

Allotropes : @iitwale on telegram

- > Different forms of the same elements are called allotropes.
- > Main elements which exhibit allotropy are C, P, S, Sn.

I Allotropes of Carbon

dangling : Immobilized free radical.

- * Amorphous $\rightarrow$ lampblack and coal are microcrystalline form of graphite

Q) Give the correct statement about diamond

~~it~~ It is a covalent solid with sp^3 hybridised C with some dangling bond

ii) It is more stable than graphite and has higher density than it.

~~it~~ It can be obtained from graphite at abnormally high pressure

~~it~~ It has a F.C.C. (face centred cubic str.) having 8 atoms per unit cell. (NEET UG)

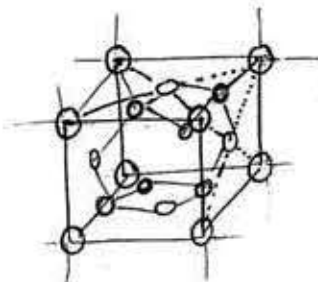
* Indefinite expansion of covalent bond ~~that~~ which are giant is called covalent solid eg C, Si,



Each C is connected
to 3 C
(Partial double bond)
(=) is more stable den -

- graphite is more stable due to partial double bond nature of C-C bond.
- density of diamond is more due to its closed pack nature
- graphite is a low density sub. and can be converted into diamond under very high Temp (15000 atm) under normal Temp.

* diamond is observed to be a face centred cubic unit cell in which alternate tetrahedral void are occupied.
f.c.c $\Rightarrow$ all corners + face centred

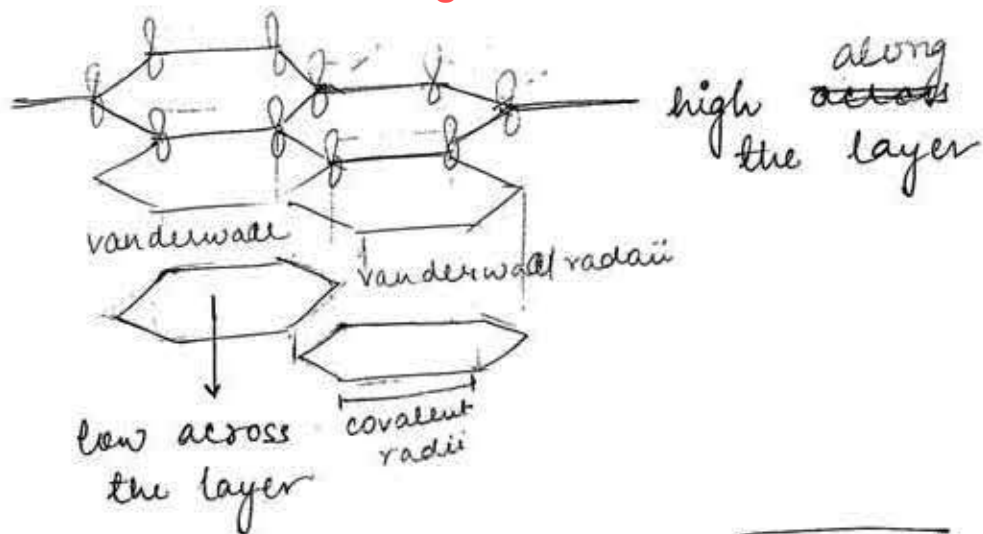


Contribution: all corners = $\frac{1}{8} \times 8 = 1$
all face centred = $\frac{1}{2} \times 6 = 3$
 $\frac{1}{4}$ tv = $1 \times 4 = 4$

In a unit cell of diamond, 8 effective c-atoms are present

Q) Find the correct statements for graphite.

- i) It is most stable ^{allotrope} and purest form of C
 - ii) It can work as a lubricant due to high C-C bond strength
 - iii) ^{AIMS} The conduction in graphite is observed to be isotropic
 - iv) The inter layer space is much higher compared with C-C bond distance in a layer
- > It is used as a lubricant and preferred in high temp systems where lubricating oils ~~is~~ can't be used
 - > The lubrication is due to inter layer gap.
 - > The layer generally traps H_2O , O_2 and air are trapped which help in the lubrication property
 - > Isotropic: similar property in all dir? Graphite show conduction due to $\oplus$ presence of free e- ~~the~~ b/w the layer and it show anisotropic behaviour towards conduction as conduction is high along the layer but very less in $\perp$ (across) the layer



* C-C distance (interlayer) is approx 2.5 times the C-C bond distance

Q) Which of the following is (✓) for fullerene
~~if~~ Fullerene has no dangling bond and $\therefore$ considered to be the purest form of C

ii) In fullerene C_{60} , the Total no C-C link is 180

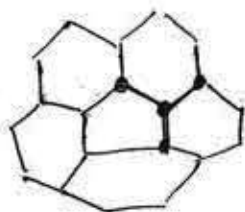
iii) If the no of pentagon in fullerene is x and hexagon are y , then $5x + 6y = 120$

iv) when H_2 flow over the surface of fullerene, then it adsorb high quantity of H .

