

P Block Elements

P-Block Elements

The element in which last electron enters in P-block are called P-block elements.

G.E.C	$ns^2 np^1$	$ns^2 np^2$	$ns^2 np^3$	$ns^2 np^4$	$ns^2 np^5$	$ns^2 np^6$	
V.S.E	3	4	5	6	7	8	
							18 zero
2nd	B	C	N	O	F	Ne	
3rd	Al	Si	P	S	Cl	Ar	
4th	Ge	Ge	As	Se	Br	Kr	
5th	Sn	Sn	Sb	Te	I	Xe	
6th	Tl	Pb	Bi	Po	At	Rn	
	Metals		Metalloids		Non-metals		

General Electronic Configuration =

$(ns^2 np)^{1-6}$

gp 13 = Boron family

gp 14 = Carbon family

gp 15 = Nitrogen (Used in fertilizers)

gp 16 = Chalcogens (Used in ore formation)

gp 17 = Halogens (Salt producing)

gp 18 = Inert gas / noble gas

Group No. 18 :-

Q¹ Why elements of gp no. 18 are known as inert gases?
 Noble gases?

→ Because they are chemically inert and formed less no. of compound (due to complete Octet)

Q² Write the reason of inertness of noble gases?

→ Because their valence shell is complete having electronic configuration $ns^2 np^6$

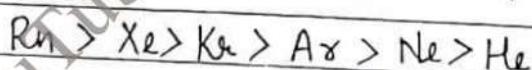
→ Value of ionisation enthalpy is maximum

→ ΔH_{eg} (electron gain enthalpy) is +ve

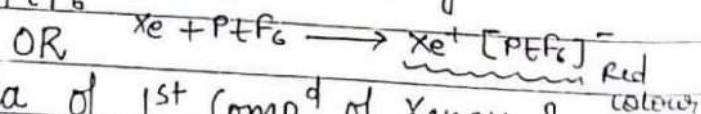
~~Reason~~ Q³ Inert gases have very low B.P. why?

→ Because they have weakest forces i.e London forces or dispersion forces that's why they have very low B.P.

B.P & Molecular Weight

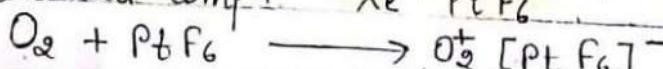


Q⁴ What inspire Neil Bartlett for carrying out Xe^{+} ?
 b/w Xenon and PtF_6^-

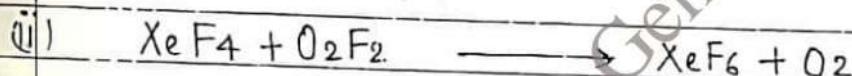
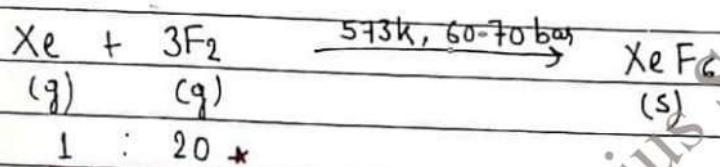
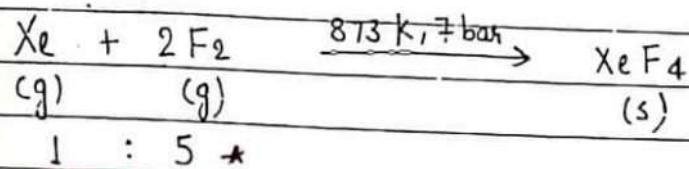
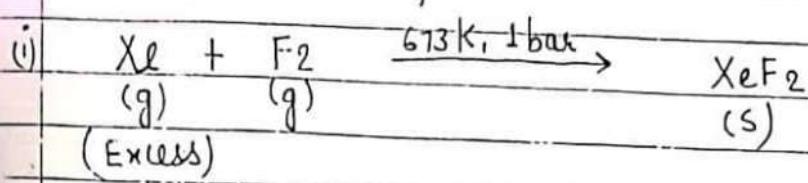


Write the formula of 1st Comp^d of Xenon?

→ Bartlett first prepared a red Comp^d which have formula $O_2^+ PtF_6^-$. Bartlett observed that first I.P. of O_2^+ is almost similar with first I.P. of Xenon. So they prepared another red coloured Comp^d $Xe^+ PtF_6^-$.



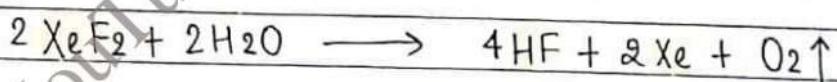
Xenon-Fluorine Compound :-



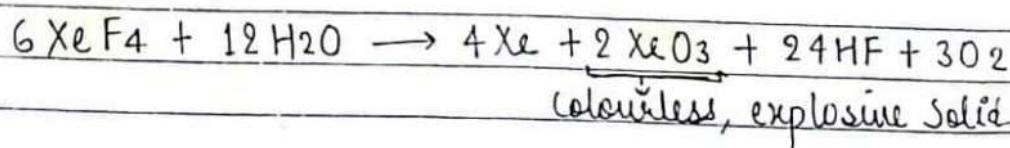
Chemical Properties of Comp^d of Xenon :-

1) Hydrolysis :-

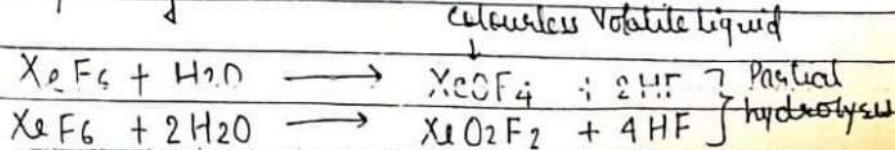
(i) Hydrolysis of XeF_2 :-

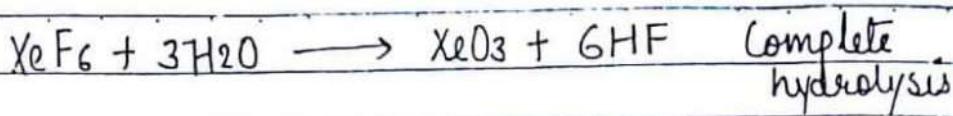


(ii) * Hydrolysis of XeF_4 :-

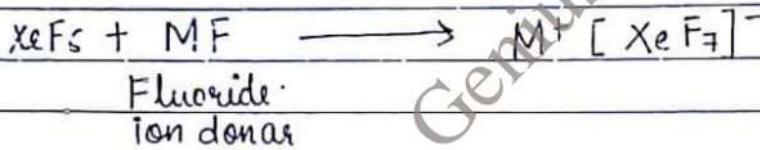
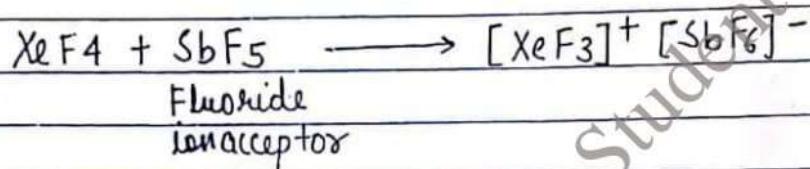
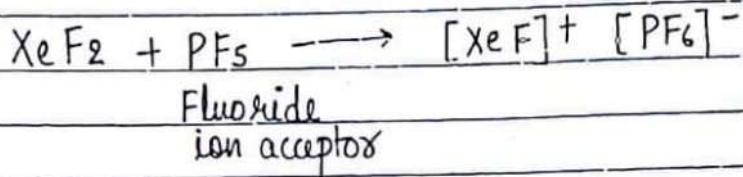


(iii) Hydrolysis of XeF_6 :-





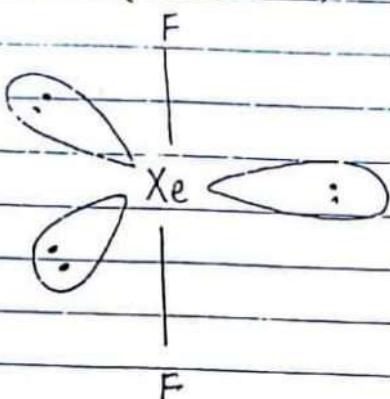
* Formation of Fluoride Anion :-



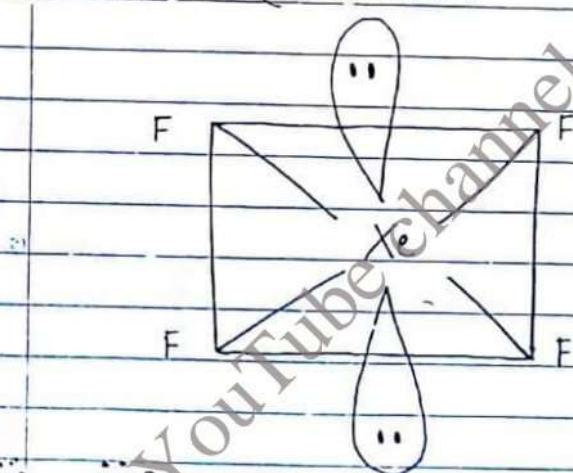
$$[\text{M} = \text{Na}, \text{K}, \text{Rb}, \text{Cs}]$$

* Draw the str. of following on the basis of VSEPR

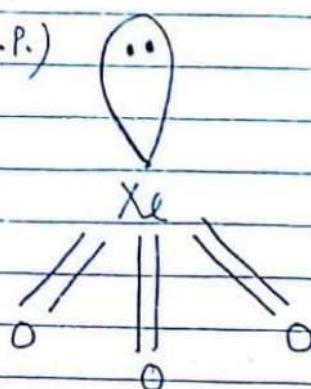
- 1 XeF_2
- 2 XeF_4
- 3 XeF_6
- 4 XeO_3
- 5 XeOF_4

(i) XeF_2 SP^3d ($2\sigma + 3\text{l.p.}$)

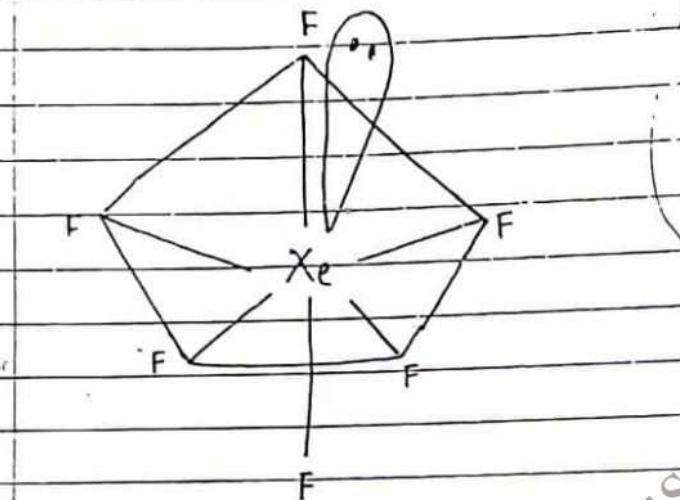
Shape :- Linear

(ii) :XeF_4 SP^3d^2 ($4\sigma + 2\text{l.p.}$)

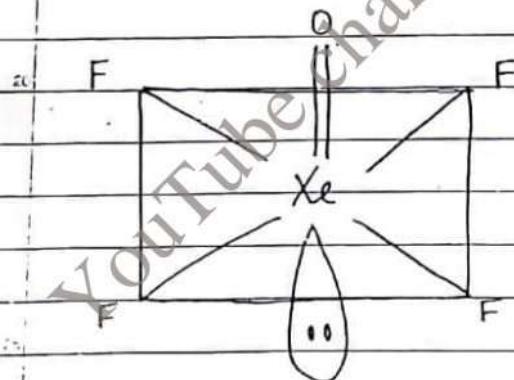
Shape :- Square Planar

(iii) XeO_3 SP^3 ($3\sigma + 1\text{l.p.}$)

shape :- Pyramidal

(iv) XeF_6 SP^3d^3 ($5\sigma + 11\text{P.P.}$)

Shape :- Capped / Distorted Octahedral

(v) XeOF_4 SP^3d^2 ($5\sigma + 11\text{P.P.}$)

Shape :- Square Pyramidal

* Uses :-

- Helium is a non-inflammable and light gas so it is used in filling balloons for meteorological obs.
- Helium is used in gas-cooled nuclear reactors. It is used to produce and sustain powerful superconducting magnets which form an essential part of modern NMR Spectrometers and Magnetic Resonance Imaging (MRI) Systems for clinical diagnosis.

Helium is used as a diluent for oxygen in modern diving apparatus bcz of its very low solubility in blood

Neon :-

- Used in discharge tubes and fluorescent bulbs for advertisement display purpose.
- Neon bulbs are used in botanical gardens and in green houses

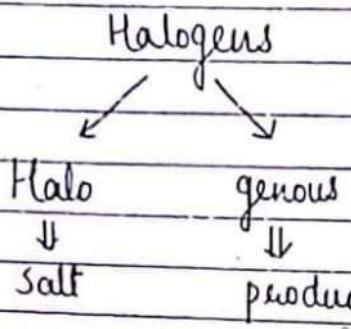
Argon :-

- Used mainly to provide an inert atmosphere in high temp. metallurgical processes (arc welding of metals or alloys) and for filling electric bulbs

Group 17 :-

Q Group 17 elements are collectively known as halogens. why?

Ans Because they produce salt so they known as Halogens

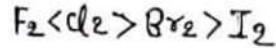


Q* Fluorine have less -ve e⁻ gain enthalpy than that of chlorine?

This is due to small size of fluorine atom. Incoming e⁻ is added in 2P Orbital of fluorine which feels more / strong interelectronic repulsion. That's why fluorine have less -ve e⁻ gain enthalpy than that of chlorine.

