CHEMISTRY OF GROUP 16 IN P-BLOCK ELEMENTS

GROUP 16 ELEMENTS

25. **Oxidation states:** They show -2, +2, +4, +6 oxidation states. Oxygen does not show +6 oxidation state due to absence of d – orbitals. Po does not show +6 oxidation state due to inert pair effect.

The stability of -2 oxidation state decreases down the group due to increase in atomic size and decrease in electronegativity.

Oxygen shows -2 oxidation state in general except in OF_2 and O_2F_2

The stability of +6 oxidation state decreases and +4 oxidation state increases due to inert pair effect.

26. **Ionisation enthalpy:** Ionisation enthalpy of elements of group 16 is lower than group 15 due to half filled p-orbitals in group 15 which are more stable. However, ionization enthalpy decreases down the group.

27. **Electron gain enthalpy:** Oxygen has less negative electron gain enthalpy than S because of small size of O.

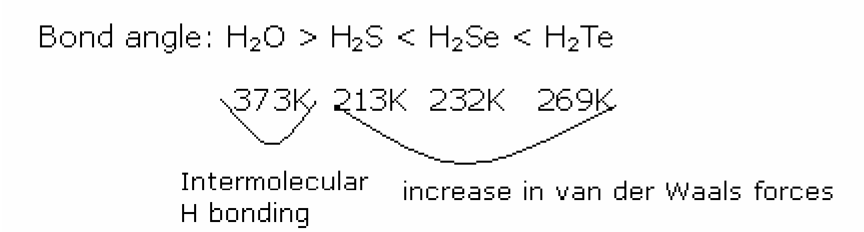
From S to Po electron gain enthalpy becomes less negative to Po because of increase in atomic size.

28. **Melting and boiling point:** It increases with increase in atomic number. Oxygen has much lower melting and boiling points than sulphur because oxygen is diatomic (O_2) and sulphur is octatomic (S_8).

29. **Reactivity with hydrogen:**

All group 16 elements form hydrides.

Bent shape



Acidic nature: $H_2O < H_2S < H_2Se < H_2Te$

This is because the H-E bond length increases down the group. Therefore, the bond dissociation enthalpy decreases down the group.

Thermal stability: $H_2O < H_2S < H_2Se < H_2Te < H_2Po$

This is because the H-E bond length increases down the group. Therefore, the bond dissociation enthalpy decreases down the group.

Reducing character: $H_2O < H_2S < H_2Se < H_2Te < H_2Po$

This is because the H-E bond length increases down the group. Therefore, the bond dissociation enthalpy decreases down the group.

30. **Reactivity with oxygen:** EO_2 and EO_3

Reducing character of dioxides decreases down the group because oxygen has a strong positive field which attracts the hydroxyl group and removal of H^+ becomes easy.

Acidity also decreases down the group.

SO_2 is a gas whereas SeO_2 is solid. This is because SeO_2 has a chain polymeric structure whereas SO_2 forms discrete units.

31. **Reactivity with halogens:** EX_2 EX_4 and EX_6

The stability of halides decreases in the order $F^- > Cl^- > Br^- > I^-$. This is because E-X bond length increases with increase in size.

Among hexa halides, fluorides are the most stable because of steric reasons.

Dihalides are sp^3 hybridised, are tetrahedral in shape.

Hexafluorides are only stable halides which are gaseous and have sp^3d^2 hybridisation and octahedral structure.

H_2O is a liquid while H_2S is a gas. This is because strong hydrogen bonding is present in water. This is due to small size and high electronegativity of O.

32. **Oxygen:**

Preparation:

$$2KClO_3 \xrightarrow[MnO_2]{heat} 2KCl + 3O_2$$

$$2H_2O_2(aq) \xrightarrow{\text{finely divided metals}} 2H_2O(l) + O_2(g)$$

$$2Ag_2O(s) \xrightarrow{\text{heat}} 4Ag(s) + O_2(g)$$

$$2HgO(s) \xrightarrow{\Delta} 2Hg(l) + O_2(g)$$

$$2Pb_3O_4(s) \xrightarrow{\Delta} 6PbO(s) + O_2(g)$$

(Re d lead)

$$2PbO_2(s) \xrightarrow{\Delta} 2PbO(s) + O_2(g)$$

33. **Oxides:**

The compounds of oxygen and other elements are called oxides.

Types of oxides:

a. Acidic oxides: Non- metallic oxides are usually acidic in nature.

$$SO_2 + H_2O \longrightarrow H_2SO_3 \text{ (sulphurous acid)}$$

b. Basic oxides: Metallic oxides are mostly basic in nature. Basic oxides dissolve in water forming bases e.g.,

$$Na_2O + H_2O \longrightarrow 2NaOH$$

$$K_2O + H_2O \longrightarrow 2KOH$$

$$CaO + H_2O \longrightarrow Ca(OH)_2$$

c. Amphoteric oxides: They show characteristics of both acidic as well as basic oxides.

$$Al_2O_3 + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2O$$

$$Al_2O_3 + 6NaOH(aq) + 3H_2O(l) \longrightarrow 2Na_3[Al(OH)_6](aq)$$

d. Neutral oxides: These oxides are neither acidic nor basic.

Example: Co, NO and N_2O

34. **Ozone:**

Preparation:

i. It is prepared by passing silent electric discharge through pure and dry oxygen 10 – 15 % oxygen is coverted to ozone.

$$3O_2(g) \longrightarrow 2O_3(g); \Delta H = +142 \text{ kJ mol}^{-1}$$

Structure of Ozone: Ozone has angular structure. Both O = O bonds are of equal bond length due to resonance.

35. **Sulphur:**

Sulphur exhibits allotropy:

a. Yellow Rhombic (α - sulphur):

b. Monoclinic (β- sulphur):

$$\alpha - \text{Sulphur} \underset{}{\overset{369\ K}{\rightleftharpoons}} \beta - \text{Sulphur}$$

At 369 K both forms are stable. It is called transition temperature.

Both of them have S_8 molecules. The ring is puckered and has a crown shape.

Another allotrope of sulphur – cyclo S_6 ring adopts a chair form.

S_2 is formed at high temperature (~ 1000 K). It is paramagnetic because of 2 unpaired electrons present in anti bonding π^* orbitals like O_2

36. **Sulphuric acid:**

Preparation: By contact process

$$\frac{1}{8}S_8 + O_2 \longrightarrow SO_2$$

$$2\,SO_2(g) + O_2(g) \xrightarrow[\substack{2\,bar\\720K}]{V_2O_5} 2\,SO_3(g) \qquad \Delta H^\theta = -196.6\,kJ\ mol^{-1}$$

Exothermic reaction and therfore low temperature and high pressure are favourable

$$SO_3(g) + H_2SO_4 \longrightarrow H_2S_2O_7\ \text{(Oleum)}$$

$$H_2S_2O_7 + H_2O \longrightarrow \underset{(96-98\%)}{2\ H_2SO_4}$$

It is dibasic acid or diprotic acid.

It is a strong dehydrating agent.

It is a moderately strong oxidizing agent.