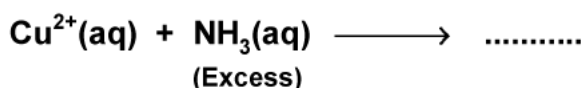


- Q1. Why does $R_3P = O$ exist but $R_3N = O$ does not? (R = alkyl group)
- Q2. Account for the following: BiH_3 is the strongest reducing agent amongst all the hydrides of group 15.
- Q3. Give reason: Nitrogen does not form pentahalide.
- Q4. Arrange the following in the increasing order of property mentioned:
 $NH_3, PH_3, AsH_3, SbH_3, BiH_3$ (Base strength)
- Q5. Arrange the following group of substances in the order of the property indicated against each group:
 $NH_3, PH_3, AsH_3, SbH_3, BiH_3$ – increasing order of boiling points.
- Q6. Arrange the following in the increasing order of their basic character:
 $NH_3, PH_3, AsH_3, SbH_3, BiH_3$.
- Q7. Account for the following: PCl_5 is known but NCl_5 is not known.
- Q8. Account for the following: Bi is a strong oxidizing agent in the +5 state.
- Q9. Why is the single N — N bond weaker than the single P — P bond?
- Q10. Give reasons for the following: $(CH_3)_3P = O$ exists but $(CH_3)_3N = O$ does not.
- Q11. Why is NH_3 more basic than PH_3 ?
- Q12. Explain the following observations: The molecules NH_3 and NF_3 have dipole moments which are of opposite direction.
- Q13. Bismuth is a strong oxidising agent in the pentavalent state. Explain.
- Q14. Account for the following: NF_3 is an exothermic compound but NCl_3 is an endothermic compound.
- Q15. Account for the following: Nitrogen is found in gaseous state.
- Q16. Though nitrogen exhibits +5 oxidation state, it does not form pentahalide. Why?
- Q17. Explain the following: $BiCl_3$ is more stable than $BiCl_2$.
- Q18. Give reasons for the following: PH_3 has lower boiling point than NH_3 .
- Q19. Why is nitrogen gas very unreactive?
- Q20. Assign reasons for the following: NF_3 is an exothermic compound whereas NCl_3 is not.
- Q21. Account for the following: $BiCl_3$ is less covalent than PCl_3 .

- Q22. Explain the following: +3 oxidation state becomes more and more stable from As to Bi in the group.
- Q23. Draw the structure of the following molecule: NF_3 .
- Q24. Account for the following: Tendency to form pentahalides decreases down the group in group 15 of the periodic table.
- Q25. Why is BiH_3 the strongest reducing agent amongst all the hydrides of group 15 elements?
- Q26. Explain the following observation: Phosphorus has greater tendency for catenation than nitrogen.
- Q27. Answer the following: Of Bi(V) and Sb(V) which may be a stronger oxidising agent and why?
- Q28. Why is the bond angle in PH_3 molecule lesser than that in NH_3 molecule?
- Q29. Give reasons for the following observation: The basic character of the hydrides of group 15 elements decreases with increasing atomic numbers.
- Q30. Explain the following observation: Ammonia has a higher boiling point than phosphine.
- Q31. Why is red phosphorus, less reactive than white phosphorus?
- Q32. Explain the following observation: Phosphorus is much more reactive than nitrogen.
- Q33. Account for the following: NH_3 is a stronger base than PH_3 .
- Q34. Why Bi(V) stronger oxidant than Sb(V)?
- Q35. Account for the following: NH_3 is clearly basic while PH_3 is only feebly basic.
- Q36. Why are pentahalides of a metal more covalent than its trihalides?
- Q37. Explain the following observations giving appropriate reasons: The stability of +5 oxidation state decreases down the group in group 15 of the periodic table.
- Q38. Account for the following: Bond angle in NH_4^+ is higher than NH_3 .
- Q39. On adding NaOH to ammonium sulphate, a colourless gas with pungent odour is evolved which forms a blue coloured complex with Cu^{2+} ion. Identify the gas.
- Q40. Write the reaction of thermal decomposition of sodium azide.
- Q41. Give reasons for the following: N_2 is less reactive at room temperature.
- Q42. PH_3 has lower boiling point than NH_3 . Why?
- Q43. Why is dinitrogen very unreactive as compared to phosphorus?
- Q44. Nitrogen does not form any pentahalide like phosphorus. Why?
- Q45. Assign reasons for the following: Ammonia (NH_3) has greater affinity for protons than phosphine (PH_3).
- Q46. Complete the following chemical equation:



Q47. Complete the following chemical equation:



Q48. Mention the optimum conditions for the industrial manufacture of ammonia by Haber's process.

Q49. Why does NH_3 act as a Lewis base?

Q50. What happens when ammonium chloride is treated with Ca(OH)_2 ?

Q51. Why does NO_2 dimerise?

Q52. Draw the structures of the following compounds: N_2O_5 .

Q53. $\text{Pb(NO}_3)_2$ on heating gives a brown gas which undergoes dimerisation on cooling? Identify the gas.

Q54. Write balanced equation when ammonia is dissolved in water.

Q55. How does ammonia react with a solution of Cu^{2+} ?

Q56. Describe the favourable conditions for the manufacture of ammonia by Haber's process.

Q57. Write the structural difference between white phosphorus and red phosphorus.

Q58. Which allotrope of phosphorus is more reactive and why?

Q59. Explain the following observations: In the structure of HNO_3 , the N — O bond (121 pm) is shorter than N — OH bond (140 pm).

Q60. Explain the following situations: In the structure of HNO_3 , the N — O bond (121 pm) is shorter than N — OH bond (140 pm).

Q61. Complete the following chemical equations: $\text{I}_2 + \text{HNO}_3(\text{Conc.}) \longrightarrow$

Q62. Complete the following chemical reaction equations: $\text{Cu} + \text{HNO}_3(\text{dilute}) \longrightarrow$

Q63. Draw structures of the following species: NO_3^- .

Q64. State reasons for the following: The N — O bond in NO_2^- is shorter than the N — O bond in NO_3^- .

Q65. Give reason: Nitric oxide becomes brown when released in air.

Q66. Explain the following: The bond angles (O — N — O) are not of the same value in NO_2^- and NO_2^+ .

Q67. Explain the following: NO_2 readily forms a dimer.

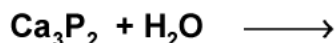
Q68. What is the covalency of nitrogen in N_2O_5 ?

Q69. Using VSEPR theory predict the probable structure of the following: N_2O_3 .

Q70. Complete the following chemical reaction equation:



Q71. Complete the following chemical reaction equation:



Q72. Complete the following chemical reaction equation:



Q73. Explain the following giving appropriate reasons: Red phosphorus is less reactive than white phosphorus.

Q74. White phosphorus is more reactive than red phosphorus.

Q75. Complete the following equations: $\text{P}_4 + \text{H}_2\text{O} \longrightarrow$.

Q76. Draw the structure of the following: Red P_4 .

Q77. Draw the structure of $\text{PCl}_5(\text{s})$ molecule.

Q78. Draw the structure of each of the following: Solid PCl_5 .

Q79. Complete the following equations:



Q80. Account for the following: PCl_5 is more covalent than PCl_3 .

Q81. Account for the following: Solid PCl_5 is more ionic nature.

Q82. Suggest a possible reason for the following observations: In the solid state, PCl_5 behaves as an ionic species.

Q83. Explain the following observations: PCl_5 acts as an oxidising agent.

Q84. Account for the following: PCl_5 acts as an oxidising agent.

Q85. Explain the following observations: All the bonds in PCl_5 molecule are not equivalent.

Q86. Which one of PCl_4^+ and PCl_4^- is not likely to exist and why?

Q87. Why does PCl_3 fume in moisture?

Q88. What happens when PCl_5 is heated?

Q89. Complete the following chemical equations:



Q90. Draw the structure of the following molecules: $(\text{HPO}_3)_3$.

Q91. What happens when H_3PO_3 is heated? Write the reactions involved.

Q92. What is the basicity of H_3PO_3 ?

Q93. H_3PO_2 is a stronger reducing agent than H_3PO_3 .

Q94. Draw the structure of the following:



- Q95. What is the basicity of H_2PO_4 ?
- Q96. Arrange the following in the increasing order of property mentioned:
 H_3PO_3 , H_2PO_4 , H_3PO_2 Reducing character)
- Q97. Why does PCl_5 fume in moisture? Give reaction.
- Q98. Assign a reason for each for the following statements: All the bonds in PCl_5 are not equal in length.
- Q99. Account for the following: There is large difference between the melting and boiling points of oxygen and sulphur.
- Q100 Give reasons: SO_2 is reducing while TeO_2 is an oxidising agent.
- Q101 Write chemical equations for the following for the following processes: orthophosphorus acid is heated.
- Q102 Write a reaction to show the reducing behaviour of H_3PO_2 .
- Q103 What is the basicity of H_3PO_2 acid and why?
- Q104 Draw the structure of H_3PO_2 molecule.
- Q105 Account for the following: H_3PO_2 has reducing nature.
- Q106 Draw the structure of the following molecule: H_3PO_3 .
- Q107 Arrange the following in the order of property indicated against each set: H_2O , H_2S , H_2Se , H_2Te – increasing acidic character.
- Q108 Elements of group 16 generally show lower value of first ionization enthalpy compared to the corresponding elements of group 15. Why?
- Q109 Why is dioxygen a gas but sulphur a solid?
- Q110 Give reasons for the following: H_2Te is the strongest reducing agent amongst all the hydrides of group 16 elements.
- Q111 Give reasons for the following: Oxygen has less electron gain enthalpy with negative sign than sulphur.
- Q112 Arrange the following group of substances in the order of the property indicated against the group: O, S, Se Te – increasing order of electron gain enthalpy with negative sign.
- Q113 Account for the following: SF_6 is inert towards hydrolysis.
- Q114 Account for the following: H_2S is less acidic than H_2Te .
- Q115 Account for the following: Oxygen shows catenation behaviour less than sulphur.
- Q116 Assign reasons for the following: Sulphur has a greater tendency for catenation than oxygen.
- Q117 Assign reasons for the following: SF_6 is more acidic than H_2O .
- Q118 Assign reasons for the following: SF_6 is kinetically inert.

Q119 Give reasons for the following: OF_6 compound is not known.

Q120 Explain the following situations: SF_4 is easily hydrolysed whereas SF_6 is not easily hydrolysed.

Q121 How would you account for the following? The value of electron gain enthalpy with negative sign for sulphur is higher than that for oxygen.

Q122 Account for the following: Elements of group 16 generally show lower value of first ionisation enthalpy compared to the elements in the corresponding periods of group 15.

Q123 State reason for the following: SF_6 is kinetically an inert substance.

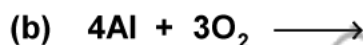
Q124 Account for the following: Thermal stability of water is much higher than that of H_2S .

Q125 Explain the following observation: Oxygen is a gas but sulphur is a solid.

Q126 Account for the following: Boiling point of water is much higher than that of hydrogen sulphide.

Q127 How are the supersonic jet aeroplanes responsible for the depletion of ozone layers?

Q128 Complete the following reactions:



Q129 Ozone is thermodynamically unstable?

Q130 Assign a reason for each of the following statements: The electron gain enthalpy with negative sign for oxygen (-141 kJ mol^{-1}) is less than that for sulphur (-200 kJ mol^{-1}).

Q131 Assign reasons for the following: SF_6 is much less reactive than SF_4 .

Q132 Draw the structures of the following molecule: SF_4 .

Q133 Give reason for the following observations: Sulphur exhibits tendency for catenation but oxygen does not do so.

Q134 Predict the shape and the asked angle (90° or more or less) in the following case: SO_3^{2-} and the angle $\text{O} - \text{S} - \text{O}$.

Q135 What happens when sulphur dioxide reacts with chlorine in the presence of charcoal?

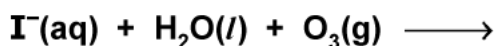
Q136 What happens when: SO_2 gas is passed through an aqueous solution of F^{3+} salt?

Q137 Draw the structure of the following: S_8 .

Q138 Account for the following: Sulphur in vapour form exhibits paramagnetic behaviour.

Q139 Which allotrope of sulphur is thermally stable at room temperature?

Q140 Complete the following chemical reaction equations:



Q141 Draw the structure of O_3 molecule.

Q142 Account for the following: The two oxygen-oxygen bond lengths in ozone (O_3) molecule are same.

Q143 Account for the following: O_3 acts as a powerful oxidising agent.

Q144 Account for the following: The two O — O bond lengths in the ozone molecule are equal.

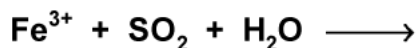
Q145 Draw the structure of the following: H_2SO_4 .

Q146 Write the structure of the following molecule: H_2SO_3 .

Q147 Excess of SO_2 reacts with sodium hydroxide solution.

Q148 Why are the two S — O bonds in SO_2 molecule of equal strength?

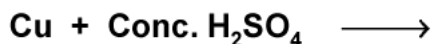
Q149 Complete the following chemical equation:



Q150 What happens when sulphur dioxide gas is passed through an aqueous solution of a Fe (III) salt?

