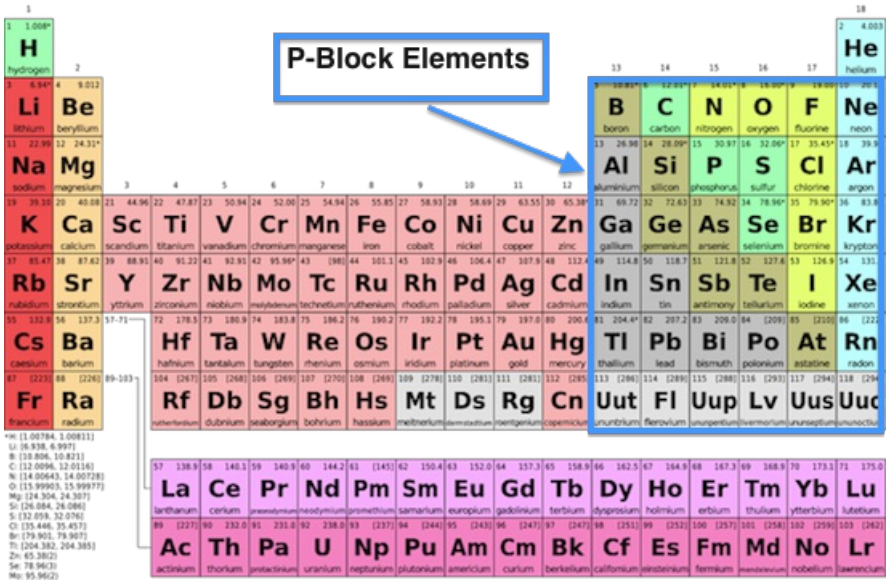
Revision Notes on p-Block Elements:



Boron Family (Group 13 Elements)

- **Members:** B, Al, Ga, In & Tl
- **Melting Point**: Decreases from B to Ga and then increases up to Tl.
- **Ionization Energies:** $1^{st} <<< 2^{nd} < 3^{rd}$
- **Metallic Character:** Increases from B to Tl. B is non-metal

Boron

Preparation of Boron:

- From Boric Acid: $B_2O_3(s) + 3Mg(s) \rightarrow 2B(s) + 3\,MgO(s)$
- From Boron Trichloride
  - (at 1270 k): $2BCl_3 + 3H_2\,(g) \rightarrow 2B(s) + 6HCl\,(g)$
  - (at 900 ^{0}C): $2BCl_3(g) + 3Zn\,(s) \rightarrow 2B(s) + 3\,ZnCl_2\,(s)$
- By electrolysis of fused mixture of boric anhydride (B_2O_3) and magnesium oxide (MgO) & Magnesium fluoride at 1100 ^{0}C
  - $2\,MgO- \rightarrow 2Mg + O_2(g)$
  - $B_2O_3 + 3Mg \rightarrow 2B + 3MgO$

- By thermal decomposition of Boron hydrides & halides:
  $B_2H_6(g) + \Delta \rightarrow 2B(s) + 3H_2(g)$

Compounds of Boron:

Orthoboric acid (H_3BO_3)

Preparation of Orthoboric acid

- **From borax** : $Na_2B_4O_7 + H_2SO_4 + 5H_2O \rightarrow Na_2SO_4 + 4H_3BO_3$
- **From colemanite** : $Ca_2B_6O_{11} + 2SO_2 + 11H_2O \rightarrow 2Ca(HSO_3)_2 + 6H_3BO_3$

Properties of Orthoboric acid

- **Action of Heat**:

$$4H_3BO_3 \xrightarrow[-4H_2O]{373\,k} 4HBO_2 \xrightarrow[-H_2O]{413\,k} H_2B_4O_7 \xrightarrow[-H_2O]{\text{Read heat}} 2B_2O_3$$

Metaboric acid Tetraboric acid Boron trioxide

- **Weak monobasic acidic behavior:**
  $B(OH)_3 \rightarrow H_3BO_3 \rightarrow H^+ + H_2O +$

Thus on titration with NaOH, it gives sodium metaborate salt

$H_3BO_3 + NaOH \rightarrow NaBO_2 + 2H_2O$

- **Reaction with Metaloxide:**

$$B(OH)_3 + MO \xrightarrow{\text{Fusion}} M - \text{borates}$$

Where M stands for a bivalent metal

- **Reaction with Ammonium boro fluoride:**

$$B(OH)_3 \xrightarrow[\text{Fusion}]{NH_4HF_2} NH_4BF_4 \xrightarrow[\text{heat}]{B_2O_3} BF_3$$