* Fullerene is non-dangling, aromatic and pure

> ~~Ques~~ 1 C $\equiv \frac{3}{2}$ link ?

$$\therefore 60 \text{ C} = 60 \times \frac{3}{2} = 90 \text{ link}$$



$$1 \text{ pentagon} = \frac{5}{3} \text{ C}$$

$$\therefore x \text{ pentagon} = \frac{5x}{3} \text{ C}$$

$$1 \text{ hexagon} = \frac{6}{3} \text{ C}$$

$$\therefore y \text{ hexagon} = \frac{6y}{3} \text{ C}$$

$$\frac{5x}{3} + \frac{6y}{3} = \text{C}_T$$

$$\text{here, } \frac{5x}{3} + \frac{6y}{3} = 60$$

$$\therefore 5x + 6y = 180$$

* Fullerene is prepared by heating graphite in the electric spark

* It has no dangling bonds

Boards Allotropes

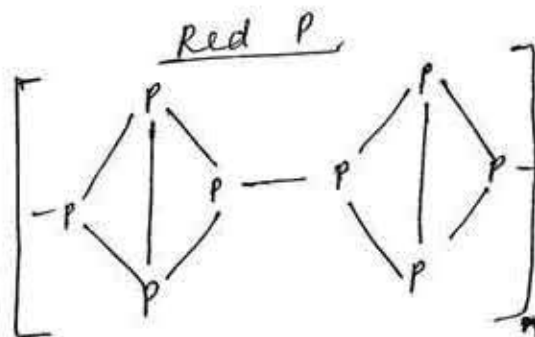
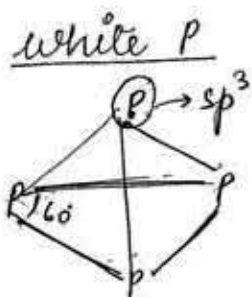
Allotropes of Phosphorus

white
red
black

Differences b/w white and Red phosphorus.

Properties

structure



Stability:

less stable
(more strain)

more stable
(less strain)

BP & MP
(volatility)

low more $\left[\because \text{BP/MP} \propto \frac{1}{\text{volatility}} \right]$ high low

Chemilumi-
nescence

Phosphorescence
(it glows in dark
due to its slow
oxidation) It mainly
gives P_4O_{10}

no ~~ss~~ such
property.

solubility

insoluble in H_2O
→ completely soluble
in CS_2 ($\text{S}=\text{C}=\text{S}$)

insoluble in H_2O

insoluble in CS_2

toxic
nature

More toxic, causes
~~loss~~ Phossy Jaw

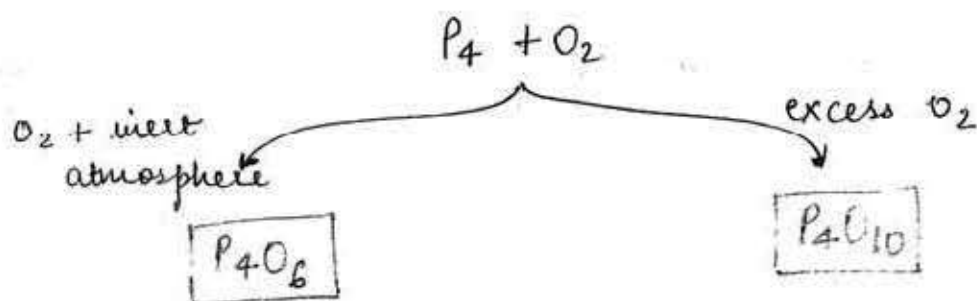
less toxic

eff of temp

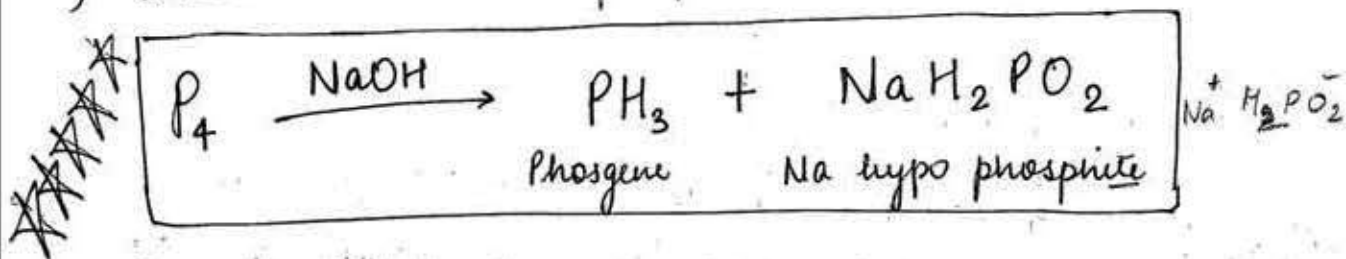
Both forms convert into black phosphorus
at high Temp.

