P-Block

15th

HNO_3

① aqua fortis [strong water]

Prep

Lab: $NaNO_3 + conc.\ H_2SO_4 \longrightarrow HNO_3$

Industrial prep → **Ostwald process**

$$NH_3 + O_2 \xrightarrow{Pt/Rh} NO + H_2O$$

$$NO + \frac{1}{2}O_2 \longrightarrow NO_2$$

$$NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$$

$$HNO_2 \longrightarrow HNO_3 + NO$$

Birkel Eyde

$$N_2 + O_2 \xrightarrow{3000^\circ C} NO$$

$$NO + \frac{1}{2}O_2 \longrightarrow NO_2$$

$$NO_2 + H_2O \longrightarrow HNO_2 + HNO_3$$

$$HNO_2 \longrightarrow NO + HNO_3$$

Note ⇒ NO oxide recycle and HNO_3 is conc.
& 68% by mass HNO_3 is obtained.
further conc. HNO_3 is obtained by it's dehydration.

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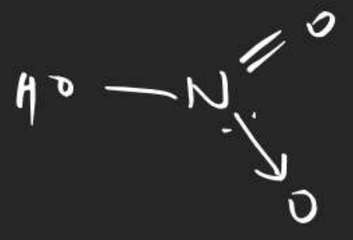
Prop:

1. Colourless liq.
2. HNO_3 usually aquires yellow or brown colour due to it's decomposition in to NO_2 by sunlight.



$$HNO_3 \xrightarrow{h\nu} NO_2 + H_2O$$

☆ Yellow or Brown colour can be remove by Heating it up to 60 - 80°C

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Chemical Reaction

already done in salt.

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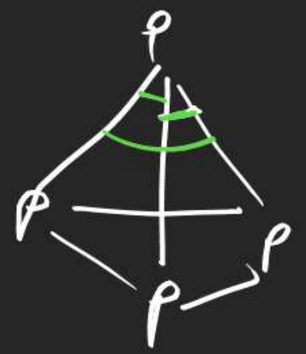
allotrope of P

1. White P
2. Red P
3. Black P

(1) White P



P_4

(1) Catches fire

$P_4 + O_2 \rightarrow P_2O_5$ (White fumes)

(2) Cold water store

(3) Highly Reactive

(4) Garlic Smell

(5) Poisonous

(6) It glow in dark due to oxidation it is Called Chemeluminesence

(7) It is Insoluble in water

(8) Soluble in CS_2

(9) Highly reactive

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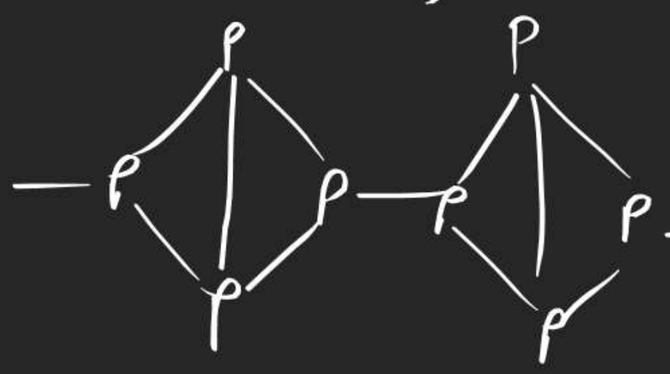
Red - P



Solid Polymeric

1. Polymeric
2. water insoluble
3. Insoluble in CS_2
4. non poisonous
5. doesnot glow in dark
6. Odourless.

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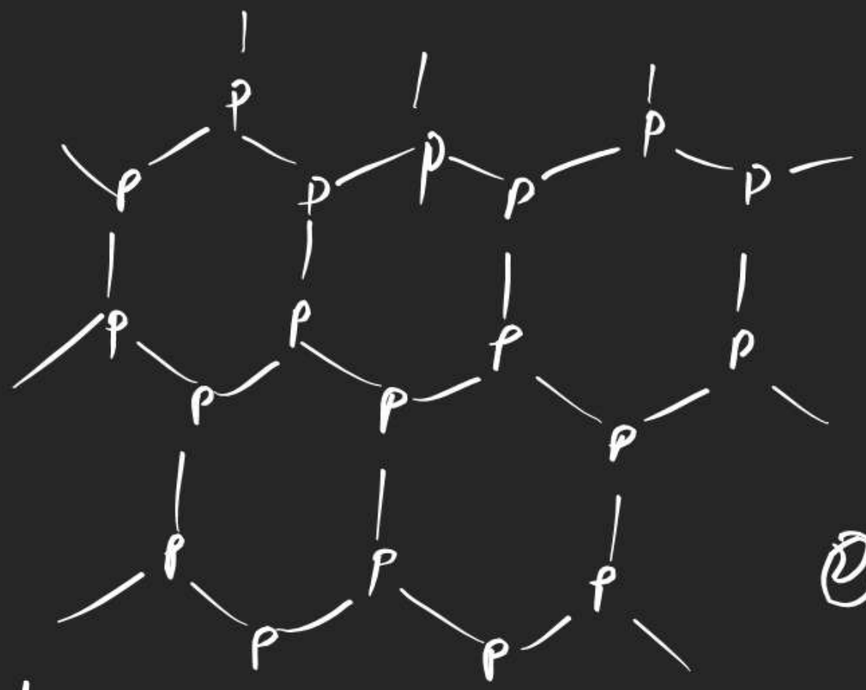
Black P



