7. p-Block Elements

Points to remember:-

The general valence shell electronic configuration of p-block elements ns^2 np^{1-6}

GROUP 15 ELEMENTS:-

Group 15 elements ; N, P, As, Sb & Bi

General electronic configuration: ns^2np^3

Physical Properties:-

- Dinitrogen is a diatomic gas while all others are solids.
- N & P are non-metals. As & Sb metalloids & Bi is a metals . this is due to decrease in ionization enthalpy & increase in atomic size .
- Electro negativity decreases down the group .

Chemical properties:-

- Common oxidation states : -3, +3 & +5.
- Due to inert effect, the stability of +5 state decreases down the group & stability of +3 state increases .
- In the case of Nitrogen all Oxidation states from +1 to +4 tend to disproportionate in acid solution , e.g.:- $3HNO_3 \rightarrow H_2O + 2NO$

Anamalous behavior of Nitrogen :- due to its small size, high electronegativity, high ionization enthalpy and absence of d-orbital.

N_2 has unique ability to pπ-pπ multiple bonds whereas the heavier of this group do not form pπ –pπ because there atomic orbitals are so large & diffuse that they cannot have effective overlapping.

Nitrogen exists as diatomic molecule with triple bond between the two atoms whereas other elements form single bonds in elemental state.

N cannot form dπ-pπ due to the non availibility of d-orbitals whereas other elements can.

Trends In Properties:-

Stability - $NH_3>PH_3>AsH_3>SbH_3>BiH_3$

Bond Dissociation Enthalpy- $NH_3>PH_3>AsH_3>SbH_3>BiH_3$

Reducing character - $NH_3>PH_3>AsH_3>SbH_3>BiH_3$

Basic character- $NH_3>PH_3>AsH_3>SbH_3>BiH_3$

Acidic character- $N_2O_3>P_2O_3>As_2O_3>Sb_2O_3>Bi_2O_3$

Dinitrogen:-

Preparation

- Commercial preparation – By the liquification & fractional distillation of air.
- Laboratory preparation – By treating an aqueous solution NH_4Cl with sodium nitrate .
  $NH_4Cl + NaNO_2 \rightarrow N_2 + 2H_2O + NaCl$

- Thermal decomposition of ammonium dichromate olso gise N_2.
  $(NH_4)_2Cr_2O_7 \rightarrow N_2 + 4H_2O + Cr_2O_3$
- Thermal decomposition of Barium or Sodium azide gives very pure N_2.

PROPERTIES

At high temperature nitrogen combines with metals to form ionic nitride (Mg_3N_2) & with non-metals , covalent nitride.

AMMONIA PREPARATION

- In laboratory it is prepared by heating ammonium salt with NaOH or lime.
  $2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + 2H_2O + CaCl_2$
- In large scale it is manufactured by Haber 'process
  $N_2+3H_2=2NH_3$
  $\Delta H^0 = -46.1 kJ/mol$
  Acc.to Lechatelier's principle the favourable conditions for the manufacture of NH_3 are:-
  Optimum temperature : 700 K
  High pressure : 200 atm

Catalytst: Iron Oxides

Promoter : K_2O & Al_2O_3

PROPERTIES

Ammonia is a colorless gas with pungent odour.

Highly soluble in water.

In solids & liquid states it exists as an associated molecule due to hydrogen bonding witch accounts for high melting & boiling points of NH_3

Trigonal Pyramidal shape NH_3 molecule.

Aqueous solution of ammonia is weakly basic due to the formation of OH^- ion .

$ZnSO_4 + 2NH_4OH \rightarrow Zn(OH)_2 + (NH_4)_2SO_4$

Ammonia can form coordinate bonds by donating its lone on nitrogen, ammonia forms complexes.

$CuSO_4 + 4NH_3 \rightarrow [Cu(NH_3)_4]_2SO_4$

Name	Formula	Oxidation state	Chemical nature
Nitrous oxide or Laughing gas	N_2O	+1	Neutral

Nitric oxide	NO	+2	Neutral
Dinitrogen trioxide	N_2O_3	+3	Acidic
Dinitrogen tetra oxide	N_2O_4or NO_2	+4	Acidic
Dinitrogen pentaoxide	N_2O_5	+5	Acidic

NITRIC ACID

PREPARATION:ostwald's procees – it is based upon catalytic oxidation of ammonia by atmospheric oxidation . The main steps are

1) $4NH_3 + 5O_2{}^{-PT}{}_{500K,\ 9BAR}{}^{--}\rightarrow 4NO + 6H_2O$
2) $2NO+O_2\rightarrow 2HNO_3+ NO$

PROPERTIES:-

(i)conc. HNO_3 is a strong oxidizing agent & attacks most metals gold & Pt. .

(ii)Cr & Al do not dissolve HNO_3 because of the formation of a positive film of oxide on the surface.