Q151 Draw the structure of the following $H_2S_2O_8$.

Q152 Complete the following equation:



Q153 Write the conditions to maximize the yield of H_2SO_4 by Contact process.

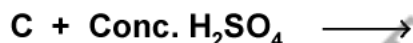
Q154 Write the structure of the following species: H_2SO_5 .

Q155 Draw the structure of the following molecule: $H_2S_2O_7$.

Q156 Complete the following equation:



Q157 Complete the following equation:



Q158 Why is $K_{a_2} \ll K_{a_1}$ for H_2SO_4 in water?

Q159 Assign reasons for the following: HCl is a stronger acid than HF though fluorine is more electronegative than chlorine.

Q160 Assign reasons for the following: HCl is a stronger acid than HF though fluorine is more electronegative than chlorine.

Q161 Why is F_2 a stronger oxidising agent than Cl_2 ?

Q162 Arrange the following groups of substances in the order of the property indicated against each group: F_2 , Cl_2 , Br_2 , I_2 – increasing order of bond dissociation enthalpy.

Q163 Arrange the following in the order of property indicated against each set: HF, HCl, HBr, HI – increasing bond dissociation enthalpy.

Q164 F_2 has lower bond dissociation enthalpy than Cl_2 . Why?

Q165 Account for the following: Acidic character increases from HF to HI.

Q166 Complete the following equation:



Q167 Why are halogens coloured?

Q168 Answer the following: Why are halogens strong oxidising agents?

Q169 How would you account for the following? Halogens are strong oxidizing agents.

Q170 Account for the following: Electron gain enthalpy with negative sign for fluorine is less than that for chlorine.

Q171 Arrange HF, HCl, HBr and HI in the order of increasing acid strength.

Q172 Account for the following: F_2 is a stronger oxidising agent than Cl_2 .

Q173 Explain giving reason for the following situation. In aqueous medium HCl is stronger acid than HF.

Q174 Give reason: Bond dissociation energy of F_2 is less than that of Cl_2 .

Q175 Despite having greater polarity, hydrogen fluoride boils at a lower temperature than water.

Q176 Explain the following observations. Despite lower value of its electron gain enthalpy with negative sign, fluorine (F_2) is a stronger oxidising agent than Cl_2 .

Q177 Account for the following: HF is not stored in glass bottles but is kept in wax-coated bottles.

Q178 HF is a weaker acid than HCl. Why ?

Q179 Account for the following: Fluorine does not exhibit positive oxidation state.

Q180 Suggest a possible reason for the following observations: Fluorine forms the largest number of interhalogen compounds amongst the halogens.

Q181 Explain the following observation: Hydrogen fluoride has a much higher boiling point than hydrogen chloride.

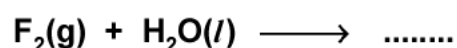
Q182 Account for the following: Fluorine always exhibits an oxidation state of -1 only in its compounds.

Q183 Explain the following: The electron gain enthalpy with negative sign for fluorine is less than that for chlorine, still fluorine is a stronger oxidising agent than chlorine.

Q184 Fluorine exhibits only -1 oxidation state in its compounds whereas other halogens exhibit many other oxidation states. Why?

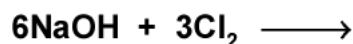
Q185 Assign reasons for the following: The negative value of electron gain enthalpy of fluorine is less than that of chlorine.

Q186 Complete the following chemical equation:



Q187 Give reasons for the following observation: Hydrogen iodide is a stronger acid than hydrogen fluoride in aqueous solution.

Q188 Complete this reaction:

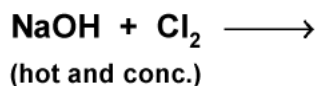


Q189 Complete the following reaction equation:



Q190 Account for the following: Chlorine water loses its yellow colour on standing.

Q191 Complete the following chemical equation:



Q192 Account for the following: Bleaching of flowers by Cl_2 is permanent while that of SO_2 is temporary?

Q193 Name two poisonous gases which can be prepared from chlorine gas.

Q194 Write balanced equation for the following reactions: Chlorine reacts with dry slaked lime.

Q195 Account for the following: Fluorine does not form oxoacids.

Q196 Draw the structures of the following: HClO_4 .

Q197 Account for the following: HClO_4 is stronger acid than HClO .

Q198 Account for the following: Fluorine forms only one oxoacid HOF .

Q199 Iron dissolves in HCl to form FeCl_2 and not FeCl_3 .

Q200 Write the balanced chemical equation for the reaction of Cl_2 with hot and conc. NaOH solution. Justify that this reaction is a disproportionation reaction.

Q201 Complete the following reaction equation:



Q202 Write the formula and describe the structure of noble gas species which is isostructural with BrO_3^- .

Q203 Draw the structures of the following BrF_3 .

Q204 Draw the structures of the following: ClF_3 .

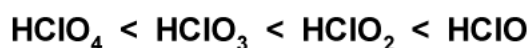
Q205 Give reasons : ICl is more reactive than I_2 .

Q206 Draw the structure of BrF_5 .

Q207 Answer the following: Which neutral molecule would be isoelectronic with ClO^- ?

Q208 Draw the structure of the following: HClO_3 .

Q209 How would you account for the following: The oxidising power of oxoacids of chlorine follows the order



Q210 Arrange HClO_3 , HClO_2 , HClO and HClO_4 in order of increasing acid strength. Give reason for your answer.

Q211 Account for the following: BrCl_3 is more stable than BrCl .

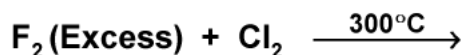
Q212 Why is ICl more reactive than I_2 ?

Q213 Predict the shape and the asked angle (90° or more or less) in each of the following cases.

ClF_3 and the angle $\text{F} - \text{Cl} - \text{F}$.

Q214 F_2 is more reactive than ClF_2 but ClF_3 is more reactive than Cl_2 .

Q215 Complete the following chemical equation:



Q216 Answer the following: Why does fluorine not play the role of a central atom in interhalogen compounds?

Q217 Draw the structure of the following: XeO_3 .

Q218 Draw the structures of the following: XeF_2 .

Q219 Give reasons for the following: Helium is used in diving apparatus as a diluent for oxygen.

Q220 Write the structures of the following molecule: XeOF_4 .

Q221 What happens when XeF_4 reacts with SbF_5 ?

Q222 Draw the structure of XeF_4 .

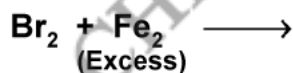
Q223 How are interhalogen compounds formulated and how are they prepared?

Q224 Give one use of ClF_3 .

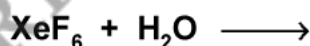
Q225 Fluorine never acts as the central atom in polyatomic interhalogen compounds.

Q226 ClF_3 molecule has a T-shaped structure and not a trigonal planar one.

Q227 Complete the following chemical equations:



Q228 Complete the following chemical reaction equation:

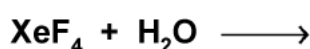


Q229 Account for the following: Helium is used in diving apparatus.

Q230 Draw the structures of the following molecules: XeF_6 .

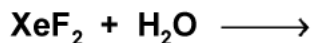
Q231 What inspired N. Bartlett for carrying out reaction between Xe and PtF_6 ?

Q232 Complete the following chemical reaction equation:



Q233 Account for the following: Unlike xenon, no distinct chemical compound of helium is known.

Q234 Complete the following equation:



Q235 Complete the following equation:



Q236 Explain the following: XeF_2 is linear molecule without a bend.

Q237 Complete the following reaction equation:



Q238 Noble gases have low boiling points. Why?

Q239 Explain the following observations: Helium forms no real chemical compound.

Q240 Predict the shape and asked angle (90° or more or less) in each of the following case.

XeF_2 and the angle $\text{F} - \text{Xe} - \text{F}$.

Q241 Explain the following observations: The majority of known noble gas compounds are those of Xenon.

Q242 Explain the following situations: XeF_2 has a straight linear structure and not a bent angular structure.

Q243 Write balanced chemical equations for the following reaction : XeF_6 is hydrolysed.

Q244 Why do some noble gases form compounds with fluorine and oxygen only?

Q245 List the uses of neon and argon gases.

Q246 Draw the structures of XeF_4 and predict their shapes.

Q247 Assign reasons for the following: Of the noble gases only xenon is known to form well-established chemical compounds.

Q248 Write the chemical equation for the following process: PtF_6 and xenon are mixed together

Q249 Complete the following reaction:



Q250 How is ammonia prepared on the large scale? Name the process and mention the optimum conditions for the production of ammonia by this process.

Q251 Give reasons for the following:

- Oxygen molecule has the formula O_2 while sulphur is S_8 .
- H_2S is less acidic than H_2Te .

Q252 Account for the following:

- H_2S has lower boiling point than H_2O .
- Reducing character decreases from SO_2 to TeO_2 .

Q253 Name the two most important allotropes of sulphur. Which one of the two is stable at room temperature? What happens when the stable form is heated about 270 K ?

Q254 With the help of chemical equation explain the principle of Contact process in brief for the manufacture of sulphuric acid by Contact process.

Q255 Draw the structure of (a) Hypochlorous acid, (b) Chlorous acid.

Q256 How are interhalogen compounds formed? What general compositions can be assigned to them?

Q257 Mr. Rakesh, a chemistry teacher, observed some suspicious movements in his neighbourhood people and one day he saw packets of ammonium nitrate in their hand. As a chemistry teacher he knew that ammonium nitrate is used in explosives. He immediately informed the police about this. Police immediately took the required action and caught them with 3 kg of ammonium nitrate which they were using in explosives. Comment in brief.

- About the value/s displayed by Mr. Rakesh.
- Name of gas evolved on heating ammonium nitrate. Write the chemical reaction.
- Write two uses of ammonium nitrate.

Q258 Describe the following about halogens (Group 17 elements):

- Relative oxidising power of halogens.
- Relative acidic strength of the hydrogen halides.

Q259 Arrange the following in order property indicated for each set.

- F_2, Cl_2, Br_2, I_2 increasing bond dissociation enthalpy.
- HF, HCl, HBr, HI increasing acid strength

Q260 Compare the oxidizing action of F_2 and Cl_2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.

Q261 With the help of chemical equations explain the principle of contact process in brief for the manufacture of sulphuric acid. (No diagram is required.)

Q262 Describe the conditions and the steps involved in the manufacture of sulphuric acid by Contact process. Write the necessary reactions. (No diagram is required.)

Q263 Describe the contact process for the manufacture of sulphuric acid with special reference to the reaction conditions, catalysts used and yield in the process.

Q264 Draw the structure of (a) H_2SO_3 , (b) H_2SO_4 , (c) $H_2S_2O_7$.

Q265 Complete the following reactions:



Q266 (a) How does xenon atom form compounds even though the xenon atom has a closed shell electronic configuration?

(b) Draw the structure of $XeOF_4$.

(c) Complete and balance the following equation : $XeF_4 + H_2O \longrightarrow$

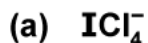
Q267 Draw structure of (a) $XeOF_4$ (b) XeO_3 .

Q268 Explain the following:

(a) Xenon does not form such fluorides as XeF_3 and XeF_5 .

(b) Out of noble gases, only Xenon is known to form real chemical compounds.

Q269 Write the formulae and the structure of noble gas species which are isostructural with



Q270 How is XeO_3 obtained? Write the related chemical equations. Draw the structure of XeO_3 .

Q271 How is ammonia manufactured industrially? Draw flow chart for the manufacture of ammonia. Give any two uses.

Q272(a) How is sulphur dioxide prepared in:

(i) Laboratory?

(ii) Industrially?

(b) What happens when sulphur dioxide is passed through water and reacts with sodium hydroxide? Write balanced equation.

(c) Write its any two uses.

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- S1.** $R_3N=O$ molecule has five covalent bonds with N atom. The octet in N cannot be extended as it does not have d -orbitals for the formation of $p\pi-d\pi$ bond.

In the case of $R_3P=O$, P can extend its octet since it has empty d -orbitals in its valence shell and form $p\pi-d\pi$ bond.

- S2.** Among hydrides of group-15 elements, the bond length increases from N — H to Bi — H with increasing size of element. Bi — H bond is longest and weakest, it can break more easily and evolve H_2 gas which acts as the reducing agent.

- S3.** Nitrogen can not expand its octet due to absence of d -orbitals.

- S4.** Increasing (Lewis) base strength order is:



The reason for this order is that as we move from NH_3 to BiH_3 , the size of the central atom increases. Hence lone pair is not easily available for donation. The electron density on the central atom decreases on moving from NH_3 to BiH_3 and so the basic strength also decreases.

- S5.** $PH_3 < AsH_3 < NH_3 < SbH_3 < BiH_3$

The abnormally high boiling point of NH_3 is due to the intramolecular H-bonding. Further as we move from PH_3 to BiH_3 the molecular mass increasing. As a result, the van der Waal's forces of attraction increase and the boiling points increase regularly from PH_3 to BiH_3 .

- S6.** Increasing (Lewis) base strength order is:



The reason for this order is that as we move from NH_3 to BiH_3 , the size of the central atom increases. Hence lone pair is not easily available for donation. The electron density on the central atom decreases on moving from NH_3 to BiH_3 and so the basic strength also decreases.

