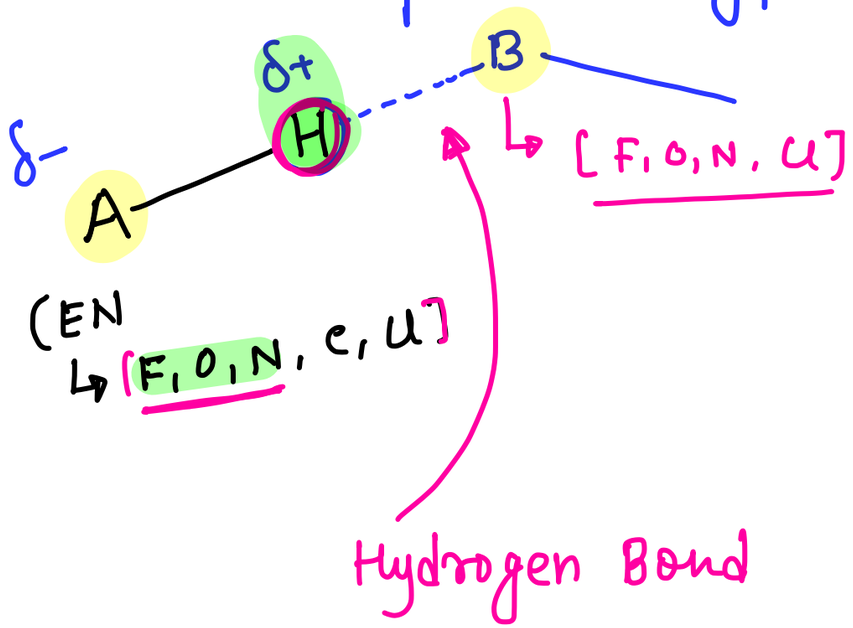
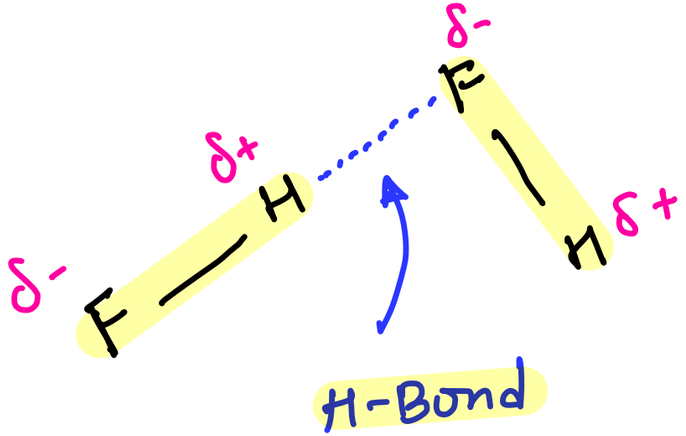
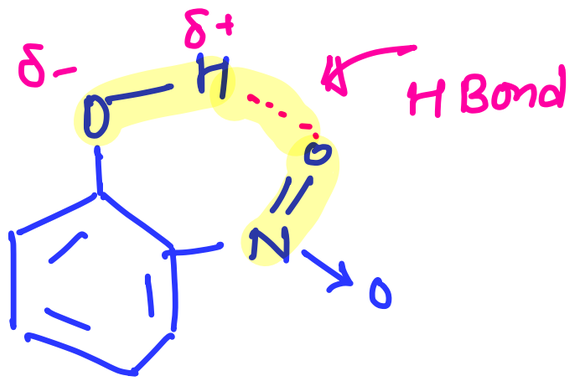
CHEMICAL BONDING

H-Bond : It a special case of dipole-dipole interaction.

