CHAPTER

7 The *p*-Block Elements

CASE STUDY / PASSAGE BASED QUESTIONS

Syllabus

Group 15 Elements : General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen : preparation properties and uses; compounds of Nitrogen : preparation and properties of Ammonia and Nitric Acid.

Group 16 Elements : General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification of Oxides, Ozone, Sulphur- allotropic forms; compounds of Sulphur: preparation, properties and uses of Sulphur-dioxide, Sulphuric Acid: properties and uses; Oxoacids of Sulphur (Structures only).

Group 17 Elements : General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures only).

Group 18 Elements : General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

1

Read the passage given below and answer the following questions :

Under the normal conditions, noble gases are monoatomic and have closed shell electronic configuration. Lighter noble gases have low boiling points due to weak dispersion forces between the atoms and the absence of other interatomic interactions. Xenon, one of the important noble gas, forms a series of compounds with fluorine with oxidation number +2, +4 and +6. All xenon fluorides are strong oxidising agents. XeF_4 reacts violently with water to give XeO_3. The geometry of xenon compounds can be deduced by considering the total number of electron pairs in their valence shell.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Among noble gases (from He to Xe) only xenon reacts with fluorine to form stable xenon fluorides because xenon

(a) has the largest size

(b) has the lowest ionisation enthalpy

(c) has the highest heat of vapourisation

(d) is the most readily available noble gas.

(ii) The structure of XeO_3 is

(a) square planar (b) pyramidal (c) linear (d) T-shaped.

OR

XeF_6 is expected to be

(a) oxidising agent (b) reducing agent

(c) unreactive (d) strongly basic.

(iii) In the preparation of compound of xenon, Bartlett had taken $O_2^+PtF_6^-$ as a base compound. This is because

(a) both O_2 and Xe have same size

(b) both Xe and O_2 have same electron gain enthalpy

(c) both have almost same ionisation enthalpy

(d) both Xe and O_2 are gases.

(iv) The oxidation state of xenon in XeO_3 is

(a) +4 (b) +2 (c) +8 (d) +6

2

Read the passage given below and answer the following questions :

Interhalogen compounds are formed when halogen group elements react with each other. These are the compounds which consist of two or more different elements of group-17. A halogen with large size and low electronegativity reacts with an element of group-17 with small size and high electronegativity. As the ratio of radius of larger and smaller halogen increases, the number of atoms in a molecule also increases.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) The stability of interhalogen compounds follows the order

(a) $IF_3 > BrF_3 > ClF_3$ (b) $ClF_3 > BrF_3 > IF_3$

(c) $BrF_3 > IF_3 > ClF_3$ (d) $ClF_3 > IF_3 > BrF_3$

(ii) Identify the correct match from the following.

(a) $[ICl_2]^-$ – bent (b) IF_7 – pentagonal bipyramidal

(c) ClF_3 – trigonal planar (d) $[BrF_4]^-$ – square pyramidal

(iii) In XA_5, the central atom has (both *X* and *A* are halogens)

(a) 5 bond pairs and no lone pairs (b) 5 bond pairs and one lone pair

(c) 6 bond pairs and no lone pairs (d) 4 bond pairs and one lone pair.

(iv) In the known interhalogen compounds, the maximum number of atoms are

(a) 4 (b) 5

(c) 8 (d) 7

OR

Which of the following is not the characteristic of interhalogen compounds?

(a) They are more reactive than halogens

(b) They are quite unstable but none of them is explosive.

(c) They are covalent in nature.

(d) They have low boiling points and are highly volatile.

3

Read the passage given below and answer the following questions :

Noble gases are inert gases with general electronic configuration of ns^2np^6. These are monoatomic, colourless, odourless and tasteless gases. The first compound of noble gases was obtained by the reaction of Xe with PtF_6. A large number of compounds of Xe and fluorine have been prepared till now. The structure of these compounds can be explained on the basis of VSEPR theory as well as concept of hybridisation. The compounds of krypton are fewer. Only the difluoride of krypton (KrF_2) has been studied in detail. Compounds of radon have not isolated but only identified by radio tracer technique. However, no true compounds of helium, neon or argon are yet known.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) The formula of the compound when Xe and PtF_6 are mixed, is

(a) XeF_6 (b) XeF_4 (c) Xe_2PtF_6 (d) $Xe^+[PtF_6]^-$

OR

The shape and hybridisation of some xenon oxy-fluoride and fluoride compounds are given below. Find the incorrect one.