- S7.** Nitrogen cannot expand its valency beyond 4 due to absence of d -orbitals whereas phosphorus show pentavalency due to presence of d -orbitals.

- S8.** On moving down the group, the stability of +5 oxidation state decreases while +3 oxidation state increases due to inert pair effect.

Thusm +5 oxidation state of Bi is less stable and Bi(V) is a stronger oxidising agent.

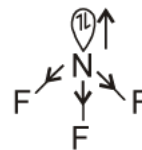
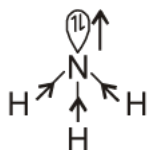
- S9.** The single N — N bond is weaker than the single P — P bond because of high interelectronic repulsion of the non-bonding electrons, occurring due to the small bond length.

- S10.** $R_3N=O$ molecule has five covalent bonds with N atom. The octet in N cannot be extended as it does not have d -orbitals for the formation of $p\pi-d\pi$ bond.

In the case of $R_3P=O$, P can extend its octet since it has empty d -orbitals in its valence shell and form $p\pi-d\pi$ bond.

S11. Lewis basic nature of Nature of NH_3 and PH_3 molecules is due to the presence of lone pairs on N and Bi atoms, respectively. P atom is much larger than N atom and also has empty d -orbitals. Electron density due to lone pair on P gets diffused because of the presence of d -orbitals and so the lone pair is not easily available for donation Hence PH_3 is less basic than NH_3 .

S12.



In NH_3 the bond moment and lone pair moment work in same direction. Hence, net dipole moment is higher.

In NF_3 the bond moment and lone pair moment work in opposite direction. Hence, net dipole moment is lower.

S13. On moving down the group, the stability of +5 oxidation state decreases while +3 oxidation state increases due to inert pair effect.

Thusm +5 oxidation state of Bi is less stable and Bi(V) is a stronger oxidising agent.

S14. In case of nitrogen, only NF_3 is known to be stable. N — F bond strength is greater than F — F bond strength, therefore, formation of NF_3 is spontaneous. In case of NCl_3 , N — Cl bond strength is lesser than Cl — Cl bond strength. Thus, energy has to be supplied during the formation of NCl_3 .

S15. Nitrogen exists as a diatomic molecule with a triple bond between two atoms. These N_2 molecules are held together by weak van der Waals force of attraction which can be easily broken by the collision of the molecules at room temperature. Therefore, N_2 is a gas at room temperature.

S16. Nitrogen can not expand its octet due to absence of d -orbitals.

S17. BiCl_3 is more stable than BiCl_5 . On moving down the group, the stability of +5 oxidation state decreases while +3 oxidation state increases due to inert pair effect.

S18. Unlike NH_3 , PH_3 molecules are not associated through hydrogen bonding in liquid state. Therefore, the boiling point of PH_3 is lower than NH_3 .

S19. The bond dissociation enthalpy of triple bond in $\text{N} \equiv \text{N}$ is very high due to $p\pi - p\pi$ overlap. Hence N_2 is less reactive at room temperature.

S20. In case of nitrogen, only NF_3 is known to be stable. N — F bond strength is greater than F — F bond strength, therefore, formation of NF_3 is spontaneous. In case of NCl_3 , N — Cl bond strength is lesser than Cl — Cl bond strength. Thus, energy has to be supplied during the formation of NCl_3 .

S21. BiCl_3 is less covalent than PCl_3 because the size of Bi^{3+} is much larger than P^{3+} (According to Fajan's rule).

S22. On moving down the group, the stability of +5 oxidation state decreases while that of +3 oxidation state increases due to inert pair effect.

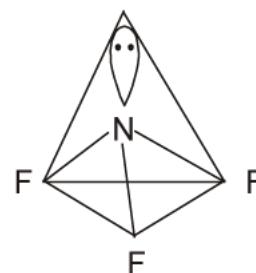
S23. Total no. of electrons around the central N atom = 5

No. of bond pairs = 3

No. of lone pairs = 1

Hybridisation = sp^3

Therefore, according to VSEPR theory; NF_3 should be pyramidal.

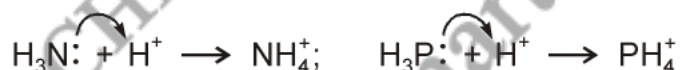


- S24.** Due to inert pair effect the stability of +5 oxidation state decreases down the group in group-15. Hence tendency to form pentahalide decreases down the group-15 of the periodic table.
- S25.** Among hydrides of group-15 elements, the bond length increases from N — H to Bi — H with increasing size of element. Bi — H bond is longest and weakest, it can break more easily and evolve H₂ gas which acts as the reducing agent.
- S26.** The property of catenation depends upon the strength of the element – element bond. Since, P — P (213 kJ mol⁻¹) bond strength is much more than N — N (159 kJ mol⁻¹) bond strength so, phosphorus shows marked catenation properties than nitrogen.
- S27.** On moving down the group, the stability of +5 oxidation state decreases while +3 oxidation state increases due to inert pair effect. Thus, +5 oxidation state of Bi is less stable than +5 oxidation state of Sb. Therefore, Bi(V) is a stronger oxidising agent than Sb(V).
- S28.** The bond angle in PH₃ is much lower [93.6°] than that in NH₃ [107.8°] due to less repulsion between bond pairs.
- S29.** Increasing (Lewis) base strength order is:



The reason for this order is that as we move from NH₃ to BiH₃, the size of the central atom increases. Hence lone pair is not easily available for donation. The electron density on the central atom decreases on moving from NH₃ to BiH₃ and so the basic strength also decreases.

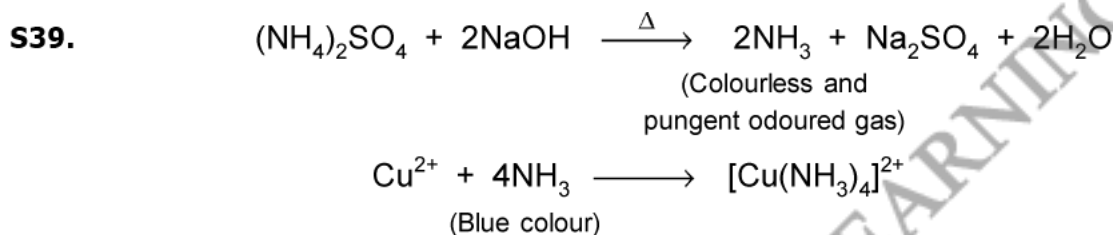
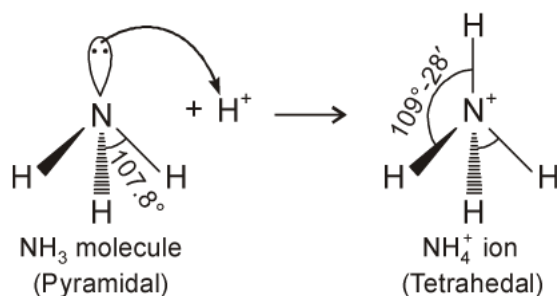
- S30.** NH₃ molecules are held together by strong inter molecular hydrogen bonds whereas PH₃ molecules are held together by weak van der Waals bonds. Thus, NH₃ has a higher boiling point than PH₃.
- S31.** White phosphorus is more reactive than red phosphorus under normal conditions because of angular strain in the P₄ molecule where the angles are only 60°.
- S32.** Since nitrogen forms triple bond between the two N-atoms and the phosphorus forms single bond between two P-atoms, bond dissociation energy of nitrogen (941.5 kJ mol⁻¹) is larger than the bond dissociation energy of phosphorus (213 kJ mol⁻¹). Hence, phosphorus is much more reactive than nitrogen.
- S33.** Due to presence of a lone pair of electrons on N and P, both NH₃ and PH₃ act as Lewis bases and accept a proton to form an additional N — H and P — H bonds respectively



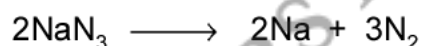
However, due to smaller size of N over P, N — H bond thus formed is much stronger than the P — H bond. Therefore, NH₃ has higher proton affinity than PH₃. In other words, NH₃ is more basic than PH₃.

- S34.** On moving down the group, the stability of +5 oxidation state decreases while +3 oxidation state increases due to inert pair effect. Thus, +5 oxidation state of Bi is less stable than +5 oxidation state of Sb. Therefore, Bi(V) is a stronger oxidising agent than Sb(V).
- S35.** Lewis basic nature of Nature of NH₃ and PH₃ molecules is due to the presence of lone pairs on N and Bi atoms, respectively. P atom is much larger than N atom and also has empty *d*-orbitals. Electron density due to lone pair on P gets diffused because of the presence of *d*-orbitals and so the lone pair is not easily available for donation Hence PH₃ is less basic than NH₃.

- S36.** In +5 oxidation state charge/radius ratio is higher than that in +3 oxidation state. Hence, +5 oxidation state has more polarising power than that of +3 oxidation state and pentahalides (in O.S. +5) are more covalent than trihalides.
- S37.** Due to inert pair effect the stability of +5 oxidation state decreases down the group in group-15. Hence tendency to form pentahalide decreases down the group-15 of the periodic table.
- S38.** N in NH_3 is sp^3 -hybridized. It has three bond pairs and one lone pair around N. Due to stronger lone pair-bond repulsions than bond pair-bond pair repulsions. The tetrahedral angle decreases from $109^\circ - 28'$ to 107.8° . As a result, NH_3 is pyramidal. However, when it reacts with a proton, it forms NH_4^+ ion which has four bond pairs and no lone pair. Due to the absence of lone pair-bond pair repulsions and presence of four identical bond pair-bond pair interaction, NH_4^+ assumes tetrahedral geometry with a bond angle of $109^\circ - 28'$. This explains why the bond angle in NH_4^+ is higher than in NH_3 .



- S40.** Thermal decomposition of sodium azide gives nitrogen gas.



- S41.** In N_2 molecule N atoms are held by triple bonds. It has very high bond dissociation energy ($941.4 \text{ kJ mol}^{-1}$). Therefore N_2 is inert at room temperature.

- S42.** NH_3 molecules are held together by strong inter molecular hydrogen bonds whereas PH_3 molecules are held together by weak van der Waals bonds. Thus, NH_3 has a higher boiling point than PH_3 .

- S43.** Bond dissociation enthalpy of N_2 molecule is very high ($941.4 \text{ kJ mol}^{-1}$) and so is least reactive at normal temperature and remains inert even in atmosphere.

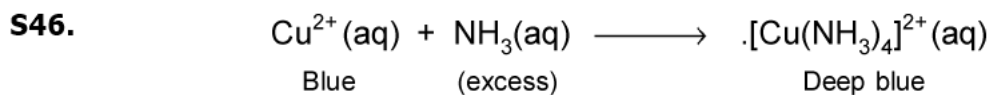
Yellow phosphorus exists as P_4 molecule with a tetrahedral shape. The P — P — P bond angle is about 60° because of which the molecule is under tremendous strain and so phosphorus is reactive.

- S44.** Nitrogen cannot expand its valency beyond 4 due to absence of d -orbitals whereas phosphorus show pentavalency due to presence of d -orbitals.

- S45.** PH_3 and NH_3 both are Lewis bases, since they have a lone pair of electrons on 'N' and 'P' atom respectively.



Because size of P is larger than N atom, therefore N atom carries more negative charge density than carried by P. Hence, NH_3 has more proton affinity than PH_3 .



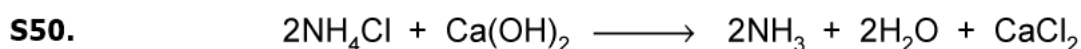
S48. Optimum conditions for the production of ammonia are:

Temperature = -700 K

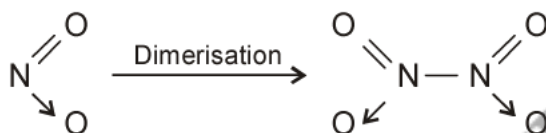
Pressure = About 200 atm ($200 \times 10^5 \text{ Pa}$)

Catalyst = Iron oxide with small amounts of K_2O and Al_2O_3 (as promoters).

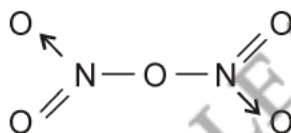
S49. NH_3 has a lone pair of electrons on the N-atom which it can donate to an electron acceptor. Hence, NH_3 acts as a Lewis base.



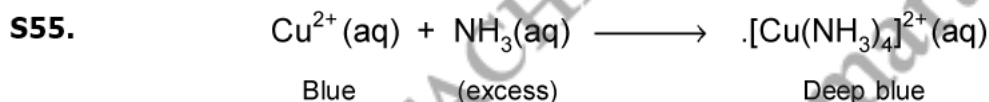
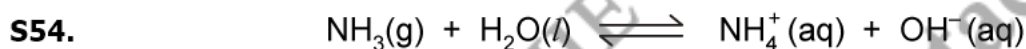
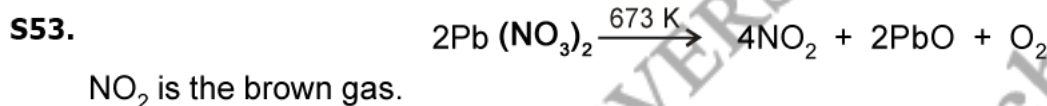
S51. Because NO_2 contains odd number of valence electrons and on dimerisation, it is converted to stable N_2O_4 molecule with even number of electrons.