Other important points:

- i) Black phosphorus is the most stable allotropes mainly due to unstrained ring.
- ii) It is available in two forms
→ α black and β -black
- iii) White and red P when heated changes into black at 473 K and 800 K respectively.
- iv) P_4 reacts with oxygen to form P_4O_6 or P_4O_{10}



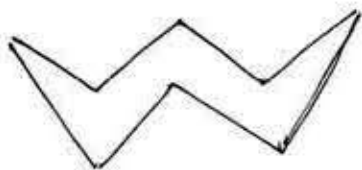
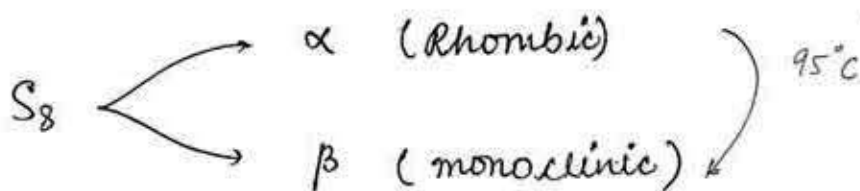
- v) white P (P_4) disproportionates NaOH to form



- vi) Two major constituent of safety matches are
→ Red P and P_4S_3

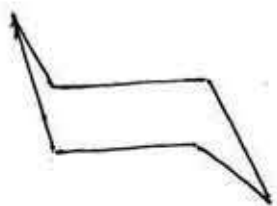
ous → ite
ite → ate

Allotropes of sulphur



assumes -
(crown - puckered shape
to minimize angle strain)

* S_6



chair/angles

* S_2

(vapour)
(1000 K)

MOT $\Rightarrow$ Paramagnetic (2 unpaired e⁻ like O_2)

[Imp. role of temperature (NCERT)]

[95°C] α Rhombic $\xrightarrow{\text{Transition Temp.}}$ monoclinic β

[119°C] sulphur will melt (pouring off) [yellow colour liquid]

$\downarrow$ viscosity $\uparrow$ es due to formⁿ of long chain

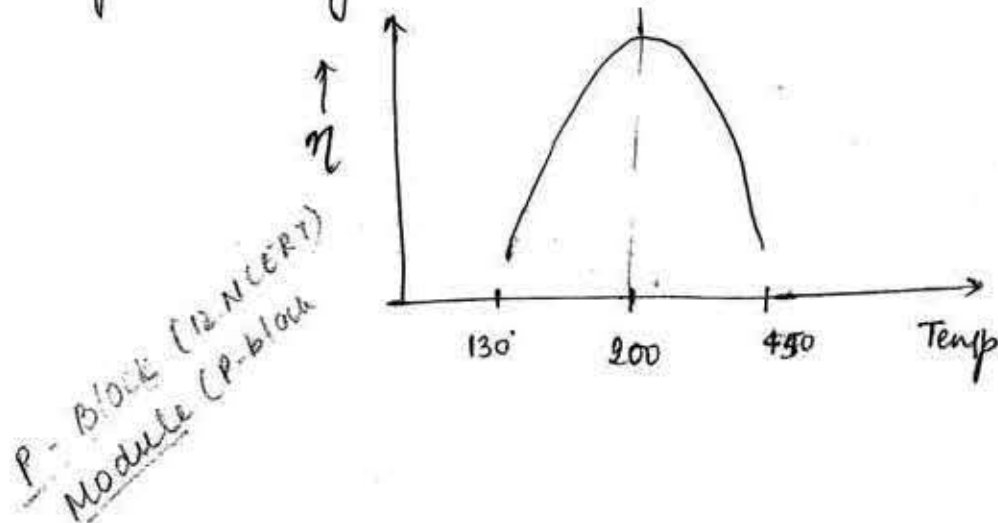
[130°C] Anamolous property construction (Reverse liquid) [tar like liquid]

$\downarrow$ [200°C] show catenation property

[high viscous fluid] loses its pouring property

Other imp. points: @iitwale on telegram

- i) Sulphur is non polar $\therefore$ readily dissolves in CS_2 (carbon disulphide)
- ii) α -form is considered to be the most stable allotropic and has different modification like roll S, flower of S and milk of S.
- iii) The major reason for the anomalous increase of viscosity with temp is catenation.



Hydrolysis:

halides

Oxides

Oxy-acids

carbides and nitrides

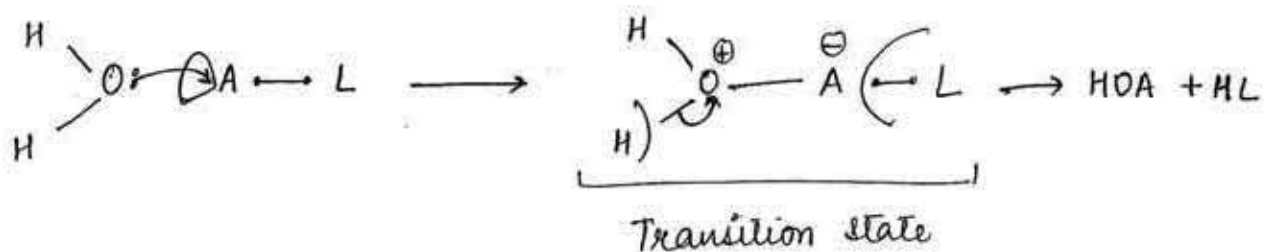
Non-metals

Xe-compound.