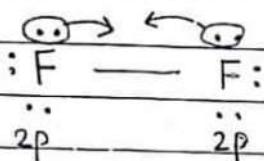
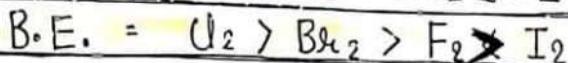
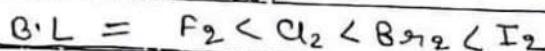
Due to large size of chlorine atom, the incoming e⁻ is added in 3P Orbital of chlorine which feels less interelectronic repulsion. That's why chlorine have more -ve e⁻ gain enthalpy than that of fluorine

(expected order)
B.E.
(experimental)



* Q Write the correct Order of Bond energy of Halogen
OR

Why Fluorine has less Bond energy than Chlorine
→ Due to small size of Fluorine interatomic repulsion b/w lone pair much stronger than chlorine that's why bond energy of F_2 is smaller than Cl_2 .

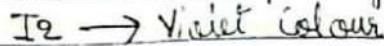
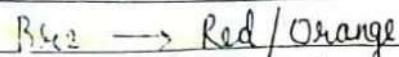
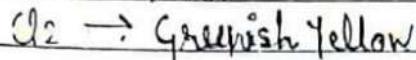
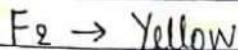


F have small size so I.P \leftrightarrow I.P is stronger so they have low B.E.

15
Q Fluorine and chlorine are gases, Bromine is liquid while iodine is solid why?

Ans Halogens are non-polar so they have only van der waals forces. On increasing molecular weight van der waals forces ↑ i.e. iodine have highest van der waals forces that's why it exists in solid state while Fluorine & chlorine have less van der waals force so they exist in gases state

Q 'All the halogens are coloured'. Justify this statement
Ans This is due to absorption of radiations in visible region which results in the excitation of outer shell electrons to higher energy level by absorbing different quanta of radiations, they display different colour.

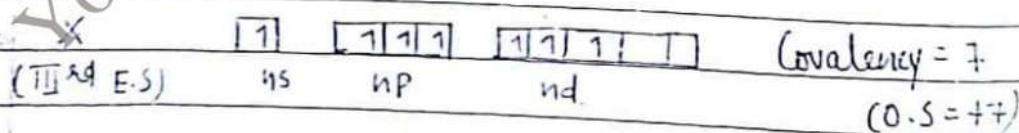
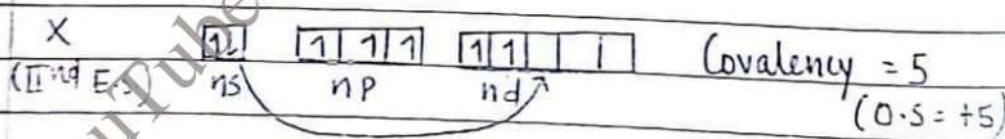
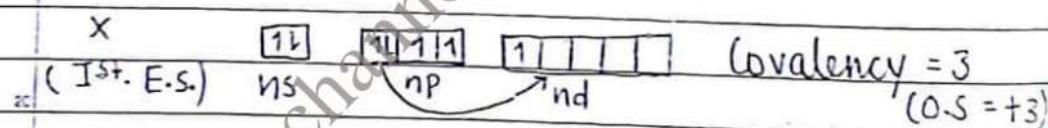
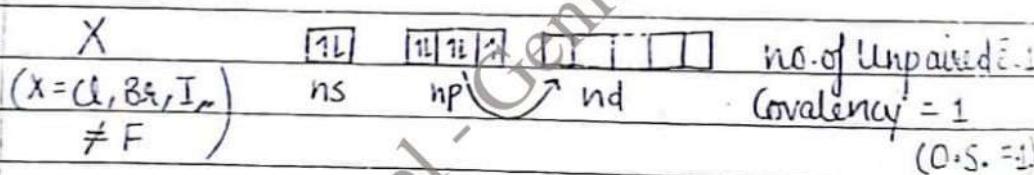


Q. Fluorine exhibits only '-1' Oxidation state while other halogens shows '+1, +3, +5, +7' (high O.S.) why?

→ Fluorine exhibit only -1 state due to :-

- i) It is highest electronegative element
- ii) In Fluorine Vacant d-orbitals are absent. Hence excitation of e⁻ can't take place so it can't expand its octet.

While in other halogens Vacant d-orbital are present so they can expand their Octet hence through high O.S.



Q: Write short note on the hydride of grp 17.

→

H — F	Size of X ↑ Bond strength ↓
H — Cl	Bond energy ↓ Bond length ↗
H — Br	Tendency to donate H^+ ↑ Acidic nature ↑
H — I	Thermal stability ↓

Q HF is liquid while other HX are gases?

→ Due to strong intermolecular hydrogen bonding

Q HF have higher B.P in comparison of other HX

→ Because of more electronegativity of fluorine, intermolecular hydrogen bonding is formed in HF.

B.P \propto Intermolecular H.B.

Scanned with CamScanner

Scanned with CamScanner

Scanned with CamScanner

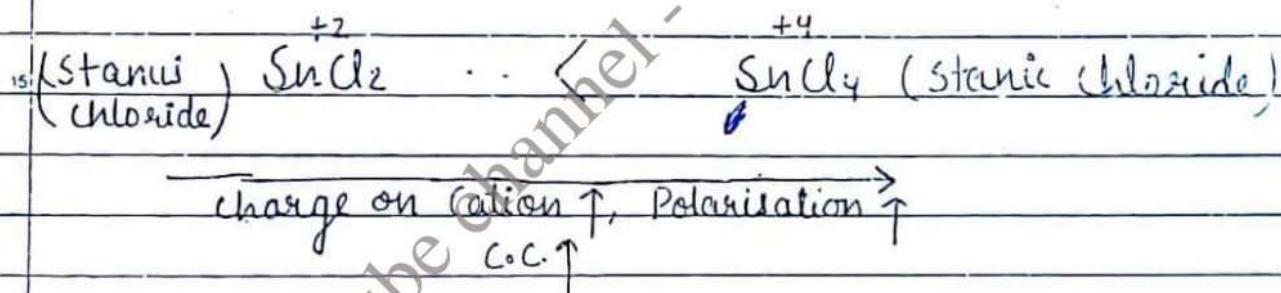
Q Arrange the following compd in decreasing Order of Ionic character.

	Size of cation ↓	Size of anion ↑	Charge on cation ↑ anion ↑
→ NaF			
NaCl		Polarisation ↑	
NaBr	C.C. ↑		Polarisation \propto C.C
NaI	I.C. ↓		\propto Size of anion

Order of I.C. :-



Q SnCl₄ is more covalent in nature than SnCl₂ ?



20 * Chlorine (Cl₂)

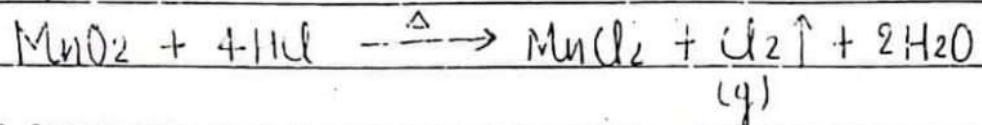
Discovered by → Schleele

Named by → John Davy

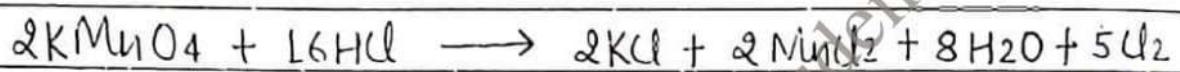
Greek Word → chlorous → greenish yellow

* Method of Preparation :-

① Reaction of MnO_2 with Concentrate HCl -

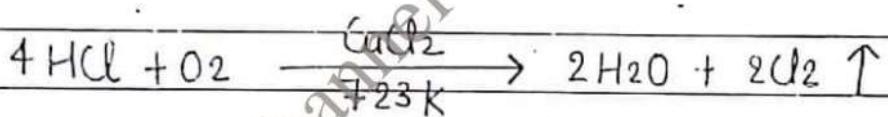


② Reaction of $KMnO_4$ with HCl :-



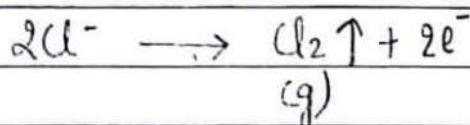
Industrial Process :-

i) Deacon's Process :-



ii) By electrolysis of conc. NaCl (Brine) :-

Anode (+ve)

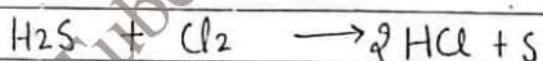
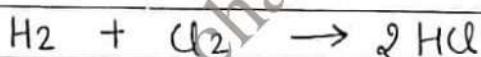
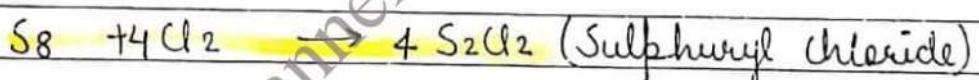
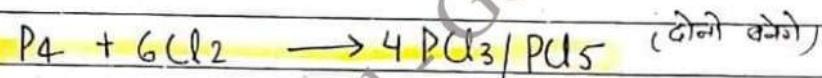
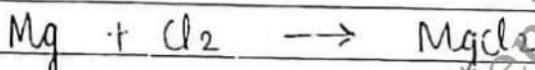
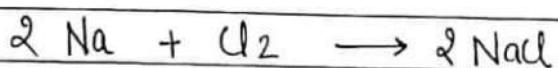
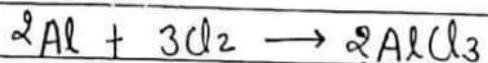


Physical Property :-

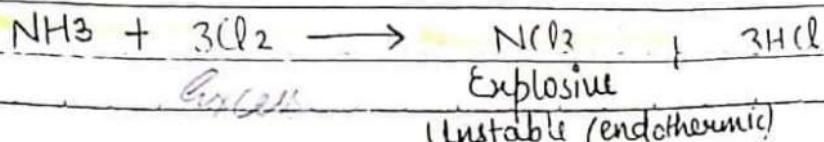
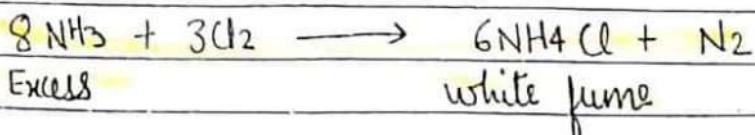
→ It is greenish yellow gas with pungent and suffocating odour.

Chemical Properties

1 Reaction with metal and non-metal :-



2 Reaction with Ammonia :-



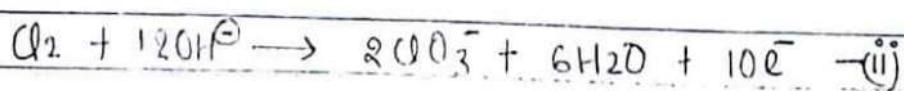
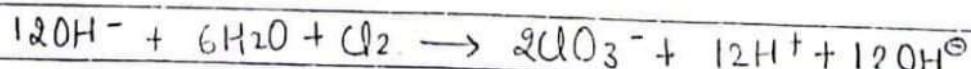
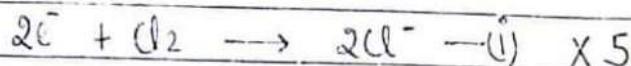
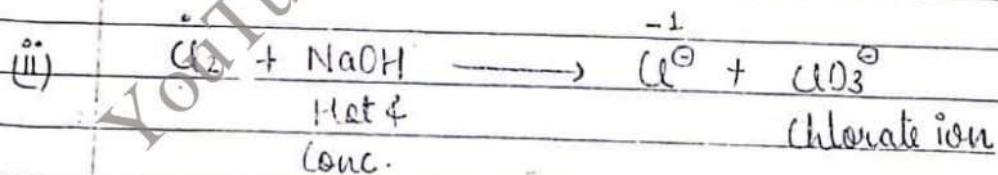
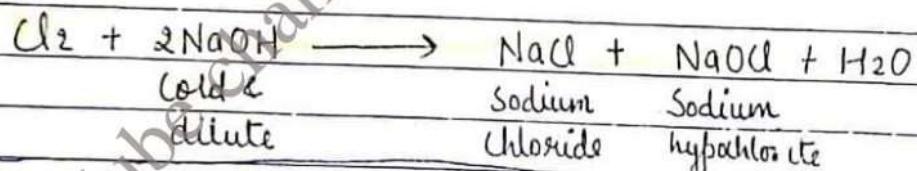
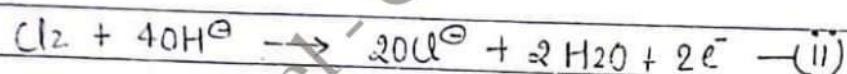
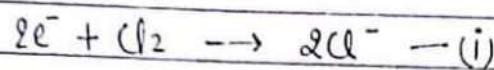
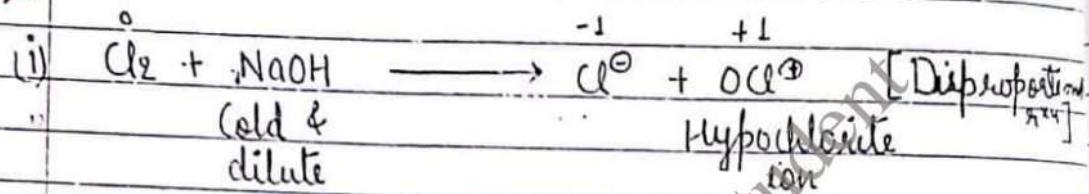
Final result heat released \rightarrow NF₃ more stable

