

# CHEMISTRY STUDY MATERIALS FOR CLASS 12 (NCERT BASED NOTES OF CHAPTER – 7)

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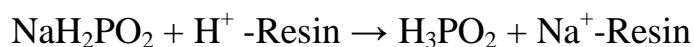
DATE:- 27/07/2021

## The p-Block Elements

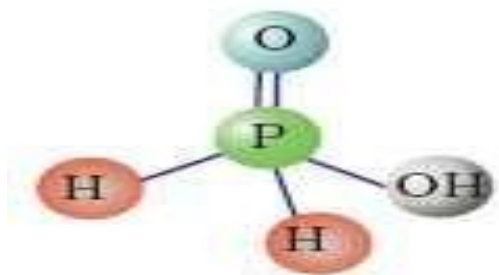
**Oxoacids of Phosphorus:** Phosphorus forms a number of oxoacids.

### 1. $\text{H}_3\text{PO}_2$ [Hypophosphorus Acid (Phosphinic Acid)]

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



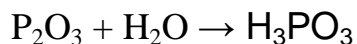
**Structure:**



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. $\text{H}_3\text{PO}_3$ [Orthophosphorus Acid (Phosphonic Acid)]

It is prepared by the action of water on  $\text{P}_2\text{O}_3$



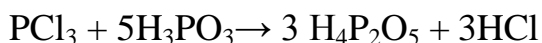
It is dibasic because of the presence of two  $\text{-OH}$  groups.

**Structure:**



### 3. $\text{H}_4\text{P}_2\text{O}_5$ [Pyrophosphorus Acid]

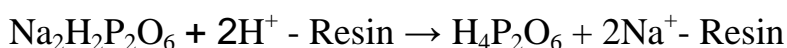
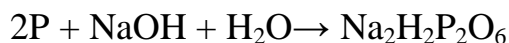
It is prepared by the action of  $\text{H}_3\text{PO}_3$  on  $\text{PCl}_3$



It is also dibasic because of the presence of two  $-\text{OH}$  groups.

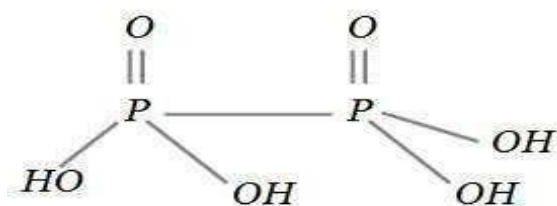
### 4. $\text{H}_4\text{P}_2\text{O}_6$ [Hypophosphoric Acid]

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



It is a tetra basic acid.

**Structure:**



### 5. $\text{H}_3\text{PO}_4$ [Orthophosphoric Acid]

It is obtained by the action of water on phosphorus pentoxide ( $\text{P}_4\text{O}_{10}$ )



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

**Structure:**

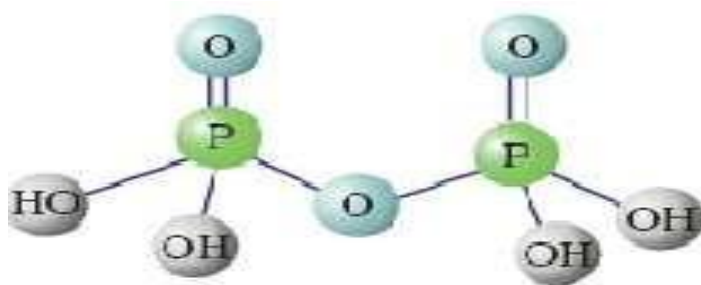


### 6. $\text{H}_4\text{P}_2\text{O}_7$ [Pyrophosphoric Acid]

It is obtained by heating Phosphoric acid at about  $250^\circ\text{C}$ .

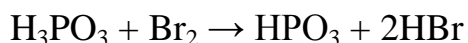


**Structure:**

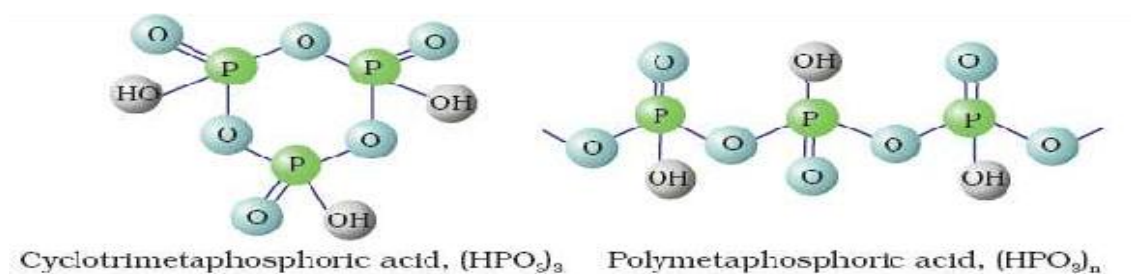


## 7. $(\text{HPO}_3)_n$ [Metaphosphoric acid]

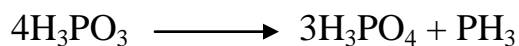
It is obtained by heating phosphorus acid with  $\text{Br}_2$  vapours in a sealed tube.