HYDROLYSIS OF COVALENT COMPOUNDS :

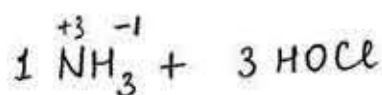
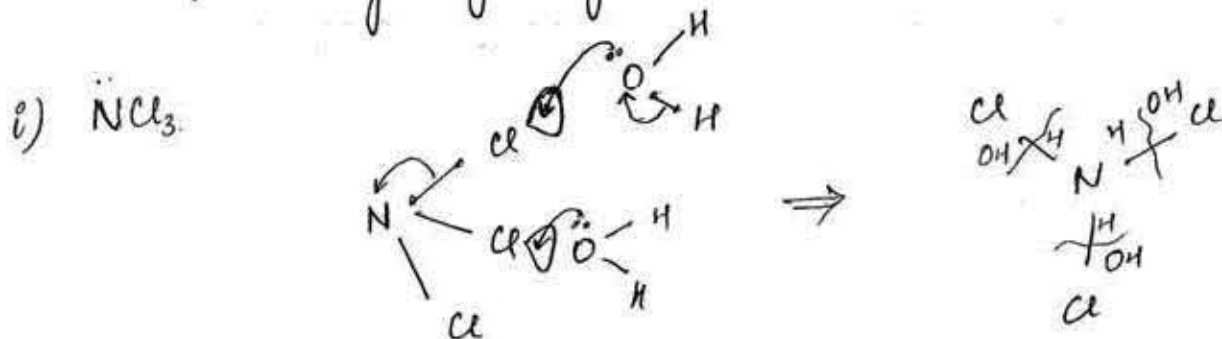
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Reaction of compound with water is hydrolysis and the general mechanism is

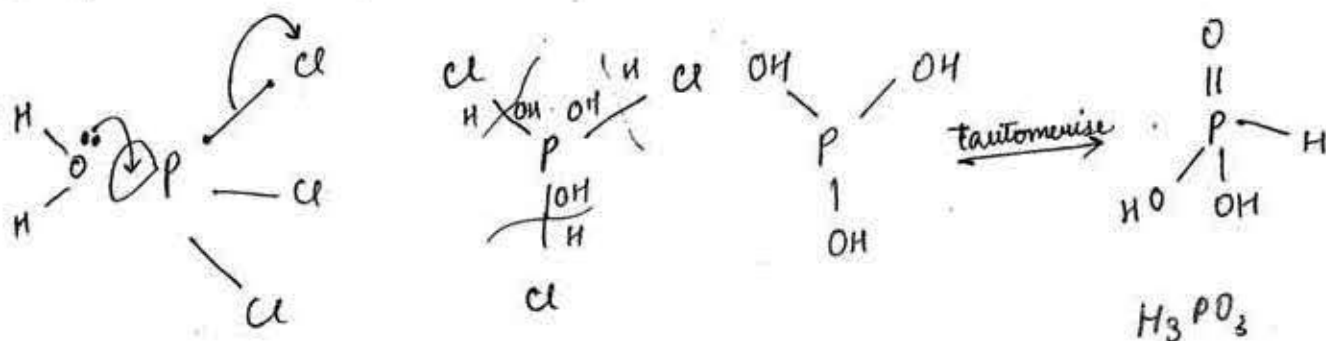


where L = leaving group

In general more covalent compound are more readily hydrolysed.

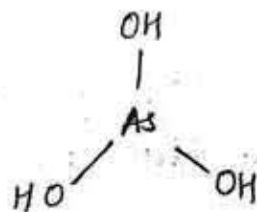
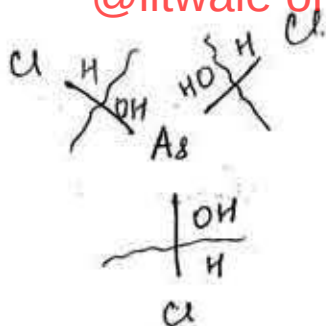


ii) PCl_3



iii) $AsCl_3$

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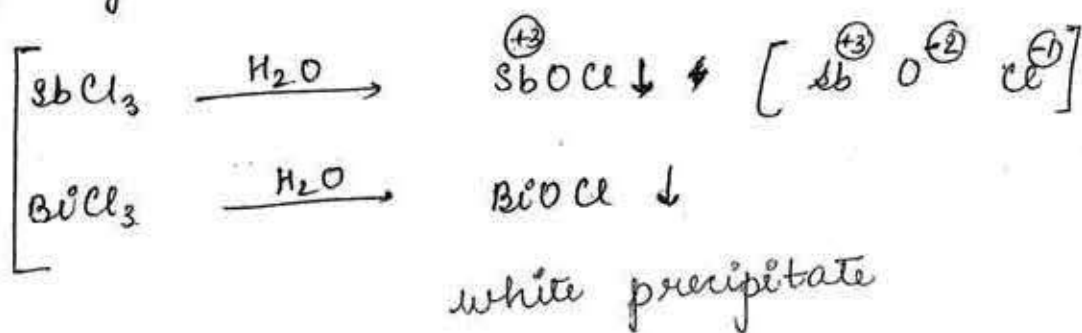


[No tautomerism]

$\because$ As has big size

iv) $SbCl_3$, $BiCl_3$.

These are ionic compounds and partially hydrolysed.