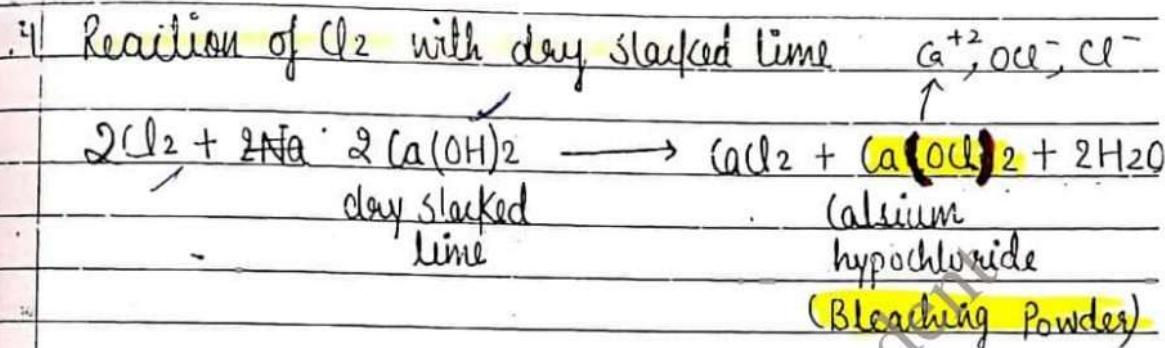
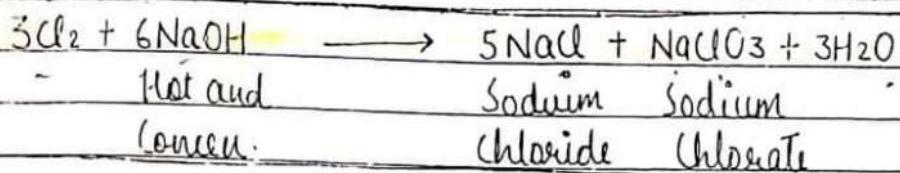
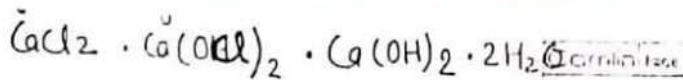
NCl₃ \rightarrow Stable (Exothermic)

NCl₃ \rightarrow Unstable (Endothermic)

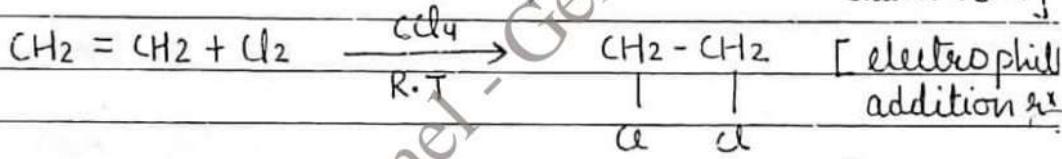
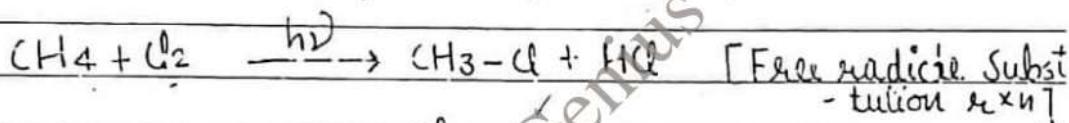
(\because Due to their large size of Cl it creates sterically hindrance in the formation of NCl₃)

~~Imp 3*~~ Reaction with NaOH : \rightarrow

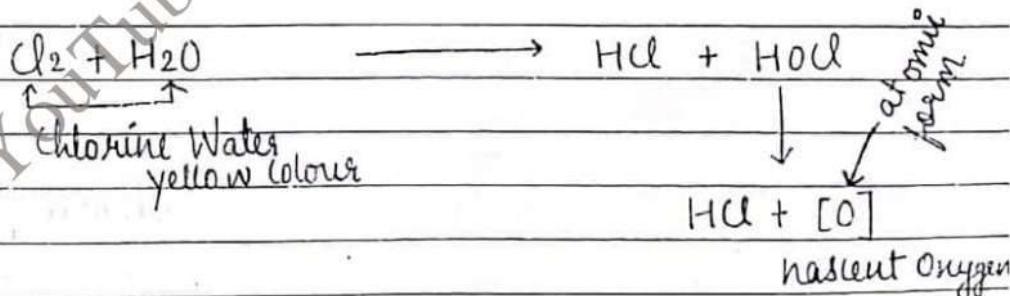




5 Reaction with hydrocarbon

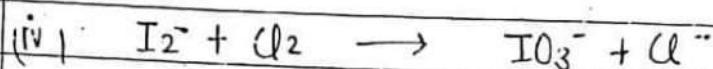
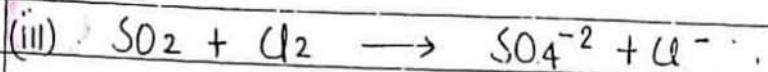
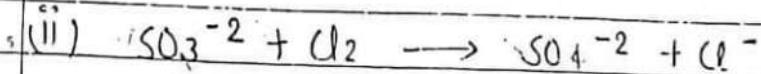
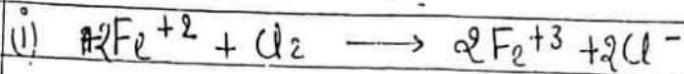


Q Write the reason of Oxidising agent and bleaching action of chlorine?



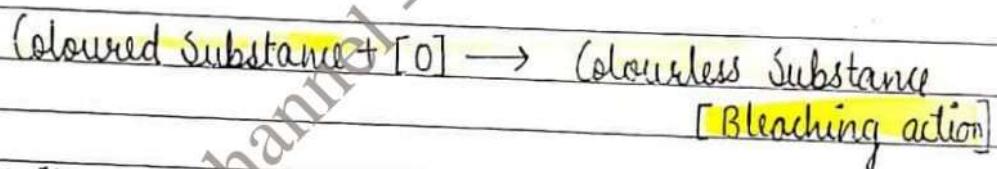
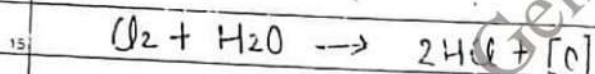
This nascent Oxygen is responsible for Oxidising & bleaching action.

Oxidising Property :-



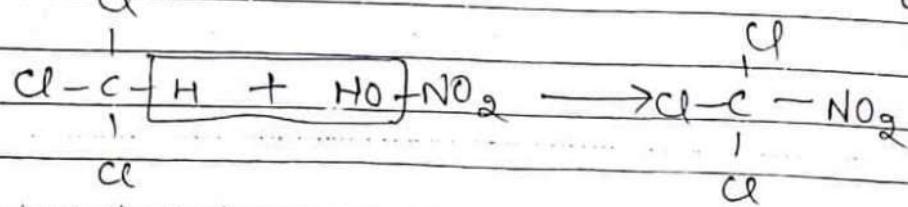
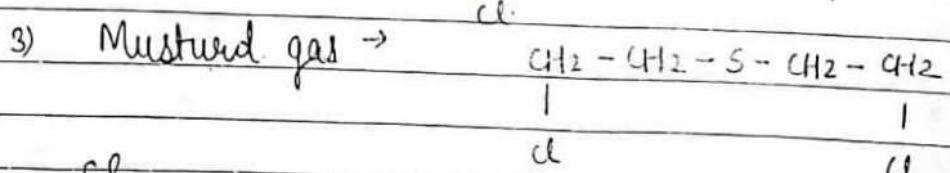
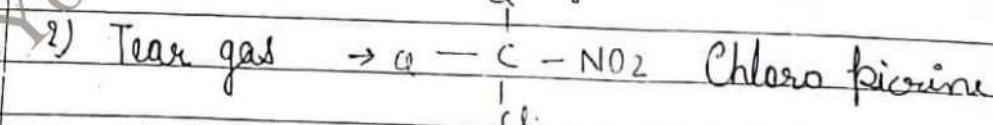
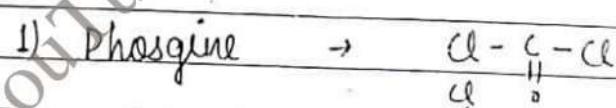
10
Iodate
ion

Bleaching Action



Q. 20 Write the name of 2 poisonous gases which are formed by chlorine?

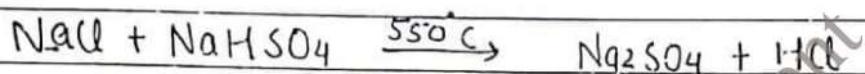
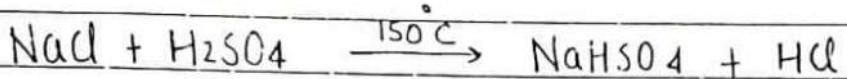
~~Ans.~~ →



* HCl (Hydrochloric acid / Hydrogen chloride)

Method of Preparation :-

1) Laboratory Method -

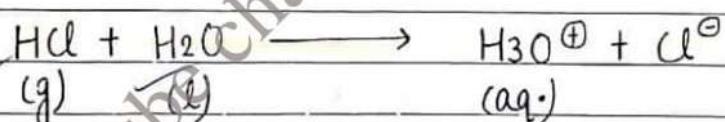


Physical Property

→ It is colourless, pungent smelling gas and easily liquify into a colourless liquid.

Chemical Property

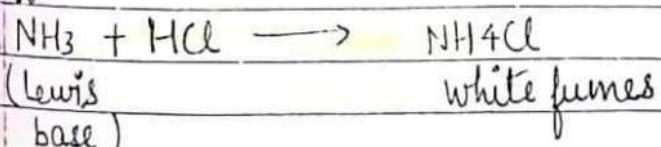
1 Its aq. solⁿ is called Hydrochloric Acid.



$$(\text{acid dissociation } K_a = 10^{-7} \text{ const.})$$

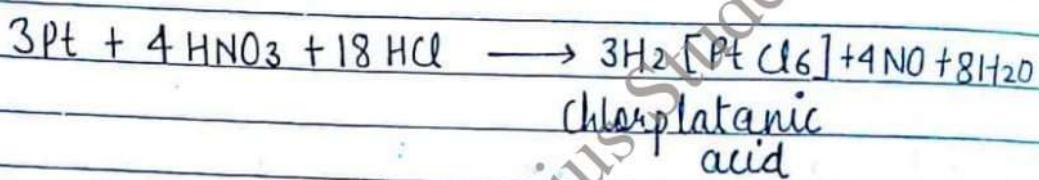
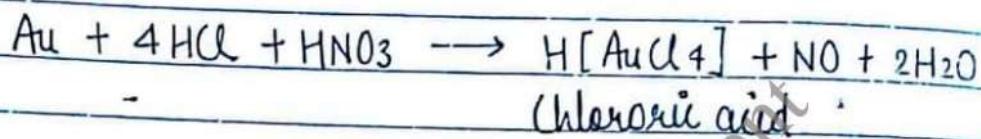
Acid strength \propto K_a

2 reaction with Ammonia :-

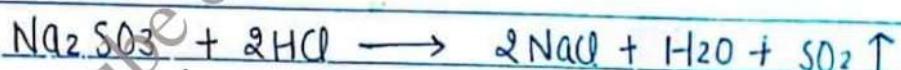
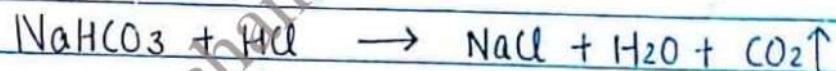
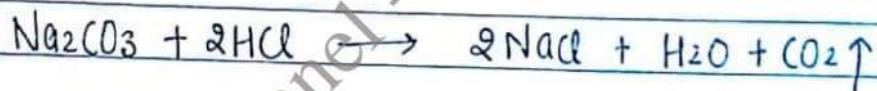


Q What is aqua regia & Write its function?
 → Three parts of Conc HCl and 1 part of Conc. HNO_3 is known as aqua regia.

It is used for dissolving noble metals i.e Au, Pt, Ag etc



3 Reaction with Carbonate / Bicarbonate / Sulphite :-



* Dioacid of Halogen :-

next-page.

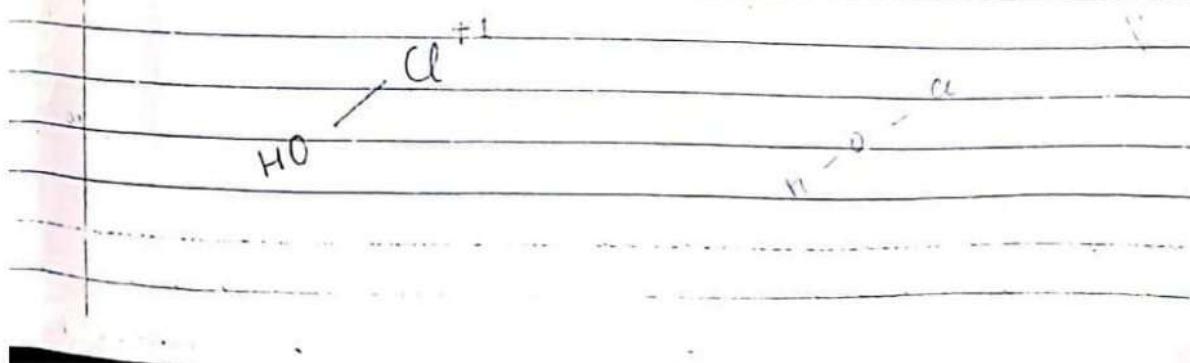
Oxoacids	F	Cl	Br	I	negative ion
1 Hypohalous acid or Halic(I) acid	$\text{HO}-\text{F}^{\text{+1}}$ Hypofluorous acid	$\text{HO}-\text{Cl}$ Hypochlorous acid	$\text{HO}-\text{Br}$ Hypobromous acid	$\text{HO}-\text{I}$ hypiodous acid	$\text{XO}^{\text{-}}$ 1-hypohalite ion
2 Halous Acid or Halic(III) acid	-	HClO_2 Chlorous acid	HBrO_2 Bromous acid	HI_2 Iodous acid	$\text{XO}_2^{\text{-}}$ Haliite ion
3 Halic acid or Halic(V) acid	--	HClO_3 Chloric acid	HBrO_3 Bromic acid	HI_3 Iodic acid	XO_3^- Haliate ion
4 Perhalic acid or Halic(VII) acid	-	HClO_4 Perchloric acid	HBrO_4 Perbromic acid	HI_4 Periodic acid	XO_4^- Perhalate ion

Q Fluorine forms only one Oxoacid. Why?