S52. The structure of N_2O_5 is



Covalence of nitrogen in $\text{N}_2\text{O}_5 = 4$



S56. Optimum conditions for the production of ammonia are:

Temperature = -700 K

Pressure = About 200 atm ($200 \times 10^5 \text{ Pa}$)

Catalyst = Iron oxide with small amounts of K_2O and Al_2O_3 (as promoters).

S57. White phosphorus consists of discrete tetrahedral P_4 molecule.

Red phosphorus is polymeric, consisting of chains of P_4 tetrahedra linked together.

S58. White phosphorus is most reactive of all the allotropes because it is unstable due to the angular strain on P_4 molecule with bond angle of 60° .

S59. HNO_3 is supposed to exist in two resonating forms. Due to two resonating structures, $\text{N} - \text{O}$ bond is shorter than $\text{N} - \text{OH}$ bond.

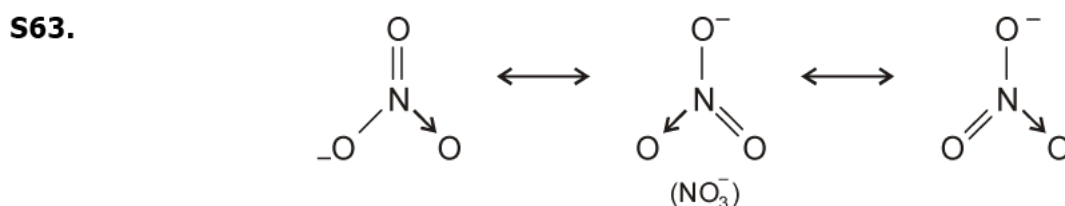


S60. HNO_3 is supposed to exist in two resonating forms. Due to two resonating structures, $\text{N} - \text{O}$ bond is shorter than $\text{N} - \text{OH}$ bond.

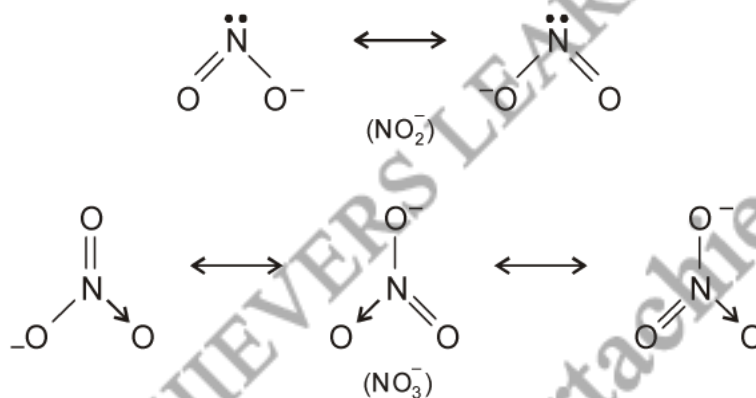


S61. $\text{I}_2 + 10\text{HNO}_3(\text{conc.}) \longrightarrow 2\text{HIO}_3 + 10\text{NO}_2 + 4\text{H}_2\text{O}$

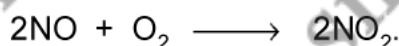
S62. $3\text{Cu} + 8\text{HNO}_3(\text{dilute}) \longrightarrow 3\text{Cu}(\text{NO}_3)_2 + 2\text{NO} + 4\text{H}_2\text{O}$



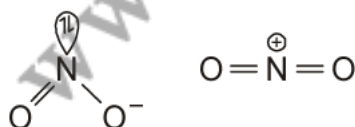
S64. In NO_2^- , the average $\text{N} - \text{O}$ bond order is 1.5 due to two resonating structures whereas in NO_3^- , the average $\text{N} - \text{O}$ bond order is 1.33 due to three resonating structures. Higher the bond order, shorter is the bond length.



S65. Nitric oxide forms brown fumes of nitrogen dioxide (NO_2) instantaneously in the presence of air.

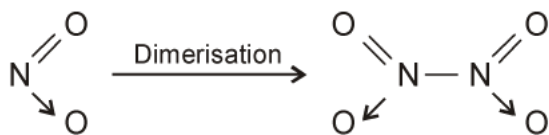


S66. In NO_2^- 'N' atom has sp^2 -hybridisation whereas in NO_2^+ , 'N' atom has sp -hybridisation.

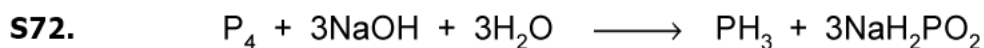
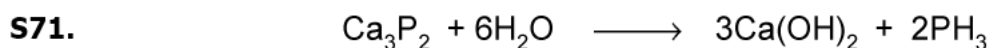
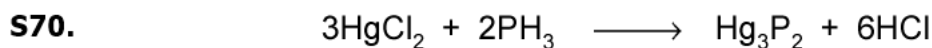
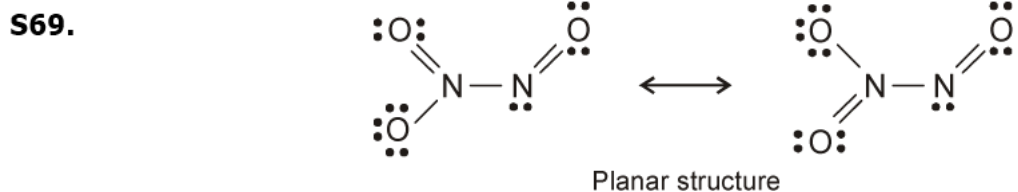
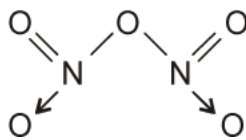


Hence, bond angles are not of the same value.

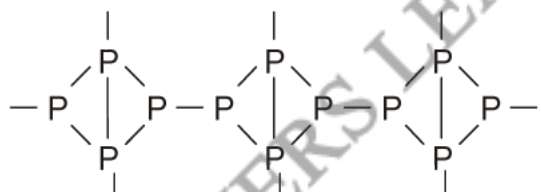
S67. Because NO_2 contains odd number of valence electrons and on dimerisation, it is converted to stable N_2O_4 molecule with even number of electrons.



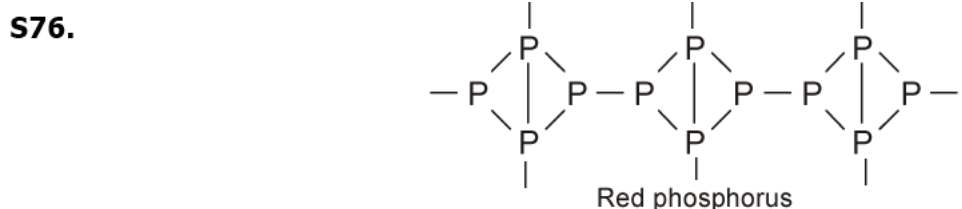
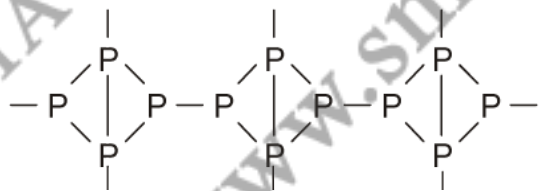
S68. In N_2O_5 covalence of nitrogen is four.



S73. White phosphorus consists of discrete P_4 molecules in which each phosphorus atom is tetrahedrally bonded to other three phosphorus atoms, So, white phosphorus is highly reactive. In red phosphorus, P_4 molecules are linked in an extended chain structure. So, red phosphorus is much less reactive.

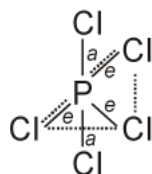


S74. White phosphorus consists of discrete P_4 molecules in which each phosphorus atom is tetrahedrally bonded to other three phosphorus atoms, So, white phosphorus is highly reactive. In red phosphorus, P_4 molecules are linked in an extended chain structure. So, red phosphorus is much less reactive.



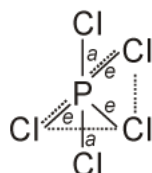
White phosphorus is more reactive due to its discrete tetrahedral structure and angular strain.

S77.



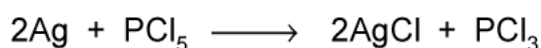
In PCl_5 , there are three equatorial and two axial bonds present. Since, three equatorial bonds are repelled by two bond pairs and two axial bonds are repelled by two bond pairs and two axial bonds are repelled by three bond pairs so, axial bonds are weaker and longer than the equatorial bonds.

S78.



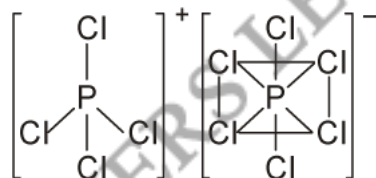
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S79.

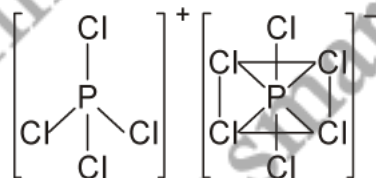


S80. In +5 oxidation state charge/radius ratio is higher than that in +3 oxidation state. Hence, +5 oxidation state has more polarising power than that of +3 oxidation state and pentahalides (in O.S. +5) are more covalent than trihalides.

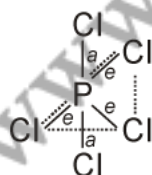
S81. Phosphorus pentachloride is a salt containing the tetrahedral cation $[\text{PCl}_4]^+$ and the octahedral anion $[\text{PCl}_6]^-$ therefore, it is ionic in solid state.



S82. Phosphorus pentachloride is a salt containing the tetrahedral cation $[\text{PCl}_4]^+$ and the octahedral anion $[\text{PCl}_6]^-$ therefore, it is ionic in solid state.



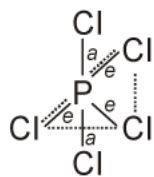
S83.



In PCl_5 , there are three equatorial and two axial bonds present. Since, three equatorial bonds are repelled by two bond pairs and two axial bonds are repelled by two bond pairs and two axial bonds are repelled by three bond pairs so, axial bonds are weaker and longer than the equatorial bonds.

S84. The oxidation state of phosphorus in PCl_5 is +5. As P has five electrons in its valence shell, it cannot increase its oxidation state beyond +5 by donating electrons. It can decrease its oxidation number from +5 to +3 or some lower value. So, PCl_5 acts as an oxidising agent.

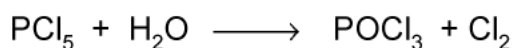
S85.



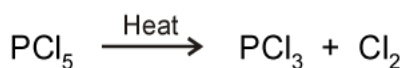
In PCl_5 , there are three equatorial and two axial bonds present. Since, three equatorial bonds are repelled by two bond pairs and two axial bonds are repelled by two bond pairs and two axial bonds are repelled by three bond pairs so, axial bonds are weaker and longer than the equatorial bonds.

S86. PCl_4^+ because PCl_3 cannot form bond with Cl^- ions.

S87. PCl_5 hydrolyses in the presence of moisture giving fumes of HCl.



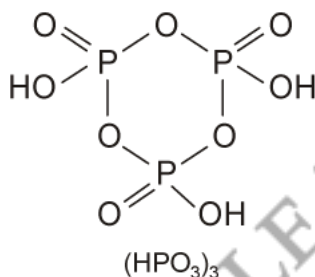
S88.



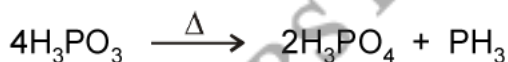
S89.



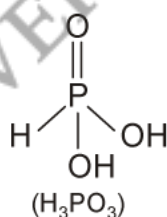
S90.



S91.



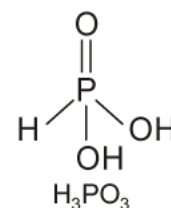
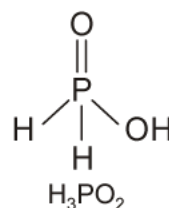
S92.



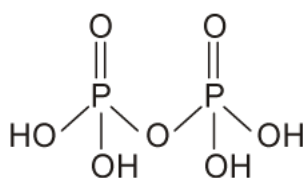
Orthophosphorous acid

It is dibasic due to the presence of two replaceable hydrogen atoms.

S93. The acids which contain P — H bond, have strong reducing properties. Hypophosphorous acid (H_3PO_2) contains two P — H bonds, whereas orthophosphorous acid (H_3PO_3) has one P — H bond. Hence, H_3PO_2 is stronger reducing agent than H_2PO_3 .

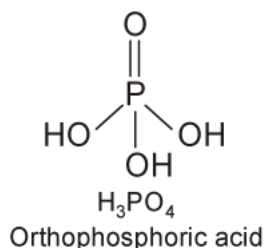


S94.



Structure of pyrophosphoric acid

S95. Basicity of oxoacids of P is equal to the number of P — OH bonds in the molecule.



It is tribasic due to the presence of three replaceable hydrogen atoms.