: when a hydrogen attached to most electroneg-ative atom A (F, O, N, C, U]. it aquires a partial +ve charge due to small charge density become high whenever any electronegative atom [F, O, N, U] comes near to it a special type of force of attraction observed called Hydrogen Bond:







CHEMICAL BONDING

Factors Affective H-Bond :

- Electronegativity of A atom increases then H-Bond will be strong.
- If EN of A is same then if EN of B increases H-Bond strength decreases :

CHEMICAL BONDING

Ex: Arrange the following in decreasing order of H Bond Strength:

(i) O — H ···· O

(ii) O — H ···· N

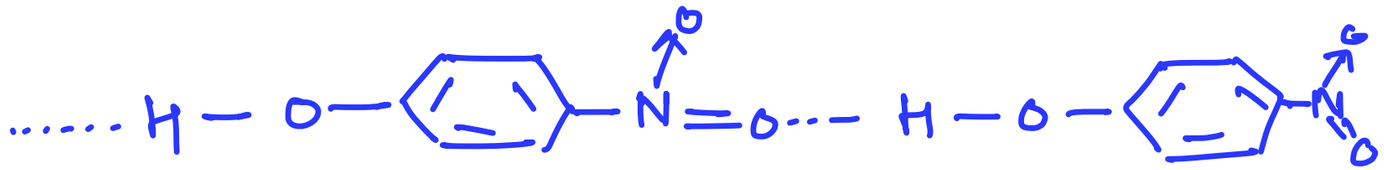
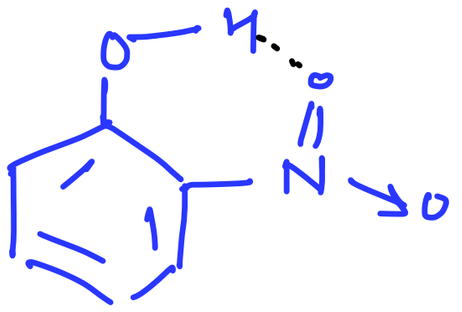
(iii) N — H ···· O

(iv) N — H ···· N

Ans: (ii) > (i) > iv > iii

CHEMICAL BONDING

: Types of Hydrogen Bond:

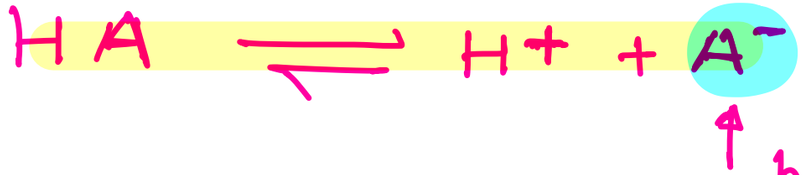
Inter molecule H-Bond	Intra molecular H-Bond
(i) When H-Bond formed b/w two molecule (same or different)	(i) When H-Bond form with a molecule:
	
P-nitrophenol	o-nitrophenol.
(ii) High boiling point	(ii) Low boiling point
(iii) Vapour pressure will be low	(iii) vapour pressure high

CHEMICAL BONDING

- Less volatile
- more Viscose

- more volatile
- Less Viscose

Application :