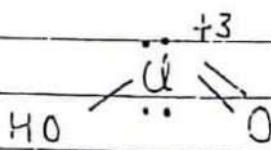
Due to small size, high electronegativity, and lack of vacant d-orbital, fluorine forms only one Oxoacid ($\text{HO}-\text{F}$)

* Structure of Oxoacids :→

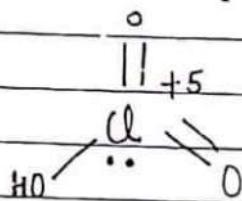
1 Hypochlorous acid [HClO]



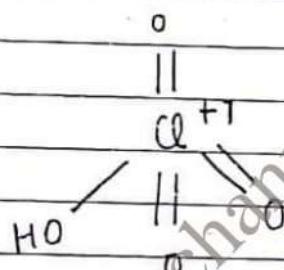
2 chlorous acid [HClO₂]



3 chloric acid [HClO₃]

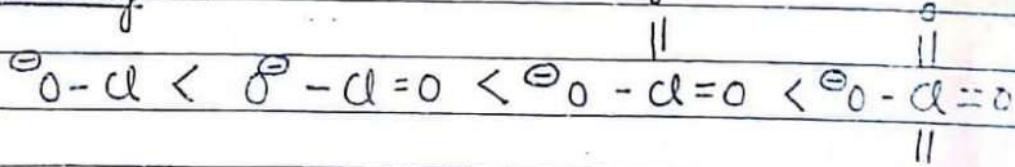


4 Perchloric acid [HClO₄]

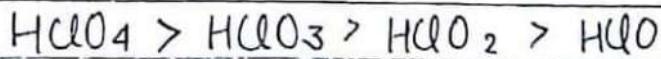


Acidic strength \propto +ve O.S
 \propto Stability of -ve ion

stability :-



Acidic strength :-



* Interhalogen Compound :-

The Compound which are formed by 2 different halogen are known as Interhalogen Compound.

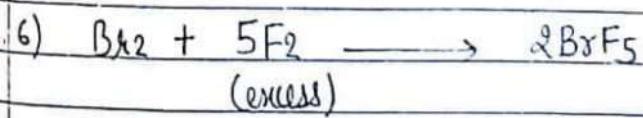
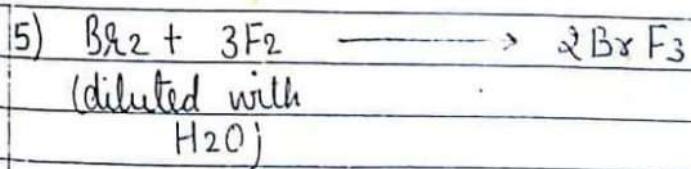
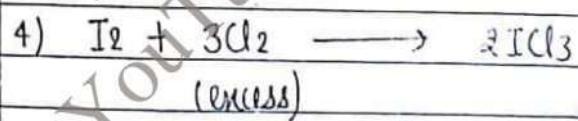
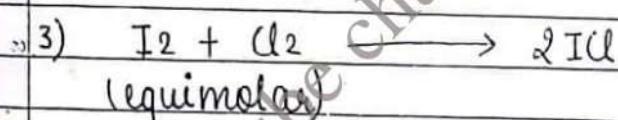
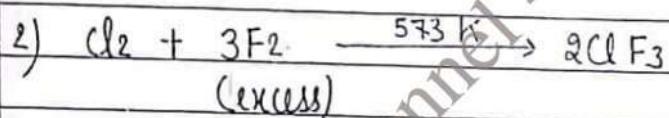
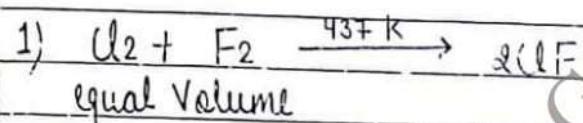
General formula :- $X X'$

$$n = 1, 3, 5, 7$$

X = Halogen of larger size & less E.N.

X' = Halogen of small size & more E.N.

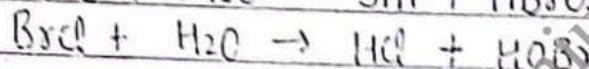
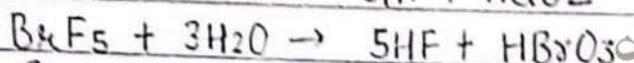
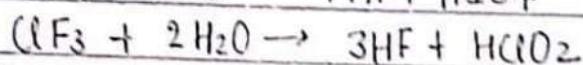
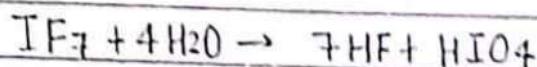
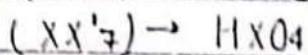
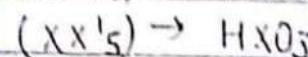
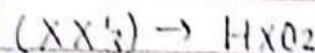
→ Method of Preparation :-



→ Hydrolysis of Inter-halogen Compound: →

Small size halogen \rightarrow HX'

Large size halogen:



Q. Interhalogen Compd are more reactive compared to halogens. Why?

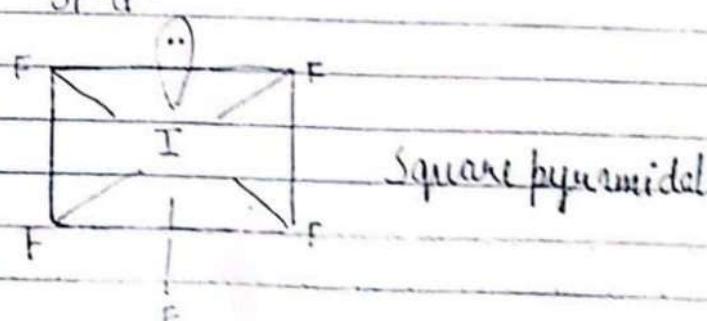
OR

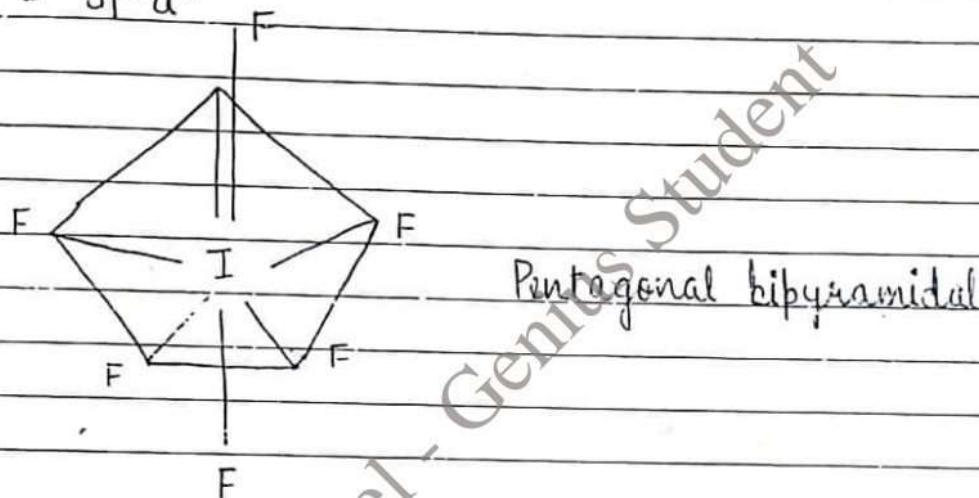
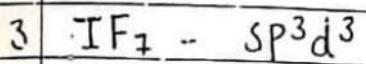
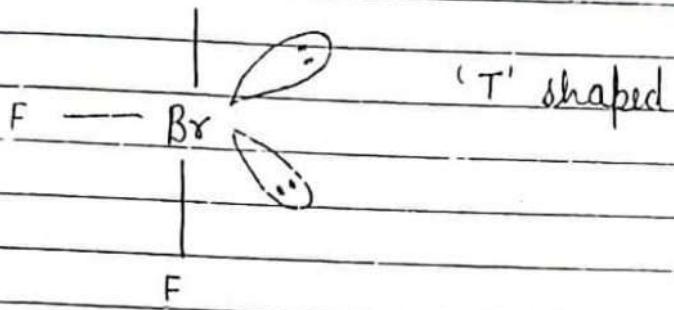
I-Cl is more reactive than Cl₂. Why?

→ In Interhalogen Compd X-X' bond is weaker (due to diff. in sizes, effective overlapping does not take place) compared to X-X bond of halogen i.e. bond energy of interhalogen compd is less that's why they are more reactive.

* Draw the structure of following compd:-

1. IF_5 - SP^3d^2





Group - 16

Q Why group 16 elements are called as chalcogens ?

→ Because of formation of several Ores , these are known as chalcogens.

(i)*	Gypsum	-	CaSO ₄ · 2H ₂ O
(ii)	Epsom Salt	-	MgSO ₄ · 7H ₂ O
(iii)	Baryta	-	BaSO ₄
(iv)	Galena	-	PbS
(v)	Zinc Blend	-	ZnS
(vi)	Copper Pyritized	-	CuFeS ₂

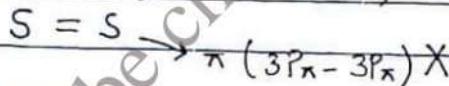
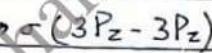
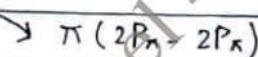
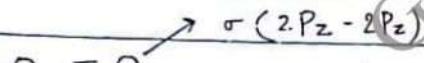
Q Why Oxygen have less -ve gain enthalpy in comparison of Sulphur?

→ Due to compact or small size of Oxygen it have more e⁻ density so incoming e⁻ feels more interelectronic repulsion so less energy is liberated on addition of electron.

Q Oxygen exists as diatomic molecule whereas Sulphur exists as S₈ molecule. Why?

→ Due to smaller size of Oxygen it have tendency to form P π - P π bond. That's why it exists as Diatomic molecule

Due to large size of Sulphur it have no tendency to form P π - P π bond that's why it exists as S₈ molecule



due to large size of S orbitals, lateral overlapping is not possible hence π -bond will not form.

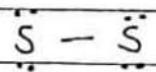
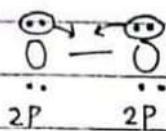
Q Sulphur have more cationic ^{power} catenation than Oxygen. Why?

OR

S-S have more bond energy in comparison of O-O. Why?

→ Due to small size of Oxygen, there is high interelectronic repulsion of non-bonding e⁻ due to which O-O is weaker than S-S.

That's why Sulphur have more catenation power than Oxygen

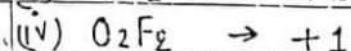
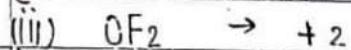
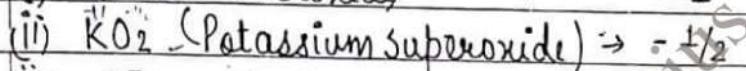
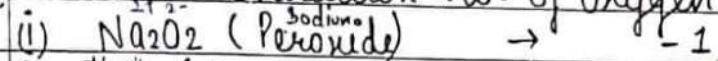


Catenation \propto Bond Energy
Power

Due to small size of Orbital

$\text{I.P} \leftrightarrow \text{I.P.}$ repulsion is high
and due to this the bond
is Weaker resulting there
is low B.E.

Q Write the Oxidation no. of Oxygen in-



Q OF_4 and OF_6 does not exists while SF_4 & SF_6 exists. Why

\rightarrow In Sulphur Vacant d-Orbital is present so
they can expand its Orbit. So SF_4 and SF_6 exists.

In Oxygen, vacant d-Orbital is absent
so they can not expand its Orbit. So OF_4 & OF_6 does
not exists.

Q Write short note on the hydride of gp 16 elements?

\rightarrow B.A

DRAGO's rule

$\rightarrow 105^\circ \text{ H}_2\text{O}$

E(Central atom) Size \uparrow

Here bond is

$92^\circ \text{ H}_2\text{S}$

E-H bond strength \downarrow

formed through

$91^\circ \text{ H}_2\text{Se}$

E-H bond energy \downarrow

pure P-Orbitals

$90^\circ \text{ H}_2\text{Te}$

Thermal Stability \downarrow

hence value of

H^+ releasing tendency \uparrow

B.A is nearly

acidic nature \uparrow

90°

Reducing Power \uparrow

Q B.P. of H_2O is higher than B.P. of other hydride why?

→ Due to formation of intermolecular hydrogen bonding in H_2O it has high B.P. (due to strong electro-vity of Oxygen). While in other hydride, there is intermolecular hydrogen bonding is absent.

Q H_2O is liquid while H_2S is gas? why

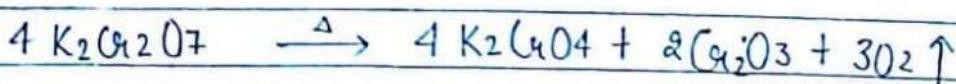
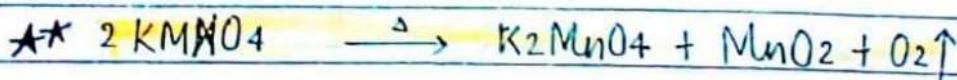
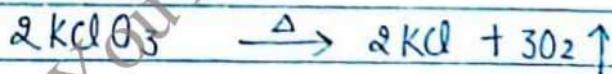
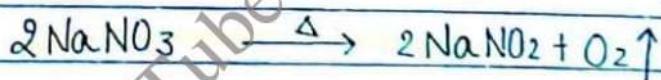
→ In H_2O due to strong electro-vity of Oxygen intermolecular hydrogen bonding is formed so it is liquid.

In H_2S , intermolecular hydrogen bonding is absent so it is gas.