(a) $XeOF_2$ - T-shape - sp^3d (b) $XeOF_4$ - square pyramidal - sp^3d^2
(c) XeF_2 - linear - sp^3d (d) XeF_6 - square planar - dsp^2

(ii) Which of the following is not formed by Xe?
(a) XeF_5 (b) XeF (c) XeF_3 (d) All of these

(iii) The number of lone pairs and bond pairs of electrons around Xe in $XeOF_4$ respectively are
(a) 0 and 5 (b) 1 and 5 (c) 1 and 4 (d) 2 and 3

(iv) Which of the following compounds has more than one lone pair of electrons around central atom?
(a) XeO_3 (b) XeF_2 (c) $XeOF_4$ (d) XeO_2F_2

4

Read the passage given below and answer the following questions :

All the elements of group 16 have $ns^2\ np^4$ configuration in their outermost shell. Therefore, the atoms of these elements try to gain or share two electrons to achieve noble gas configuration. Sulphur and other elements of group 16 are less electronegative than oxygen, so, they cannot accept electrons easily. By sharing of two electrons with other elements, these elements acquire $ns^2\ np^6$ configuration and exhibit +2 oxidation state. Except oxygen, group 16 elements have vacant *d*-orbitals in their valence shell to which electrons can be promoted from *p*- and *s*-orbitals of the same shell. As a result, they can show +4 and +6 oxidation states also.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Oxygen shows +2 oxidation state in
(a) OF_2 (b) H_2O (c) Cl_2O (d) H_2O_2

(ii) Like sulphur, oxygen is not able to show +4 and +6 oxidation states because
(a) oxygen is a gas while sulphur is a solid
(b) sulphur has high ionisation enthalpy as compared to oxygen
(c) oxygen has no *d*-orbitals in its valence shell
(d) oxygen has high electron affinity as compared to sulphur.

OR

Compounds of sulphur with +4 oxidation state acts as a/an
(a) oxidising agent (b) reducing agent
(c) both oxidising as well as reducing agent (d) cannot be predicted.

(iii) Oxidation state of sulphur in $Na_2S_4O_6$ is
(a) 7/2 (b) 5/2 (c) 1/2 (d) 3/2

(iv) The oxidation states of sulphur in S_8, SO_3 and H_2S are respectively
(a) 0, +6 and –2 (b) +6, 0 and –2 (c) –2, 0 and +6 (d) +2, +6 and –2

5

Read the passage given below and answer the following questions :

Nitric acid reacts with most of the metals (except noble metals like gold and platinum) and non-metals. Towards its reaction with metals, HNO_3 acts as an acid as well as an oxidising agent. Like other acids, HNO_3 liberate nascent hydrogen from metals which further reduces the nitric acid into number of products like NO, NO_2, N_2O or NH_3. The different stages of reduction of nitric acid are :

$$\overset{+5}{HNO_3} \xrightarrow{+e^-} \overset{+4}{NO_2} \xrightarrow{+2e^-} \overset{+2}{NO} \xrightarrow[NaOH]{+e^-} \overset{+1}{N_2O} \xrightarrow{+4e^-} \overset{-3}{NH_3}$$

The product of the reduction of HNO_3 depends upon the nature of the metal, concentration of nitric acid and temperature.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Which of the following reactions is used to prepare laughing gas?

