The p-Block Elements

Oxoacids of Phosphorus: Phosphorus forms a number of oxoacids.

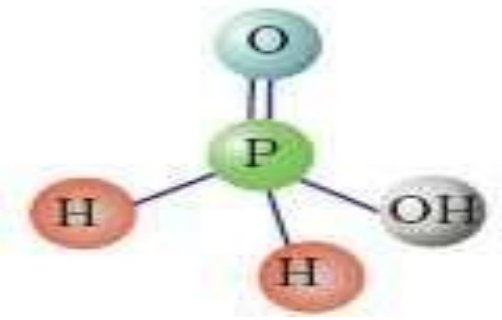
1. **H_3PO_2 [Hypophosphorus Acid (Phosphinic Acid)]**

   It is prepared by heating white phosphorus with concentrated NaOH solution followed by passing through cation exchange resin.

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2 \text{ (sodium hypophosphite)}$$

$$NaH_2PO_2 + H^+\text{-Resin} \rightarrow H_3PO_2 + Na^+\text{-Resin}$$

Structure:



It is a strong reducing agent due to the presence of a P-H bond. It is monobasic even though it contains three hydrogen atoms. This is because the hydrogen atoms directly bonded to the P atom will not dissociate.

2. **H_3PO_3 [Orthophosphorus Acid (Phosphonic Acid)]**

It is prepared by the action of water on P_2O_3

$$P_2O_3 + H_2O \rightarrow H_3PO_3$$

It is dibasic because of the presence of two –OH groups.

Structure:

3. **$H_4P_2O_5$ [Pyrophosphorus Acid]**

It is prepared by the action of H_3PO_3 on PCl_3

$PCl_3 + 5H_3PO_3 \rightarrow 3\ H_4P_2O_5 + 3HCl$

It is also dibasic because of the presence of two –OH groups.

4. **$H_4P_2O_6$ [Hypophosphoric Acid]**

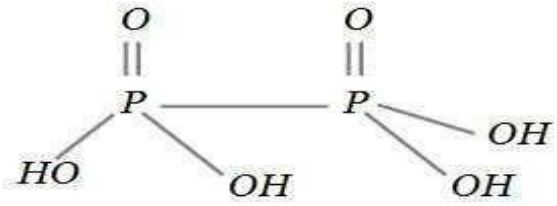
It is prepared by the action of an alkali on red Phosphorus followed by passing through cation exchange resin.

$2P + NaOH + H_2O \rightarrow Na_2H_2P_2O_6$

$Na_2H_2P_2O_6 + 2H^+ \text{ - Resin} \rightarrow H_4P_2O_6 + 2Na^+ \text{- Resin}$

It is a tetra basic acid.

Structure:



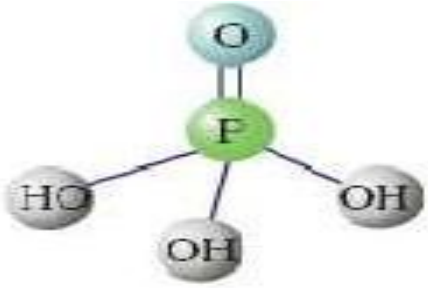
5. **H_3PO_4 [Orthophosphoric Acid]**

It is obtained by the action of water on phosphorus pentoxide (P_4O_{10})

$P_4O_{10} + 6\ H_2O \rightarrow 4\ H_3PO_4$

It is also called Phosphoric acid. It's a tribasic acid and has a tetrahedral shape.

Structure:

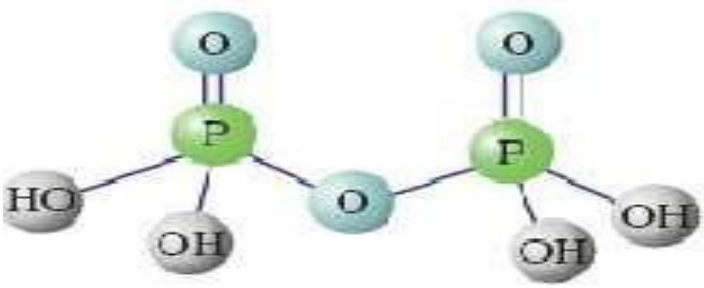


6. **$H_4P_2O_7$ [Pyrophosphoric Acid]**

It is obtained by heating Phosphoric acid at about 250^0c.

$2\ H_3PO_4 \rightarrow H_4P_2O_7$. It's a tetra basic acid.

Structure:

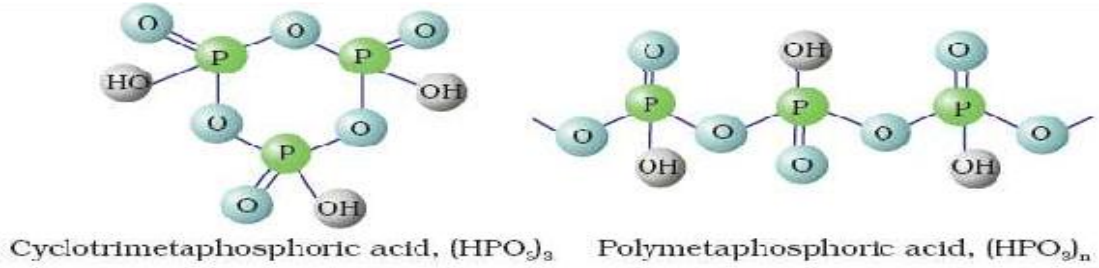


7. $(HPO_3)_n$ [Metaphosphoric acid]

It is obtained by heating phosphorus acid with Br_2 vapours in a sealed tube.

$$H_3PO_3 + Br_2 \rightarrow HPO_3 + 2HBr$$

Structure: It exists as a trimer or a polymer as follows:



The oxoacids of phosphorus in +3 oxidation state undergo Disproportionation (i.e. simultaneously oxidised and reduced). For example, orthophophorous acid (or phosphorous acid) on heating disproportionate to give orthophosphoric acid (phosphoric acid) and phosphine.

$$4H_3PO_3 \longrightarrow 3H_3PO_4 + PH_3$$

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