II $\Rightarrow$ CCl_4 , $SiCl_4$, SiF_4

1) $CCl_4 \Rightarrow$ It is almost unhydrolysed in normal conditions ~~but~~ because

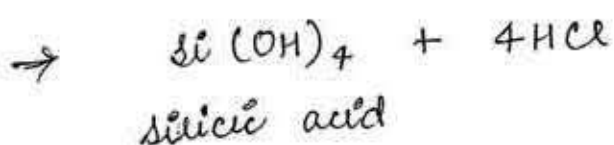
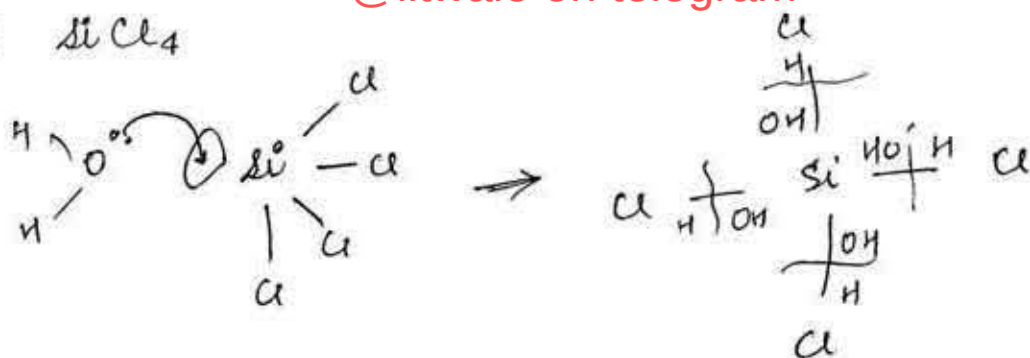
a) C doesn't have vacant d orbital

b) C is less electronegativity

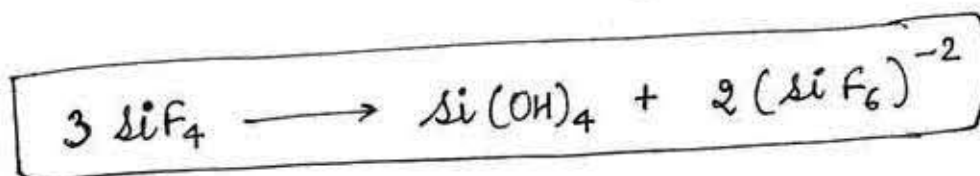
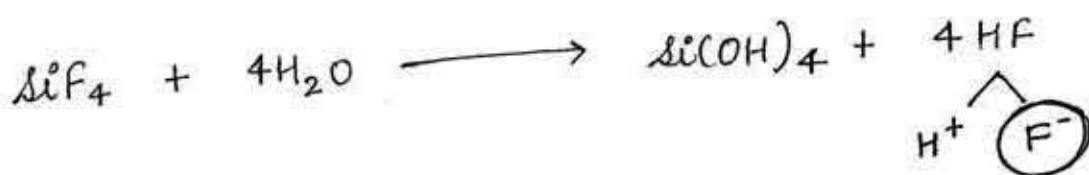
(It can't get -ve charge from Cl)

2) On hydrolysis, the oxidation no does not change

ii) SiCl_4

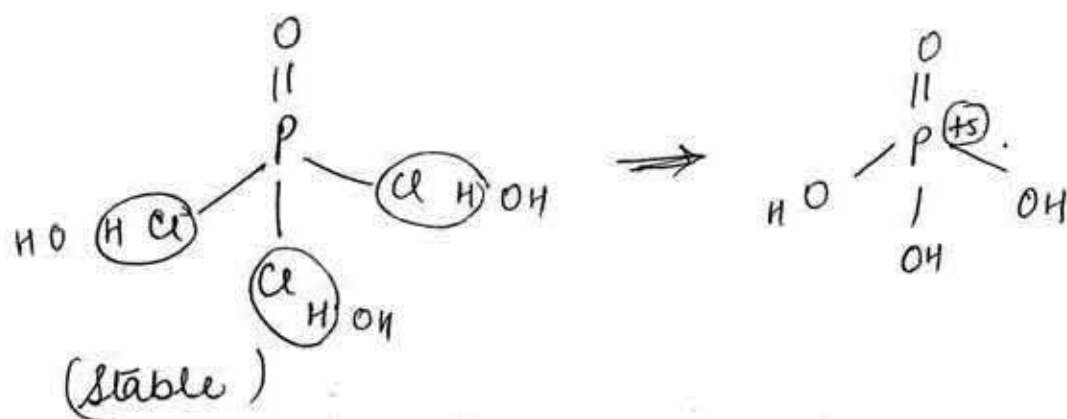
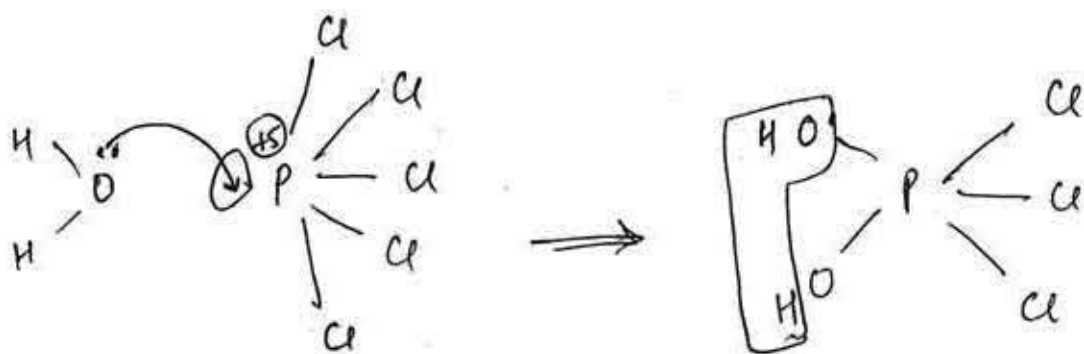


iii) SiF_4



From the reaction, it is clear that, hydrolysis of SiF_4 is partial due to formation of $(\text{SiF}_6)^{-2}$

* SiCl_4 will be completely hydrolysed due to more hindered $(\text{SiCl}_6)^{-2}$ ion which doesn't exist.