**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, orthophosphorous acid (or phosphorous acid) on heating disproportionate to give orthophosphoric acid (phosphoric acid) and phosphine.



## Group 16 Elements

The members of this group are oxygen (O), sulphur (S), selenium (Se), tellurium (Te) and polonium (Po). They are also called Chalcogens (means ore producing). Oxygen and sulphur are non-metals, selenium and tellurium are metalloids, while polonium is a radioactive metal.

Ionisation enthalpy of these elements decreases down the group. It is due to increase in size.

However, the elements of this group have lower ionisation enthalpy values compared to those of Group 15 elements. This is due to the fact that Group 15 elements have extra stable half-filled p orbitals electronic configurations.

Oxygen atom has less negative electron gain enthalpy than sulphur because of the compact nature of its shells due to which the electronic repulsion is greater.

**.Oxidation states:** The elements of Group 16 exhibit a number of oxidation states (-2,+2,+4 & +6). The stability of -2 oxidation state decreases down the group. Since electronegativity of oxygen is very high, it shows only -2 oxidation state (except in the case of OF<sub>2</sub> where its oxidation state is + 2). Other elements of the group exhibit + 2, + 4 & + 6 oxidation states. But + 4 and + 6 are more common. Sulphur, selenium and tellurium usually show + 4 oxidation state in their compounds with oxygen and + 6 with fluorine. Down the group, the stability of + 6 oxidation state decreases and that of + 4 oxidation state increases (due to inert pair effect).

### Oxidation States

Elements:-	<b>O</b>	<b>S</b>	<b>Se</b>	<b>Te</b>	<b>Po</b>
Atomic No.:-	<b>8</b>	<b>16</b>	<b>34</b>	<b>52</b>	<b>84</b>
	<b>-2</b>	<b>-2</b>	<b>-2</b>	<b>-2</b>	<b>--</b>
		<b>+6</b>	<b>+6</b>	<b>+6</b>	<b>+6</b>
		<b>+4</b>	<b>+4</b>	<b>+4</b>	<b>+ 4</b>
		<b>+2</b>	<b>+2</b>	<b>+2</b>	<b>+2</b>

**Notes:-**1. Due to non-metallic (O and S) and metalloidalic (Se and Te) nature O, S, Se and Te show negative oxidation state (-2)

2. Due to absence of d- sub-shell, non-metallic nature and high En values (anomalous property) "O" shows -2 oxidation state only.

3. Due to presence of vacant d- sub shell, non-metallic nature and more electronegative value "S" shows variables oxidation states.

4. Due to inert pair effect "Se, Te and Po" show variables oxidation states.

### ***Anomalous properties of oxygen***

Oxygen differs from the rest of the members of this group due to its smaller size, high electro negativity, high ionisation enthalpy and non-availability of *d* orbitals. Some of the anomalous properties shown by oxygen are:

1. Oxygen has the ability to form ***pπ-pπ* multiple** bonds with itself and with other elements like C and O. Other elements of this group do not form *pπ-pπ* bonds.

2. Oxygen exists as a diatomic molecule with a triple bond (one  $s$  and two  $p$ ) between the two atoms. So its bond enthalpy is very high. While other elements of this group are polyatomic with single bonds.
3. The double  $O = O$  bond is weak. So the catenation tendency is weaker in oxygen.
4. Due to the absence of  $d$  orbitals in its valence shell, the maximum covalency of oxygen is two
5. Oxygen cannot form  **$d\pi-p\pi$  bond**. While Sulphur and selenium can form  **$d\pi-d\pi$  bond** with transition metals.

### **Hydrides of 16<sup>th</sup> group elements**

All the elements of Group 16 form hydrides of the type  $H_2E$  ( $E = S, Se, Te, Po$ ). Their acidic character increases from  $H_2O$  to  $H_2Te$ . This is due to the decrease in bond ( $H-E$ ) dissociation enthalpy down the group. So the thermal stability also decreases down the group. All the hydrides except water possess reducing property and this character increases from  $H_2S$  to  $H_2Te$ .

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