegativity as compared to sulphur. Therefore, there is extensive hydrogen bonding in H_2O , which is absent in H_2S molecule. H_2S are held together only by weak Vander Waal's forces of attraction. Hence, H_2O exists as a liquid while H_2S as a gas.

Question 16: Which of the following does not react with oxygen directly?

Zn, Ti, Pt, Fe

Solution 16: Pt is a noble metal and does not react very easily. All other elements, Zn, Ti, Fe, are quite reactive. Hence, oxygen does not react with platinum (Pt) directly.

Question 19: How is O_3 estimated quantitatively?

Solution 19: Quantitatively, ozone can be estimated with the help of potassium iodide. When ozone is made to react with potassium iodide solution buffered with a borate buffer *pH* 9.2 , iodine is liberated. This liberated iodine can be titrated against a standard solution of sodium thiosulphate, using starch as an indicator. The reactions involved in the process are given below.

$$2I^- + O_3 \longrightarrow 2OH^- + I_2 + O_2$$

Iodide *Ozone* *Iodine*

$$I_2 + 2Na_2S_2O_2 \longrightarrow Na_2S_2O_6 + 2NaI$$

Sodium Thiosulphate *Sodium tetrathionate*

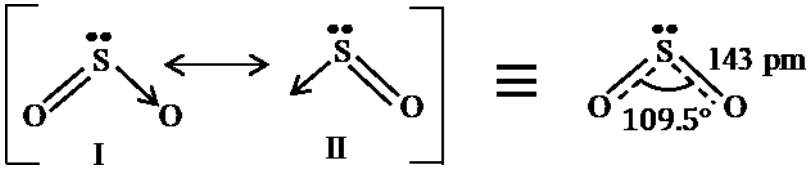
Question 20: What happens when sulphur dioxide is passed through an aqueous solution of *Fe* (*III*)

Solution 20: SO2 acts as a reducing agent when passed through an *Fe*(*III*) salt. Itaqueous solution containing reduces *Fe*(*III*) to *Fe*(*II*) i.e., ferric ions to ferrous ions.

$$2Fe^{3+} + SO_2 + 2H_2O \longrightarrow 2Fe^{2+} + SO_4^{2-} + 4H^{1+}$$

Question 21: Comment on the nature of two S-O bonds formed in SO_2 molecule. Are the two S-O bonds in this molecule equal?

Solution 21: The electronic configuration of S is $1s^2\ 2s^2\ 2p^2 3s^2 3\ p^4$, During the formation of SO_2, one electron from 3p orbital goes to the 3d orbital and S undergoes sp^2 hybridization. Two of these orbitals form sigma bonds with two oxygen atoms and the third contains a lone pair. p-orbital and d-orbital contain an unpaired electron each. One of these electrons forms pπ - pπ bond with one oxygen atom and the other forms pπ- dπ bond with the other molecule. This is the reason SO_2 hybrid of structures I and II. has a bent structure. Also, it is a resonance Both S-O bonds are equal in length (143 pm) and have a multiple bond character.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