(iii)it oxidises non metals like I_2 to HNO_3, C to CO_2 , S to H_2so_4

(iv)brown ring tes is used to detect NO^-.

PHOSPHOROUS:-

ALLOTROPIC FORMS: White , red α-black &β-black .

White phosphorous is more reactive red phosphorous because white P exists as discrete P_4 molecules . in red P several P_4molecules are linked to formed polymeric chain.

PHOSPHINE

Preparation:It is prepared in laboratory by heating white P with concentrated naoh solution in an

Inert atmosphere of CO_2 [$P_4+3NaOH+3H_2O\rightarrow PH_3+3NaH_2PO_2$]

Phosphorous halides

Phosphorous forms two types of halides PX_3& PX_5 (X=F,I,Br)

Trihalides have pyramidal shape and pentahalides have trigonal bipyramidal structure.

OXOACIDS OF PHOSPHOROUS

- **The acids in +3 oxidation state disproportionate to higher & lower oxidation.**

  $4H_3PO_3\rightarrow 3H_3PO_4+PH_3$

- **Acids which contains P-H bond have strong reducing properties.EX:-H_3PO_2**

  Are ionisable and cause the basicity.

- **Hydrogen atom which are attached with oxygen in P-OH form are ionisable**

GROUP-16 ELEMENTS (CHALCOGENS)

Grouo 16 Elements:O,S,SE,TE,PO

General electronic configuration:ns^2np^4

Element	Occurence
Oxygen	Comprises 20.946% by volume of the atmosphere.
Sulphur	As sulphates such as gypsum $CaSO_4.2H_2O$,Epsom salt $MgSO_4.7H_2O$ and sulphides Such as galena PbS,zinc blende ZnS,copper pyrites $CuFeS_2$ As metal selenides and tellurides in sulphide ores.
Se&Te	as a decay product of thorium and uranium minerals.

ATOMIC & PHYSICAL PROPERTIES

- **Ionisation enthalpy decreases from oxygen to polonium.**
- **Oxygen atom has less negative electron gain enthalpy than S because of the compact nature of the oxygen atom.However from the S onwards the value again becomes less negative upto polonium.**
- **Electronegativity gradually decreases from oxygen to polonium,metallic character increases from oxygen to polonium.**
- **Oxygen & S are non-metals,selenium and telerium are metalloids.Po is a radioactive metal.**
- **Oxygen is a diatomic gas while S,Se&Te are octa atomic S_8,Se_8&Te_8 molecules which has puckered ' ring' structure.**

CHEMICAL PROPERTIES

- Common oxidation state:- -2,+2,+4 &+6.
- Due to inert effect,the stability of +6 decreases down the group and stability of +4 increases.

Oxygen exhibits +1 state in O_2F_2,+2 in OF_2.

Anamolous behavior of oxygen-due to its small size,high electronegativity and absence of d-orbitals.

TREND IN PROPERTIES

Acidic character-$H_2O<H_2S<H_2Se<H_2Te$

Thermal stability-$H_2O>H_2S>H_2Se>H_2Te$

Reducing character-$H_2S<H_2Se<H_2Te$

Boiling point-$H_2S<H_2Se<H_2Te<H_2O$

Reducing property of dioxides-$SO_2>SeO_2>TeO_2$

Stability of halides-F>Cl>Br>I

HALIDES

DI HALIDES:sp^3 hybridisation but angular structure.

TETRA HALIDES:sp3 hybridisation-see-saw geometry

HEXA HALIDES:sp^3d^2,octahedral SF_6

DIOXYGEN

Prepared by heating oxygen containing salts like chlorates,nitrares

$2KClO_3 \xrightarrow{heat} 2KCl+3O_2$

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

$5SO_2+2MnO_4^- +2H_2O \rightarrow 5SO_4^{2-} +4H^+ +2Mn^{2+}$

SO2 molecule is angular.

OXIDES

A binary compound of oxygen with another element is called oxide. Oxides can be classified on the basis of nature

- Acidic Oxides:- Non metallic oxides. Aqueous solutions are acids. Neutralize bases to form salts.Ex:So_2,Co_2,N_2O_5 etc.
- Basic Oxides:metallic oxides.Aqueous solutions are alkalis. Neutralize acids to form salts.Ex:Na_2O,K_2o,etc.
- Amphoteric oxides:-some metallic oxides exhibit a dual behavior. Neutralize bothacids & bases to form salts.
  Ex:-Al_2O_3,SbO_2,SnO,etc……..

OZONE

PREPARATION

Prepared by subjecting cold, dry oxygen to silent electric discharge.

$3O_2 \rightarrow 2O_3$

PROPERTIES

Due to the ease with which it liberates atoms of nascent oxygen, it acts as a powerful oxidizing agent. For eg:- it oxidiseslead sulphide to lead sulphate and iodide ions to iodine.

