

Chapter 7- p block elements

LEVEL-1 QUESTIONS

1.  $\text{NH}_3$  has higher boiling point than phosphine. Why?

Ans—Ammonia is a polar molecule it form in-termolecular hydrogen bonding.

2. Why  $\text{BiH}_3$  the strongest reducing agent amongst all the hydrides of group 15 elements ?

Ans- Less B.E or longer bond length.

3. Why  $\text{H}_2\text{S}$  is acidic and  $\text{H}_2\text{O}$  is neutral ?

Ans-The S---H bond is weaker than O---H bond because the size of S atom is bigger than that of O atom. Hence  $\text{H}_2\text{S}$  can dissociate to give  $\text{H}^+$  ions in aqueous solution.

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

Ans- Phosgene ( $\text{COCl}_2$ ), tear gas ( $\text{CCl}_3\text{NO}_2$ )

5. Name the halogen which does not exhibit positive oxidation state.

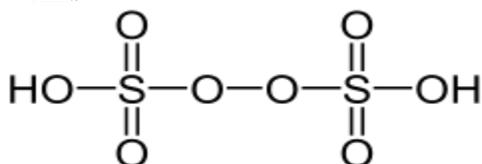
Ans- Fluorine being the most electronegative element does not show positive oxidation state.

6. Iodine forms  $\text{I}_3^-$  but  $\text{F}_2$  does not form  $\text{F}_3^-$  ions. Why?

Ans- Due to the presence of vacant d-orbitals,  $\text{I}_2$  accepts electrons from I-ions to form  $\text{I}_3^-$  ions, but because of d-orbitals  $\text{F}_2$  does not accept electrons from F-ions to form  $\text{F}_3^-$  ions.

7. Draw the structure of peroxosulphuric acid.

Ans-



8. Phosphorous forms  $\text{PCl}_5$  but nitrogen cannot form  $\text{NCl}_5$ . Why?

Ans- Due to the availability of vacant d-orbital in p.

9. Give reasons for the following:

(i) Conc.  $\text{HNO}_3$  turns yellow on exposure to sunlight.

(ii)  $\text{PCl}_5$  behaves as an ionic species in solid state.

Ans- (i) Conc  $\text{HNO}_3$  decompose to  $\text{NO}_2$  which is brown in colour &  $\text{NO}_2$  dissolves in  $\text{HNO}_3$  to it yellow.

(ii) It exists as  $[\text{PCl}_4]^+[\text{PCl}_6]^-$  in solid state.

10. How is ozone estimated quantitatively?

Ans- When ozone reacts with an excess of potassium iodide solution

Buffered with a borate buffer (pH 9.2), Iodide is liberated which can be titrated against a standard solution of sodium thiosulphate. This is a quantitative method for estimating  $\text{O}_3$  gas.

11. Are all the five bonds in  $\text{PCl}_5$  molecule equivalent? Justify your answer.

Ans-  $\text{PCl}_5$  has a trigonal bipyramidal structure and the three equatorial P-Cl bonds are equivalent, while the two axial bonds are different and longer than equatorial bonds.

12.  $\text{NO}_2$  is coloured and readily dimerises. Why?

Ans-  $\text{NO}_2$  contains odd number of valence electrons. It behaves as a typical odd molecule. On dimerization, it is converted to stable  $\text{N}_2\text{O}_4$  molecule with even number of electrons.

13. Account for the following.

(i)  $\text{SF}_6$  is less reactive than.

(ii) Of the noble gases only xenon chemical compounds.

Ans- (i) In  $\text{SF}_6$  there is less repulsion between F atoms than in  $\text{SF}_4$ .

(ii) Xe has low ionisation enthalpy & high polarising power due to larger atomic size.

**14. With what neutral molecule is  $\text{ClO}^-$  isoelectronic? Is that molecule a Lewis base?**

$\text{ClF}$ . Yes, it is Lewis base due to presence of lone pair of electron.

**15.(i) why is He used in diving apparatus?**

(ii) Noble gases have very low boiling points. Why?

(iii) Why is  $\text{ICl}$  more reactive than  $\text{I}_2$ ?

Ans- (i) It is not soluble in blood even under high pressure.

(ii) Being monoatomic they have weak dispersion forces.

(iii) I-Cl bond is weaker than I-I bond

**16. Account for the following.**

(i) Noble gas form compounds with  $\text{F}_2$  &  $\text{O}_2$  only.

(ii) Sulphur shows paramagnetic behavior.