S96. Reducing character of oxyacids of phosphorus depends on the number of P — H bonds. More the number of P — H bonds in oxyacid, more is the reducing character. H_3PO_2 has two P — H bonds, H_3PO_3 has one P — H bond and H_3PO_4 has no P — H bond. Thus, order of reducing character is $\text{H}_3\text{PO}_2 > \text{H}_3\text{PO}_3 > \text{H}_3\text{PO}_4$.

S97. PCl_5 hydrolyses in the presence of moisture giving fumes of HCl.



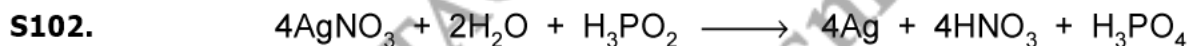
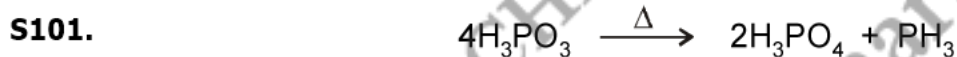
S98.



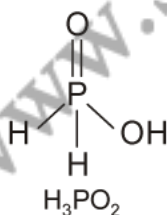
In PCl_5 , there are three equatorial and two axial bonds present. Since, three equatorial bonds are repelled by two bond pairs and two axial bonds are repelled by two bond pairs and two axial bonds are repelled by three bond pairs so, axial bonds are weaker and longer than the equatorial bonds.

S99. Oxygen molecules are held together by weak van der Waal's forces because of the small size and high electronegativity of oxygen. Sulphur shows catenation and the molecule is made up of 8 atoms with strong intermolecular forces. Hence, there is large difference in the melting and boiling points of oxygen and sulphur.

S100. The +6 oxidation state of S is more stable than +4 therefore, SO_2 acts as a reducing agent. Further, since the stability of +6 oxidation decreases from S to Te therefore, the reducing character of the dioxides decreases while their oxidising character increases. Thus, TeO_2 acts as an oxidising agent.

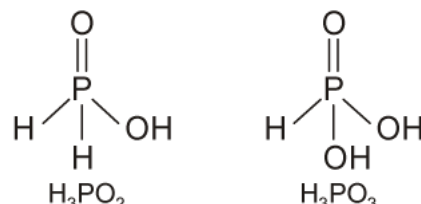


S103.

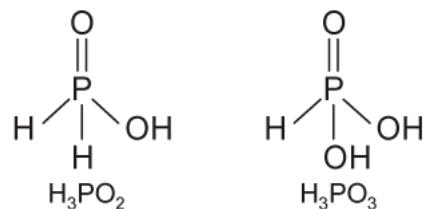


It is monobasic acid due to the presence of one replaceable hydrogen.

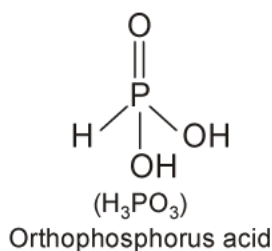
S104. The acids which contain P — H bond, have strong reducing properties. Hypophosphorus acid (H_3PO_2) contains two P — H bonds, whereas orthophosphorus acid (H_3PO_3) has one P — H bond. Hence, H_3PO_2 is stronger reducing agent than H_3PO_3 .



S105. The acids which contain P — H bond, have strong reducing properties. Hypophosphorus acid (H_3PO_2) contains two P — H bonds, whereas orthophosphorus acid (H_3PO_3) has one P — H bond. Hence, H_3PO_2 is stronger reducing agent than H_2PO_3 .

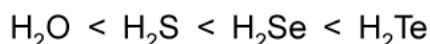


S106.



It is dibasic due to the presence of two replaceable hydrogen atoms.

S107.



As the atomic size increases down the group, the bond length increases and hence, the bond strength decreases. Consequently, the cleavage of $E - \text{H}$ bond. ($E = \text{O}, \text{S}, \text{Se}, \text{Te}$ etc.) becomes easier. As a result, the tendency to release hydrogen as proton increases *i.e.*, acidic strength increases down the group.

S108. The first ionization enthalpy of group-16 elements is lower than those of group-15 elements despite their smaller atomic radii and higher nuclear charge. This is due to the relatively symmetrical and more stable configuration of the elements of group-15 as compared to those of the elements of group-16.

S109. O_2 molecules are held together by weak van der Waal's forces because of the small size and high electronegativity of oxygen.

Sulphur shows catenation and the molecule is made up of eight atoms, (S_8) with strong intermolecular attractive forces. Hence, sulphur exists as solid at room temperature.

S110. Bond dissociation enthalpy and hence thermal stability of hydrides decreases from H_2O to H_2Te . Therefore, H_2Te releases hydrogen readily. Hence, H_2Te is the strongest reducing agent amongst all the hydrides of group 16.

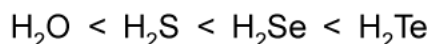
S111. The electron gain enthalpy of oxygen is less negative than sulphur. This is due to its small size. As a result of which the electron-electron repulsion in the relatively small $2p$ -subshell are comparatively larger and hence the incoming electrons are not accepted with same ease as in case of other (sulphur) elements of this group.

S112. Electron gain enthalpy of oxygen is less negative than sulphur due to compact size of oxygen atom (inert-electronic repulsion is more in O). From sulphur onwards enthalpy again becomes less negative upto P.



S113. In SF_6 , S atom is sterically protected by six F atoms and does not allow any reagent to attack on the S atom. Due to these reasons, SF_6 is kinetically an inert substance.

S114.



As the atomic size increases down the group, the bond length increases and hence, the bond strength decreases. Consequently, the cleavage of $E - \text{H}$ bond. ($E = \text{O}, \text{S}, \text{Se}, \text{Te}$ etc.) becomes easier. As a result, the tendency to release hydrogen as proton increases *i.e.*, acidic strength increases down the group.

S115. The property of catenation depends upon $E - E$ bond strength of the element. As $S - S$ bond is much stronger (213 kJ mol^{-1}) than $O - O$ bond (138 kJ mol^{-1}), sulphur has greater tendency for catenation than oxygen.

S116. The property of catenation depends upon $E - E$ bond strength of the element. As $S - S$ bond is much stronger (213 kJ mol^{-1}) than $O - O$ bond (138 kJ mol^{-1}), sulphur has greater tendency for catenation than oxygen.

S117. $\text{H}_2\text{O} < \text{H}_2\text{S} < \text{H}_2\text{Se} < \text{H}_2\text{Te}$

As the atomic size increases down the group, the bond length increases and hence, the bond strength decreases. Consequently, the cleavage of $E - H$ bond. ($E = \text{O, S, Se, Te}$ etc.) becomes easier. As a result, the tendency to release hydrogen as proton increases *i.e.*, acidic strength increases down the group.

S118. In SF_6 , S atom is sterically protected by six F atoms and does not allow any reagent to attack on the S atom. Due to these reasons, SF_6 is kinetically an inert substance.

S119. OF_6 compound is not known because oxygen cannot expand its octet due to unavailability of d -orbital.

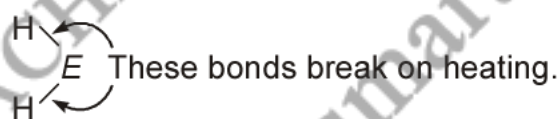
S120. In SF_6 , six F atoms protect the sulphur atom from attack by the reagent to such an extent that even thermodynamically most favourable reactions like hydrolysis do not occur. But in SF_4 , S is not sterically protected as it is surrounded by only four F atoms hence, SF_4 is reactive.

S121. The electron gain enthalpy of oxygen is less negative than sulphur. This is due to its small size. As a result of which the electron-electron repulsion in the relatively small $2p$ -subshell are comparatively larger and hence the incoming electrons are not accepted with same ease as in case of other (sulphur) elements of this group.

S122. The first ionization enthalpy of group-16 elements is lower than those of group-15 elements despite their smaller atomic radii and higher nuclear charge. This is due to the relatively symmetrical and more stable configuration of the elements of group-15 as compared to those of the elements of group-16.

S123. In SF_6 , S atom is sterically protected by six F atoms and does not allow any reagent to attack on the S atom. Due to these reasons, SF_6 is kinetically an inert substance.

S124. The thermal stability of the hydrides decrease from H_2O to H_2Te . This is because as the size of central element increases, the bond $E - H$ become weaker and thus breaks on heating.



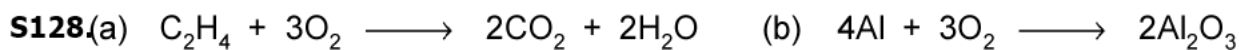
S125. O_2 molecules are held together by weak van der Waal's forces because of the small size and high electronegativity of oxygen.

Sulphur shows catenation and the molecule is made up of eight atoms, (S_8) with strong intermolecular attractive forces. Hence, sulphur exists as solid at room temperature.

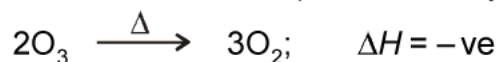
S126. H_2O H_2S
Boiling point $373 \text{ K} > 213 \text{ K}$

The abnormally high boiling point of H_2O is due to strong intermolecular H-bonding. Since, all other elements have much lower electronegativity than oxygen, they do not undergo H-bonding.

S127. Nitrogen oxide emitted from the exhausts of supersonic jet aeroplanes readily combines with ozone to form nitrogen dioxide and diatomic oxygen. Since, supersonic jets fly in the stratosphere near the ozone layer, they are responsible for the depletion of ozone layer.



S129. Ozone is thermodynamically unstable and decomposes into oxygen.

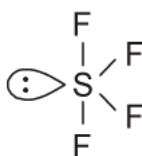


The above conversion is exothermic *i.e.*, ΔH is negative. Also, entropy increases *i.e.*, $\Delta S = +ve$. Thus, ΔG for the decomposition of ozone is negative. Hence, it is thermodynamically unstable.

S130. The electron gain enthalpy of oxygen is less negative than sulphur. This is due to its small size. As a result of which the electron-electron repulsion in the relatively small $2p$ -subshell are comparatively larger and hence the incoming electrons are not accepted with same ease as in case of other (sulphur) elements of this group.

S131. In SF_6 , six F atoms protect the sulphur atom from attack by the reagent to such an extent that even thermodynamically most favourable reactions like hydrolysis do not occur. But in SF_4 , S is not sterically protected as it is surrounded by only four F atoms hence, SF_4 is reactive.

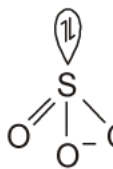
S132.



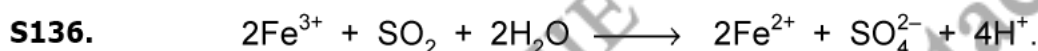
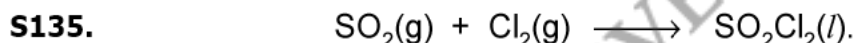
SF_4 is a gas with sp^3d -hybridisation and has trigonal bipyramidal geometry and see-saw structure due to the presence of lone pair of electrons in equatorial positions.

S133. The property of catenation depends upon $E-E$ bond strength of the element. As $S-S$ bond is much stronger (213 kJ mol^{-1}) than $O-O$ bond (138 kJ mol^{-1}), sulphur has greater tendency for catenation than oxygen.

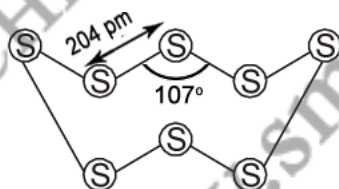
S134.



Shape: Pyramidal $O-S-O$ angle $> 90^\circ$.



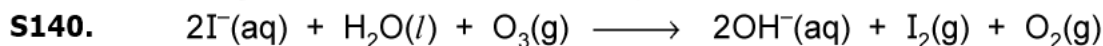
S137.



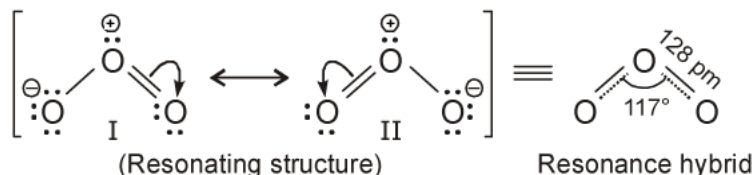
Structure of S_8

S138. At elevated temperature, sulphur vapour exists as S_2 molecules which are paramagnetic like O_2 .

S139. Rhombic sulphur.



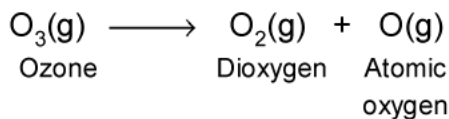
S141.



S142. The two O — O bond lengths in the ozone molecule are equal as it is a resonance hybrid of two main forms:



S143. Ozone is a powerful oxidising agent because ozone has higher energy content than dioxygen hence, decompose to give dioxygen and atomic oxygen.

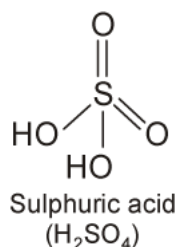


The atomic oxygen thus liberated brings about the oxidation while molecular oxygen is set free.

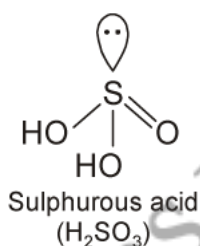
S144. The two O — O bond lengths in the ozone molecule are equal as it is a resonance hybrid of two main forms:



S145.