Ammonium boro fluoride

Borax (sodium tetraborate) $Na_2B_4O_7.\ 10H_2O$

Preparation from Boric Acid

$4H_3BO_3 + Na_2CO_3 \text{-->} Na_2B_4O_7 + 6H_2O + CO_2$

Properties of Borax

- **Basic Nature**:-

Aqueous solution of borax is alkaline in nature due to its hydrolysis

$Na_2B_4O_7 + 3H_2O \rightarrow NaBO_2 + 3H_3BO_3$

$NaBO_2 + 2H_2O$ □ $NaOH + H_3BO_3$

- **Action of heat:**

$$Na_2B_4O_7.10H_2O \xrightarrow[-10H_2O]{heat} Na_2B_4O_7 \xrightarrow{740^\circ C} 2NaBO_2 + B_2O_3$$

Diborabe(B_2H_6)

<u>Preparation of Diborane:</u>

Reduction of Boron Trifluoride:

$BF_3 + 3LiAlH_4 \rightarrow 2B_2H_6 + 3\ LiAl\ F_4$

From $NaBH_4$:

$2NaBH_4 + H_2SO_4$ □ $B_2H_6 + 2H_2 + Na_2SO_4$
$2NaBH_4 + H_3PO_4$ □ $B_2H_6 + 2H_2 + NaH_2PO_4$

Properties of Diborane:

- **Reaction with water**: $B_2H_6 + H_2O$ -->$2H_3BO_3 + 6H_2$
- **Combustion:** $B_2H_6 + 2O_2$ --? $B_2O_3 + 3H_2O$ ΔH = -2615 kJ/mol

Compounds of Aluminium:

Aluminium Oxide or Alumina (Al_2O_3)

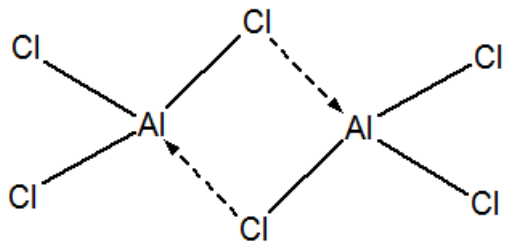
$2Al(OH)_3$ +Heat $\rightarrow$ $Al_2O_3 + 2H_2O$

$2Al(SO_4)_3$ +Heat $\rightarrow$ $Al_2O_3 + 2SO_3$

$(NH_4)_2Al_2(SO_4)_3{\cdot}24H_2O$ --> $2NH_3 + Al_2O_3 + 4SO_3 + 25\ H_2O$

Aluminum Chloride $AlCl_3$:

Structure of Aluminium Chloride:



<u>Properties of Aluminium Chloride</u>

- White, hygrosciopic solid
- Sublimes at 183 ^0C
- Forms addition compounds with NH_3, PH_3, $COCl_2$ etc.

- Hydrolysis: $AlCl_3 + 3H_2O$ --> $Al(OH)_3 + 3HCl + 3H_2O$
- Action of Heat: **2**$AlCl_3 .6H_2O$ --> $2Al(OH)_3$ à $Al_2O_3 + 6HCl + 3H_2O$

Carbon Family (Group 14 Elements):

- **Members:** C, Si, Ge, Sn, & Pb
- **Ionization Energies:** Decreases from C to Sn and then increases up to Pb.
- **Metallic Character:** C and Si are non metals, Ge is metalloid and Sn and Pb are metals
- **Catenation:** C and Si show a tendency to combine with its own atoms to form long chain polymers

Compounds of Carbon:

Carbon Monoxide

Preparation of Carbon Monoxide

- By heating carbon in limited supply of oxygen: $C + 1/2O_2$ --> CO.
- By heating oxides of heavy metals e.g. iron, zinc etc with carbon.
  - $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
  - $ZnO + C \rightarrow Zn + CO$
- By passing steam over hot coke: $C + H_2O \rightarrow CO + H_2$ (water gas)
- By passing air over hot coke: $2C + O_2 + 4N_2 \rightarrow 2CO + 4N_2$ (Producer gas)

?**Properties of Carbon Monoxide:**

- A powerful reducing agent : $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
  $CuO + CO \rightarrow Cu + CO_2$
- Burns in air to give heat and carbon dioxide: $CO + 1/2O2 \rightarrow CO2 + heat$.