$PbS+4O_3 \rightarrow PbSO_4+4O_2$

SULPHUR DIOXIDE

PREPARATION

Burning of S in air

$S+O_2 \rightarrow SO_2$

Roasting of sulphide minerals

(Iron pyrites)

$4FeS_2+11O_2 \rightarrow 2Fe_2O_3+8SO_2$

(Zinc blend)$2ZnS+3O_2 \rightarrow 2ZnO+2SO_2$

PROPERTIES

- Highly soluble in water to form solution of sulphurous acid
  $SO_2+H_2O \rightarrow H_2SO_3$
- SO_2 reacts with Cl_2 to form sulphuryl chloride
  $SO_2+Cl_2 \rightarrow SO_2Cl_2$

- It reacts with oxygen to form SO_3 in presence of V_2O_5 catalyst
  $2SO_2+O_2 \rightarrow 2SO_3$

- Moist SO_2 behaves as a reducing agent. It converts Fe(III) ions to Fe(II) ions& decolourises acidified potassium permanganate (VII) solution(It is the test for the gas).

SULPHURIC ACID

PREPARATION

It is manufactured by contact process which involves 3 steps

1. Burning of S or Sulphide ores in air to generate SO_2.
2. Conversion of SO_2 to SO_3 in presence of V_2O_5 catalyst
3. Absorption of SO_3 in H_2SO_4 to give oleum.

PROPERTIES

1. In aqeous solution it ionizes in 2 steps

$H_2SO_4+H2O \rightarrow H3O++HSO4-$

$HSO_4^-+H_2O \rightarrow H_3O^++SO_4^{2-}$

2. It is a strong dehydrating agent Eg:-charring action of sugar

$C12H22O11 \xrightarrow{H2SO4} 12C+11H_2O$

3. It is a moderately strong oxidizing agent.

$Cu+2H_2SO_4(conc.) \rightarrow CuSO_4+SO_2+2H_2O$

$C+2H_2SO_4(conc.) \rightarrow CO_2+2SO_2+2H_2O$

GROUP 17 ELEMENTS(HALOGENS)

Group 17 elements: F,Cl,Br,I,At

General electronic configuration:ns^2np^5

Element	Occurence
Fluorine	As insoluble fluorides(fluorspar CaF_2,Cryolite and fluoroapattie)
Cl.Br,I	Sea water contains chlorides, bromides and iodides of Sodium,potassium magnesium and calcium, but is mainly sodium chloride solution(2.5% by mass). Certain forms of marine life(various seaweeds)

ATOMIC & PHYSICAL PROPERTIES

i. Atomic & ionic radii increase from fluorine to iodine.
ii. Ionization enthalpy gradually decreases from fluorine to iodine due to increase in atomic size.
iii. Electron gain enthalpy of fluorine is less than that of chlorine. It is due to small size of fluorine & repulsion between newly added electron &electrons already present in its small 2p orbital.
iv. Electronegativity decreases from fluorine to iodine. Fluorine is the most electronegative element in the periodic table.
v. The color of halogens is due to absorption of radiations in visible region which results in the excitation of outer electrons to higher energy level.
vi. Bond dissociation enthalpy of fluorine is smaller than that of chlorine is due to electron-electron repulsion among the lone pair in fluorine molecules where they are much closer to each other than in case of chlorine. The trend: Cl-Cl>Br-Br>F-F>I-I.

CHEMICAL PROPERTIES

OXIDATION STATES:-1.However, chlorine, bromine &iodine exhibit +1, +3, +5, +7 oxidation states also.

Fluorine forms two oxides OF_2 and O_2F_2. These are essentially oxygen fluorides because of the higher electronegativity of fluorine than oxygen.

Anomalous behavior of fluorine- due to its small size, highest electronegativity, low F-F bond dissociation enthalpy and absence of d-orbitals.

TRENDS IN PROPERTIES

Oxidizing property – $F_2>Cl_2>Br_2>I_2$

Acidic strength- $HF<HCl<HBr<HI$

Stability & bond dissociation enthalpy- $HF>HCl>HBr>HI$

Stability of oxides of halogens- $I>Cl>Br$

Ionic character of halides –$MF>MCl>MBr>MI$

CHLORINE

PREPARATION

1. $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$
2. $4NaCl + MnO_2 + 4H_2SO_4 \rightarrow MnCl_2 + 4\ NaHSO_4 + 2H_2O + Cl_2$
3. $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$
4. **DEACON'S PROCESS**

   $4HCl + O_2 \xrightarrow{CuCl_2} 2Cl_2 + 2H_2O$
5. By electrolysis of brine solution. Cl_2 is obtained at anode.

PROPERTIES

i. With cold and dilute Cl_2 produces a mixture of chloride and hypochlorite but with hot and concentrated alkalis it gives chloride and chlorate.

$2NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O$

$6NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$

ii. With dry slaked lime it gives bleaching powder.