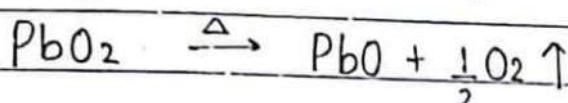
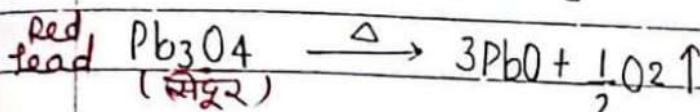
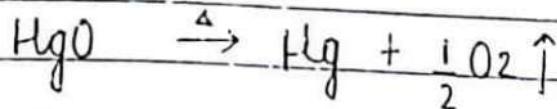
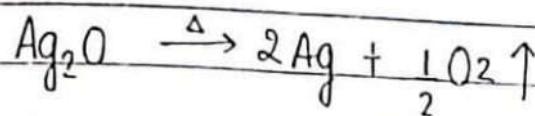
A O_2 (Dioxygen) :-

1 Method of Preparation

(i) By the thermal decomposition of chlorates, Dichromates, nitrates, Permagnets :-

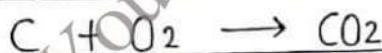
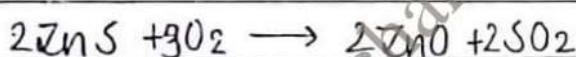
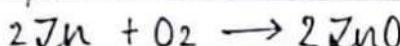
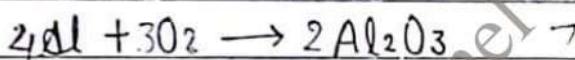
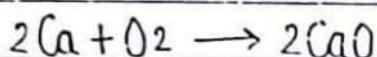


2) By thermal decomposition of Metal Oxide :-

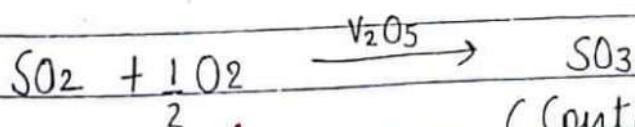
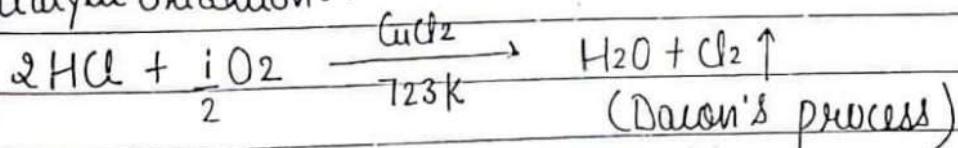


Chemical Properties :-

i) Reaction with metal, non-metal and other compound



Catalytic Oxidation :-



(Contact-chamber method)

Key rxn of preparation.

Oxides :→

Binary compound of Oxygen with another element
is called Oxide

non-metallic character ↑ ; acidic nature ↑

Metallic character ↑
Basic nature ↑



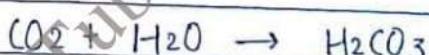
Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	SO ₃	Cl ₂ O ₇
Basic nature		Amphoteric nature			Acidic nature	

Oxides of Metals → Basic nature

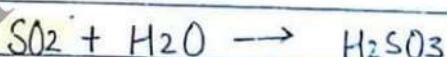
Oxides of Non-metals → Acidic nature

Acidic Oxide :-

Eg :- CO₂, SO₂, SO₃, N₂O₄, N₂O₃, N₂O₅, Cl₂O₇,
CrO₃, Mn₂O₇, V₂O₅



Carbonic acid



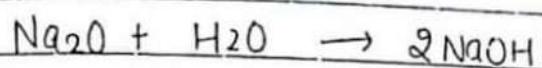
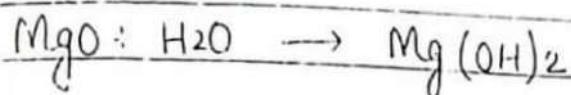
Sulphurous Acid



Sulphuric acid

2 Basic Oxide :-

Eg : MgO, Na₂O, CaO, Fe₂O₃, MnO₂

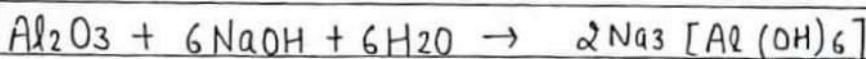
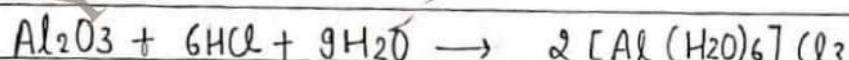


3 Neutral Oxide

N₂O, NO, CO

* 3 Amphoteric Oxide :-

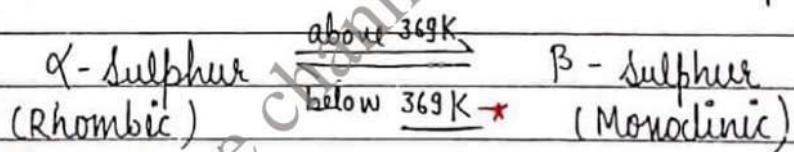
ZnO	B ₂ O ₃	Al ₂ O ₃	B ₂ O ₃	Si ₂ O ₃	Ca ₂ O ₃	PbO	SnO
जंगा	बैरी	अलीने	बैरी	सिर	काया	पंजावी	सांवा



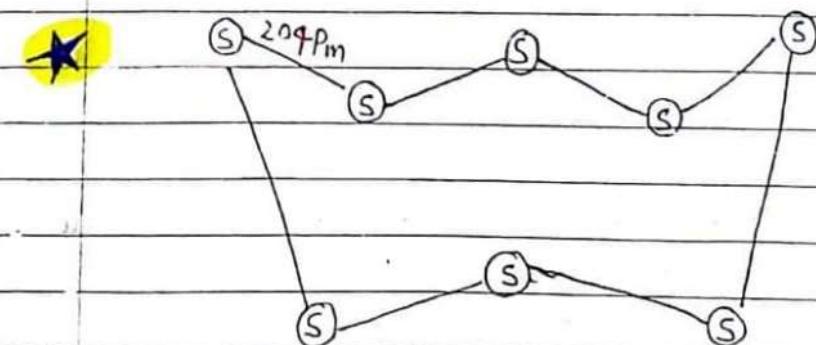
1 Allotropes of Sulphur :→

Properties	Rhombic Sulphur (α -Sulphur)	Monoclinic Sulphur (β -Sulphur)
1 Colour	Yellow	Colourless
2 M.P.	385.8 K	393 K
3 Specific density <small>gravity</small>	2.06	1.98
4 Solubility	Insoluble in H_2O , Soluble in CS_2	Soluble in CS_2

Monoclinic Sulphur is stable above 369 K temp.
while Rhombic Sulphur is stable below 369 K temp.
and both forms are stable at 369 K temp.
which is known as Transition temperature



→ In both allotropes (Monoclinic or Rhombic) S_8 molecules are present which are crown shaped



Q Which form of sulphur shows paramagnetic behaviour?

→ At 200°C, S₈ present as ring in Vapour phase but 1-2% S₂ molecules are also present. On increasing temp. S₂ species formed in more which have unpaired e⁻ in π* orbital like as O₂. That's why it exhibits paramagnetic behaviour.

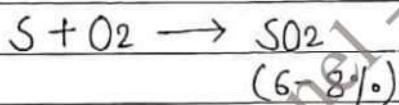
COMPOUNDS OF SULFUR

1. SO₂ :→

(sulphur dioxide)

Method of Preparation :-

(i) By the combustion of sulphur :→

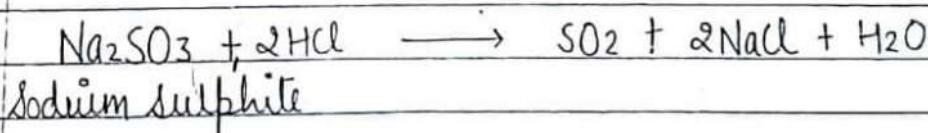


(ii) Industrial Preparation :→



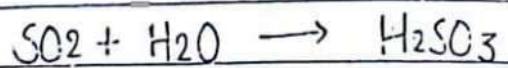
Iron pyrites

(iii) Laboratory Method :→



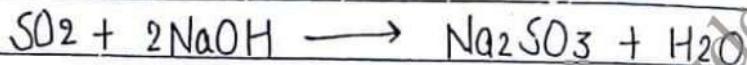
Chemical Properties :-

(i) Reaction with Water :-



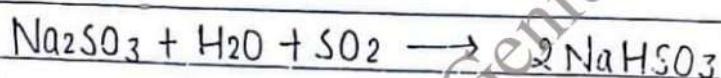
sulphurous acid

(ii) Reaction with NaOH :-



(Milky)

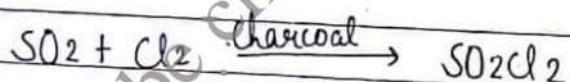
(water insoluble)



Milkyness disappear

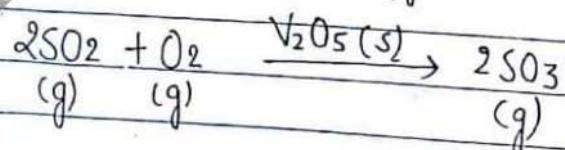
(Water soluble)

Reaction with chlorine :-



sulphuryl chloride

(iv) Reaction with Oxygen :-

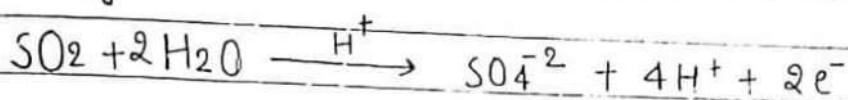


(g) (g)

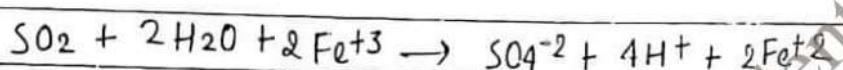
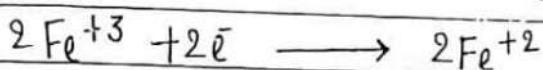
(g)

Ques.

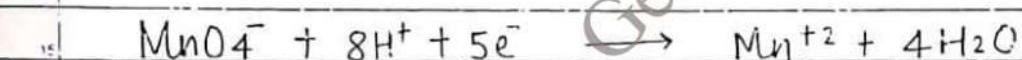
3 Reducing Nature :



(A) It reduces ferric ion into ferrous ion

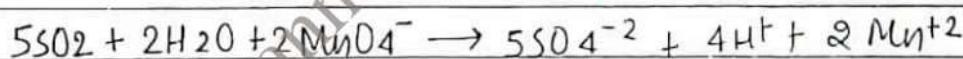


(B) It decolorise violet colour solution of $KMnO_4$



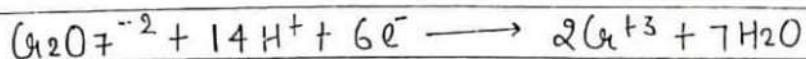
Violet/Pink

(Light Pink)



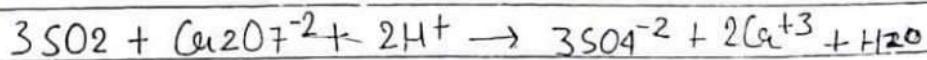
CO_2 does not show this rxn becoz it has already four bond.

(C) It Convert Orange colour of $K_2Cr_2O_7$ solution into green colour solution



Orange

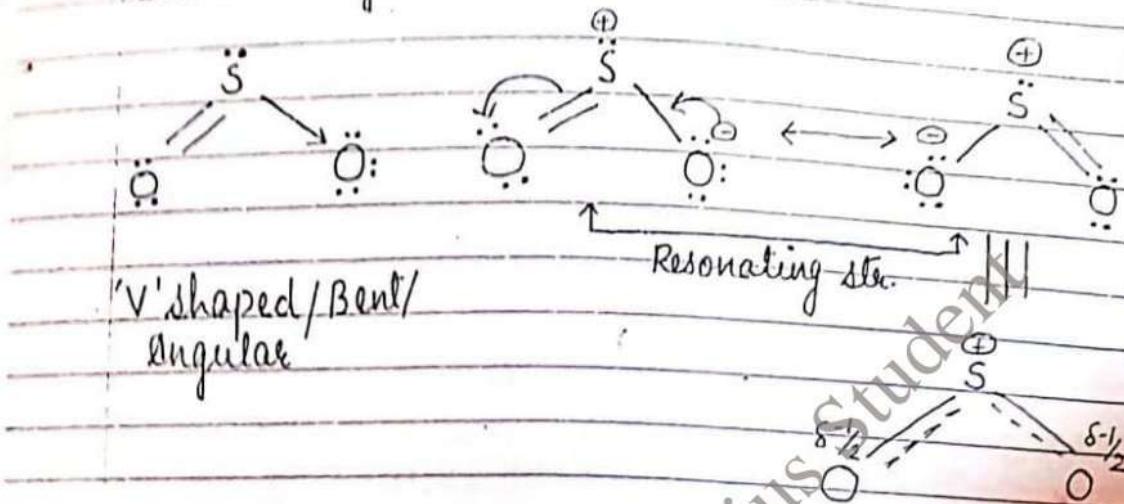
green



CO_2 does not show this rxn.

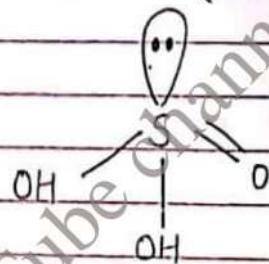
NOTE:-
Reaction (B) and (C) ^{Used} for chemical test of SO_2

Structure of SO_2 :-



OXOACIDS OF SULPHUR

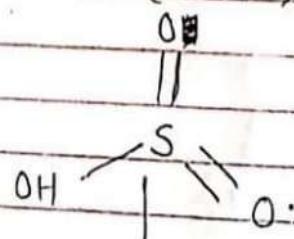
1 Sulphurous acid (H_2SO_3)



: Basicity = no. of -OH groups
= no. of H^+ given by
Compd

Basicity = 2

2 Sulphuric acid (H_2SO_4)



Basicity = 2

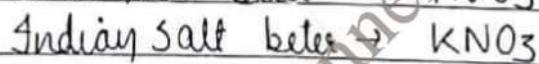
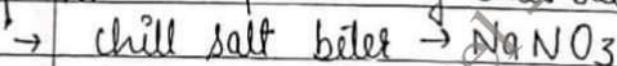
Q Which is known as King of chemicals and why?

H₂SO₄ is known as King of chemicals bcz it is used in following industrial process:-

- (i) In petrol refining
- (ii) Manufacture of Pigments and Paints
- (iii) Laboratory reagent
- (iv) In metallurgy
- (v) In detergent industry
- (vi) In formation of nitrocellulose product
- (vii) In lead storage battery

Group No 15

Q Write the formulae of chill salt peter & Indian salt peter?