(a) $Pb + \text{dil. } HNO_3 \longrightarrow$ (b) $Hg + \text{dil. } HNO_3 \longrightarrow$

(c) $Zn + \text{dil. } HNO_3 \longrightarrow$ (d) $Cu + \text{dil. } HNO_3 \longrightarrow$

(ii) Gold and platinum does not dissolve in HNO_3 but soluble in 1 : 3 mixture of HNO_3 and HCl due to the formation of respectively

(a) $Au(NO_3)_2$, $[Pt(NO_3)_2]$ (b) $H[AuCl_4]$, $H_2[PtCl_6]$

(c) $[AuCl_6]^{2-}$, $[PtCl_2]^{2-}$ (d) $[Au(NO_3)_4]^+$, $[Pt(NO_3)_6]^{2-}$

(iii) Identify *B* in the following reaction.

$$Cu + HNO_{3(conc.)} \longrightarrow \underset{\text{Deep blue colour}}{(A)} + \underset{\text{Gas}}{(B)} + H_2O$$

(a) NO_2 (b) N_2 (c) NO (d) N_2O

(iv) In which of the following reactions HNO_3 will not act as an oxidising agent?

(a) $HNO_3 + H_2SO_4 \rightarrow$ (b) $HNO_3 + FeSO_4 + H_2SO_4 \rightarrow$

(c) $KI + HNO_3 \rightarrow$ (d) $Au + HNO_3 \rightarrow$

OR

When dil. HNO_3 reacts with Hg, which gas will liberate?

(a) N_2 (b) O_2 (c) NO (d) NO_2

6

Read the passage given below and answer the following questions :

Ozone is an unstable, dark blue diamagnetic gas. It absorbs the UV radiation strongly, thus protecting the people on earth from the harmful UV-radiation from the sun. The use of chlorofluorocarbon (CFC) in aerosol and refrigerators and their subsequent escape into the atmosphere, is blamed for making holes in the ozone layer over the Antarctica. Ozone acts as a strong oxidising agent in acidic and alkaline medium. For this property, ozone is used as a germicide and disinfectant for sterilizing water. It is also used in laboratory for the ozonolysis of organic compounds and in industry for the manufacture of potassium permanganate, artificial silk, etc.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Which of the following statements is not correct for ozone?

(a) It oxidises lead sulphide. (b) It oxidises potassium iodide.

(c) It oxidises mercury. (d) It cannot act as bleaching agent in dry state.

OR

Ozone gives carbonyl compounds with

(a) alkyl chloride

(b) alkanes

(c) alkenes followed by decomposition with Zn/H_2O

(d) alcohols followed by decomposition with Zn/H_2O.

(ii) Ozone reacts with moist iodine gives

(a) HI (b) HIO_3 (c) I_2O_5 (d) I_2O_4

(iii) Ozone acts as an oxidising agent due to

(a) liberation of nascent oxygen (b) liberation of oxygen gas

(c) both (a) and (b) (d) none of these.

(iv) The colour of ozone molecule is

(a) white (b) blue (c) pale green (d) pale yellow.

7

Read the passage given below and answer the following questions :

Chlorine is a greenish yellow gas with pungent and suffocating odour. With dry slaked lime, it gives bleaching powder. Bleaching powder is a mixture of calcium hypochlorite and basic calcium chloride : $[Ca(OCl)_2 \cdot CaCl_2 \cdot Ca(OH)_2 \cdot 2\,H_2O]$.

The amount of chlorine obtained from a sample of bleaching powder by the treatment with excess of dilute acids or CO_2 is called available chlorine. Chlorine is a powerful bleaching agent. Bleaching effect of chlorine is permanent.

The following questions are multiple choice questions. Choose the most appropriate answer :

(i) Chlorine gas reacts with _____ to form bleaching powder.

(a) $Ca(OH)_2$ (b) $CaCl_2$

(c) $CaSO_4$ (d) dry CaO

(ii) Chlorine reacts with cold and dilute alkali to form

(a) chloride (b) hypochlorite (c) chlorate (d) both (a) and (b)

OR

Which of the following is produced on the reaction of bleaching powder with a few drops of conc. HCl?

