HYDROGEN BONDING

→ Hydrogen bonding is a type of dipole-dipole attraction b/w hydrogen and electronegative atom of other molecule present in same substance or other substance

- It results from the attraction force between hydrogen atom and very electronegative atoms like N, O or F.

$$\overset{\delta-}{N}-\overset{\delta+}{H} \qquad \overset{\delta-}{O}-\overset{\delta+}{H} \qquad \overset{\delta-}{F}-\overset{\delta+}{H}$$

- It is represented by three dotted lines.(---)

$$\overset{\delta+}{H}-\overset{\delta-}{F}\cdots\overset{\delta+}{H}-\overset{\delta-}{F}\cdots\overset{\delta+}{H}-\overset{\delta+}{F}$$

H-bond

Condition for H-bonding

(i) Size of electronegative atom must be small.

(ii) It take place b/w Highly electronegative atoms and Hydrogen.

F, O, N

Types of Hydrogen Bonding

(1) Intermolecular hydrogen bonding

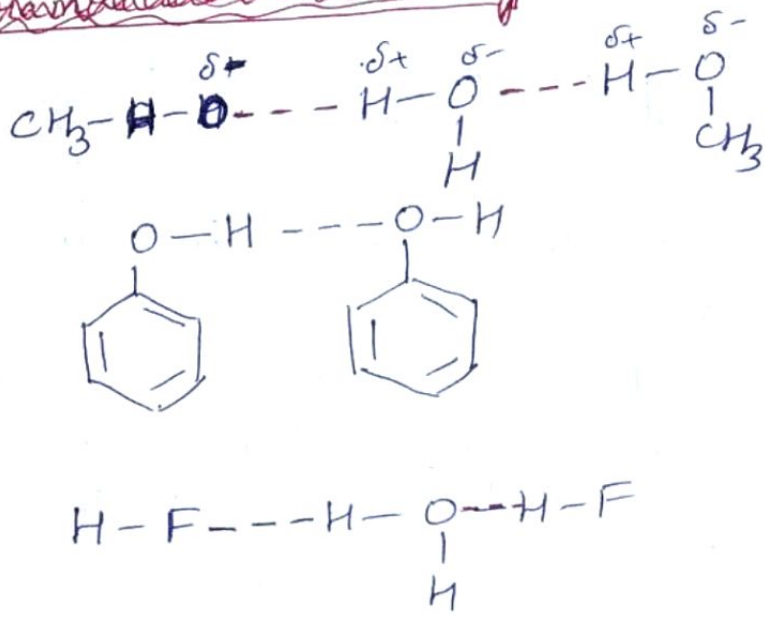
(2) Intramolecular " "

(i) **Intermolecular H-bonding**- It takes place b/w H-atom of one molecule and electronegative atom of other molecule.

$$\overset{\delta+}{H}-\overset{\delta+}{F}\cdots\overset{\delta+}{H}-\overset{\delta-}{F}\cdots\overset{\delta+}{H}-\overset{\delta-}{F}$$

$$H-\overset{\delta-}{O}(-H)\cdots\overset{\delta+}{H}-\overset{\delta-}{O}(-H)\cdots\overset{\delta+}{H}-\overset{\delta-}{O}(-H)\cdots\overset{\delta+}{H}-O-H$$

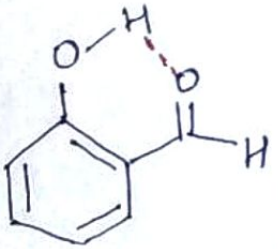
(i) ~~Intermolecular H-bonding~~ –



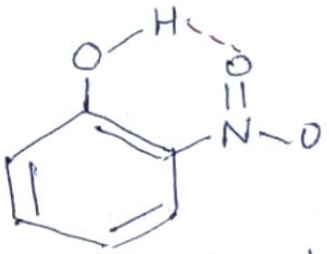
(ii) Intramolecular hydrogen bonding

When a bond is formed between H-atom as well as electronegative atom of the same molecule, intra mol. H-bonding is formed.

– This happens when two functional groups of a molecule can form hydrogen bond.



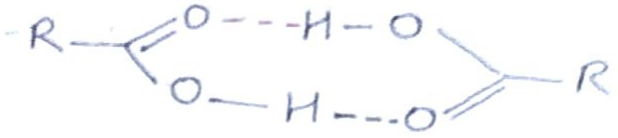
Salicaldehyde



O-Nitro Phenol

Effect on Physical Properties

(1) Association – Due to hydrogen bonding, the molecules of some acids exist as dimer.



(2) **Dissociation** – Hydrogen fluoride, HF dissociates and gives the difluoride ion instead of fluoride ion.

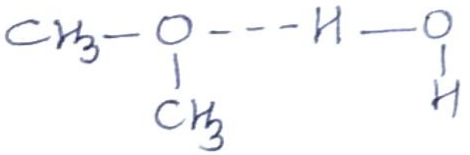
(3) **Melting and Boiling Point** – Due to hydrogen bonding the melting & boiling point of solutions increases.

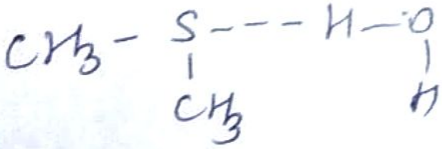
H_2O > CH_3OH > CH_3OCH_3
(373K) (336K) (262K)
Order of extent of hydrogen bonding

(4) **Solubility** – The solubility of organic compounds in water is attributed to hydrogen bond formation.

CH_3-O-CH_3 → More miscible in H_2O

CH_3-S-CH_3 → Partially miscible in H_2O


(strong attraction, ∵ electronegativity of O_2 is more)


(weak)

(5) Viscosity – Intermolecular H-bonding increases attractions between the molecules in the different layers of the H-bonded liquids. This results in the increase in viscosity (η)

$\eta_{H_2O} = 10.05$ millipoise

$\eta_{CH_3OH} = 5.97$ " "

$\eta_{CH_3OCH_3} = 2.33$ " "

η glycerol $= 10^4$ millipoise