Black P — α, β

(1) α-Black P is prep by Heated Red P at 803 K

(2) β-Black P is prep. by Heated White P at 473 K

thermodynamic stability

Black > Red > White.

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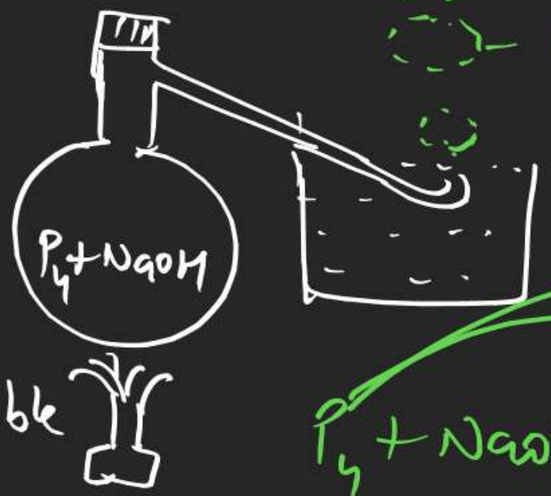
PH_3

Prep.

$$Ca_3P_2 + H^+-OH^- \longrightarrow Ca(OH)_2 + PH_3$$

$$Ca_3P_2 + H^+-Cl^- \longrightarrow CaCl_2 + PH_3$$

Lab.



White fumes of P_2O_5

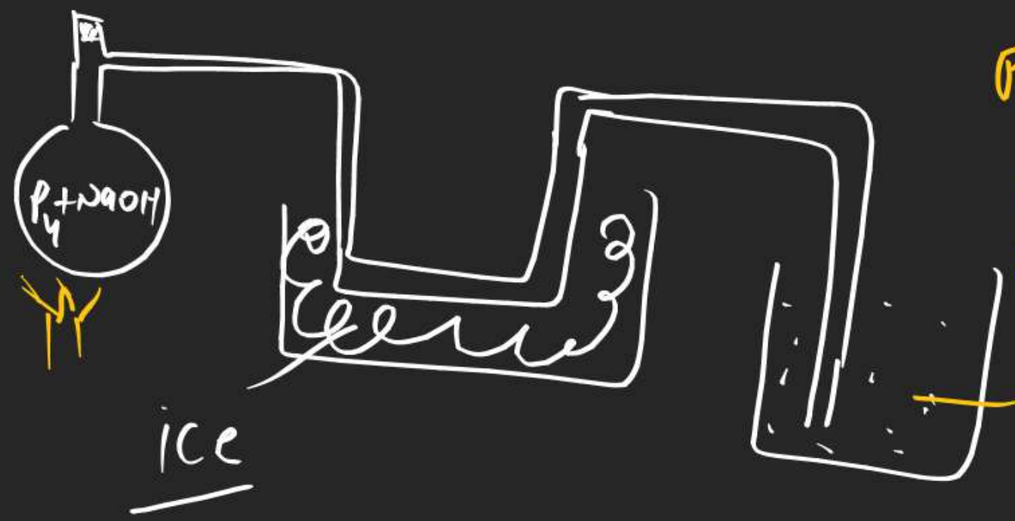
flammable or non flammable

$$P_4 + NaOH \longrightarrow \overset{-3}{P}H_3 + NaH_2\overset{+1}{P}O_2$$

Sodium Hypophosphite

Impure PH_3 — Inflammable due to presence of P_2H_4 and P_4 vap.