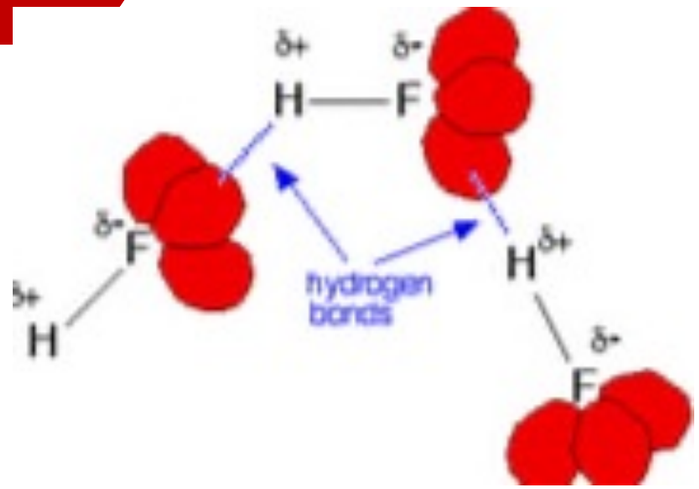


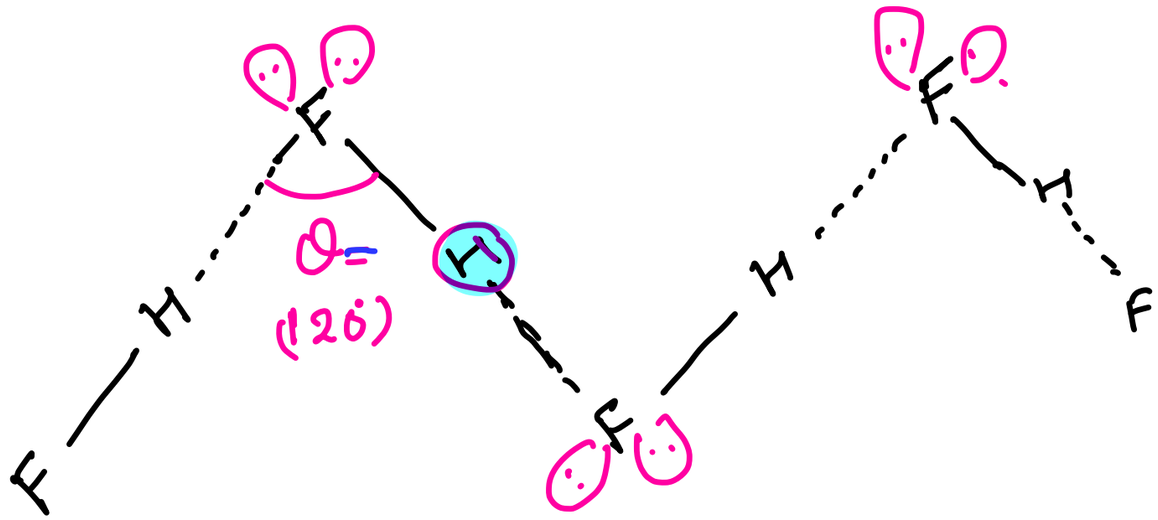
Acid means which produce H^+ ion in aqueous soln more H^+ means more acidic: As A^- becomes more stable more amount of H^+ obtained means more acidic:

CHEMICAL BONDING

Examples of H-Bonding

(i) HF





- Maximum No of H-Bond formed by HF molecule = 2
- Bending always occure from Fluorine
- Due to maximum differance in EN strongest H-Bond bond will be H---F

HF molecule some time exist in $[HF_2^-]$ form.

CHEMICAL BONDING

$[F \cdots H \cdots F]^-$

Ex: KHF_2 exist while KHU_2 does not exist Explain?

$KHF_2 \longrightarrow K^+ + HF_2^-$ $(F \text{---} H \text{---} F)^-$ exist

$KHU \longrightarrow K^+ + HU_2^-$ ↳ Does not exist

Ex: if we ionise KHF_2 we obtain?

(a) $K^+ + HF_2^-$ ✓

(b) $K^+ + H^+ + 2F^-$

(iii) $K^{+2} + 2F^- + H_2$

(d) Non of these

CHEMICAL BONDING

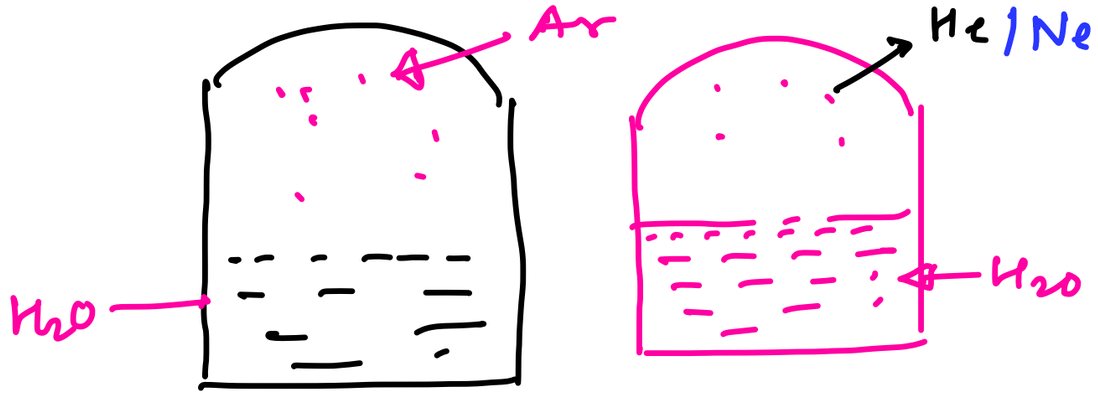
Ex: which of the following does not exist