Tests For Carbon Monoxide:

- Burns with blue flame
- Turns the filter paper soaked in platinum or palladium chloride to *pink or green*.

Carbon di-oxide

Preparation of Carbon di-oxide

- By action of acids on carbonates: $CaCO_3 + 2HCl$ □ $CaCl_2 + H_2O + CO_2$
- By combustion of carbon: $C + O_2$ □ CO_2

Properties of Carbon di-oxide

- It turns lime water milky $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 \downarrow + H_2O$,
- Milkiness disappears when CO_2 is passed in excess
  $CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$
- Solid carbon dioxide or *dry ice* is obtained by cooling CO2 under pressure. It passes from the soild state straight to gaseous state without liquefying (hence dry ice).

Carbides:

- **Salt like Carbides :** These are the ionic salts containing either C_2^{2-} (acetylide ion) or C^{4-} (methanide ion)e.g. CaC_2, Al_4C_3, Be_2C.
- **Covalent Carbides :** These are the carbides of non-metals such as silicon and boron. In such carbides, the atoms of two elements are bonded to each other through covalent bonds. SiC also known as *Carborundum*.
- **Interstitial Carbides :** They are formed by transition elements and consist of metallic lattices with carbon atoms in the interstices. e.g. tungsten carbide WC, vanadium carbide VC.

Compounds of Silicon:

Sodium Silicate (Na_2SiO_3):

?Prepared by fusing soda ash with pure sand at high temperature:
$Na_2CO_3 + SiO_3 \rightarrow Na_2SiO_3 + CO_2$

Silicones:
Silicon polymers containing Si – O – Si linkages formed by the hydrolysis of alkyl or aryl substituted chlorosilanes and their subsequent polymerisation.

Silicates:

Salts of silicic acid, H_4SiO_4 comprised of SiO_4^{4-} units having tetrahedral structure formed as result of sp^3 hybridization.

Nitrogen Family (Group 15 Elements)

- **Members:** N, P, As, Sb & Bi
- **Atomic Radii:** Increases down the group. Only a small increases from As to Bi.
- **Oxidation state:** +3, +4 & +5.Stability of +3 oxidation state increases down the group.
- **Ionization energy:** Increases from N to Bi.

Nitrogen

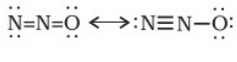
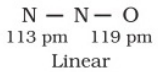
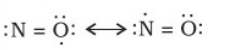
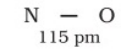
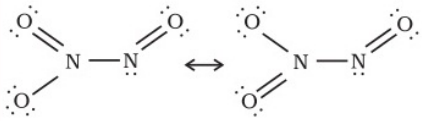
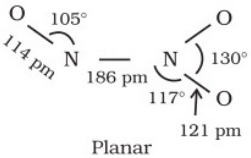
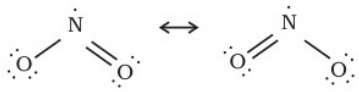
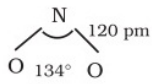
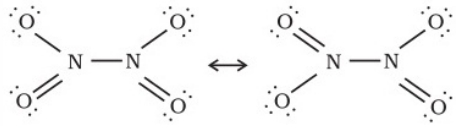
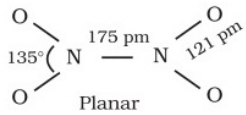
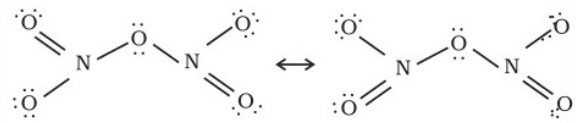
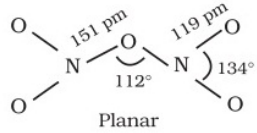
Preparation of Nitrogen:

- $3CuO + 2NH_3 + Heat \rightarrow N_2 + Cu + 3H_2O$
- $CaOCl_2 + 2NH_3 + Heat \rightarrow CaCl_2 + 3H_2O + N_2$
- $NH_4NO_2 + Heat \rightarrow 3H_2O + N_2 + Cr_2O_3$