Pure PH_3 = non flammable



$$PH_3 + HI \longrightarrow PH_4I$$

$$PH_4I + KOH \longrightarrow PH_3 + KI$$

(PH_3 pure)

PH_4I ⇌ PH_3 + HI

HI

$$AlP + H_2SO_4 \longrightarrow Al_2(SO_4)_3 + PH_3$$

(PH_3 pure)

$$H_3PO_3 \xrightarrow{\Delta} PH_3 + H_3PO_4$$

$$H_3PO_2 \xrightarrow{\Delta} PH_3 + H_3PO_4$$

Prop:

(i) PH_3 is colourless gas having Rotten fishy smell.

(ii) Sparingly soluble in water but Complete soluble in CS_2

(iii) highly poisonous.

Chemical Reaction

$$PH_3 + CuSO_4 \longrightarrow Cu_3P_2$$

Black

$$NH_3 + CuSO_4 \longrightarrow [Cu(NH_3)_4]SO_4$$

Switzer's salt

(Deep Blue)

$$PH_3 + AgCl_2 \longrightarrow Ag_3P_2$$

(Yellow ppt)

Holme's signal

$$\begin{cases} Ca_3P_2 + H^+-OH^- \longrightarrow Ca(OH)_2 + PH_3 \\ CaC_2 + H^+-OH^- \longrightarrow Ca(OH)_2 + CH \equiv CH \end{cases}$$

and Will-o-wisp → Gauze → P_2H_4

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Halides of P

PCl_3

$P + Cl_2 \longrightarrow PCl_3$ (limit)

$PCl_3 + H_2O \longrightarrow H_3PO_3$

$P_4 + SOCl_2 \longrightarrow PCl_3 + SO_2 + S_2Cl_2$ (+4)

(Thionyl Chloride)

PCl_5 (yellowish white powder)

$P_4 + Cl_2 \longrightarrow PCl_5$ (excess)

$PCl_5 + H_2O \longrightarrow POCl_3 + 2HCl$

$POCl_3 + H_2O \longrightarrow H_3PO_4$

$P_4 + SO_2Cl_2 \longrightarrow PCl_5 + SO_2$ (+6)

(Sulphuryl Chloride)

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$$PCl_3 + CH_3COOH \longrightarrow CH_3COCl + H_3PO_3$$

$$PCl_3 + C_2H_5OH \longrightarrow C_2H_5Cl + H_3PO_3$$

$$PCl_5 + CH_3COOH \longrightarrow CH_3COCl + POCl_3 + HCl$$

$$PCl_5 + C_2H_5OH \longrightarrow C_2H_5Cl + POCl_3 + HCl$$

H_3PO_2 Hypometaphosphorous acid

H_3PO_3 = Phosphorous acid

H_3PO_4 = Phosphoric acid

$H_4P_2O_6$ = Hypo phosphoric acid

$H_4P_2O_7$ = Pyrophosphoric acid

$H_4P_2O_8$ = Peroxodiphosphoric acid

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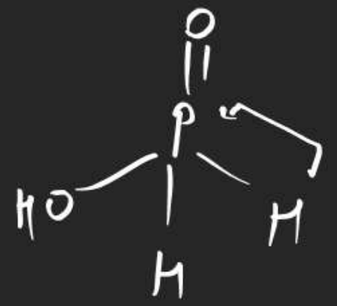
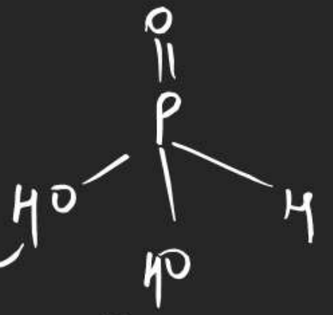
H_3PO_2

basicity = number of ionisable hydrogen

Reducing acid



basicity = 1

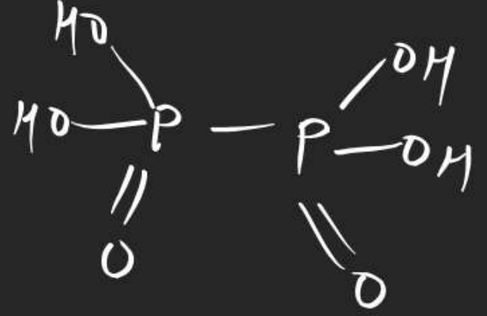


basicity = 2

basicity = 3

basicity = it is expressed by OH group which are directly attached by Central atom.