(I) KHF_2

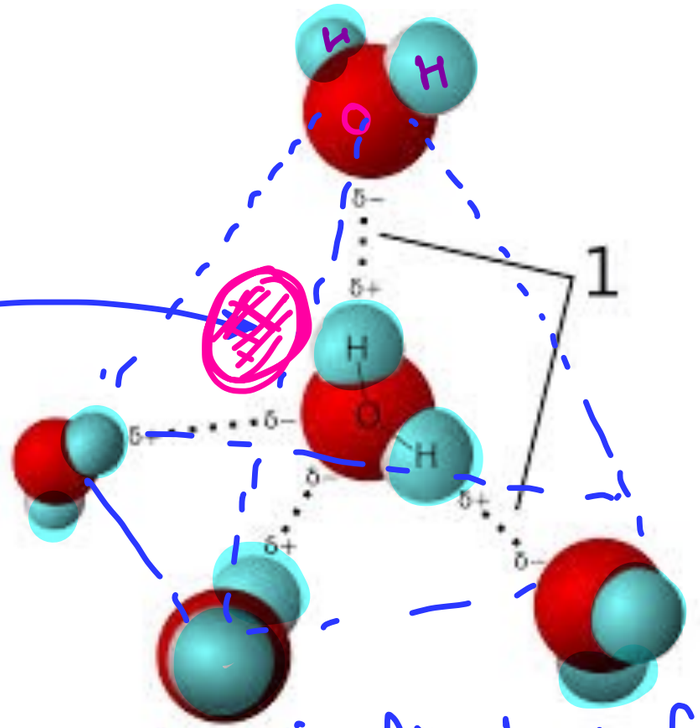
(II) $NaHF_2$

(III) KF

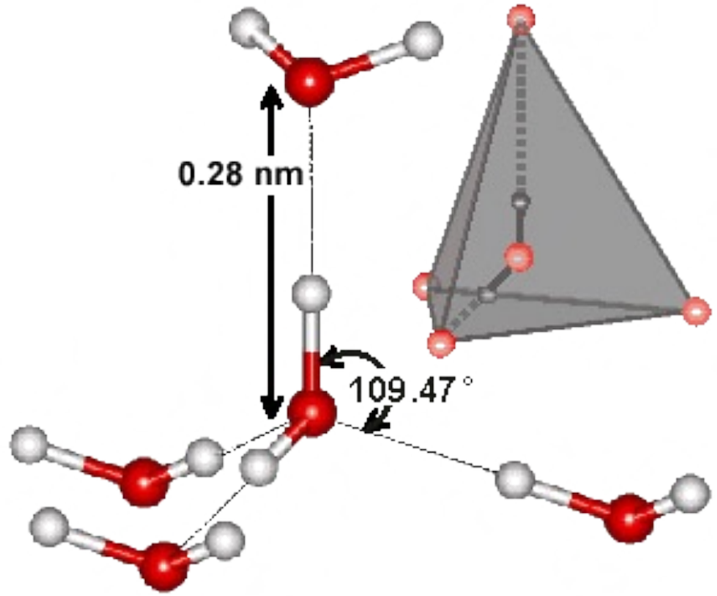
✓ (IV) KHO_2



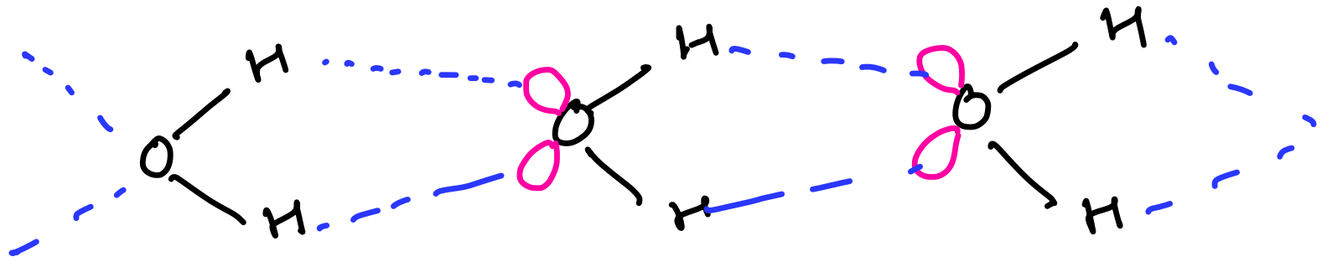
(2) H_2O :



tetrahedral Vacant space called tetrahedral void whose size is fixed at fixed temperature



CHEMICAL BONDING



- $H_2O(l)$ structure contain less no of hydrogen bond as compared to $H_2O(s)$

- In ice structure one oxygen attached to four hydrogen in which two are co-valent bonded and other two are hydrogen bonded.