Properties of Dinitrogen:

- Formation of Nitrides (with Li, Mg, Ca & Al): $Ca + N_2 + Heat \rightarrow Ca_3N_2$
- Oxidation: $N_2 + O_2 \rightarrow 2NO$
- Reaction with carbide (at 1273 K): $CaC_2 + N_2 \rightarrow CaCN_2 + C$

Oxides of Nitrogen

Formula	Resonance Structures	Bond Parameters
N_2O		 Linear
NO		
N_2O_3		 Planar
NO_2		 Angular
N_2O_4		 Planar
N_2O_5		 Planar

Oxy -Acids of Nitrogen :

Oxy Acids	Name of oxy – acid
1. $H_2N_2O_2$	Hyponitrous acid
2. H_2NO_2	Hydronitrous acid
3. HNO_2	Nitrous acid
4. HNO_3	Nitric acid
5. HNO_4	Per nitric acid

Ammonia (NH_3):

Preparation of Ammonia:

- By heating an ammonium salt with a strong alkali ;$NH_4Cl + NaOH \rightarrow NH_3 + NaCl + H_2O$
- By the hydrolysis of magnesium nitride: $Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$.
- Haber's process : $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$.

Properties of Ammonia:

- **Basic nature :** Its aq. solution is basic in nature and turns red litmus blue.
  $NH_3 + H_2O \leftrightarrow NH_4^+ + OH^-$
- **Reaction with halogens :**
  - $8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$
  - $NH3 + 3Cl_2$ (in excess) $\rightarrow NCl_3 + 3HCl$
  - $8NH3 + 3Br_2 \rightarrow 6NH4Br + N_2$
  - $NH_3 + 3Br_2$ (in excess) $\rightarrow NBr_3 + 3HBr$
  - $2NH_3 + 3I_2 \rightarrow NH_3.NI_3 + 3HI$
  - $8NH_3.NI_3 \rightarrow 6NH_4I + 9I_2 + 6N_2$
- **Complex formation :**
  - $Ag^+ + NH_3 \rightarrow [Ag(NH_3)_2]^+$
  - $Cu^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+}$
  - $Cd^{2+} + 4NH_3 \rightarrow [Cd(NH_3)_4]^{2+}$

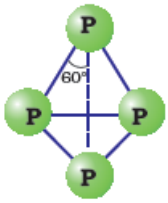
Precipitation of heavy metal ions from the aq. solution of their salts :

- $FeCl_3 + 3NH_4OH \rightarrow Fe(OH)_3 + 3NH_4Cl$
  Brown ppt.
- $AlCl_3 + 3NH_4OH \rightarrow Al(OH)_3 + 3NH_4Cl$
  White ppt.
- $CrCl_3 + 3NH_4OH \rightarrow Cr(OH)_3 + 3NH_4Cl$
  Green ppt.

Phosphorus:

Allotropy of Phosphorus:

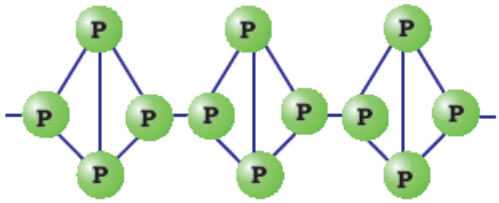
a) White phosphorus:



- Translucent white waxy solid
- Extremely reactive
- Poisonous and insoluble in water

b) Red Phosphorus:

- Formed by heating white phosphorus in absence of air.
- Does not burn spontaneously at room temperature.



c) Black Phosphorus: Formed by further heating of red phosphorus.

Compounds of Phosphorus:

a) Phosphine, PH_3:

<u>Preparation of Phosphine</u>

- $Ca_3P_2 + 6H_2O \rightarrow 2\ PH_3 + 3\ Ca(OH)_2$
- $4H_3PO_3$ +Heat $\rightarrow$ PH_3+ 3 H_3PO_4
- PH_4I +KOH $\rightarrow$ PH_3+KI + H_2O
- P4 + 3KOH + $3H_2O \rightarrow PH_3$ +$3KH_3PO_2$

Properties of Phosphine:

- Formation of Phosphonic Iodide: PH_3 + HI à PH_4I
- Combustion: $PH_3 + 2O_2$ à H_3PO_4

b) Phosphorous Halides:

Preparation:

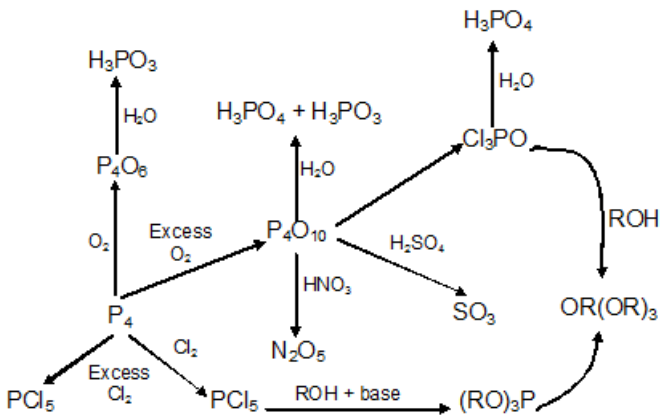
- P_4+ $6Cl_2 \rightarrow 4PCl_3$
- P_4+ $10Cl_2 \rightarrow 4PCl_5$
- P_4+ $8SOCl_2 \rightarrow 4PCl_3 + 4SO_2$+ $2S_2Cl_2$
- P_4+ $10SOCl_2 \rightarrow 4PCl_5 + 10SO_2$

Properties:

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

- $PCl_5 + 4H_2O$ □ $POCl_3$ à $H_3PO_4 + 5HCl$
- $PCl_3 + 3CH_3COOH$ □ $3\ CH_3COCl + H_3PO_3$
- $PCl_5 + CH_3COOH$ □ $CH_3COCl + POCl_3 + HCl$
- $2Ag + PCl_5$ □ $2AgCl + PCl_3$
- $2Sn + PCl_5$ □ $SnCl_4 + 2PCl_3$
- PCl_5 + Heat □ $PCl_3 + Cl_2$

?C) Oxides of Phosphorus:



d) Oxy – Acids of Phosphorus:

Oxo acid	Name
H_3PO_2	Hypophosphorus acid
H_3PO_3	Phosphorus acid
$H_4P_2O_6$	Hypophosphoric acid
H_3PO_4	Orthophosphoric acid
$H_4P_2O_7$	Pyrophosphoric acid
HPO_3	Metaphosphoric acid

Oxygen Family (Group 16 Elements) :

Sr. No.	Property	Oxygen	Sulfur	Selenium	Tellurium	Polonium
1.	Configuration	$[He]2s^2 2p^4$	$[Ne]3s^2 3p^4$	$[Ar]4s^2 4p^4$	$[Kr]5s^2 5p^4$	$[Xe]6s^2 6p^4$
2.	Common oxidation state	-2	-2, +4, +6	+4, +6	+4, +6	
3.	Atomic radius (pm)	66	104	116	143	167
4.	First ionization energy (KJ/mol)	1314	1000	941	869	812
5.	Electronegativity	3.5	2.5	2.4	2.1	2.0

Chemical Properties of Group 16:

Formation of volatile Hydrides:

$$Na_2S + H_2SO_4 \longrightarrow Na_2SO_4 + H_2S$$

$$Na_2Se + 2HCl \longrightarrow 2NaCl + H_2Se$$

Formation of Halides:

$$\frac{1}{8}S_8(s) + 3F_2(g) \longrightarrow SF_6(g)$$

$$\frac{1}{4}S_8(\ell) + Cl_2(g) \longrightarrow S_2Cl_2(\ell)$$

$$Te(s) + 2Cl_2(g) \longrightarrow TeCl_4(s)$$

$$Te(s) + 2I_2(g) \longrightarrow TeI_4(s)$$

Formation of Oxide:

a) All elements (except Se) forms monoxide.

b) All elements form dioxide with formula MO_2, SO_2 is a gas, SeO_2 is volatile solid. While TeO_2 and PoO_2 are non – volatile crystalline solids.

c) Ozone: It is unstable and easily decomposes into oxygen. It acts as a strong oxidising agent due to the case with which it can liberate nascent oxygen.