S146.



S147.



S148.

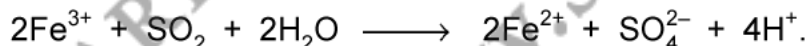


Due to resonance, the two π-bonds are equal (143 pm) and are of equal strength.

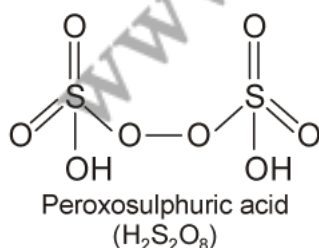
S149.



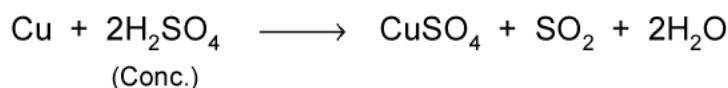
S150.



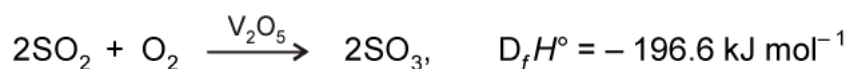
S151.



S152.



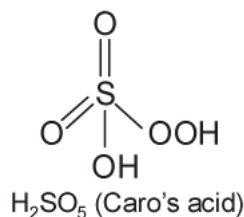
S153 In contact process, the rate determining step is



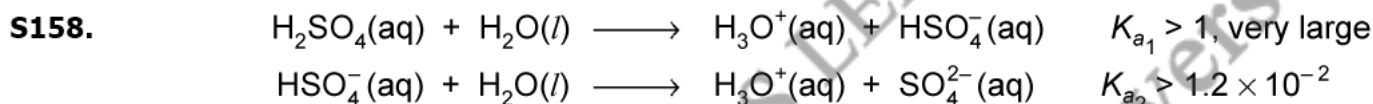
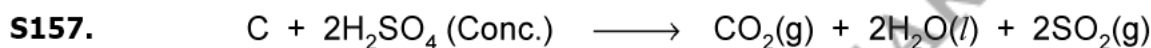
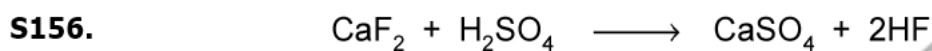
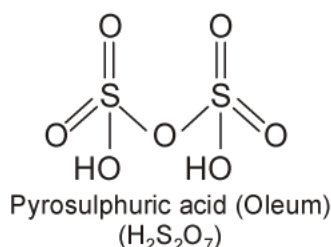
This reaction is reversible and exothermic i.e., DH is negative. Thus, according to Le-Chatelier's principle, the conditions to maximise the yield are as follows:

- (a) **At lower temperature:** As heat is evolved in the reaction so, at lower temperature the reaction proceeds more in forward direction.
- (b) **At higher pressure:** As three moles of gaseous reactants give two moles of gaseous products thus, at higher pressure reaction moves in forward direction.

S154.



S155.

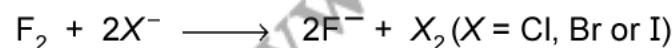


K_{a_2} is smaller than K_{a_1} because dissociation of HSO_4^- is less probable due to presence of negative charge on the ion.

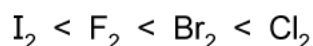
S159 Since, fluorine is the most electronegative element, it shows only a negative oxidation state of -1 , and does not show any positive oxidation state.

S160 HF is the weakest acid because of its high bond dissociation energy due to small size of fluorine atom.

S161 Fluorine is the strongest oxidising agent as it accept electron easily. It oxidise other halide ions in solution or even in solid phase.



S162 Increasing bond dissociation enthalpy order is

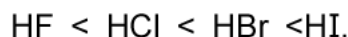


Bond dissociation enthalpy of F_2 is less than that of Br_2 and Cl_2 due to the lone pair-lone pair repulsions.

S163 $\text{HI} < \text{HBr} < \text{HCl} < \text{HF}$.

S164 F_2 has lower bond dissociation enthalpy than Cl_2 because F atom is very small and hence the electron-electron repulsions between the lone pairs of electrons are very large.

S165 The acidic strength of the hydrohalic acids in the order:



This order is a result of bond dissociation enthalpies of $\text{H}-\text{X}$ bond decreases from $\text{H}-\text{F}$ to $\text{H}-\text{I}$ as the size of halogen atom increases.

S166. $\text{SO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{S}_2\text{O}_7$

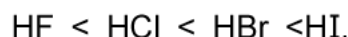
S167 Halogens absorb radiations in visible region which results in excitation of outer electrons to higher level resulting in different colours.

S168 General electronic configuration of halogens is ns^2np^5 . They easily accept one electron to complete their octet. This makes them a good oxidising agent.

S169 General electronic configuration of halogens is ns^2np^5 . They easily accept one electron to complete their octet. This makes them a good oxidising agent.

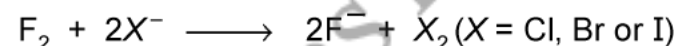
S170 The electron gain enthalpy of fluorine is less negative than that of chlorine due to the small size of fluorine atom.

S171 The acidic strength of the hydrohalic acids in the order:



This order is a result of bond dissociation enthalpies of $\text{H}-\text{X}$ bond decreases from $\text{H}-\text{F}$ to $\text{H}-\text{I}$ as the size of halogen atom increases.

S172 Fluorine is the strongest oxidising agent as it accept electron easily. It oxidise other halide ions in solution or even in solid phase.

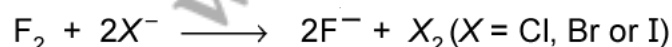


S173 In aqueous medium HCl is stronger acid than HF because bond dissociation enthalpy of $\text{H}-\text{Cl}$ is lower than that of HF .

S174 F_2 has lower bond dissociation enthalpy than Cl_2 because F atom is very small and hence the electron-electron repulsions between the lone pairs of electrons are very large.

S175 Higher boiling point of H_2O is due to the extensive H-bonding than HF .

S176 Fluorine is the strongest oxidising agent as it accept electron easily. It oxidise other halide ions in solution or even in solid phase.



S177 HF acid attacks glass with the formation of fluoro silicate ions. Thus, it is stored in wax-coated glass bottles to prevent the reaction.

S178. HF is the weakest acid because of its high bond dissociation energy due to small size of fluorine atom.

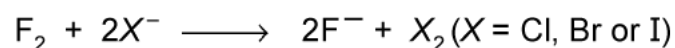
S179. This is due to non-availability of *d*-orbitals in valence shell of fluorine.

S180. Fluorine is the most electronegative element among halogens and it cannot exhibit any positive oxidation state. Therefore, it forms largest number of interhalogen compounds.

S181. Hydrogen fluoride has much higher boiling point (b.p. 293 K) than hydrogen chloride (b.p. 189 K) due to strong hydrogen bonding.

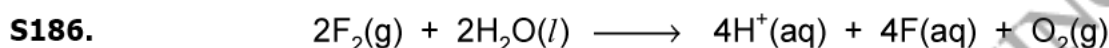
S182. This is due to non-availability of *d*-orbitals in valence shell of fluorine.

S183. Fluorine is the strongest oxidising agent as it accepts electron easily. It oxidises other halide ions in solution or even in solid phase.

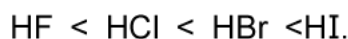


S184. This is due to non-availability of *d*-orbitals in valence shell of fluorine.

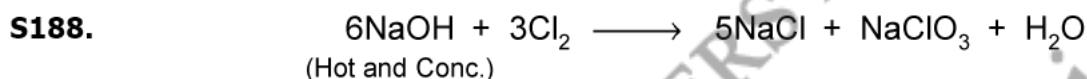
S185. The electron gain enthalpy of fluorine is less negative than that of chlorine due to the small size of fluorine atom.



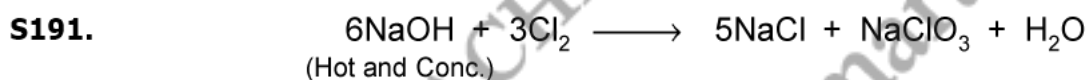
S187. The acidic strength of the hydrohalic acids in the order:



This order is a result of bond dissociation enthalpies of H — X bond decreases from H — F to H — I as the size of halogen atom increases.



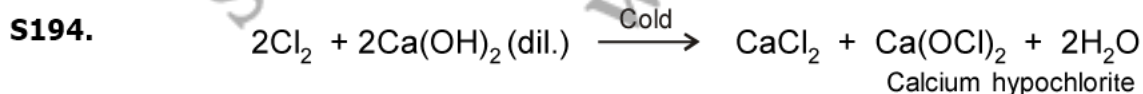
S190. Chlorine water on standing loses its yellow colour due to the formation of HCl and HClO.



S192. The bleaching action of Cl_2 is due to oxidation of coloured substances to colourless substances by nascent oxygen. Since, the bleaching action of Cl_2 is due to oxidation and that of SO_2 is due to reduction, therefore, bleaching effect of Cl_2 is permanent while that of SO_2 is temporary.

S193.(a) Phosgene

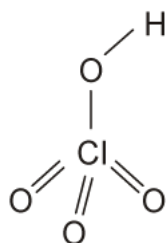
(b) Mustard gas



S195. Fluorine forms only one oxoacid HOF. Because for the formation of other oxoacids *d*-orbitals are required for the multiple $p\pi - d\pi$ bonding between extra oxygen atoms and fluorine.

High electronegativity and small size of fluorine also favours only the formation of one oxoacid.

S196.



HClO₄ (Perchloric acid)

S197. As the number of oxygen bonded to the central atom increases, the oxidation number of the oxidation atom increases causing a weakening of the O — H bond strength and an increase in the acidity. Hence, HClO₄ is stronger acid than HClO.

S198. Fluorine forms only one oxoacid HOF. Because for the formation of other oxoacids *d*-orbitals are required for the multiple $p\pi - d\pi$ bonding between extra oxygen atoms and fluorine.

High electronegativity and small size of fluorine also favours only the formation of one oxoacid.

S199. Its reaction with iron produces H₂.



Liberation of hydrogen prevents the formation of ferric chloride.

S200. $3\text{Cl}_2 + 6\text{NaOH} \longrightarrow 5\text{NaCl} + \text{NaCl}_3 + 3\text{H}_2\text{O}$

This reaction is a disproportionation reaction as chlorine from zero oxidation state is changed to -1 and +5 oxidation states.

S201. $\text{I}_2 + 6\text{H}_2\text{O} + 5\text{Cl}_2 \longrightarrow 2\text{HIO}_3 + 10\text{HCl}$
Iodic acid

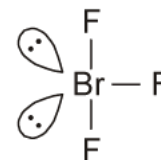
S202. The central atom Br has seven electrons. Four of these electrons form two double bonds or coordinate bonds with two oxygen atoms while the fifth electron forms a single bond with O⁻ ion. The remaining two electrons form one lone pair. Hence, in all there are three bond pairs and one lone pair around Br atom in BrO₃⁻. Therefore, according to VSEPR theory, BrO₃⁻ should be pyramidal.

Here, BrO₃⁻ has 26 (7 + 3 × 6 + 1 = 26) valence electrons. A noble gas species having 26 valence electrons is XeO₃ (8 + 3 × 6 = 26). Thus, like BrO₃⁻, XeO₃ is also pyramidal.

S203. Hybridisation – sp^3d

Structure – Trigonal bipyramidal

Shape – Bent-T

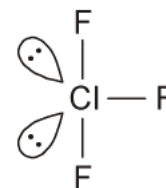


S204. Hybridisation – sp^3d

Structure – Trigonal bipyramidal

Shape – Bent (T-shaped)

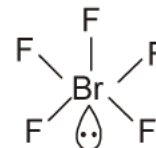
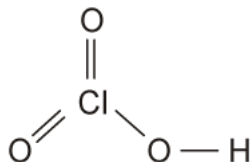
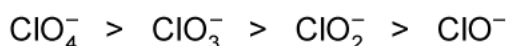
Angle F — Cl — F: Less than 90°



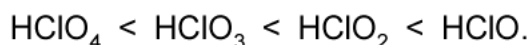
S205. Interhalogen compounds are more reactive than halogens (except fluorine) because X — X' bond (I — Cl) bond) in interhalogens is weaker than X — X bond (I — I bond) in halogens except F — F bond. In other words I — Cl bond is weaker than I — I bond. That why ICl is more reactive than I₂.

S206. Geometry – Octahedral

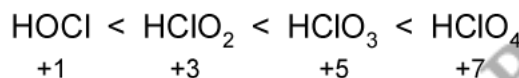
Shape – Square pyramidal

Hybridisation – sp^3d^3 **S207.** ClO^- has $17 + 8 + 1 = 26$ electrons.A neutral molecule with 26 electrons is OF_2 ($8 + 2 \times 9$) = $18 + 8 = 26$ electrons.**S208.****S209.** As the stability of the oxoanion increases, its tendency to decompose to give O_2 decreases and hence its oxidising power decreases. Since, the stability of the oxoanion decreases in the order:

therefore, oxidising power of their oxoacids increases in the reverse order:

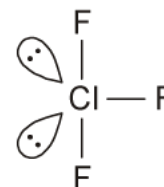
**S210.** Acid strength of oxoacids of the same halogen increases with increase in oxidation number of the halogen.