(a) Hypochlorous acid (b) Oxygen (c) Chlorine (d) Calcium oxide

(iii) Chlorine is used as a bleaching agent. The bleaching action is due to

(a) oxidation (b) chlorination (c) hydrogenation (d) reduction

(iv) Bleaching powder contains a salt of an oxoacid as one of its components. The anhydride of that oxoacid is

(a) Cl_2O (b) Cl_2O_7 (c) ClO_2 (d) Cl_2O_6

8

Read the passage given below and answer the following questions :

All the elements of group 16 form hydrides : H_2O, H_2S, H_2Se, H_2Te and H_2Po. All these hydrides have angular structure which involves sp^3 hybridisation of the central atom. All hydrides are volatile. The volatility increases from H_2O to H_2S and then decreases. All hydrides are weakly acidic in character. The increase in acidic character from H_2O to H_2Te is a result of the decrease in the 1 H–E (where E = O, S, Se, Te, Po) bond dissociation enthalpy from H_2O to H_2Te. All the hydrides except water are reducing agents. The reducing property of these hydrides increases from H_2S to H_2Te.

In these questions (Q.No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** Water has high boiling point.
Reason : Water molecules are associated with hydrogen bonding.

(ii) **Assertion :** H_2Te has less acidic character than H_2S.
Reason : Bond dissociation enthalpy of H—Te is less than H—S.

(iii) **Assertion :** Reducing nature of hydrides of group-16 elements increases as the atomic number of central atom increases.
Reason : Due to strong force of attraction of H – *E* bond.

(iv) **Assertion :** H_2O is the only hydrides of the chalcogens which is liquid.
Reason : In ice each O-atom is surrounded by 4H-atoms.

OR

Assertion : The thermal stability of the hydrides decreases as : $H_2O > H_2S > H_2Se > H_2Te$.
Reason : Due to increase in the size of central atom on going down the group.

9

Read the passage given below and answer the following questions :

The halogen elements show great resemblances to one another in their chemical behaviour and properties of their compounds with other elements. There is, however, a progressive change in properties from F through Cl, Br, and I to At. F is most reactive among the halogens and infact, from all other elements and it has certain other properties that set it apart from the other halogens.

In these questions (Q.No. i-iv), a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

(i) **Assertion :** F_2 has high reactivity.
Reason : F_2 has low bond dissociation enthalpy.

(ii) **Assertion :** The bond between F – F is weaker than between Cl – Cl.
Reason : Atomic size of F is smaller than that of Cl.

OR

Assertion : Fluoride does not show oxidation number greater than zero.
Reason : The halogens chlorine, bromine and iodine can show positive oxidation state of +1, +3 and +7.

(iii) **Assertion :** F atom has less negative electron affinity than Cl atom.
Reason : Additional electrons are repelled more effectively by 3*p*- electrons in Cl than by 2*p*- electrons in F atom.

(iv) **Assertion :** Fluorine is strongest oxidising agent in halogens.
Reason : It displaces other halogens from its aqueous solution.

ASSERTION & REASON

In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

(a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
(c) Assertion is correct statement but reason is wrong statement.
(d) Assertion is wrong statement but reason is correct statement.

10. **Assertion :** Nitrogen has higher ionization energy than that of oxygen.
Reason : Nitrogen has smaller atomic size than that of oxygen.

11. **Assertion :** Although PF_5, PCl_5 and PBr_5 are known, the pentahalides of nitrogen have not been observed.
Reason : Phosphorus has lower electronegativity than nitrogen.

12. **Assertion :** Sulphuric acid is more viscous than water.
Reason : Concentrated sulphuric acid has a great affinity for water.

13. **Assertion :** Among nitrogen halides NX_3, the dipole moment is highest for NI_3 and lowest for NF_3.
Reason : Nitrogen halides NX_3, have trigonal pyramidal structure.

14. **Assertion :** Among the hydrides of nitrogen family, BiH_3 has the highest boiling point.
Reason : The boiling point increases down the group because of increase in size.

15. **Assertion :** Nitrogen is unreactive at room temperature but becomes reactive at elevated temperatures or in presence of a catalyst.
Reason : In nitrogen molecule, there is extensive delocalization of electrons.