- One H_2O molecule is surrounded by four H_2O molecule tetrahedrally.

CHEMICAL BONDING

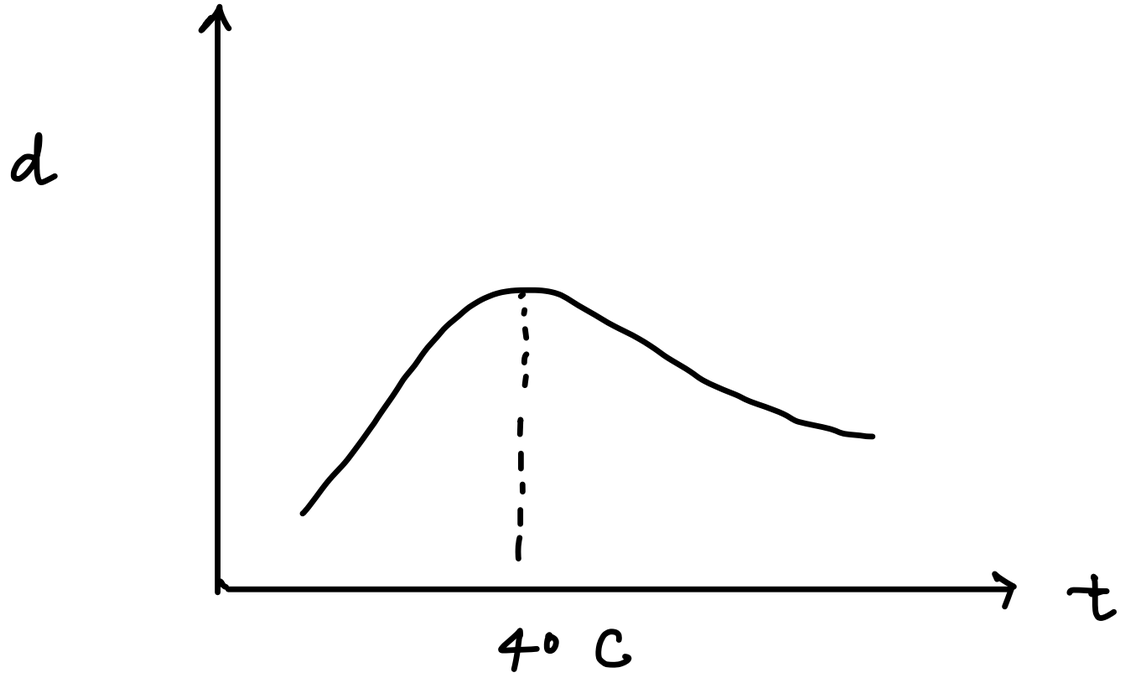
- In tetrahedral vacant space is called tetrahedral void the size of void is fixed

- When gas are present during ice formation some gas trapped in void called Clathrate formation:

: Due to small size of He & Ne they do not form clatherate with ice

: Due to vacant void space the density of ice is lower than density of water.

CHEMICAL BONDING



(i) Before 4° C : No of H-Bonds will be More the No of tetrahedral void will be more means more vacant space means density!

(ii) above 4°C : on increasing temperature expansion take place which reduces density!

CHEMICAL BONDING

Similar As hydrogen Deutrium also form also form hydrogen Bond:

order of density of 0°C.

$H_2O(s)$. $H_2O(\ell)$. $D_2O(s)$ $D_2O(\ell)$

$D_2O(\ell) > D_2O(s) > H_2O(\ell) > H_2O(s)$

Q: Select the true / false statement:

i) $D_2O(s)$ sink in $D_2O(\ell)$ False

(ii) $D_2O(s)$ sink in $H_2O(\ell)$ True

(iii) $H_2O(s)$ sink in $H_2O(\ell)$ False

(iv) $H_2O(s)$ float in $D_2O(\ell)$ True

CHEMICAL BONDING

Ex: H Bond strength HF vs. H_2O will be ?