(iii) HF is much less volatile than HCl.

(iv) White phosphorous is kept under water.

(v) Ammonia is a stronger base than phosphine.

Ans- (i)  $\text{F}_2$  &  $\text{O}_2$  are best oxidizing agents.

(ii) In vapour state sulphur partly exists as  $\text{S}_2$  molecule which has two unpaired electrons in the antibonding  $\pi^*$  orbitals like  $\text{O}_2$  and, hence, exhibit paramagnetism.

(iii) HF is associated with intermolecular H bonding.

(iv) Ignition temperature of white phosphorous is very low (303 K). Therefore on exposure to air, it

spontaneously catches fire forming  $\text{P}_4\text{O}_{10}$ . Therefore to protect it from air, it is kept under water.

(v) Due to the smaller size of N, lone pair of electrons is readily available.

**16. Arrange the following in the increasing order of the property mentioned.**

(i)  $\text{HOCl}$ ,  $\text{HClO}_2$ ,  $\text{HClO}_3$ ,  $\text{HClO}_4$  (Acidic strength)

(ii)  $\text{As}_2\text{O}_3$ ,  $\text{ClO}_2$ ,  $\text{GeO}_3$ ,  $\text{Ga}_2\text{O}_3$  (Acidity)

(iii)  $\text{NH}_3$ ,  $\text{PH}_3$ ,  $\text{AsH}_3$ ,  $\text{SbH}_3$  (HEH bond angle)

(iv) HF, HCl, HBr, HI (Acidic strength)

(v) MF, MCl, MBr, MI (ionic character)

Ans- (i) Acidic strength:  $\text{HOCl} < \text{HClO}_2 < \text{HClO}_3 < \text{HClO}_4$

(ii) Acidity:  $\text{Ga}_2\text{O}_3 < \text{GeO}_2 < \text{AsO}_3 < \text{ClO}_2$

(iii) Bond angle:  $\text{SbH}_3 < \text{AsH}_3 < \text{PH}_3 < \text{NH}_3$

(iv) Acidic strength:  $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

(v) Ionic character:  $\text{MI} < \text{MBr} < \text{MCl} < \text{MF}$

### LEVEL-2 QUESTIONS

**1 Draw the structure of following compounds-**

a)  $\text{N}_2\text{O}$ ,  $\text{NO}$ ,  $\text{N}_2\text{O}_3$ ,  $\text{NO}_2$  and  $\text{N}_2\text{O}_5$ .

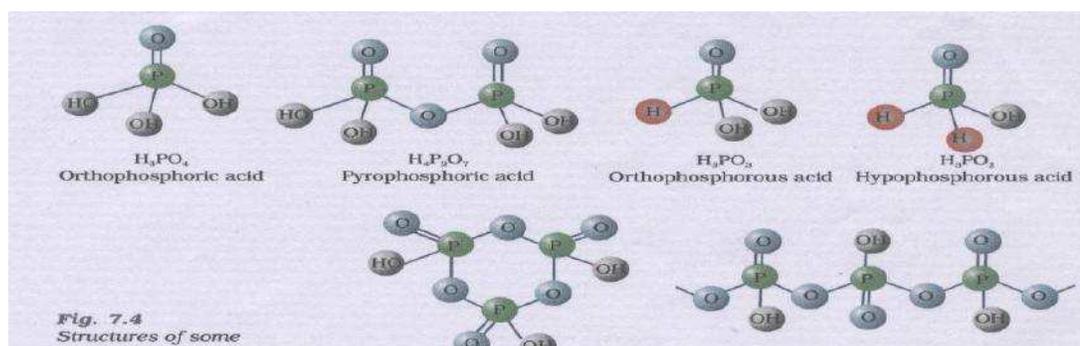
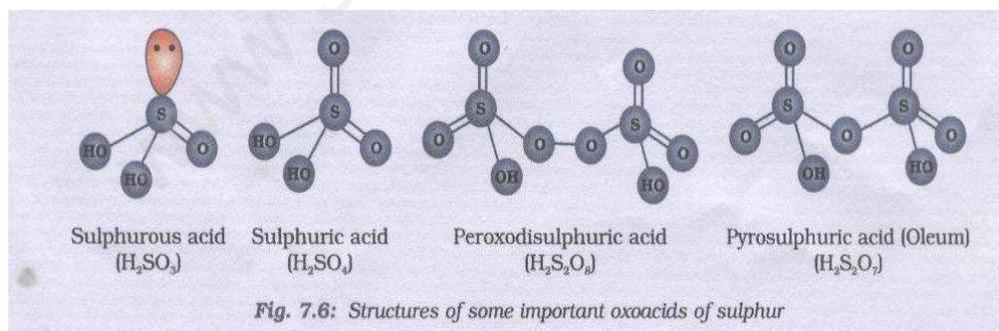
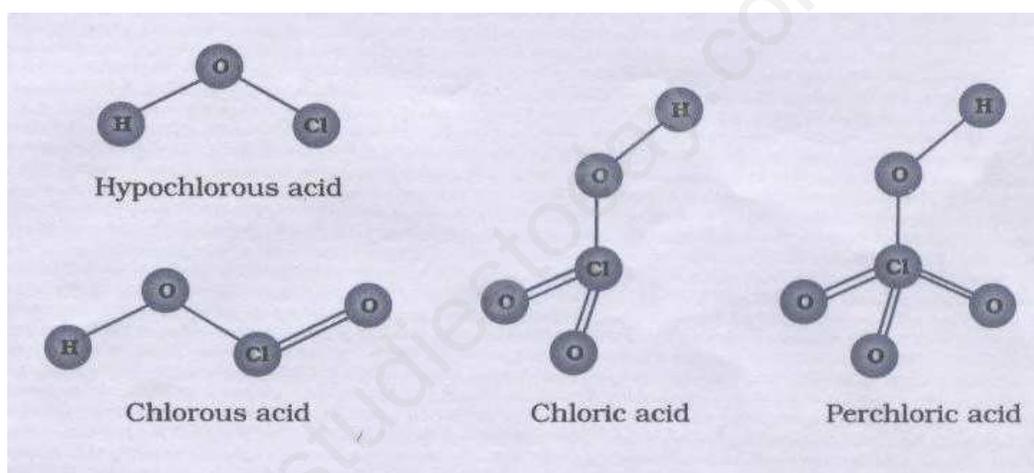
b) Oxoacides of Phosphorous, Sulphur and chlorine