16. **Assertion :** NO_3^- is planar while NH_3 is pyramidal.
Reason : N in NO_3^- is sp^2 hybridized but in NH_3 it is sp^3 hybridized.

17. **Assertion :** Halogens are coloured.
Reason : Halogen molecules absorb some wavelength of visible light and the electrons are promoted to higher energy molecular orbitals.

18. **Assertion :** Ozone reacts with BaO_2 to give BaO.
Reason : Ozone acts as an oxidising agent in this reaction.

19. **Assertion :** Xenon forms fluorides.
Reason : Because 5*d*-orbitals are available for valence shell expansion.

20. **Assertion :** Cl_2 gas bleaches the articles permanently.
Reason : Cl_2 is a strong reducing agent.

21. **Assertion :** The m.pt./b.pt. of noble gases are quite high.
Reason : The interparticle forces among noble gases in their liquid state are weak van der Waals' forces.

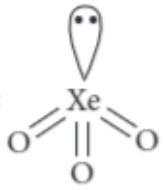
22. **Assertion :** HOF bond angle in HFO is higher than HOCl bond angle in HClO.
Reason : Oxygen is more electronegative than all halogens except fluorine.

23. **Assertion :** SF_6 cannot be hydrolysed but SF_4 can be.
Reason : Six F atoms in SF_6 prevent the attack of H_2O on sulphur atom of SF_6.

24. **Assertion :** Caro's acid has S atom in +6 oxidation state.
Reason : Caro's acid contains one peroxo O_2^{2-} group.

25. **Assertion :** Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2.
Reason : Oxygen forms $p\pi$-$p\pi$ multiple bond due to small size and small bond length but $p\pi$-$p\pi$ bonding is not possible in sulphur.

1. **(i) (b)**

(ii) (b):  (Pyramidal structure)

OR

(a) : All xenon fluorides are strong oxidising agents.

$$XeF_6 + H_2O \longrightarrow XeO_3 + 6HF$$

(iii) (c)

(iv) (d): $XeO_3 \Rightarrow x + (-2) \times 3 = 0 \Rightarrow x = +6$

2. **(i) (a):** Thermal stability decreases as the size difference or the electronegativity difference between the two halogen atoms decreases.

(ii) (b): $[ICl_2]^-$ – linear, ClF_3 – T-shaped, $[BrF_4]^-$ – Square planar

(iii) (b): It has square pyramidal shape and has 5 bond pairs and one lone pair.

(iv) (c) : In IF_7, iodine is the least electronegative halogen, so its highest oxidation number (+7) is more stable than those of the lighter member of the group.

OR

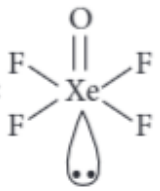
(d) : Some interhalogens are solids and are not volatile.

3. **(i) (d)**

OR

(d) : XeF_6 has sp^3d^3 hybridisation and distorted octahedral shape.

(ii) (d): Xe has completely filled 5*p* -orbital. As a result, when it undergoes bonding with an odd number (1, 3 or 5) of fluorine atoms, it leaves behind one unpaired electron. This causes the molecule to become unstable. As a result, XeF, XeF_3 and XeF_5 do not exist.

(iii) (b): 

(iv) (b): XeF_2 has 3 lone pairs on Xe atom.

4. **(i) (a):** As fluorine is more electronegative than oxygen, so, oxygen exhibits +2 oxidation state in OF_2.

(ii) (c)

OR

(c) : In SO_2, sulphur having +4 oxidation state, so it can lose its two more electrons to attain +6 oxidation state. It can gain electrons to attain its lowest oxidation state of –2. Therefore, it can behave as both reducing and oxidising agent.