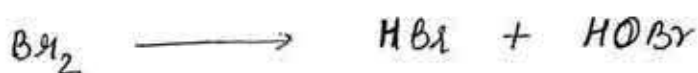
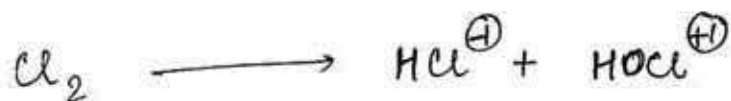
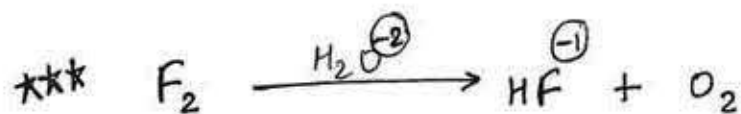
* Incomplete hydrolysis $\rightarrow POCl_3$

complete hydrolysis $\rightarrow H_3PO_4$

No. of water molecules required for complete hydrolysis $\rightarrow (5-1) \rightarrow 4$

halogens :

* F oxidise water whereas ~~the~~ other halogens disproportionate in water.

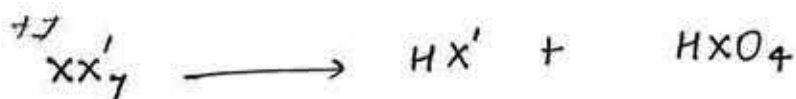
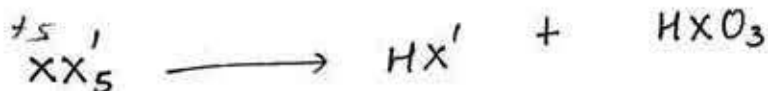
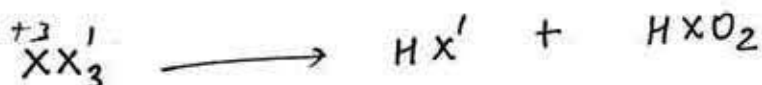
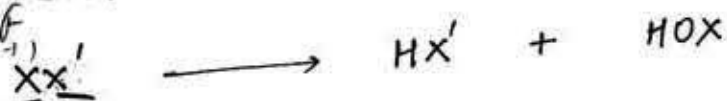


disproportionates

** Interhalogen (NCERT) compⁿ formed by 2 halogens

$X = Cl, Br, I$

$X' = F$



X' will go to H whereas +vely charged
C.A will form its oxy-acid.



Oxides

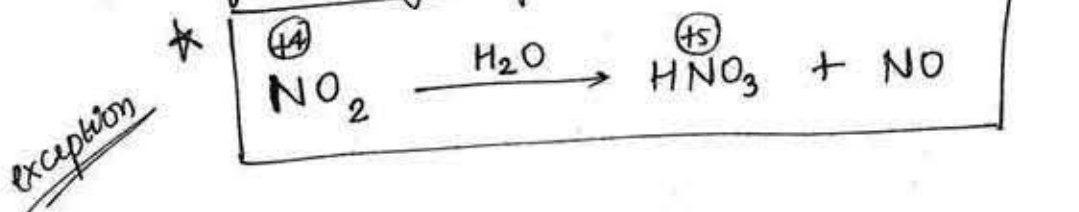
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p-block acidic oxide hydrolyse into the corresponding oxo acids generally without a change in oxidation no.

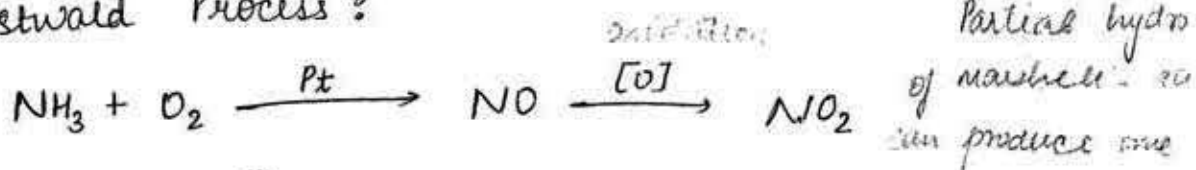


* N_2O_5 is anhydride of HNO_3 .

* NO_2 disproportionates in water to give HNO_3 and NO and the reaction is a part of Ostwald process for the industrial manufacturing of nitric acid.