H --- F (19 J)

H --- O (12 J)

$H-F > H_2O$

Ex: H-Bond Extent HF vs H_2O ?

$H_2O > HF$

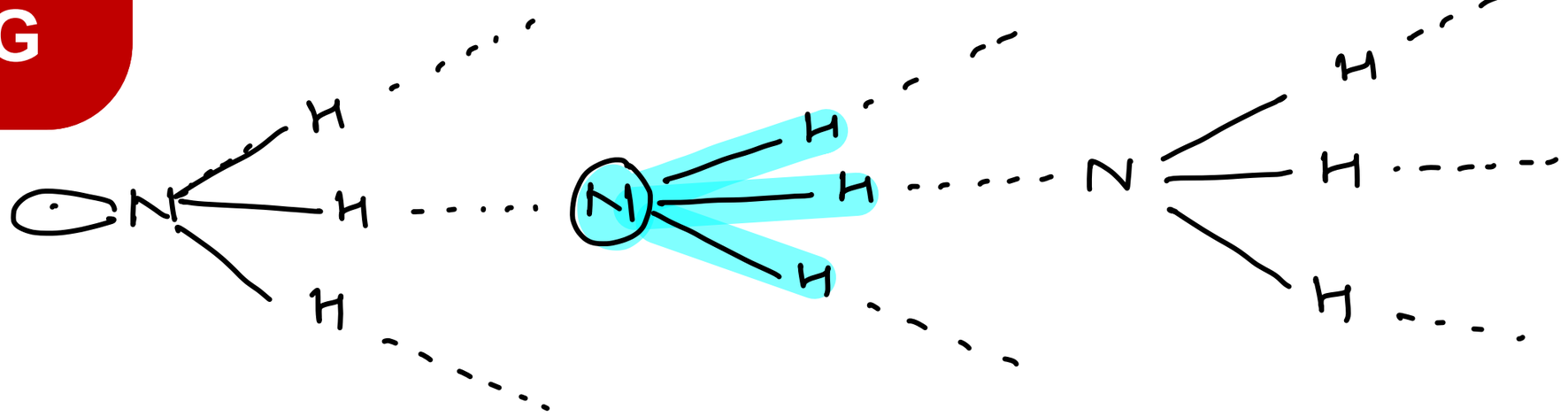
HW Ex: the H Bond strength HF is greater than H_2O but Boiling point H_2O H_2O is 100°C while HF is 39°C

CHEMICAL BONDING

③ NH_3

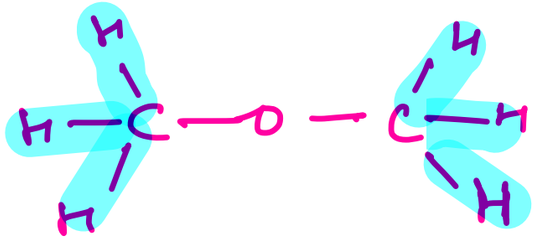
$HF > H_2O > NH_3$

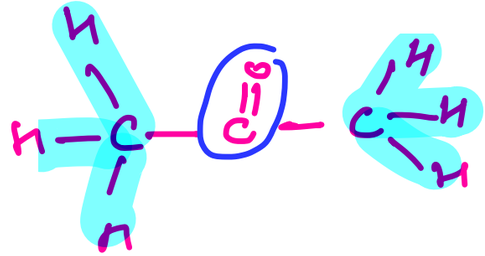
(Strength)

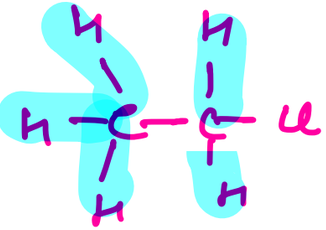


- One NH_3 form 4 H-Bond.