(iii) (b): $Na_2S_4O_6 \Rightarrow 2(+1) + 4x + 6(-2) = 0 \Rightarrow x = 5/2$

(iv) (a)

5. **(i) (c):** $4Zn + 10HNO_3 \longrightarrow 4Zn(NO_3)_2 + 5H_2O + \underset{\text{Laughing gas}}{N_2O}$

(ii) (b): $Au + 3[Cl] \longrightarrow AuCl_3 \xrightarrow{HCl} H[AuCl_4]$ (From aqua regia)

$Pt + 4[Cl] \longrightarrow PtCl_4 \xrightarrow{HCl} H_2[PtCl_6]$ (From aqua regia)

(iii) (a): $Cu + 4HNO_{3(conc.)} \longrightarrow \underset{(A)}{Cu(NO_3)_2} + \underset{(B)}{2NO_2} + 2H_2O$

(iv) (a): $HNO_3 + H_2SO_4 \longrightarrow NO_2^+ + HSO_4^- + H_2O$

In this reaction HNO_3 is acting as OH^- donor and H_2SO_4 as H^+ donor. This is not a redox reaction.

OR

(c) : $6Hg + 8HNO_{3(dil.)} \longrightarrow 3Hg_2(NO_3)_2 + 2NO + 4H_2O$

6. **(i) (d)**

OR

(c) : Ozone reacts with alkenes to form ozonides which on hydrolysis or reduction gives carbonyl compounds.

(ii) (b): $I_2 + 5O_3 + H_2O \longrightarrow 2HIO_3 + 5O_2$

(iii) (a)

(iv) (b)

7. **(i) (a)**

(ii) (d) : In cold, chlorine reacts with dilute alkalies to form chlorides and hypochlorites.

OR

(c)

(iii) (a): $Cl_2 + H_2O \longrightarrow 2HCl + [O]$

(iv) (a): Bleaching powder contains OCl^- ion, hence the oxoacid is HOCl. Anhydride of HOCl is Cl_2O.

$$\begin{matrix} H \\ HO \end{matrix}\boxed{\begin{matrix} OCl \\ Cl \end{matrix}} \xrightarrow{-H_2O} Cl_2O$$

8. (i) (a): The high boiling point of water is due to the association of H_2O molecules through hydrogen bonding.

(ii) (d): H_2Te is more acidic than H_2S.

(iii) (c): Due to weakening of H–*E* bond as the bond length increases with increase of size of *E*-atom.

(iv) (b)

OR

(a)

9. (i) (a): Fluorine is most electronegative element and has low bond dissociation enthalpy.

(ii) (a): In F – F bond, due to smaller size of fluorine, e^-–e^- repulsion occur, so its bond strength is less.

OR

(b) : Fluorine is most electronegative element and can not exhibit any +ve oxidation state. Other halogens

OR

(d) : Some interhalogens are solids and are not volatile.

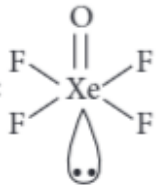
3. (i) (d)

OR

(d) : XeF_6 has sp^3d^3 hybridisation and distorted octahedral shape.

(ii) (d): Xe has completely filled 5*p* -orbital. As a result, when it undergoes bonding with an odd number (1, 3 or 5) of fluorine atoms, it leaves behind one unpaired electron. This causes the molecule to become unstable. As a result, XeF, XeF_3 and XeF_5 do not exist.

(iii) (b):



(iv) (b): XeF_2 has 3 lone pairs on Xe atom.

13. (b): In case of NI_3, the lone pair moment adds on the resultant of the N–I moments but in case of NF_3, the lone pair moment on N partly cancels the resultant N–F moments.

14. (a)

15. (b): Due to small size and high dissociation energy (946 KJ mol^{-1}) of nitrogen, it is unreactive.

16. (a)

17. (a)

18. (c): Ozone acts as a reducing agent in this reaction.

$BaO_2 + O_3 \longrightarrow BaO + 2O_2\uparrow$

19. (b): Xenon forms fluorides primarily because only fluorine and oxygen are electronegative enough to excite electron of xenon into its vacant 5*d*–orbitals and allow bonding.

20. (c): Cl_2 is an oxidising agent. It bleaches the articles by oxidation permanently in presence of moisture.

21. (d): The melting point/ boiling point of noble gases are quite low. The interparticle forces among noble gases are weak van der Waals' forces.