$2Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OH)_2 + CaCl_2 + 2H_2O$

iii. It is a powerful bleaching agent; bleaching action is due to oxidation

$Cl_2 + H_2O \rightarrow 2HCl + (O)$

Colored substance+(O)→colorless substance

iv. Action of concentrated H_2SO_4 on NaCl give HCl gas.

$NaCl + H_2SO_4 \xrightarrow{420K} NaHSO_4 + HCl$

3:1 ratio of conc. HCl & HNO_3 is known as aquaregia & it is used for dissolving noble metals like Au and Pt.

OXOACIDS OF HALOGENS (SEE TABLE 7.10& FIG.7.8)

Interhalogen compounds are prepared by direct combination of halogens.

Ex: ClF, ClF3, BrF5, IF7

They are more reactive than halogens because X-X' is weaker than X-X bonds in halogens (except F-F).

TYPE	STRUCTURE
XX'_3	Bent T-shaped
XX'_5	Square pyramidal
XX'_7	Pentagonal bipyramidal

GROUP 18 ELEMENTS

GROUP 18 ELEMENTS: He, Ne, Ar,Kr,Xe &Rn

General electronic configuration:ns^2np^6

Atomic radii- large as compared to other elements in the period since it corresponds to Vander Waal radii.

Inert – due to complete octet of outermost shell, very high ionization enthalpy & electron gain enthalpies are almost zero.

The first noble compound prepared by Neil Bartlett was $XePtF_6$&Xenon. $O_2^+PtF_6^-$.led to the discovery of $XePtF_6$ since first ionization enthalpy of molecular oxygen ($1175kJmol^{-1}$) was almost identical with that of xenon ($1170kJmol^{-1}$).

PROPERTIES

$Xe+F_2$--------673K, 1bar--→XeF_2

$Xe\ (g) + 2F_2\ (g)$ ----873k, 7bar→$XeF_4(s)$

$Xe\ (g) + 3F_2\ (g)$ ----573k, 6070bar→$XeF_6(s)$

$XeF_6+MF \rightarrow M^+\ [XeF_7]^-$

$XeF_2+PF5 \rightarrow [XeF]^+[PF_6]^-$

$XeF_6+2H_2O \rightarrow XeO_2F_2+4HF$(partial hydrolysis)

SOLVED QUESTIONS

1 MARK QUESTIONS

1. Ammonia has higher boiling point than phosphine. Why?

   -AMMONIA FORMS INTERMOLECULAR H-BOND.

2. Why BiH_3 the strongest reducing agent amongst all the hydrides of group 15 elements ?

3. Why does PCl_3 fume in moisture ?

   In the presence of (H_2O) , PCl_3 undergoes hydrolysis giving fumes of HCl .

   $PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

4. What Happens when H_3PO_3 is Heated ?

   It disproportionate to give orthophosphoric acid and Phosphine .

   $4H_3PO_3 \rightarrow 3H_3PO_4\ PH_3$

5. Why H_2S is acidic and H_2S is neutral ?

   The S---H bond is weaker than O---H bond because the size of S atomis bigger than that of O atom . Hence H_2S can dissociate to give H^+ Ions in aqueous solution .

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

Phosgene ($COCl_2$) , tear gas (CCl_3NO_2)

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

   Flourine being the most electronegative element does not show positive oxidation state .

8. Iodine forms I_3^- but F_2 does not form F_3^- ions .why?

   Due to the presence of vacant D-orbitals , I_2 accepts electrons from I-ions to form I_3-ions , but because of d-orbitals F_2 does not accept electrons from F-ions to form F_3 ions.

9. Draw the structure of peroxosulphuric acid .

10. Phosphorous forms PCl_5 but nitrogen cannot form NCl_5. Why?

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

2 MARK QUESTION (SHORT ANSWER TYPE QUESTION)

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

This is because HF does not attack wax but reacts with glass.It dissolves SiO_2 present in glass forming hydrofluorosilicic acid.

$SiO_2 + 6HF \rightarrow H_2SiF_6 + 2H_2O$

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

Nitrous oxide (N_2O) is called laughing gas, because when inhaled it produced hysterical laughter. It is prepared by gently heating ammonium nitrate.

$NH_4NO_3 \rightarrow N_2O + 2H_2O$

3. Give reasons for the following:

(i) Conc.HNO_3 turns yellow on exposure to sunlight.

(ii) PCl_5 behaves as an ionic species in solid state.

(i)Conc HNO_3 decompose to NO_2 which is brown in colour & NO_2 dissolves in HNO_3 to it yellow.

(ii)It exists as $[PCl_4]^+[PCl_6]^-$ in solid state.

4. What happens when white P is heated with conc.NaOH solution in an atmosphere of CO_2? Give equation.

Phosphorus gas will be formed.