c) Compounds of Xenon

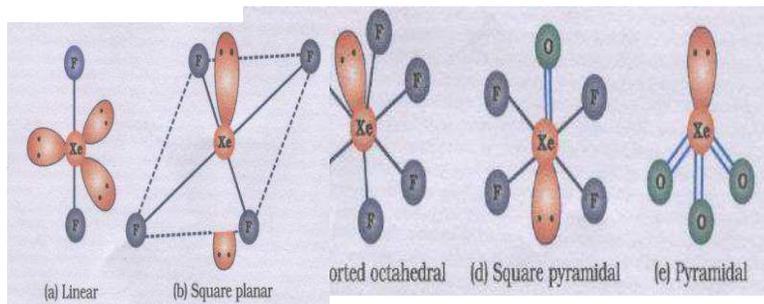
Ans- a)

Formula	Resonance Structures	Bond Parameters
$N_2O$	$\ddot{N}=\ddot{N}=\ddot{O} \leftrightarrow :\ddot{N}\equiv\ddot{N}-\ddot{O}:$	$N - N - O$ 113 pm 119 pm Linear
$NO$	$:\ddot{N}=\ddot{O}:\leftrightarrow :\ddot{N}=\ddot{O}:$	$N - O$ 115 pm
$N_2O_3$		$O - N - N - O$ 105° 136° 114 pm 186 pm 117° Planar
$NO_2$		$N$ 120 pm 134° Angular
$N_2O_4$		$O - N - N - O$ 175 pm 121 pm 135° Planar
$N_2O_5$		$O - N - O - N - O$ 151 pm 119 pm 112° 134° Planar

B)



c)

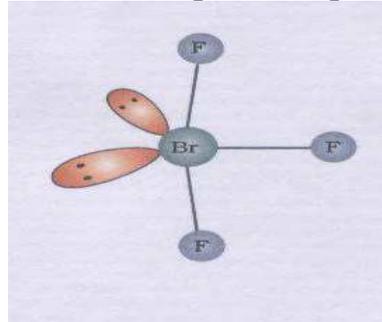


2. What happens when white P is heated with conc. NaOH solution in an atmosphere of CO<sub>2</sub>? Give equation.

Ans- Phosphorus gas will be formed.  $P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$

3. Give example of a molecule having geometry T- shaped.

Ans- BrCl<sub>3</sub> (lp=2 and bp=3)



4. Write the balanced chemical equation for the reaction of Cl<sub>2</sub> with hot and concentrated NaOH. Is this reaction a disproportionation reaction? Justify:



5. Why is HF acid stored in wax coated glass bottles?

Ans- This is because HF does not attack wax but reacts with glass. It dissolves SiO<sub>2</sub> present in glass forming hydrofluorosilicic acid.