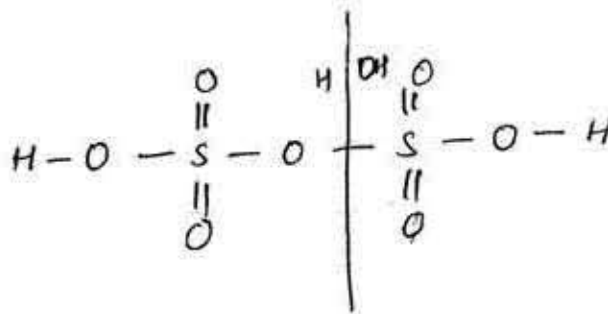
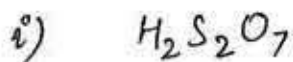
Ostwald Process :



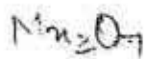
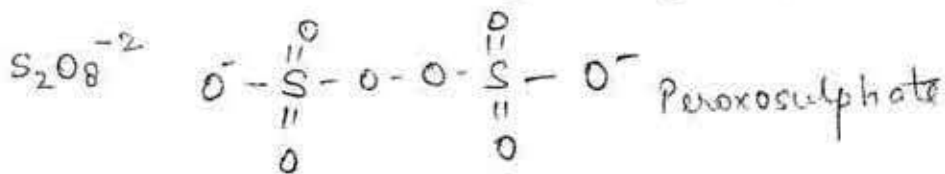
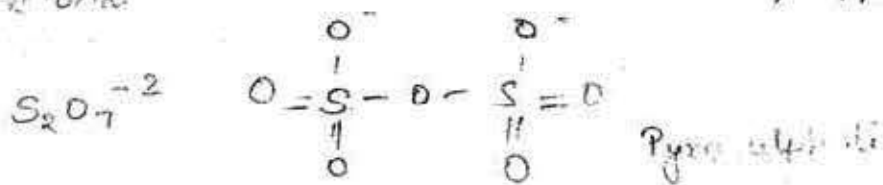
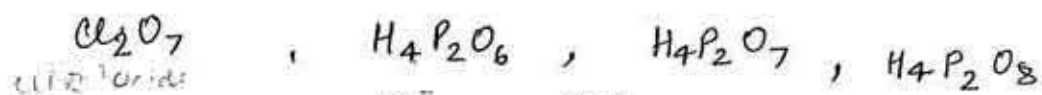
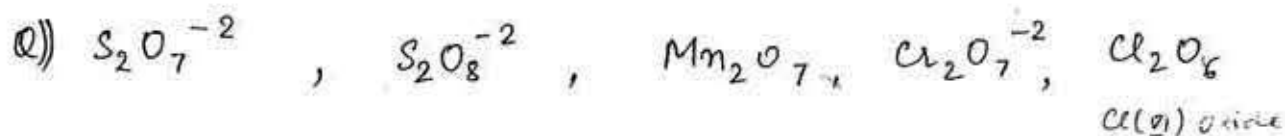
Partial hydrolysis of marshite can produce one mole of H_2SO_4 and one mole of H_2

Both NO_2 and HNO_2 disproportionate in H_2O and give identical products.

Oxy-acids

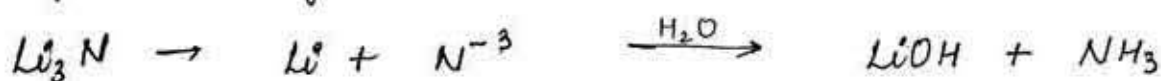
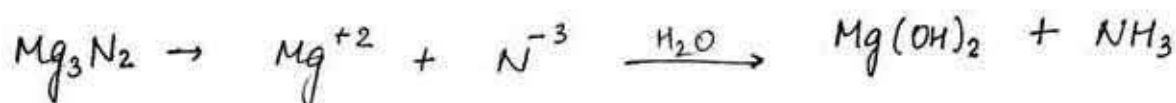
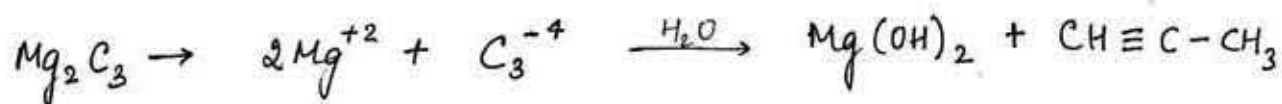
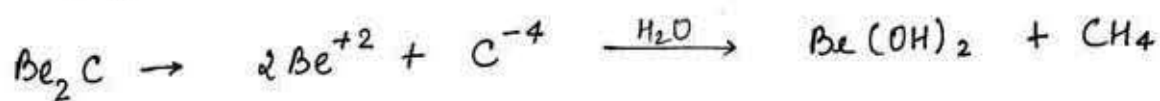


Prediction of structures of oxides, Oxyacid or oxyanions :



Carbides and Nitrides

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* Mg(OH)₂ and Al(OH)₃

Both insoluble
Both have white ppt
used as antacids.