Note:



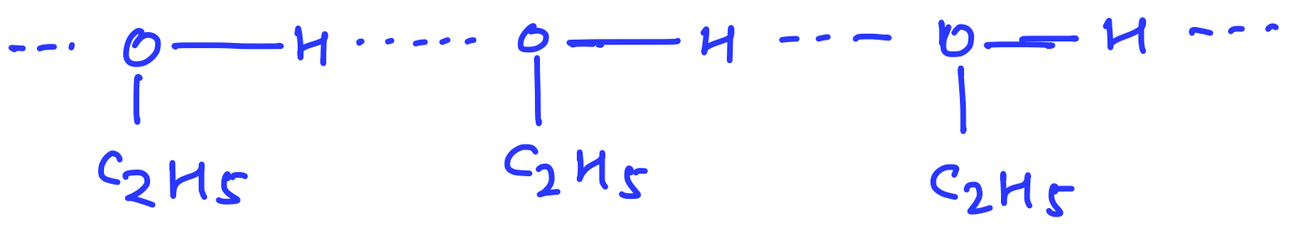




do not form hydrogen bond:

CHEMICAL BONDING

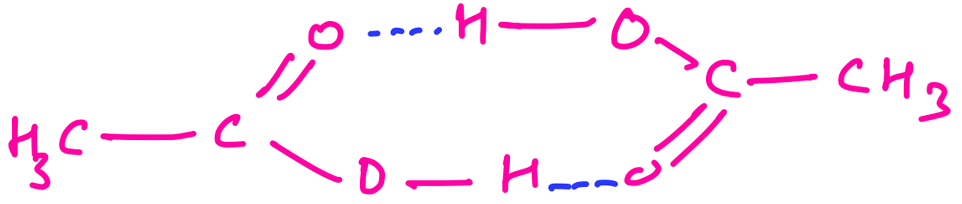
R–OH. [Ex. C_2H_5OH]



Acetic Acid : polar solvent

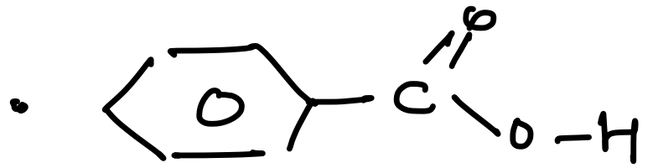
$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