$P_4+_3NaOH+3H_2O\rightarrow PH_3+3NaH_2PO_2$

5. How is ozone estimated quantitatively?

When ozone reacts with an excess of potassium iodide solution

Buffered with a borate buffer (Ph9.2), Iodide is liberated which can be titrated against a standard solution of sodium thiosulphate . This is a quantitative method for estimating O_3gas.

6. Are all the five bonds in PCl_5 molecule equivalent? Justify your answer.

PCl5 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.

7. NO2 is coloured and readily dimerises.Why ?

NO2 contains odd number of valence electrons.It behaves as a typical odd molecules .On dimerization; it is converted to stable N_20_4 molecule with even number of electrons.

8. Write the balanced chemical equation for the reaction of Cl2 with hot and concentrated NaOH .Is this reaction a dispropotionation reaction? Justify:

$3Cl_2+6NaOH\rightarrow 5NaCl+NaClO_3+3H_2O$

Yes, chlorine from zero oxidation state is changed to -1 and +5 oxidation states.

9. Account for the following.

(i)SF_6 is less reactive than.

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

(i)In SF_6 there is less repulsion between F atoms than In SF_4.

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

10. With what neutral molecule is ClO^-Isoelectronic? Is that molecule a Lewis base?

CiF .Yes, it is Lewis base due to presence of lone pair of electron.

3 MARK QUESTIONS

1(i) why is He used in diving apparatus?

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

(iii)Why is ICl moe reactive than I_2?

(I)It is not soluble in blood even under high pressure.

(ii)Being monoatomic they have weak dispersion forces.

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

2. Complete the following equations.

(i)XeF4+H2O→

(ii)$Ca_3P_2+H_2O \rightarrow$

(iii)$AgCl_{(s)}$ +NH3 (aq)→

(i) $6XeF4+12H_2O \rightarrow 4Xe+2XeO_3+24HF+3O_2$

(ii)$Ca_2P_2+6H_2O \rightarrow 3Ca\ (OH)_2+2PH_3$

(iii)$AgCl_{(s)} +2NH_{3\ (aq)} \rightarrow [Ag(NH_3)_2]Cl_{(aq)}$

3. (i)How is XeOF4 prepared ?Draw its structure.

(ii)When HCL reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride .Why?

(i)Partial hydrolysis of $XeOF_4$

$XeF_6+H_2O \rightarrow XeOF_4+2HF$

Structure-square pyramidal. See Fig7.9

(ii) Its reaction with iron produces h2

$Fe+2HCl \rightarrow FeCl_2+H_2$

Liberation of hydrogen prevents the formation of ferric chloride.

5 MARK QUESTION

1. Account for the following.

(i)Noble gas form compounds with F_2&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.

(i)F_2&O_2 are best oxidizing agents.

(ii)In vapour state sulphur partly exists as S_2 molecule which has two unpaired electrons in the antibonding pi *orbitals like 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 explosure to air, it spontaneously catches fire forming P_4O_{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.

2. When Conc. H_2SO_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

The gas 'A' is NO_2 whereas 'B' is N_2O_4.

$XNO_3 + H_2SO_4 \rightarrow XHSO_4 + HNO_3$

Salt (conc.)

$Cu + 4HNO_3$ (Conc.) $\rightarrow Cu(NO_3)2 + 2NO_2 + 2H_2O$

Blue Brown (A)

$2NO_2$ (on cooling) $\rightarrow N_2O_4$

Colourless(B)

3. Arrange the following in the increasing order of the property mentioned.

(i)HOCl, $HClO_2$, $HClO_3$, $HClO_4$ (Acidic strength)

(ii)As_2O_3, ClO_2, GeO_3, Ga2O3 (Acidity)

(iii)NH_3, PH_3, AsH_3, SbH_3 (HEH bond angle)

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

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

(i)Acidic strength:HOCl<$HClO_2$<$HClO_3$<$HClO_4$

(ii)Acidity: Ga2O3<GeO_2<AsO_3<ClO_2

(iii)Bond angle: SbH_3<AsH_3<PH_3<NH_3

(iv)Acidic strength: HF<HCl<HBr<HI

(v)Ionic character: MI<MBr<MCl<MF

ASSIGNMENTS

Very shot answer type questions:

1) PH3 has lower boiling point than NH_3. Explain.

2) Why are halogens coloured.

3) What are chalcogens?

4) Which noble gas is Radioactive?

5) Explain why fluorine always exhibit an oxidation state of - 1 only.

6) Which compound led to the discovery of compounds of noble gas?

7) Name the most electronegative element.

8) Why is OF6 compound not known?

9) Why is N2 not particularly reactive?

10) Ammonia acts as aligned. Explain.

Short answer type questions:

1) Write Phosphorous is more reactive than red phosphorous. Explain.

2) Why do noble gases have comparatively large atomic sizes?