Thus, the increasing order of acid strength is

**S211.** O.S. of Br in BrCl_5 is +5, whereas in case of BrCl_3 is +3. As Br is more stable in +3 oxidation state than +5, due to inert pair effect. Therefore, it is unstable and readily reduces from +5 to +3 oxidation state.**S212.** Interhalogen compounds are more reactive than halogens (except fluorine) because $X - X'$ bond (I — Cl) bond) in interhalogens is weaker than $X - X$ bond (I — I bond) in halogens except F — F bond. In other words I — Cl bond is weaker than I — I bond. That why ICl is more reactive than I_2 .**S213.** Hybridisation – sp^3d

Structure – Trigonal bipyramidal

Shape – Bent (T-shaped)

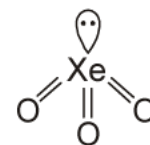
Angle F — Cl — F: Less than 90° **S214.** Interhalogen compounds are more reactive than halogen because the $X' - X$ bond in interhalogens is weaker than $X - X$ bond in halogens. But in case of fluorine, the F — F bond is weaker. This is because of the small size of fluorine atoms, the F — F bond distance is very small due to which there is appreciable inter-electronic repulsion. This repulsion weakens the bond between two fluorine atoms. Hence, F_2 is more reactive than ClF_3 but ClF_3 is more reactive than chlorine.**S215.** 3F_2 (Excess) + $\text{Cl}_2 \xrightarrow{300^\circ\text{C}} 2\text{ClF}_3$.**S216.** Fluorine does not have d -orbitals and its cannot show higher oxidation state. Therefore, it does not play the role of a central atom in inter halogen compounds.

S217 XeO₃:

Hybridisation = sp^3

Geometry = Tetrahedral

Shape = Pyramidal



S218 XeF₂: Total valence electron pair = $\frac{8+2}{2} = 5$

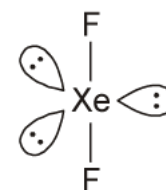
Bond pair = 2

Lone pairs = $5 - 2 = 3$

Hybridisation = sp^3d

Geometry = Trigonal bipyramidal

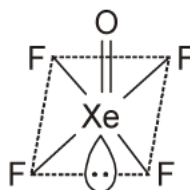
Shape = Linear



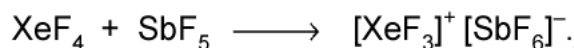
S219 Helium is used in diving apparatus as diluent for oxygen because of its low solubility (as compared to N₂) in blood, a mixture of oxygen and helium is used in diving apparatus used by deep sea divers.

S220 XeOF₄ is square pyramidal.

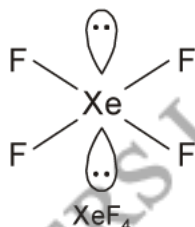
Hybridisation – sp^3d^2



S221.



S222.

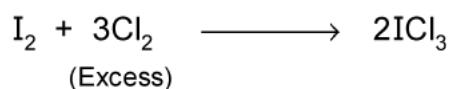
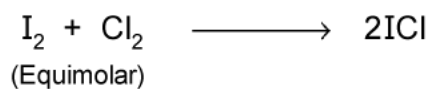
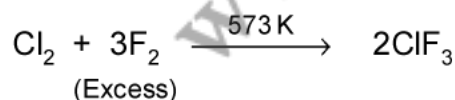
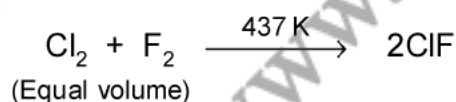


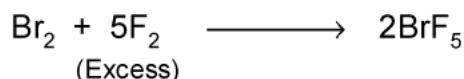
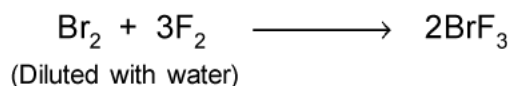
Shape : Square planar

Hybridisation : sp^3d^2

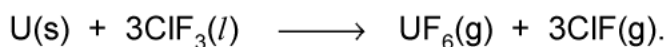
S223 Interhalogen compounds are formulated as XX' , XX'_3 , XX'_5 and XX'_7 where X is halogen of larger size and X' of smaller size.

The interhalogen compounds can be prepared by direct combination or by the action of halogen on lower interhalogen compounds. The product formed depends upon some specific conditions, for example,



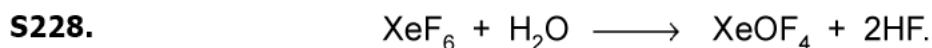
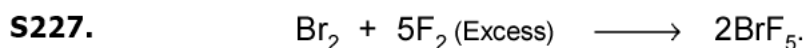
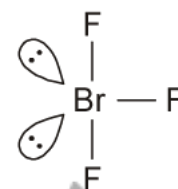


S224. ClF_3 is used for the production of UF_6 in enrichment of U^{235} .

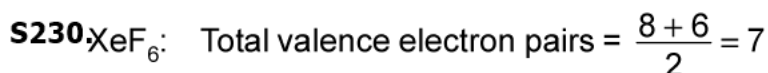


S225. Fluorine does not have d -orbitals and its cannot show higher oxidation state. Therefore, it does not play the role of a central atom in inter halogen compounds.

S226. In ClF_3 , central atom Cl has three bond pairs and two lone pairs. According to VSEPR theory, the two lone pairs will occupy the equatorial position to minimise $lp - lp$ and $lp - bp$ repulsion. In addition, the axial fluorine atoms will be bent towards the equatorial fluorine in order to minimise the $lp - lp$ repulsions. That's why ClF_3 has a bent T-shaped structure.



S229. Helium is used in diving apparatus as diluent for oxygen because of its low solubility (as compared to N_2) in blood, a mixture of oxygen and helium is used in diving apparatus used by deep see divers.



$$\text{Bond pair} = 6$$

$$\text{Lone pair} = 7 - 6 = 1$$

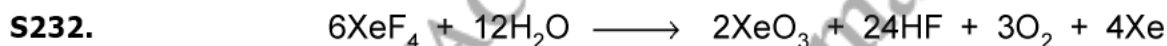
$$\text{Hybridisation} = sp^3d^3$$

$$\text{Shape} = \text{Distorted octahedral}$$

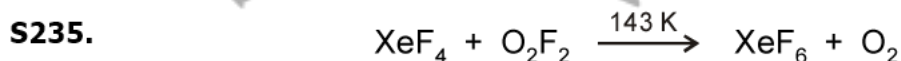
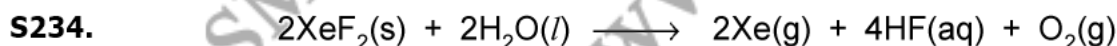
$$\text{Geometry} = \text{Pentagonal bipyramidal}$$



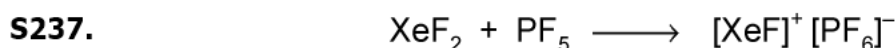
S231. Neil Bartlett first prepared a red compound which is formulated as $\text{O}_2^+\text{PtF}_6^-$. He then realised that the first ionisation enthalpy of molecular oxygen (1175 kJ/mol) is almost identical with Xe (1170 kJ/mol). He made efforts to prepare same type of compound with Xe and was successful in preparing another red compound $\text{Xe}^+\text{PtF}_6^-$.



S233. Extremely small size and fully filled outer orbital makes helium very stable and resistant to chemical reaction and hence, it does not form compounds unlike bigger atoms of other elements of noble gas family.



S236. Since there are two $\text{Xe} - \text{F}$ covalent bonds and three lone pairs in XeF_2 . According to VSEPR theory, the shape of XeF_2 is linear.



S238 Noble gases being monoatomic gases are held together by weak London dispersion forces, therefore they have low boiling points.

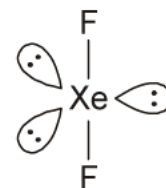
S239 Helium has completely filled ns^2 electronic configurations in its valence shell. Due to its small size and high IE, helium is chemically unreactive. That's why it forms no real chemical compound.

S240 XeF_2 : Total valence electron pair = $\frac{8+2}{2} = 5$

Bond pair = 2

Lone pairs = $5 - 2 = 3$

Hybridisation = sp^3d



Geometry = Trigonal bipyramidal

Shape = Linear

$\text{F} - \text{Xe} - \text{F} : 180^\circ$.

S241 Since, xenon (Xe) has least ionization energy among noble gases hence it readily forms chemical compounds particularly with O_2 and F_2 .

S242 Since there are two $\text{Xe} - \text{F}$ covalent bonds and three lone pairs in XeF_2 . According to VSEPR theory, the shape of XeF_2 is linear.

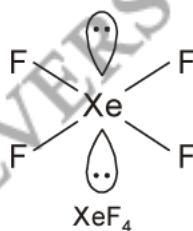
S243. $\text{XeF}_6 + \text{H}_2\text{O} \longrightarrow \text{XeOF}_4 + 2\text{HF}$.

S244 Fluorine and oxygen are the most electronegative elements and hence are very reactive. Therefore, they form compounds with noble gases particularly with xenon.

S245 Neon is used in discharge tubes and fluorescent bulbs for advertisement display purposes.

Argon is used to provide an inert atmosphere in high temperature metallurgical processes and for filling electric bulbs.

S246.



Shape : Square planar

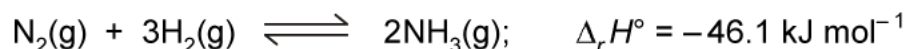
Hybridisation : sp^3d^2

S247 Except radon which is radioactive, Xe has least ionisation energy among noble gases and hence it readily forms chemical compounds particularly with oxygen and fluorine.

S248. $\text{PtF}_6 + \text{Xe} \longrightarrow \text{Xe}^+ [\text{PtF}_6]^-$

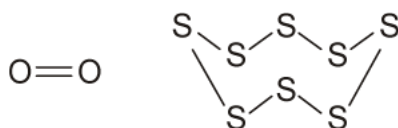
S249. $\text{XeF}_6 + \text{KF} \longrightarrow \text{K}^+ [\text{XeF}_7]^-$.

S250 Ammonia is manufactured industrially by Haber's process.



This is a reversible exothermic reaction. High pressure about 200 atm, low temperature about 700 K and use of catalyst such as iron oxide with small amounts of Al_2O_3 and K_2O would favour the formation of ammonia according to Le-Chatelier's principle.

S251(a) Due to small size oxygen forms $p\pi - p\pi$ multiple bonds. As a result, oxygen exists as diatomic (O_2) molecule. Due to its bigger size sulphur does not form $p\pi - p\pi$ multiple bonds. Consequently, sulphur because of its higher tendency of catenation and lower tendency for $p\pi - p\pi$ multiple bonds forms octa-atomic (S_8) molecules having eight membered puckered ring structure.



(b) $H_2O < H_2S < H_2Se < H_2Te$

As the atomic size increases down the group, the bond length increases and hence, the bond strength decreases. Consequently, the cleavage of $E-H$ bond. ($E = O, S, Se, Te$ etc.) becomes easier. As a result, the tendency to release hydrogen as proton increases *i.e.*, acidic strength increases down the group.

S252(a)

	H_2O		H_2S
Boiling point	373 K	>	213 K

The abnormally high boiling point of H_2O is due to strong intermolecular H-bonding. Since, all other elements have much lower electronegativity than oxygen, they do not undergo H-bonding.

(b) The +6 oxidation state of S is more stable than +4 therefore, SO_2 acts as a reducing agent. Further, since the stability of +6 oxidation decreases from S to Te therefore, the reducing character of the dioxides decreases while their oxidising character increases. Thus, TeO_2 acts as an oxidising agent.

S253. Sulphur exists in numerous allotropes of which yellow rhombic (α -sulphur) and monoclinic (β -sulphur) is most important. The stable form is rhombic, which transform to monoclinic sulphur, when heated above 369 K.

S254. Contact process: It involves three stages:

(a) Burning of sulphur or sulphide ore in air to generate SO_2 .



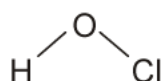
(b) Conversion of SO_2 to SO_3 by reaction with oxygen in the presence of V_2O_5 catalyst.



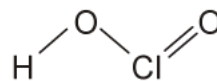
(c) The SO_3 gas from the catalytic converter is absorbed in conc. H_2SO_4 to form oleum ($H_2S_2O_7$). Dilution of oleum with water give H_2SO_4 of desired concentration.



S255(a) HOCl: Hypochlorous acid

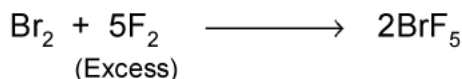
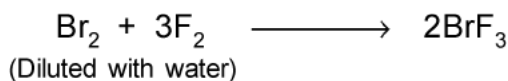
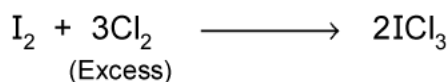
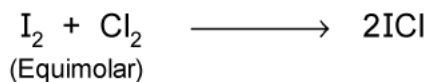
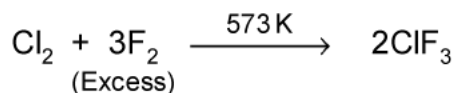
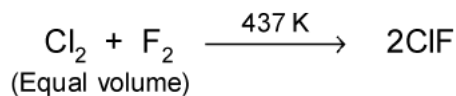


(b) HOClO: Chlorous acid



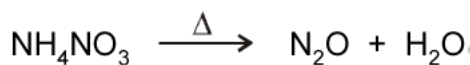
S256 Interhalogen compounds are formulated as XX' , XX'_3 , XX'_5 and XX'_7 where X is halogen of larger size and X' of smaller size.