6. What is laughing gas? Why is it so called? How is it prepared?

Ans- Nitrous oxide (N<sub>2</sub>O) is called laughing gas, because when inhaled it produced hysterical laughter. It is prepared by gently heating ammonium nitrate.



**LEVEL-3 QUESTIONS**

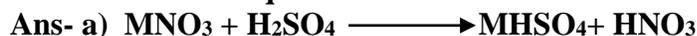
1. A translucent white waxy solid (A) on heating in inert atmosphere is converted to its allotropic form (B). Allotrope (A) on reaction with very dilute aqueous KOH liberates a highly poisonous gas (C) having rotten fish smell. With excess of chlorine it forms (D) which hydrolyses to compound (E). Identify compounds (A) to (E).

Ans: A= White phosphorus B= Red phosphorous C= Phosphine  
D= Phosphoruspentachloride E= Phosphoric acid.

2. When conc.  $\text{H}_2\text{SO}_4$  was added into an unknown salt present in a test tube, a brown gas (A) was evolved. This gas intensified when copper turnings were also added into this test tube. On cooling, the gas (A) changed into colorless gas (B).

a. Identify the gases A and B.

b. Write the equations for the reactions involved



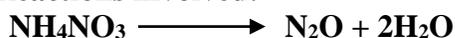
3. A colorless inorganic salt A decomposes at about 250 C to give only two products B and C leaving no residue. The oxide C is a liquid at room temperature and is neutral to litmus paper while B is neutral oxide. White phosphorus burns in excess of B to produce Strong dehydrating agent. Give balanced equations for above processes.

Ans: A=  $\text{NH}_4\text{NO}_3$

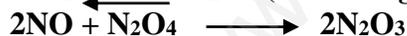
B=  $\text{N}_2\text{O}$

C=  $\text{H}_2\text{O}$

Reactions involved:



4. On heating lead (II) nitrate gives a brown gas "A". The gas "A" on cooling changes to colorless solid "B". Solid "B" on heating with NO changes to a blue Solid "C". Identify "A", "B" and "C".



A=  $\text{NO}_2$  B=  $\text{N}_2\text{O}_4$  and C=  $2\text{N}_2\text{O}_3$

5. An amorphous solid "A" burns in air to form a gas "B" which turns lime water milky. The gas is also produced as a by-product during roasting of sulphide ore. This gas decolorizes acidified aqueous  $\text{KMnO}_4$  solution and reduces  $\text{Fe}^{2+}$  and  $\text{Fe}^{3+}$ . Identify the solid "A" and the gas "B".

Ans: A=  $\text{S}_8$  B=  $\text{SO}_2$



6. Why does  $\text{PCl}_3$  fume in moisture ?

Ans- In the presence of ( $\text{H}_2\text{O}$ ),  $\text{PCl}_3$  undergoes hydrolysis giving fumes of HCl



7. What Happens when  $\text{H}_3\text{PO}_3$  is Heated ?

Ans- It disproportionate to give orthophosphoric acid and Phosphine .



8. When Conc.  $\text{H}_2\text{SO}_4$  was added to an unknown salt present in a test tube, a brown gas (A) was evolved. This gas intensified when copper turnings were added in to test tube. On cooling gas (A) changed in to a colourless gas (B).

(a) Identify the gases 'A' and 'B'

(b) Write the equations for the reactions involved

Ans- The gas 'A' is  $\text{NO}_2$  whereas 'B' is  $\text{N}_2\text{O}_4$ .



Salt (conc.)

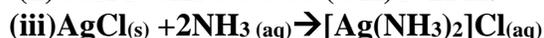
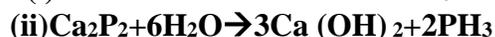
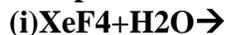


Blue Brown (A)



Colourless(B)

9. Complete the following equations.



10. (i) How is  $\text{XeOF}_4$  prepared ? Draw its structure.

(ii) When  $\text{HCl}$  reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride

Why?

Ans- (i) Partial hydrolysis of  $\text{XeOF}_4$



Structure-square pyramidal. See Fig 7.9

(ii) Its reaction with iron produces  $\text{H}_2$



Liberation of hydrogen prevents the formation of ferric chloride.