Q Why ionisation potential of gp 15 elements are higher than gp 16?

→ Bcz gp 15 elements have half filled EC (ns² np³) which is more stable so more amount of energy is required for removal of e⁻ so ionization potential of G-15 elements are higher than G-16 elements

Q B.P. of ammonia is higher than other hydrides of its group. Why?

OR

Why NH_3 have higher B.P. than PH_3 ? Why?

Ans In NH_3 , intermolecular hydrogen bonding is present due to which association of molecules takes place but in PH_3 intermolecular hydrogen bonding is absent.

Q Why Phosphorous Pentahalides ^{have} more covalent nature than Phosphorous trihalides?

L Polarisation power depend upon charge on cation.

In PCl_5 , P^{+5} will more polarised cation that's why PCl_5 have more covalent character than PCl_3 .

Polarisation \propto charge on cation

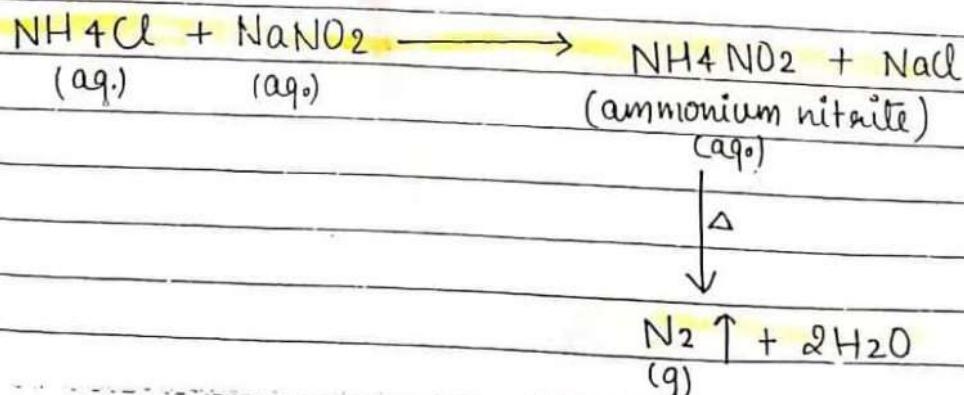
\propto Covalent nature

Nitrogen trihalides \rightarrow ~~not~~ Pentahalide \rightarrow X

* DINITROGEN (N_2)

Method of preparation :-

1 Laboratory Method :-

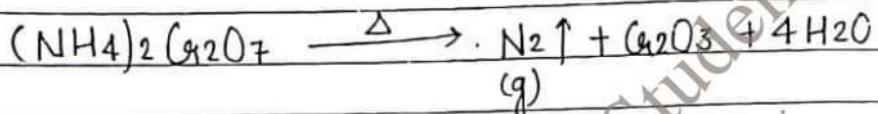


NOTE

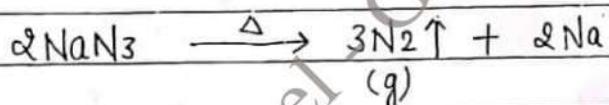
In this reaction some amt. of NO and HNO₃ are also formed as impurity which can be removed by passing the gas through aq. H₂SO₄ soln containing Potassium dichromate (K₂Cr₂O₇)

By the thermal decomposition of ammonium dichromate.

$$\Delta H = -ve$$



3. By the thermal decomposition of Sodium and Barium Azide :→



* Note :- By this method, very pure N₂ gas is obtained

Chemical Properties : → Colorless, odourless

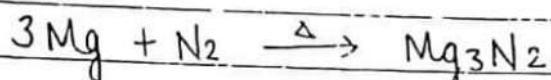
Q N₂ behave as inert gas at room temp. Explain?

Ans Due to high Bond energy / enthalpy of N≡N bond.

Reaction with Metals :-

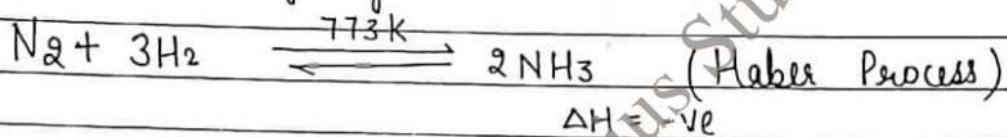


Lithium Nitride

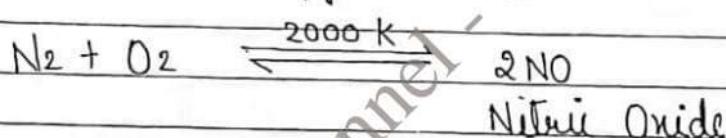


Magnesium Nitride

Reaction with hydrogen :-



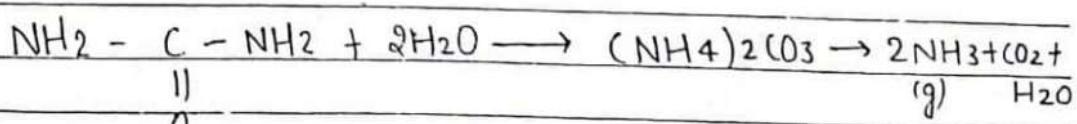
Reaction with Oxygen :-



★ Ammonia (NH_3) :-

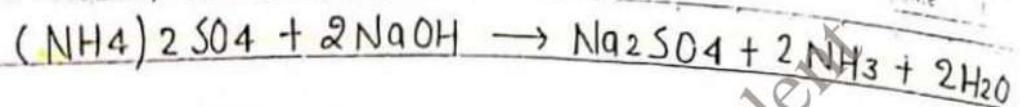
Method of Preparation -

(i) By decomposition / hydrolysis of Urea :-

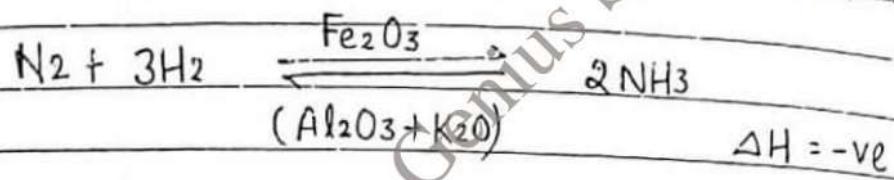


(ii) Reaction of ammonium salt with Base Alkali :-





3. By Haber Process (on large scale) \rightarrow Industrial process



* Favorable condⁿ to maximise yield of ammonia:-

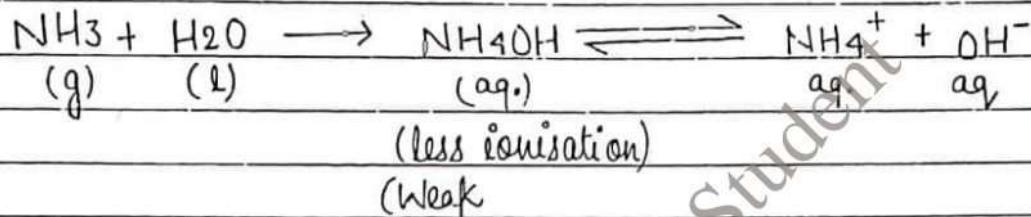
- (i) High pressure (200 atm) is required
- (ii) Because rxn is exothermic, hence low temp (around 700 K)
- (iii) Catalyst such as iron Oxide (Fe_2O_3) with small amt. of K_2O and Al_2O_3 are used to increase the rate of attainment of eqb.

phy. prop - colourless with pungent smell
 of NH_3 → Highly soluble in H_2O
 Due to higher vaporisation enthalpy of NH_3
 Chemical Properties :→ it is used as a cooling agent

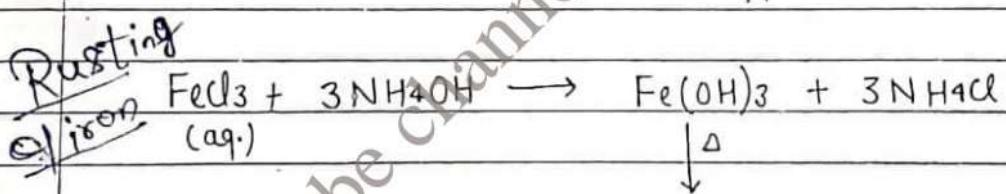
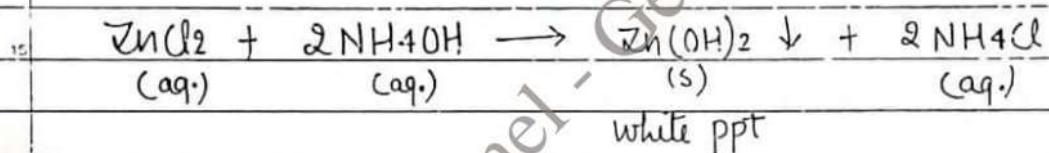
(i) Basic nature :-

Q: Aq. Solⁿ of NH_3 is behave as Weak base. Why?

→ Due to formation of OH^- ion in small amt.

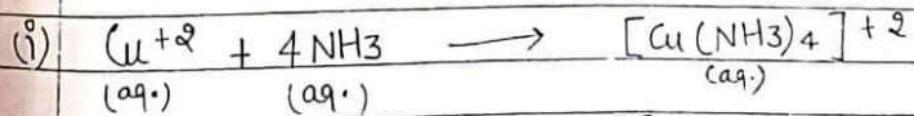


* Reaction with metal salt :-



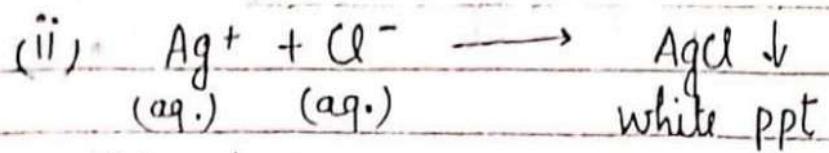
hydrated ferric oxide (Rust)
 (Brown)

Imp. Formation of Complex ion :-

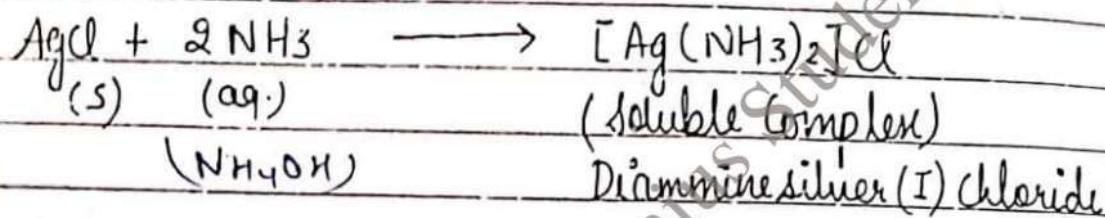


Tetraamminecopper(II) ion
 (deep blue colour)

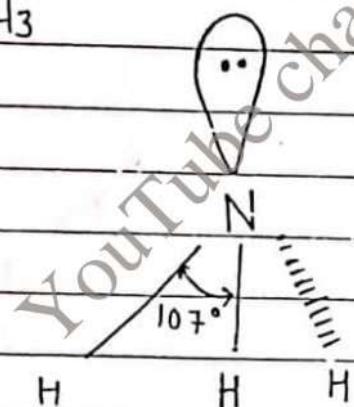
Swincks' reagent



Colourless



* Structure of Ammonia :-

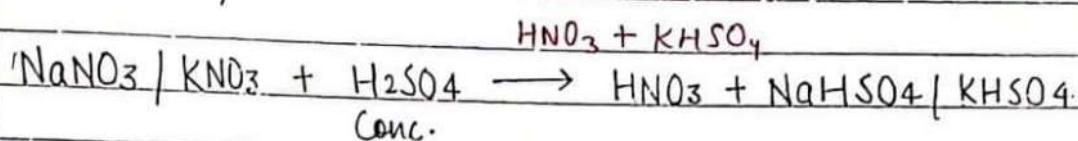
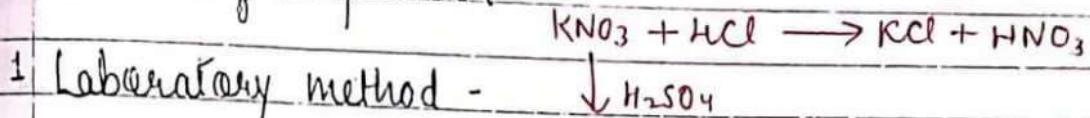


In ammonia, L.P. is present on nitrogen atom so it behave as lewis base

Trigonal Pyramidal

* NITRIC ACID $[HNO_3]$:-

Method of Preparation -

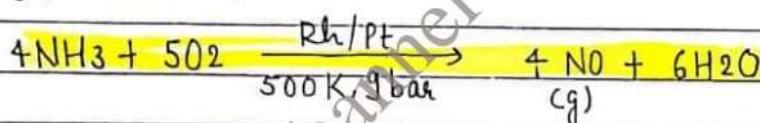


* 2. Ostwald's Process -

On large scale $\overset{\text{Production of}}{\uparrow} HNO_3$ is take place by the atmospheric Catalytic Oxidation of NH_3

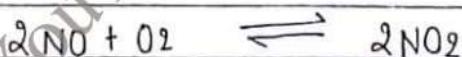
Step 1 :

In this step Catalytic oxidation of NH_3 by atmospheric Oxygen take place



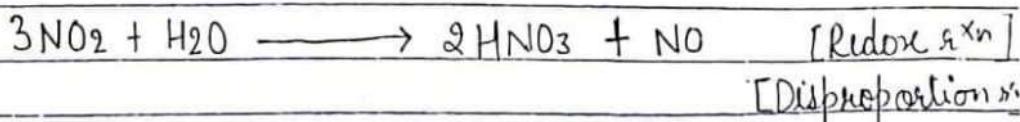
Step 2 :

Nitric Oxide combine with O_2 to give NO_2



Step 3 :