Oxyacids:

Sulphur	Selenium	Tellurium
Sulphurous acid H_2SO_3.	Selenious acid H_2SeO_3	Tellurous acid H_2TeO_3.
Sulphuric acid H_2SO_4	Selnenic acid H_2SeO_4	Telluric acid H_2TeO_4.
Peroxomonosulphuric acid H_2SO_5(Caro's acid)		
Peroxodisulphuric acid		
$H_2S_2O_8$ (Marshell's acid)		
Thio sulphuric acid $H_2S_2O_3$		
Dithiconic acid $H_2S_2O_6$		
Pyrosulphuric acid $H_2S_2O_7$		

Allotropes of Sulphur :

Rhombic sulphur:

- It has bright yellow colour.
- It is insoluble in water and carbon disulphide. Its density is 2.07 gm cm^{-3} and exists as S_8 molecules. The 8 sulphur atoms in S_8 molecule forms a puckered ring.

Monoclinic Sulphur :

- Stable only above 369 K. It is dull yellow coloured solid, also called *b - sulphur*. It is soluble in CS_2 but insoluble in H_2O.
- It slowly changes into rhombic sulphur. It also exist as S_8 molecules which have puckered ring structure. It however, differs from the rhombic sulphur in the symmetry of the crystals

Plastic Sulphur:

- It is obtained by pouring molten sulphur to cold water.
- It is amorphous form of sulphur.
- It is insoluble in water as well as CS_2.

Sulphuric Acid:

- Due to strong affinity for water, H_2SO_4 acts as a powerful dehydrating agent.
- Concentrated H_2SO_4 reacts with sugar, wood, paper etc to form black mass of carbon. This phenomenon is called charring.
- It is moderately strong oxidizing agent.

$$C + 2H_2SO_4 \longrightarrow 2H_2O + 2SO_2 + CO_2$$

$$\frac{1}{8}S_8 + 2H_2SO_4 \longrightarrow 2H_2O + 3SO_2$$

$$P_4 + 10H_2SO_4 \longrightarrow 4H_3PO_4 + 10SO_2 + 4H_2O$$

$$2HBr + H_2SO_4 \longrightarrow 2H_2O + SO_2 + Br_2$$

$$H_2S + H_2SO_4 \longrightarrow 2H_2O + S + SO_2$$

$$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$$

$$Pb + 2H_2SO_4 \longrightarrow PbSO_4 + SO_2 + 2H_2O$$

- Decomposes carbonates, bicarbonates, sulphides, sulphites, thiosulphates and nitrites at room temperatures.

$$H_2SO_4 + Na_2CO_3 \longrightarrow Na_2SO_4 + H_2O + CO_2 \uparrow$$

$$H_2SO_4 + 2NaHCO_3 \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2 \uparrow$$

$$H_2SO_4 + Na_2S \longrightarrow Na_2SO_4 + H_2S \uparrow$$

- Salts like chlorides, fluorides, nitrates, acetates, oxalates are decomposed by hot conc. H_2SO_4 liberating their corresponding acids.

$$H_2SO_4 + CaCl_2 \longrightarrow CaSO_4 + 2HCl \uparrow$$

$$H_2SO_4 + CaF_2 \longrightarrow CaSO_4 + 2HF$$

$$H_2SO_4 + 2KNO_3 \longrightarrow K_2SO_4 + 2HNO_3$$

?

Halogen Family (Group 17 Elements)

Inter halogen compounds:

Type XX'_1 (n = 1) (with linear shape)	Type XX'_3 (n = 3) (with T-shape)	XX'_5 (n = 5) (with square pyramidal shape)	XX'_7 (n = 7) with pentagonal bipyramidal shape)
ClF	ClF_3	ClF_5	
BrF BrCl	BrF_3	BrF_5	
ICl, IBr, IF	ICl_3, IF_3	IF_5	IF_7

Hydrogen Halides:

Properties of Hydrogen Halides:

- All the three acids are reducing agents HCl is not attacked by H_2SO_4.
  - $2HBr + H_2SO_4 \rightarrow 2H_2O + SO_2 + Br_2$
  - $2HI + H_2SO_4 \rightarrow 2H_2O + SO_2 + I_2$
- All the three react with $KMnO_4$ and $K_2Cr_2O_7$
  - $2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl2 + 8H_2O + 5Cl_2$

- $K_2Cr_2O_7 + 14HBr \rightarrow 2KBr + 2CrBr_3 + 7H_2O + 3Br_2$

- Other reactions are similar.
  - Dipole moment : HI < HBr < HCl < HF
  - Bond length: HF < HCl < HBr < HI
  - Bond strength: HI < HBr < HCl < HF
  - Thermal stability: HI < HBr < HCl < HF
  - Acid strength: HF < HCl < HBr < BI
  - Reducing power: HF < HCl < HBr < HI

Pseudohalide ions and pseudohalogens:

Ions which consist of two or more atoms of which at least one is nitrogen and have properties similar to those of halide ions are called pseudohalide ions. Some of these pseudohalide ions can be oxidised to form covalent dimers comparable to halogens (X_2). Such covalent dimers of pseudohalide ions are called pseudohalogens.