→ Milk of magnesia

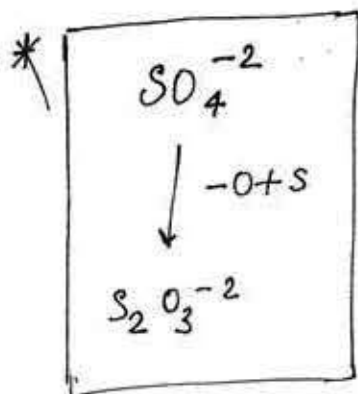
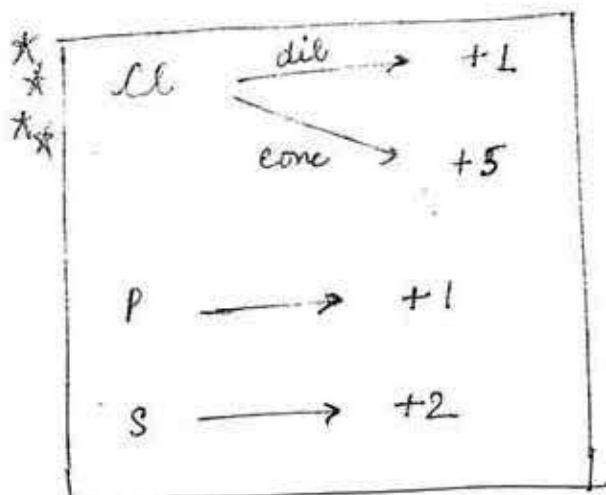
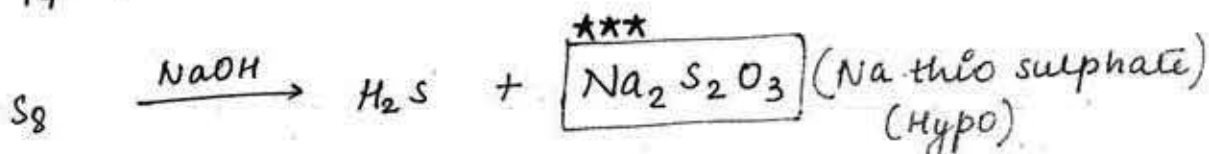
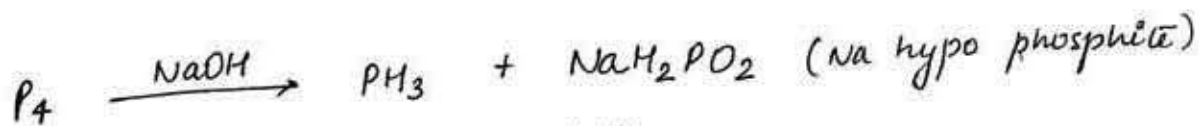
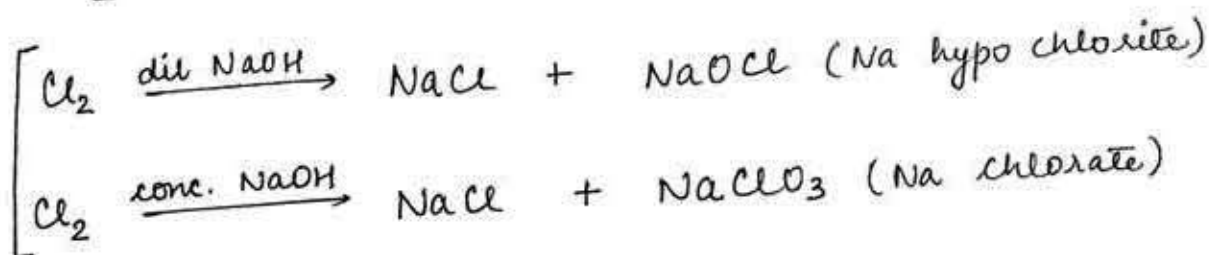
* Ca₃P₂ and CaC₂ (calcium phosphide & calcium carbide)

Ca₃P₂ and CaC₂ on hydrolysis give combustible gases like PH₃ (phosphine) which on combustion ?
fog like appearance and used in

- sea signalling system (home signals)
- smoke screens

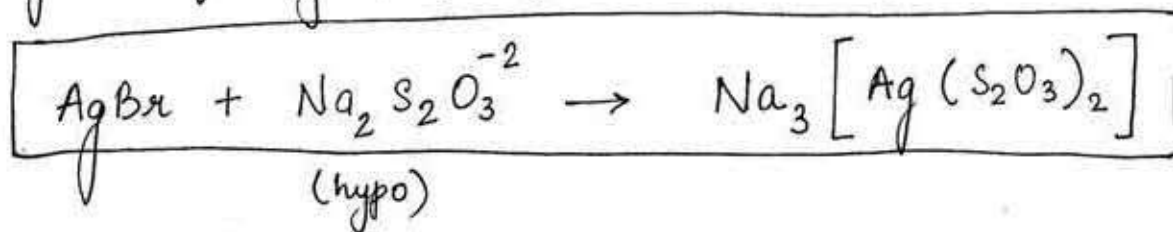
Hydrolysis of Non-metals

Non-metals like P, S and Cl show disproportionation in aq. alkaline medium as shown

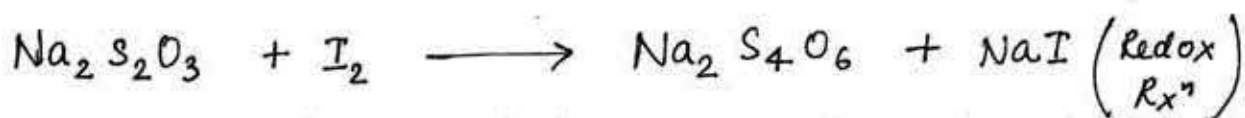


Uses of Hypo: @iitwale on telegram

> It is used in the removal of undecomposed AgBr (fixing step of photography).



> Hypo can be used in Iodometric titration using starch indicator to estimate the quantity of iodine.



(at low Temp) $\Rightarrow$ so that the evaporation of iodine can be avoided.

Xe-compound

$\text{XeF}_2 \Rightarrow$ It undergo redox change during hydrolysis and oxidise water

$\text{XeF}_4 \Rightarrow$ disproportionates

$\text{XeF}_6 \Rightarrow$ hydrolysis without redox.