: Nonpolar solvent : dimer is formed



CHEMICAL BONDING

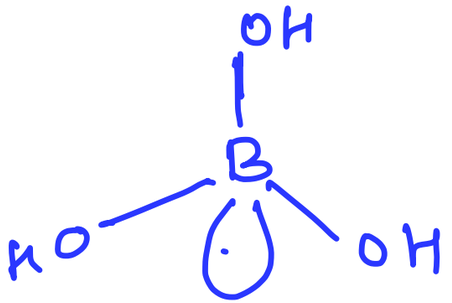
Benzoic Acid



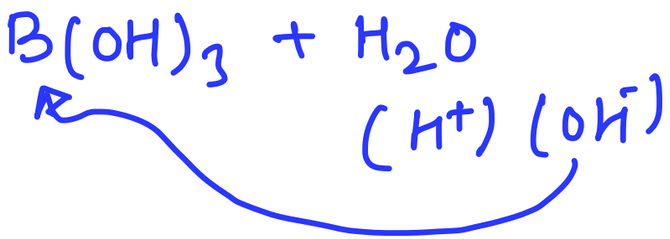
CHEMICAL BONDING

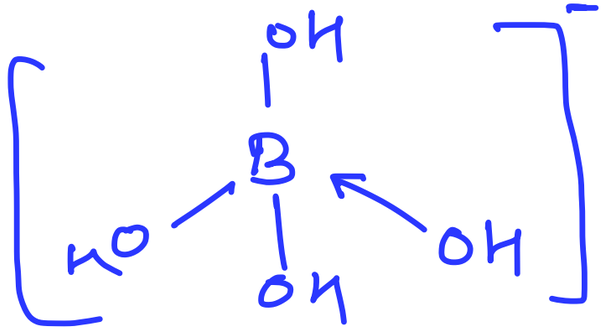
Boric Acid : $B(OH)_3$

$$B(OH)_3\,(aq.) \rightleftharpoons B(OH)_4^- + H^+$$



is

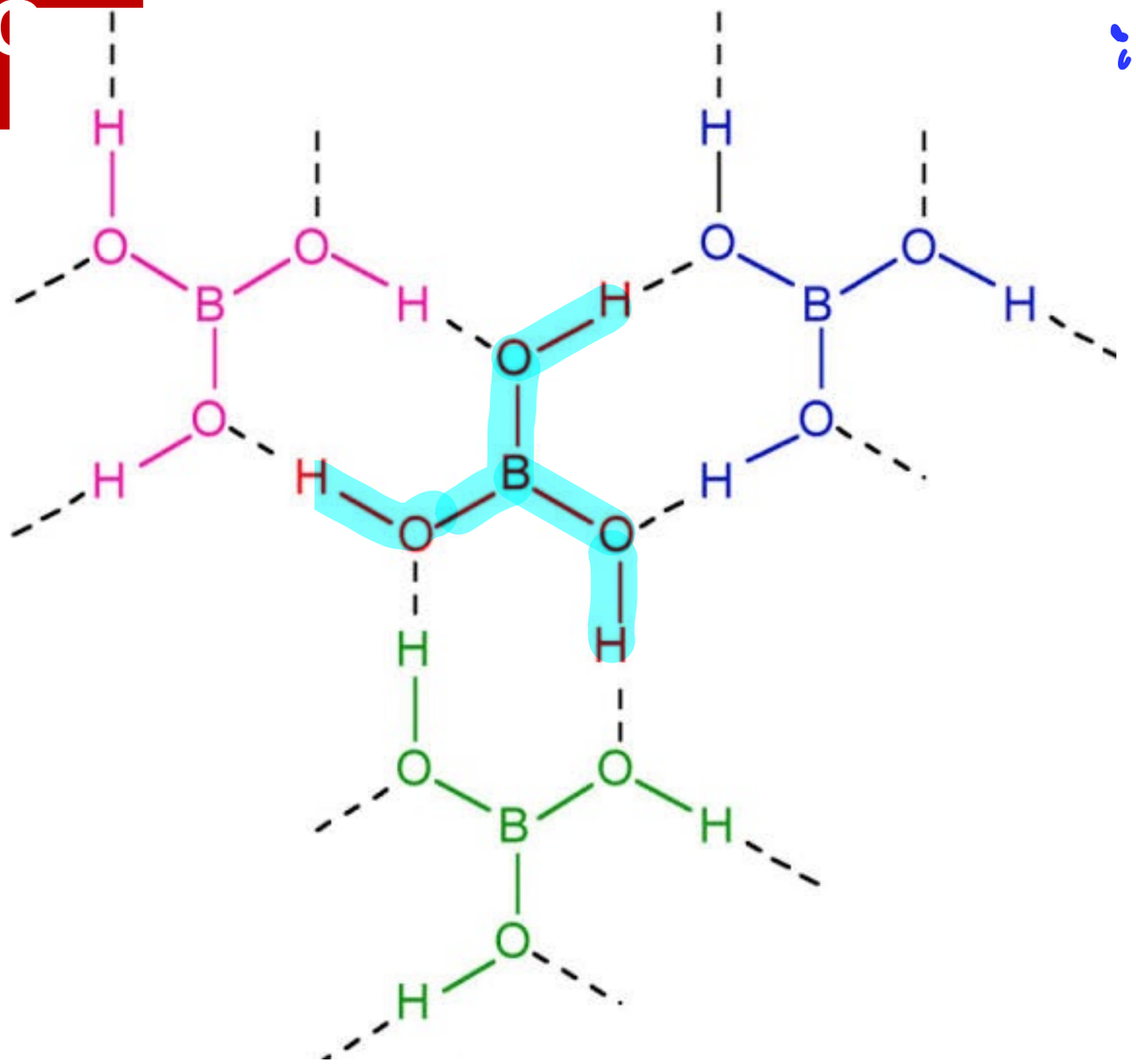




$B(OH)_3$ is not an Arhenius acid it is a Lewis acid as it takes lone pair from OH^- of water and produce (H^+ from water)

CHEMICAL BONDING

$B(OH)_3$ (s) :



: total Number of H-Bond formed by 1 molecule = 6

: Structure of boric acid is hexagonal Layered structure

: two layers are bonded by vander-waal forces :