3) Arrange in decreasing order of Ionic character

M – F, M – Cl, M – Br, M – I

4) Phosphinic acid behaves as a monoprotic acid

5) Arrange the following in the order of property indicated:

a)AS_2O_3, ClO_2, GeO_2, Ga_2O_3__Increasing acidity

b) H_2O, H_2S, H_2Se, H_2Te__Increasing acid strength.

6) Arrange in decreasing order of bond energy:

F_2, Cl_2, Br_2, I_2

7) Complete the following:

i) $HNO_3 + P_4O_{10} \rightarrow$

ii) $IO^-_3 + I^- + H^+ \rightarrow$

8) Give the chemical reactions in support of following observations:

a) The +5 oxidation state of Bi is less stable than +3 oxidation state.

b) Sulphur exhibits greater tendency for catenation than selenium.

9) How would you account for following?

i)Enthalpy of dissociation of F_2 is much less than that of Cl_2.

ii)Sulphur in vapour state exhibits paramagnetism.

10) Draw structures of following:

a)Pre-oxomonasalphuric acid H_2SO_5

b)XeF_4

Level – III

1. Complete and balance:

i) $F_2 + H_2O$ Cold $\rightarrow$

ii) $BrO^-_3 + F_2 + OH^-$ →

iii) $Li + N_2$ (cold) →

iv) $NH_3 + NaOCl$ →

2) Despite lower electron affinity of F_2, is stronger oxidising agent than Cl_2. Explain.

3) Give reasons:

a) Nitric oxide becomes brown when released in air.

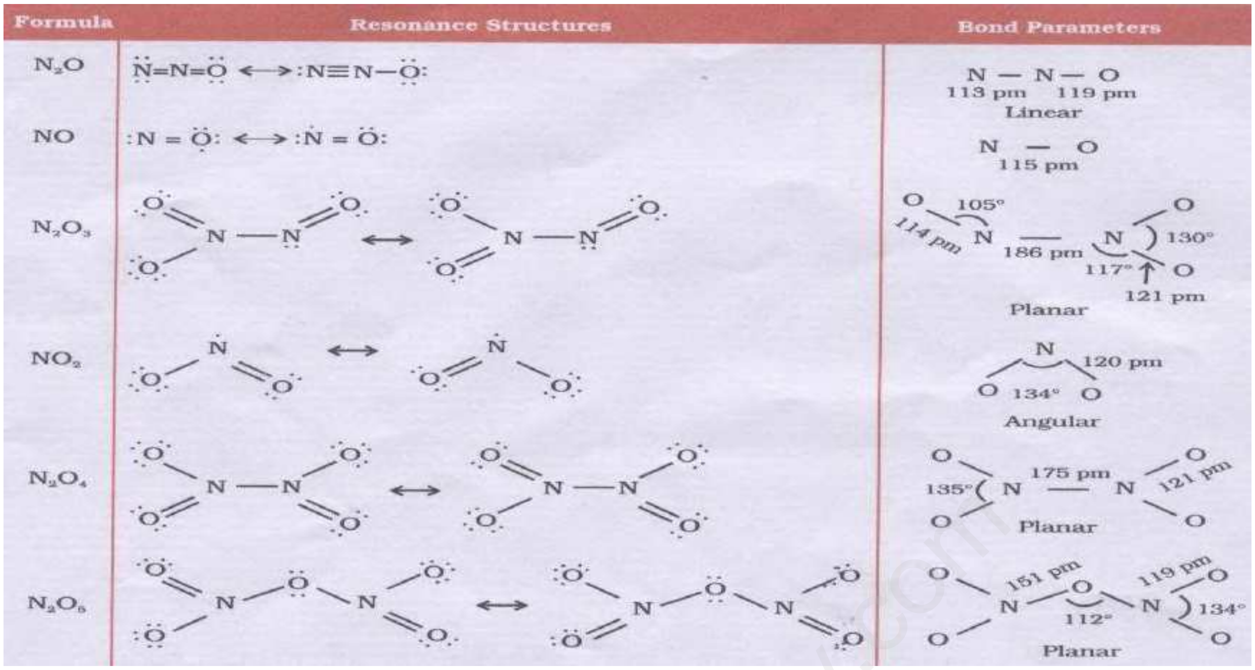
b) PCl5 is ionic in nature in the solid state.