NO_2 dissolves in Water to give HNO_3



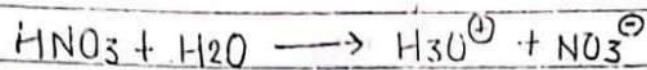
Chemical Properties :-

1 Strong acidic nature

Physical properties

Colorless, acidic nature

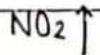
Basic, dissolve in H₂O



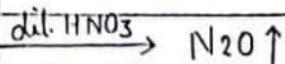
Imp

2 Strong Oxidising nature :-

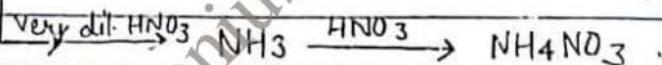
Conc. HNO₃



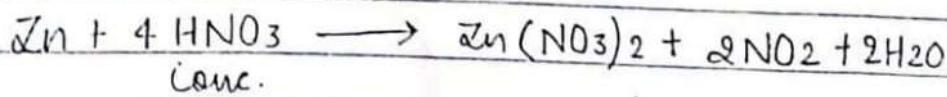
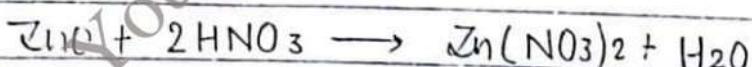
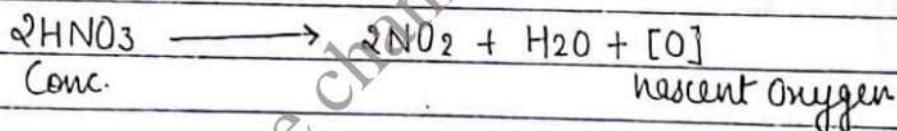
M



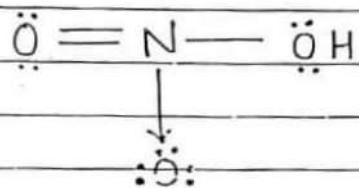
above H₂ in ECS
except Pb



Reaction of Zn with Conc. HNO₃ :-



* Structure of HNO_3 :-

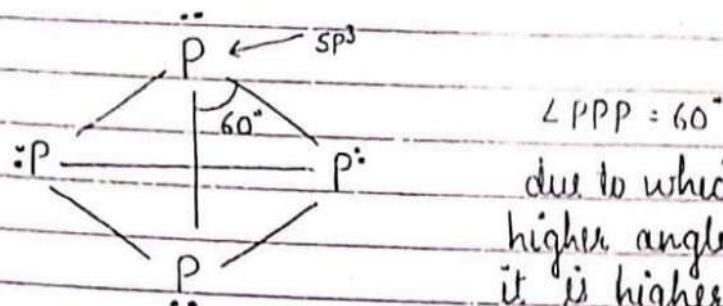


PHOSPHORUS :

Allotropes of Phosphorus :-

- 1 White Phosphorus :- Ignition temp^r = 30°C
- It is translucent white wavy solid
transparent
- It is poisonous, insoluble in water ^{but} soluble in Carbondisulphide [CS_2]
- ★ Due to slow oxidation, it gets yellow-greenish light so it glows in dark. This phenomenon is known as 'Chemiluminescence'

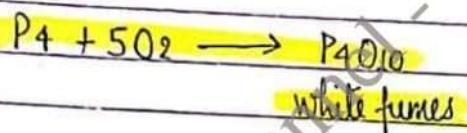
Structure :-



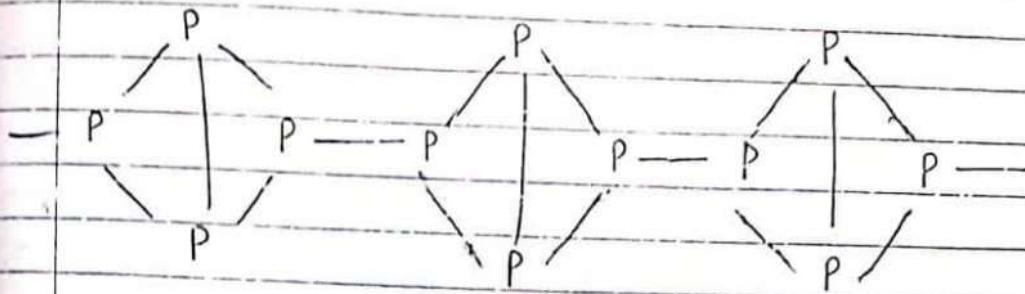
due to which P₁ also have higher angle strain. So it is higher unstable & more reactive.

Tetrahedral

- * In the presence of air its oxidation takes place due to which its temp increases and after some time due to low ignition temp it catches fire & give dense white fume of P_2O_5 . hence it kept under water.



- 2 Red Phosphorous Ignition temp^r → 1260°C
→ It is odourless, non-poisonous having iron grey lusture and insoluble in water as well as CS₂,
→ It does not glow in dark
→ It is much less reactive than white Phosphorous
→ It is polymeric consisting of chains of P₄ tetrahedral linked together



Linear Polymeric chain

3. Black Phosphorus :-

Red P $\xrightarrow[\text{in sealed tube}]{\text{heated at } 803K}$ α - black Phosphorus

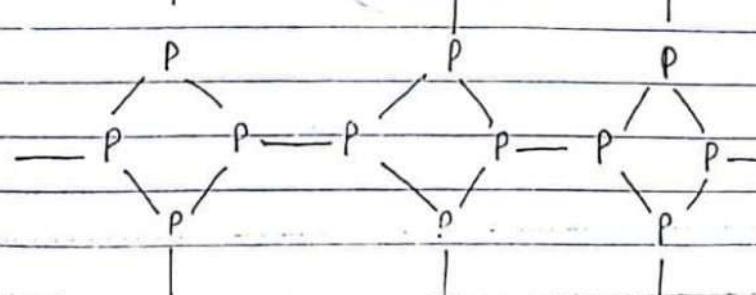
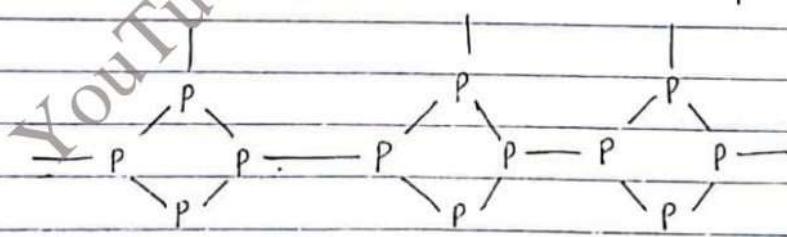
(Monoclinic, Rhombohedral, Insulator)

White P $\xrightarrow[\text{Clipped str. like graphite, Conductor}]{+73K, \text{high P}}$ β - Black Phosphorus

(Clipped str. like graphite, Conductor)

Structure:-

Black Phosphorus have 3-D network like str. So it is thermodynamically most stable allotrop form of Phosphorus.



Stability Order :-

Black P > Red P > white P

Reactivity Order :-

white P > Red P > Black P

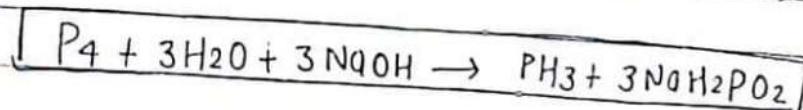
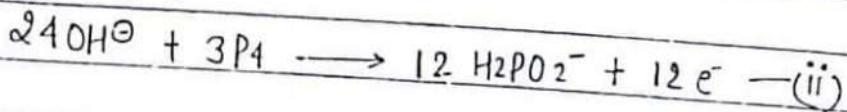
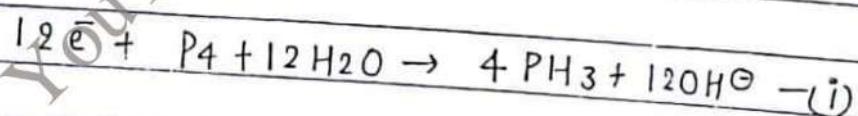
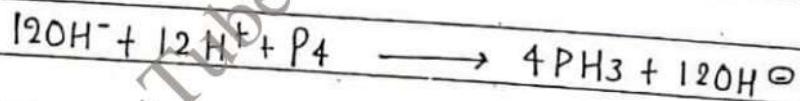
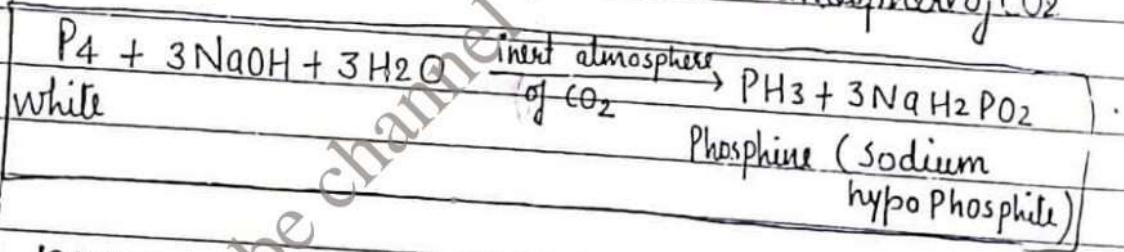
Compound of Phosphorus :-

1. **PHOSPHINE (PH_3) :-**

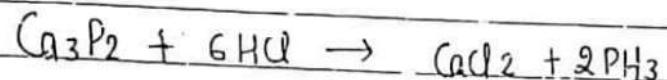
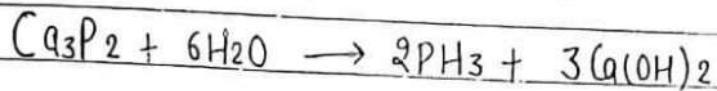
Method of Preparation :-

* (1) **Laboratory Method :-**

It is prepared by heating white Phosphorus with Conc NaOH solⁿ in an inert atmosphere of CO_2 .



2 By hydrolysis of Calcium Phosphide:-

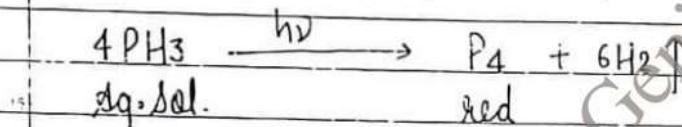


Physical Property:-

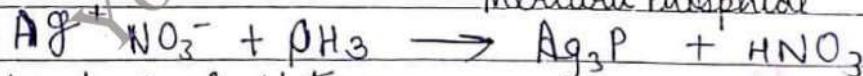
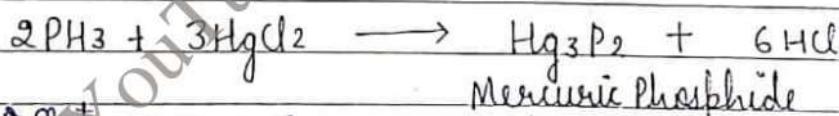
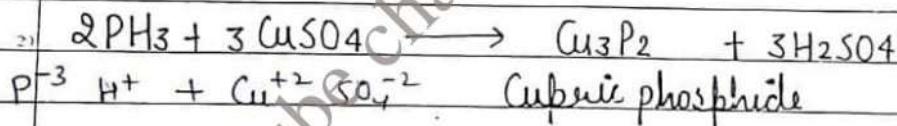
Colourless, rotten fish smell and highly Poisonous gas

Chemical rxn :-

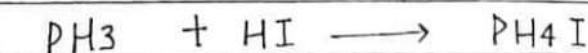
1 Aq. Solⁿ of Phosphine decomposes in light & form red P₄ ga.



2 Reaction with Copper Sulphate and Mercuric Chloride; Corresponding phosphide are obtained



3 Weak Basic Nature :-



(Weak base)

Phosphonium Iodide

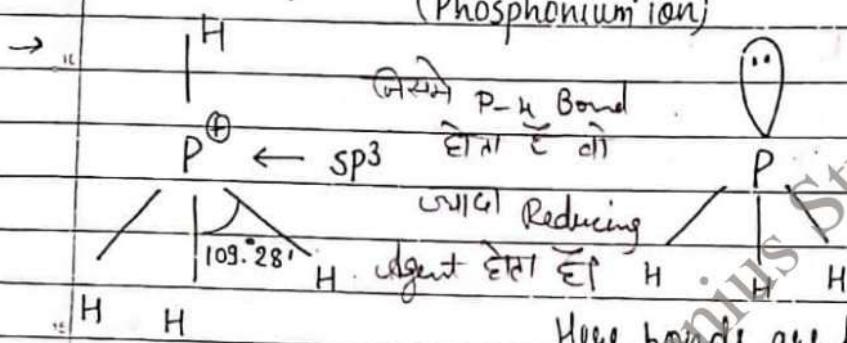


Phosphonium Bromide

Q What are 'Holme's Signals'?