The best known psuedohalide ion is CN^-

Pseudohalide ions	Name
CN^-	Cyanide ion
OCN^-	Cyanate ion
SCN^-	Thiocyante ion
$SeCN^-$	Selenocyanate ion
NCN^{2-}	Cyanamide ion
N_3^-	Azide ion
OMC^-	Fulminate ion

Pseudohalogen

- $(CN)_2$ cyanogen
- $(SCM)_2$ thiocyanogen

Some important stable compound of Xenon

- XeO_3 Pyramidal
- XeO_4 Tetrahedral
- $XeOF_4$ Square pyramidal
- XeO_2F_2 Distorted octahedral

First rare gas compound discovered was $Xe^+ (PtF_6]^-$ by Bartlett.

Oxyacids of Chlorine

Formula	Name	Corresponding Salt
HOCl	Hypochlorous acid	Hypochlorites
$HClO_2$	Chlorous acid	Chlorites
$HClO_3$	Chloric acid	Chlorates
$HClO_4$	Perchloric acid	Perchlorates

Acidic Character: Acidic character of the same halogen increases with the increase in oxidation number of the halogen: $HClO_4 > HClO_3 > HClO_2 > HOCl$

Preparation

HOCl :

- $Ca(OCl)_2 + 2HNO_3 \rightarrow Ca(NO_3)_2 + 2HOCl$

$HClO_2$:

- $BaO_2 + 2ClO_2 \rightarrow Ba(ClO_2)_2$ (liquid) + O_2
- $Ba(ClO_2)_2 + H_2SO_4$(dil.) $\rightarrow BaSO_4 \downarrow + 2HClO_2$

$HClO_3$:

- $6Ba(OH)_2 + 6Cl_2 \rightarrow 5BaCl_2 + Ba(ClO_3)_2 + 6H_2O$
- $Ba(ClO_3)_2 + H_2SO_4$(dil.) $\rightarrow BaSO_4 \downarrow + 2HClO_3$

$HClO_4$:

- $KClO_4 + H_2SO_4 \rightarrow KHSO_4 + HClO_4$
- $3HClO_3 \rightarrow HClO_4 + 2ClO_2 + H_2O$

The Noble Gases (Group 18 Elements):

The noble gases are inert in nature. They do not participate in the reactions easily because they have

- stable electronic configuration i.e. complete octet.
- high ionization energies.
- low electron affinity.

Compounds of Xenon

$$Xe + F_2 \xrightarrow[673\,K]{\text{Nickel tube}} XeF_2$$
(1: 2)

$$Xe + 2F_2 \xrightarrow[5-6\ atm]{\text{Nickel tube, } 673\,K} XeF_4$$
(1: 5)

$$Xe + 3F_2 \xrightarrow[50-60\ atm]{\text{Nickel tube, } 575\,K} XeF_6$$
(1: 20)

Molecule	Total electron pairs (BP + LP)	Hybridisation	Shape
XeF_2	5	Sp^3d	Linear
XeF_4	6	Sp^3d^2	Square planar
XeF_6	7	sp^3d^3	Distorted octahedral

Uses of Nobles gas

The noble gases are used in following ways:

(A) Helium

- It is used to fill airships and observation balloons.
- In the oxygen mixture of deep sea divers.
- In treatment of asthma.
- Used in inflating aeroplane tyres.
- Used to provide inert atmosphere in melting and welding of easily oxidizable metals.

(B) Neon

- It is used for filling discharge tubes, which have different characteristic colours and are used in advertising purposes.
- Also used in beacon lights for safety of air navigators as the light possesses fog and stram perpetrating power.

(C) Argon

Along with nitrogen it is used in gas – filled electric lamps because argon is more inert than nitrogen.