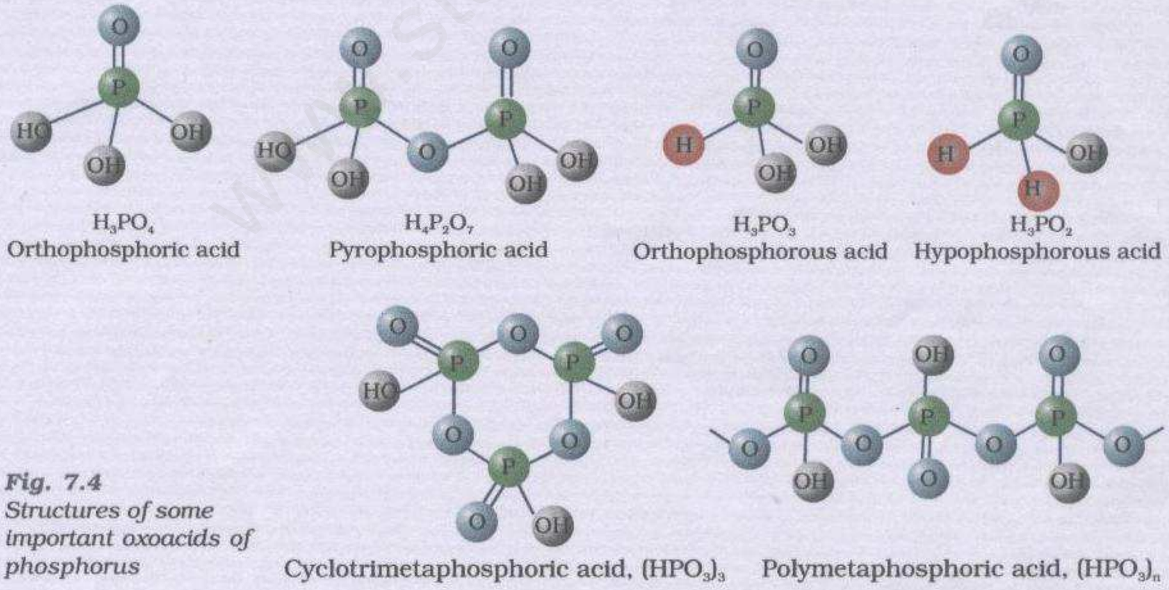
4) Which of the two is more covalent $SbCl_3$ or $SbCl_5$?

5) Addition of Cl_2 to KI solution gives if brown colour but excess at if turns it colourless. Explain.

Identify hybridization state of central atom and use conceot of VSEPR theory . also its shape (geometry) and draw the structure.

PCl_3	sp^3	bp=3	lp=1	
PCl_5	sp^3d	bp=5	lp=0	
BrF_3	sp^3d	bp=3	lp=2	
XeF_2	sp^3d	bp=2	lp=3	
XeF_4	sp^3d^2	bp=4	lp=2	
$XeOF_4$	sp^3d^2	bp=5	lp=1	
XeO_3	sp^3	bp=3	lp=1	
XeF_6	sp^3d^3	bp=6	lp=1	
SF_4	sp^3d	bp=4	lp=1	