The interhalogen compounds can be prepared by direct combination or by the action of halogen on lower interhalogen compounds. The product formed depends upon some specific conditions, for example,



S257(a) Mr. Rakesh displayed values like awareness care, concern alertness.

(b) Nitrous oxide (N_2O)



(c) (i) It is used as a fertiliser.

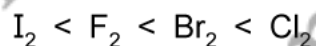
(ii) It is used to modify the detonation rate.

S258(a) From top to bottom in group-17 oxidising power of halogens decreases



(b) F_2 has lower bond dissociation enthalpy than Cl_2 because F atom is very small and hence the electron-electron repulsions between the lone pairs of electrons are very large.

S259(a) Increasing bond dissociation enthalpy order is



Bond dissociation enthalpy of F_2 is less than that of Br_2 and Cl_2 due to the lone pair-lone pair repulsions.

(b) The acidic strength of the hydrohalic acids in the order:

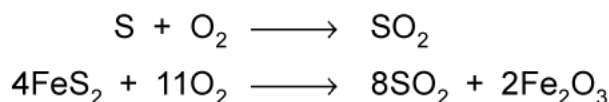


This order is a result of bond dissociation enthalpies of $\text{H}-\text{X}$ bond decreases from $\text{H}-\text{F}$ to $\text{H}-\text{I}$ as the size of halogen atom increases.

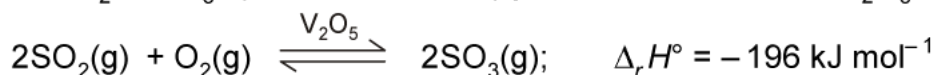
S260. Oxidising power of a substance depends on the factors like bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy. Due to small size of fluorine, its electron gain enthalpy is less than that of chlorine. However, its low bond dissociation enthalpy and high hydration enthalpy compensate the low electron gain enthalpy. Fluorine because of its small size has higher hydration enthalpy than chlorine. Also, due to repulsion between electrons it has lower bond dissociation energy. Thus, fluorine has better oxidising action than chlorine.

S261. Contact process: It involves three stages:

- (a) Burning of sulphur or sulphide ore in air to generate SO_2 .



- (b) Conversion of SO_2 to SO_3 by reaction with oxygen in the presence of V_2O_5 catalyst.



- (c) The SO_3 gas from the catalytic converter is absorbed in conc. H_2SO_4 to form oleum ($\text{H}_2\text{S}_2\text{O}_7$). Dilution of oleum with water give H_2SO_4 of desired concentration.

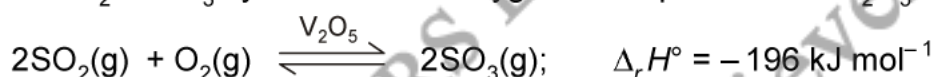


S262. Contact process: It involves three stages:

- (a) Burning of sulphur or sulphide ore in air to generate SO_2 .



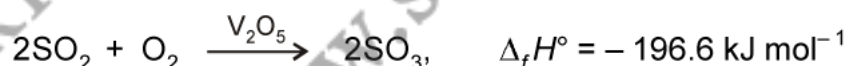
- (b) Conversion of SO_2 to SO_3 by reaction with oxygen in the presence of V_2O_5 catalyst.



- (c) The SO_3 gas from the catalytic converter is absorbed in conc. H_2SO_4 to form oleum ($\text{H}_2\text{S}_2\text{O}_7$). Dilution of oleum with water give H_2SO_4 of desired concentration.



S263. In contact process, the rate determining step is

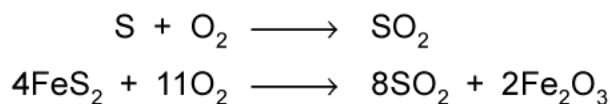


This reaction is reversible and exothermic i.e., ΔH is negative. Thus, according to Le-Chatelier's principle, the conditions to maximise the yield are as follows:

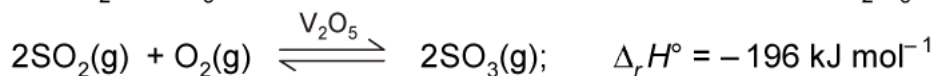
- (a) **At lower temperature:** As heat is evolved in the reaction so, at lower temperature the reaction proceeds more in forward direction.
- (b) **At higher pressure:** As three moles of gaseous reactants give two moles of gaseous products thus, at higher pressure reaction moves in forward direction.

Contact process: It involves three stages:

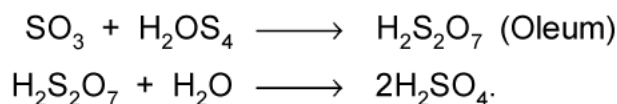
(a) Burning of sulphur or sulphide ore in air to generate SO_2 .



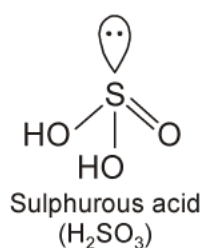
(b) Conversion of SO_2 to SO_3 by reaction with oxygen in the presence of V_2O_5 catalyst.



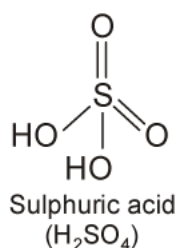
(c) The SO_3 gas from the catalytic converter is absorbed in conc. H_2SO_4 to form oleum ($\text{H}_2\text{S}_2\text{O}_7$). Dilution of oleum with water give H_2SO_4 of desired concentration.



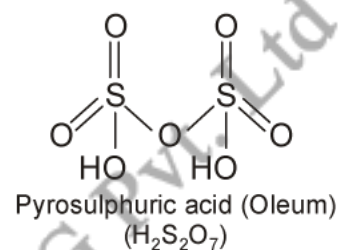
S264(a)



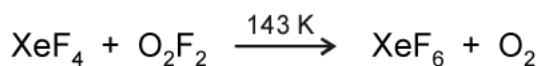
(b)



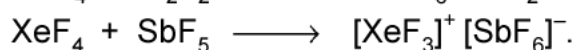
(c)



S265(a)

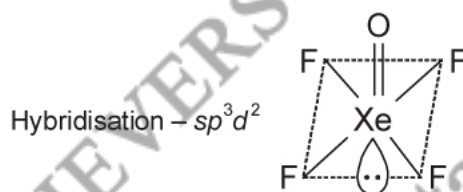


(b)

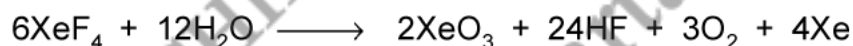


S266(a) Except radon which is radioactive, Xe has least ionisation energy among noble gases and hence it readily forms chemical compounds particularly with oxygen and fluorine.

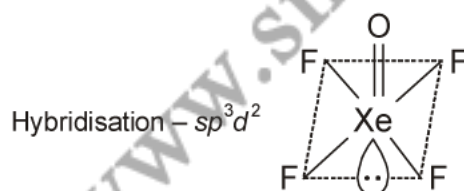
(b) XeOF_4 is square pyramidal.



(c)



S267(a) XeOF_4 is square pyramidal.

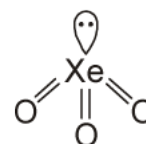


(b) XeO_3 :

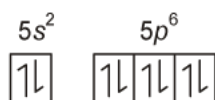
Hybridisation = sp^3

Geometry = Tetrahedral

Shape = Pyramidal



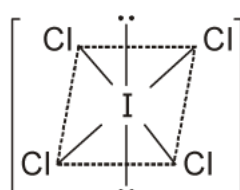
S268(a)



All the orbital of Xe have paired electrons. The promotion of one, two or three electrons from $5p$ -filled orbitals to the $4d$ -vacant orbitals will give rise to two, four and six-half filled orbitals. Therefore, xenon can combine with even number of fluorine atoms, not odd. Thus, it cannot form XeF_3 and XeF_5 .

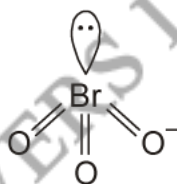
- (b) Helium has completely filled ns^2 electronic configurations in its valence shell. Due to its small size and high IE, helium is chemically unreactive. That's why it forms no real chemical compound.

S269(a) **Structure of ICl_4^-** : I in ICl_4^- has four bond pairs and two lone pairs. Therefore, according to VSEPR theory, it should be square planar as shown. Here, ICl_4^- has $(7 + 4 \times 7 + 1) = 36$ valence electrons. A noble gas species having 36 valence electrons is XeF_4 ($8 + 4 \times 7 = 36$). Therefore, like ICl_4^- , XeF_4 is also square planar.



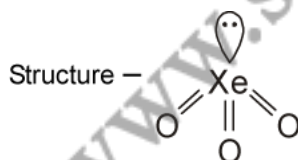
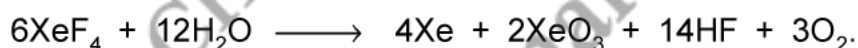
Square Planar

- (b) **Structure of BrO_3^-** : The central atom Br has seven electrons. Four of these electrons form two double bonds or coordinate bonds with two oxygen atoms while the fifth electron forms a single bond with O^- ion. The remaining two electrons form one lone pair. Hence, in all there are three bond pairs and one lone pair around Br atom in BrO_3^- . Therefore, according to VSEPR theory, BrO_3^- should be pyramidal.

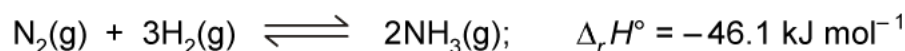


Pyramidal

S270 XeO_3 can be obtained by hydrolysis of XeF_4 and XeF_6 .

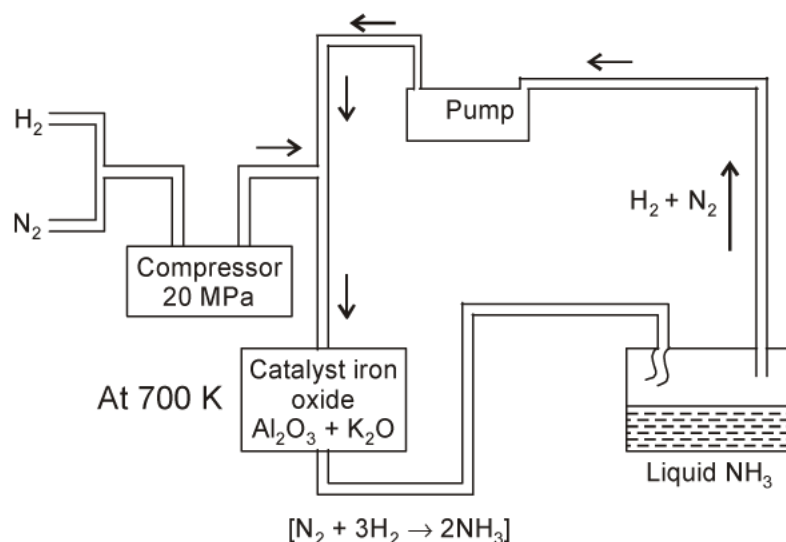


S271 Ammonia is manufactured industrially by Haber's process.



This is a reversible exothermic reaction. High pressure about 200 atm, low temperature about 700 K and use of catalyst such as iron oxide with small amounts of Al_2O_3 and K_2O would favour the formation of ammonia according Le-Chatelier's principle.

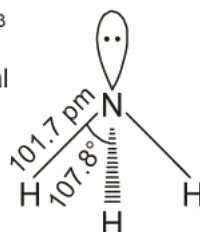
The flow chart for the production of ammonia is shown below:



Structure of ammonia:

Hybridisation : sp^3

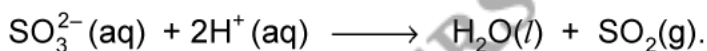
Shape : Pyramidal



Uses of ammonia:

- Ammonia is used to produce various nitrogenous fertilizers – for example: urea, ammonium nitrate, ammonium phosphate etc.
- Liquid ammonia is used as a refrigerant.

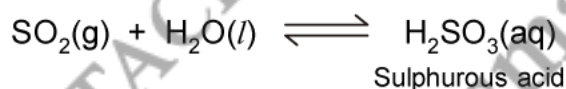
S272(a) (i) It is prepared in laboratory by treating a sulphite with dil. H_2SO_4 .



(ii) It is produced industrially as a by-product of the roasting of sulphide ores.



(b) When sulphur dioxide is passed through water, it forms a solution of sulphurous acid.



When sulphur dioxide reacts with sodium hydroxide solution sodium sulphite is formed.



(c) **Use:**

- In refining sugar and petroleum.
- In bleaching wool and silk.

- (iii) As an anti-chlor, disinfectant and preservative.
- (iv) In the manufacture of sulphuric acid, sodium hydrogen sulphite and calcium hydrogen sulphite.

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