$H_4P_2O_6$



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Prep. of oxyacid

H_3PO_3 H_3PO_4

White P + alkali $\longrightarrow$ H_3PO_2

Phosphorous acid + Br_2 $\xrightarrow[\text{sealed tube}]{\text{Heat in}}$ $(HPO_3)_n$

$P_2O_3 + H_2O \longrightarrow H_3PO_3$

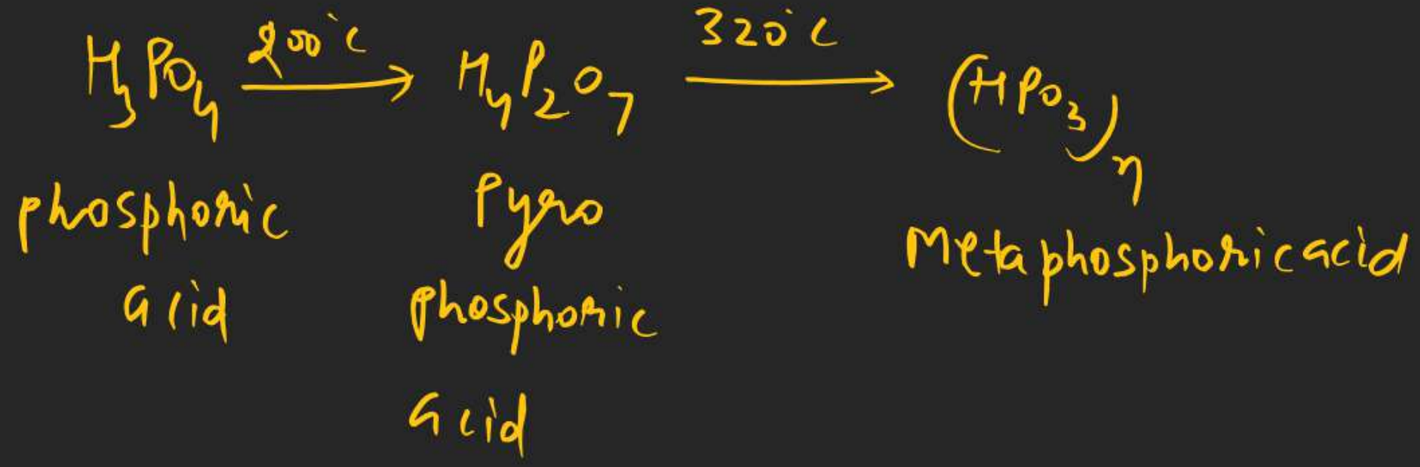
$P_2O_5 + H_2O \longrightarrow H_3PO_4$

$PCl_3 + H_3PO_3 \longrightarrow H_4P_2O_5$ (Pyrophosphorous acid.)

(Meta phosphoric acid)

Red P + alkali $\longrightarrow H_4P_2O_6$

Heating of phosphoric acid $\longrightarrow H_4P_2O_7$



Graham Salt

$(NaPO_3)_6$

$Na_6P_6O_{18}$

Sodium Hexameta phosphate

$(NaPO_3)_n$

$n = 10^2$ to 10^6 → Long Chain

linear water soluble polymer and it is used for removal of Hardness of water

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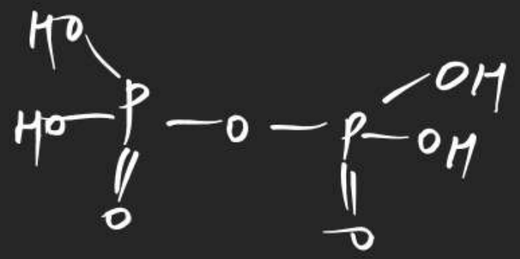
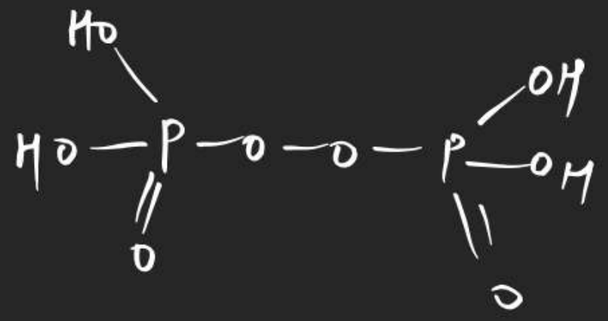
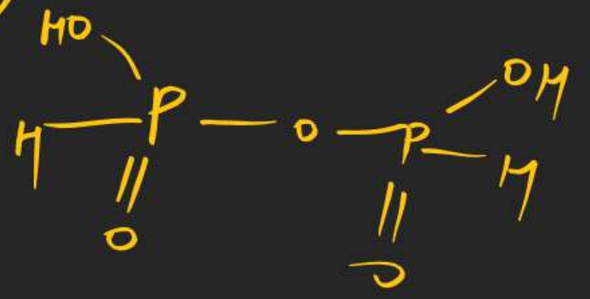




$H_4P_2O_5$



basicity = 2