→ Containers containing Calcium Phosphide (Ca_3P_2) and Calcium Carbide (CaC_2) are pierced & thrown in the sea, the gases [Phosphine (PH_3) and aceteline (C_2H_2)] evolved and burn due to autocombustion $\xrightarrow{\text{+ PH}_3}$ which serves as a signals & known as 'Holme's signal'

* Q Bond angle in PH_4^+ is higher than that of PH_3 . Why?
(Phosphonium ion)

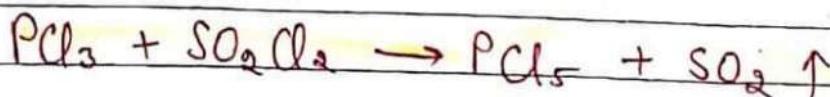
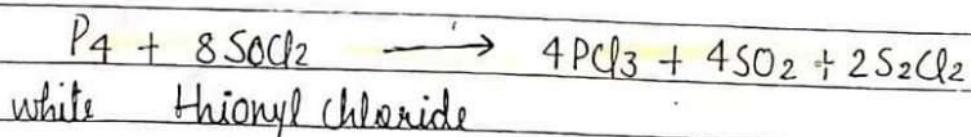
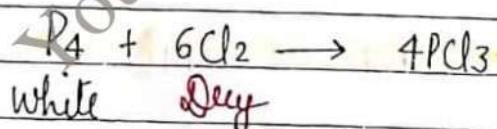


Here bonds are formed by overlapping of pure S & P orbital so value of bond angle is $\approx 94^\circ$

* Halides of Phosphorus :-

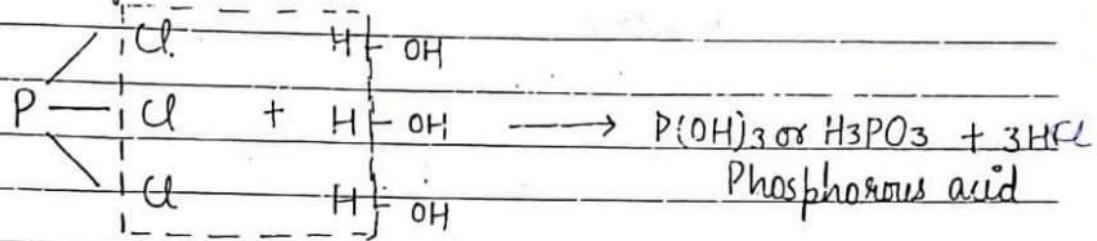
*1 Phosphorus Trichloride (PCl_3) -

Method of Preparation :-

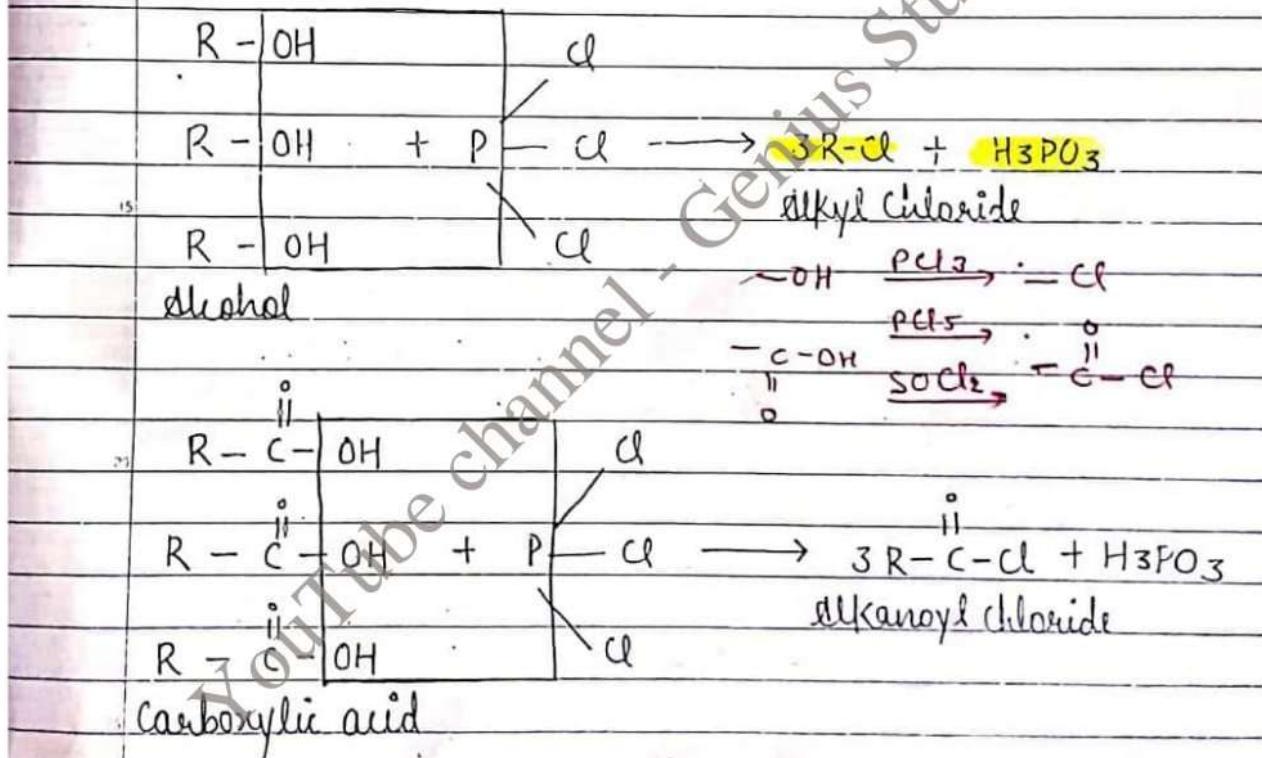


Chemical Properties:-

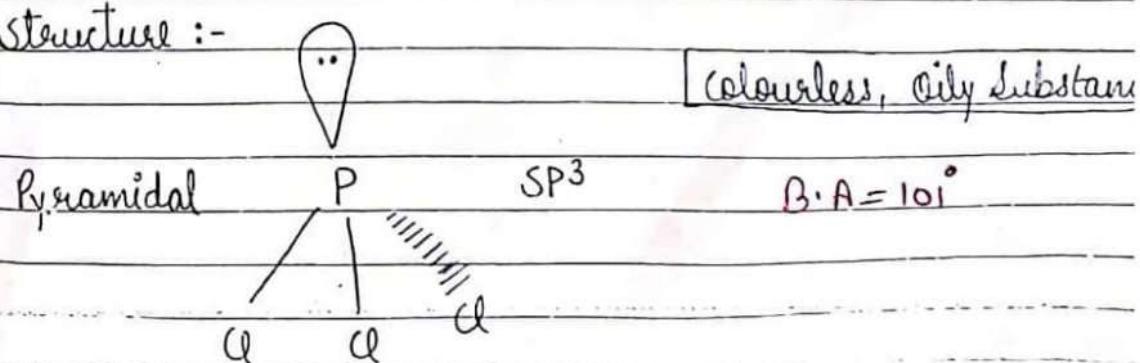
1 Hydrolysis :-



2. Reaction with Organic Compounds



Structure :-



Colourless, Oily Substance

Pyramidal

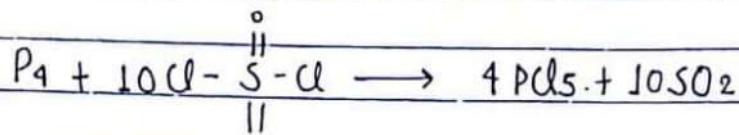
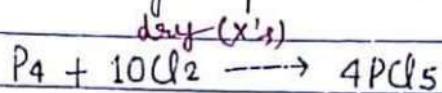
P

SP³

$$\beta \cdot A = 101^\circ$$

★ 2 PCl₅ (Phosphorus Pentachloride)

1 Method of Preparation

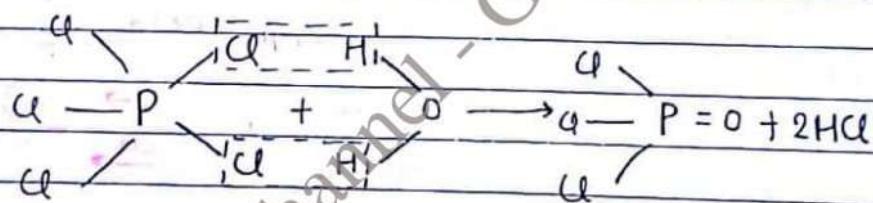


sulphonyl chloride

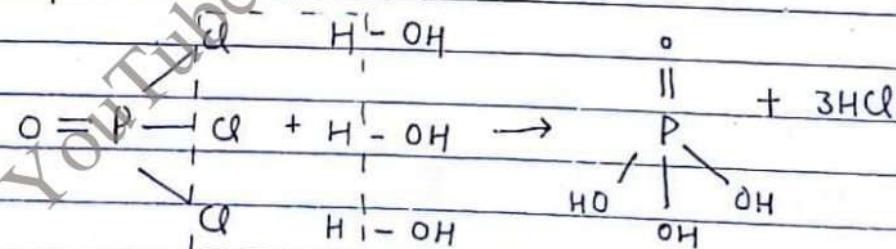
Chemical Properties :-

1 Hydrolysis :-

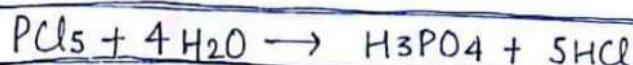
Step 1 :-



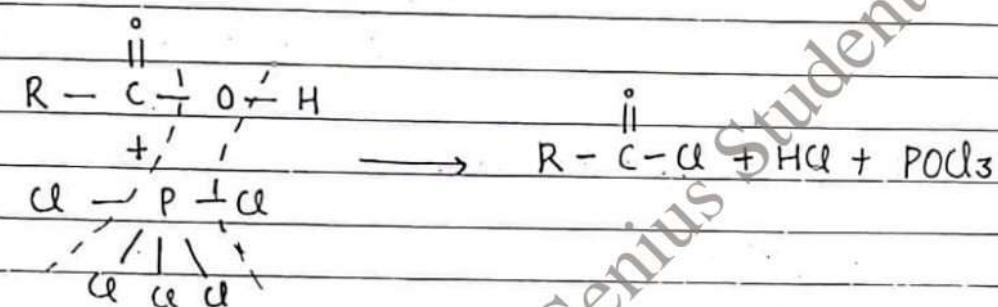
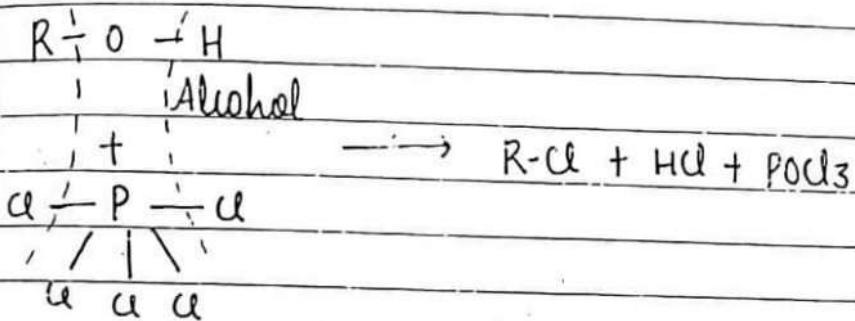
Step 2 :-



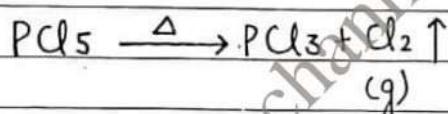
Phosphoric acid



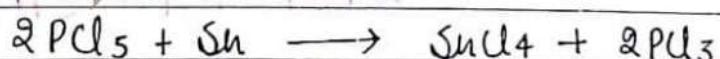
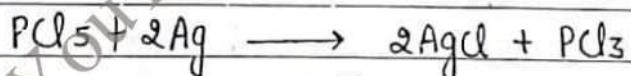
→ Reaction with Organic Compound :-



Effect of Heating :-

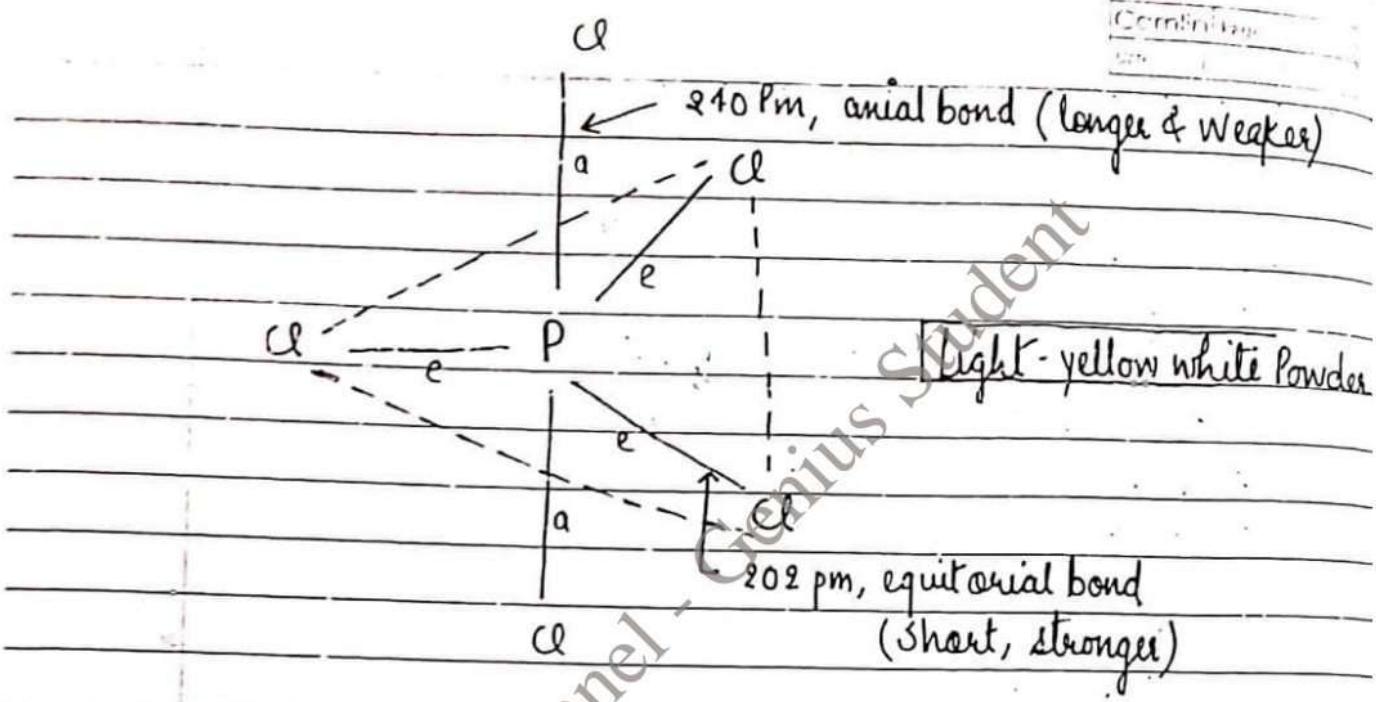


Reaction with Metals :-



Structure of PCl_5 -

In gaseous & liquid phase structure of PCl_5 is trigonal bipyramidal which have 2 types of bonds, one is Axial bond which are longer and weaker while other are Equatorial bond which are shorter & stronger. This is the fact that axial bond feel more repulsion than equi. bond.



Trigonal Bipyramidal

$$\angle -e = 120^\circ (3)$$

$$\angle -e = 90^\circ (6)$$

$$\angle -a = 180^\circ (1)$$

Note In solid state PCl_5 exists as ion-pair