22. (d): HOF bond angle in HFO is lesser than

(iv) (a): $HNO_3 + H_2SO_4 \longrightarrow NO_2^+ + HSO_4^- + H_2O$

In this reaction HNO_3 is acting as OH^- donor and H_2SO_4 as H^+ donor. This is not a redox reaction.

OR

(c) : $6Hg + 8HNO_{3(dil.)} \longrightarrow 3Hg_2(NO_3)_2 + 2NO + 4H_2O$

6. (i) (d)

OR

(c) : Ozone reacts with alkenes to form ozonides which on hydrolysis or reduction gives carbonyl compounds.

(ii) (b): $I_2 + 5O_3 + H_2O \longrightarrow 2HIO_3 + 5O_2$

(iii) (a)

(iv) (b)

7. (i) (a)

(ii) (d) : In cold, chlorine reacts with dilute alkalies to form chlorides and hypochlorites.

OR

(c)

(iii) (a): $Cl_2 + H_2O \longrightarrow 2HCl + [O]$

(iv) (a): Bleaching powder contains OCl^- ion, hence the oxoacid is HOCl. Anhydride of HOCl is Cl_2O.

$$\begin{matrix} H\boxed{O}Cl \\ HO\boxed{Cl} \end{matrix} \xrightarrow{-H_2O} Cl_2O$$

8. (i) (a): The high boiling point of water is due to the association of H_2O molecules through hydrogen bonding.

(ii) (d): H_2Te is more acidic than H_2S.

(iii) (c): Due to weakening of H–*E* bond as the bond length increases with increase of size of *E*-atom.

(iv) (b)

OR

(a)

9. (i) (a): Fluorine is most electronegative element and has low bond dissociation enthalpy.

(ii) (a): In F – F bond, due to smaller size of fluorine, $e^- – e^-$ repulsion occur, so its bond strength is less.

OR

(b): Fluorine is most electronegative element and can not exhibit any +ve oxidation state. Other halogens have vacant *d*-orbitals.

(iii) (c): Additional electrons are repelled more effectively by 2*p*-electrons in F than by 3*p*- electrons in Cl atom.

(iv) (b): The electrode potential of F_2 is maximum while that of I_2 is minimum.

10. (c): $N(1s^2 2s^2 2p^3)$ has higher ionisation energy than $O(1s^2 2s^2 2p^4)$ due to stable half-filled configuration. Nitrogen has larger atomic size than oxygen.

11. (b): Nitrogen cannot expand its octet due to the non-availability of *d*-orbital.

12. (b): Molecules of sulphuric acid are associated due to large number of intermolecular hydrogen bonding.

13. (b): In case of NI_3, the lone pair moment adds on the resultant of the N–I moments but in case of NF_3, the lone pair moment on N partly cancels the resultant N–F moments.

14. (a)

15. (b): Due to small size and high dissociation energy (946 KJ mol^{-1}) of nitrogen, it is unreactive.

16. (a)

17. (a)

18. (c): Ozone acts as a reducing agent in this reaction.

$BaO_2 + O_3 \longrightarrow BaO + 2O_2\uparrow$

19. (b): Xenon forms fluorides primarily because only fluorine and oxygen are electronegative enough to excite electron of xenon into its vacant 5*d*–orbitals and allow bonding.

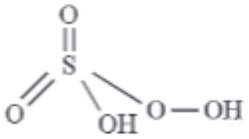
20. (c): Cl_2 is an oxidising agent. It bleaches the articles by oxidation permanently in presence of moisture.

21. (d): The melting point/ boiling point of noble gases are quite low. The interparticle forces among noble gases are weak van der Waals' forces.

22. (d): HOF bond angle in HFO is lesser than that of HOCl bond angle in HClO. Oxygen is more electronegative than all halogens except fluorine.

23. (a)

24. (a): This can be explained through structure of caro's acid (peroxomonosulphuric acid).



Oxidation no. of S = *x*, oxidation no. of H = + 1,
Oxidation no. of O in peroxo linkage = –1 (each),
Oxidation no. of other oxygen atoms = –2 (each).

$2 + x - 6 - 2 = 0$ or $x = +6$.

25. (a)