H_3PO_4
Orthophosphoric acid

$H_4P_2O_7$
Pyrophosphoric acid

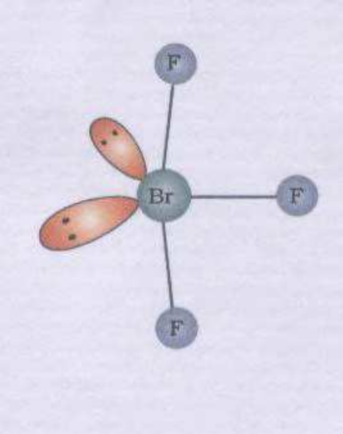
H_3PO_3
Orthophosphorous acid

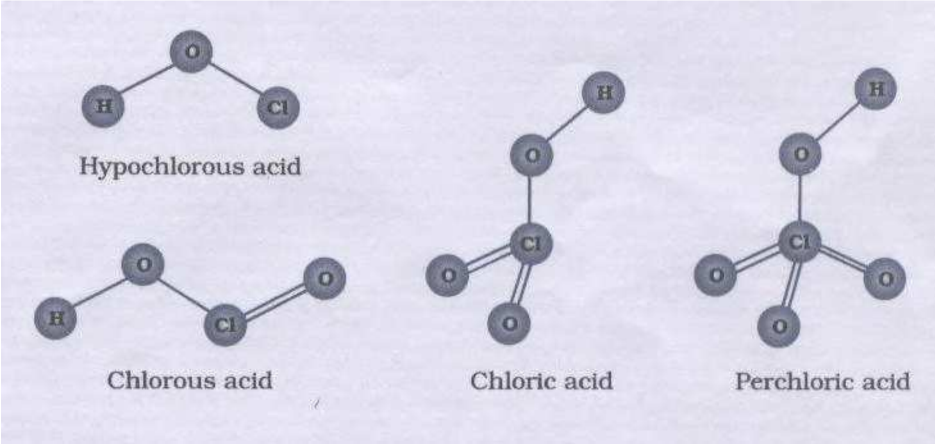
H_3PO_2
Hypophosphorous acid

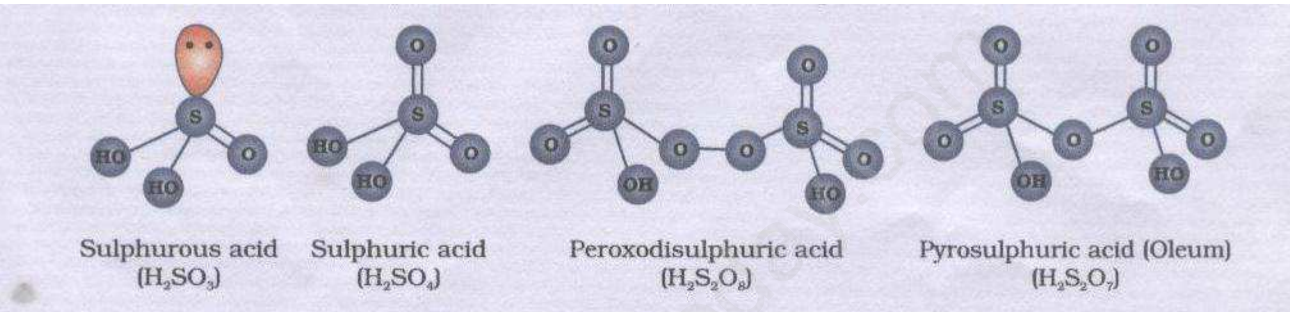
Cyclotrimetaphosphoric acid, $(HPO_3)_3$

Polymetaphosphoric acid, $(HPO_3)_n$

Fig. 7.4 Structures of some important oxoacids of phosphorus

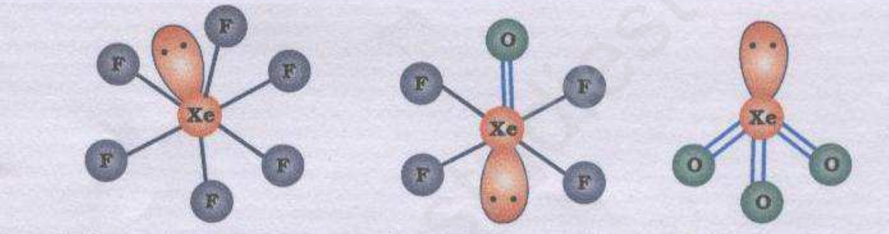




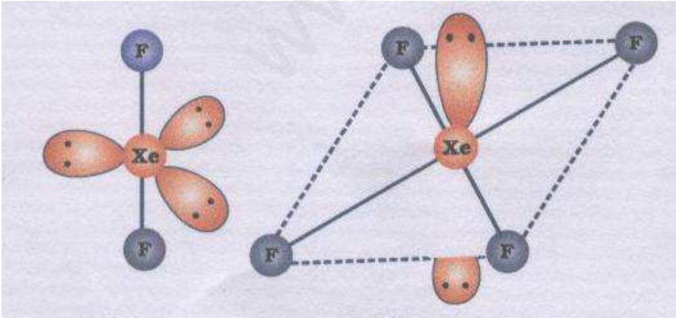


Sulphurous acid (H_2SO_3) Sulphuric acid (H_2SO_4) Peroxodisulphuric acid $(H_2S_2O_8)$ Pyrosulphuric acid (Oleum) $(H_2S_2O_7)$

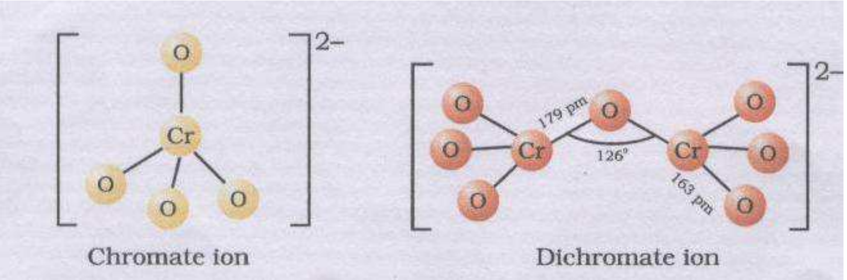
Fig. 7.6: Structures of some important oxoacids of sulphur



(c) Distorted octahedral (d) Square pyramidal (e) Pyramidal

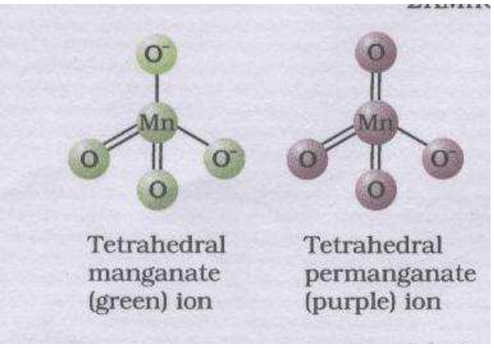


(a) Linear (b) Square planar



Chromate ion

Dichromate ion



Tetrahedral
manganate
(green) ion

Tetrahedral
permanganate
(purple) ion