

# Hydrogen Bonding

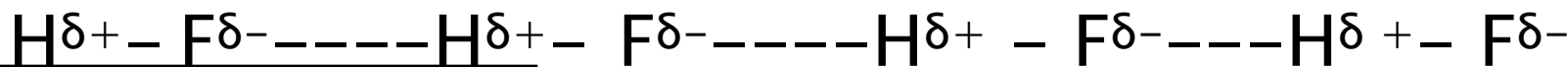
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# HYDROGEN BONDING

- } When hydrogen is bonded to highly electronegative atom (such as N, O, F), the bonding electron pair is drawn towards the electronegative atom.

# Hydrogen bonding

- } Hydrogen has no **inner shell** electron and is very small in size, the positive charge density developed is **high**
- } The nucleus of hydrogen atom is exposed to attraction by nearby cloud, **a lone pair electrons** on the electronegative atom



# Hydrogen bonding

## ❖ Definition:

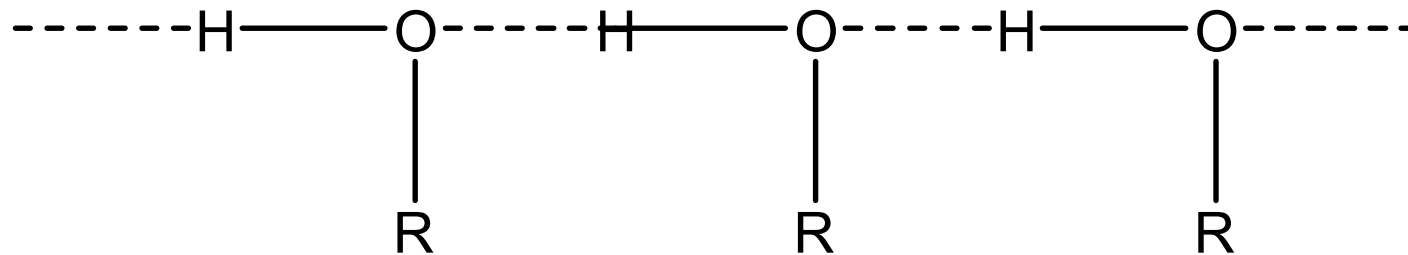
} The force of **attraction** which binds **hydrogen** atom of one molecule with highly **electronegative atom** of another molecule of the same substance is called as **hydrogen bond**

# Hydrogen bonding

- ❖ Essential requirements for the formation of hydrogen bond :
- } A hydrogen atom must be directly bonded to a highly **electronegative** atom (e.g. F ,O and N)
- } An **unbonded** pair of electrons (**lone pair of electrons**) is presented on the electronegative atom

# Hydrogen bonding

❖ Examples :

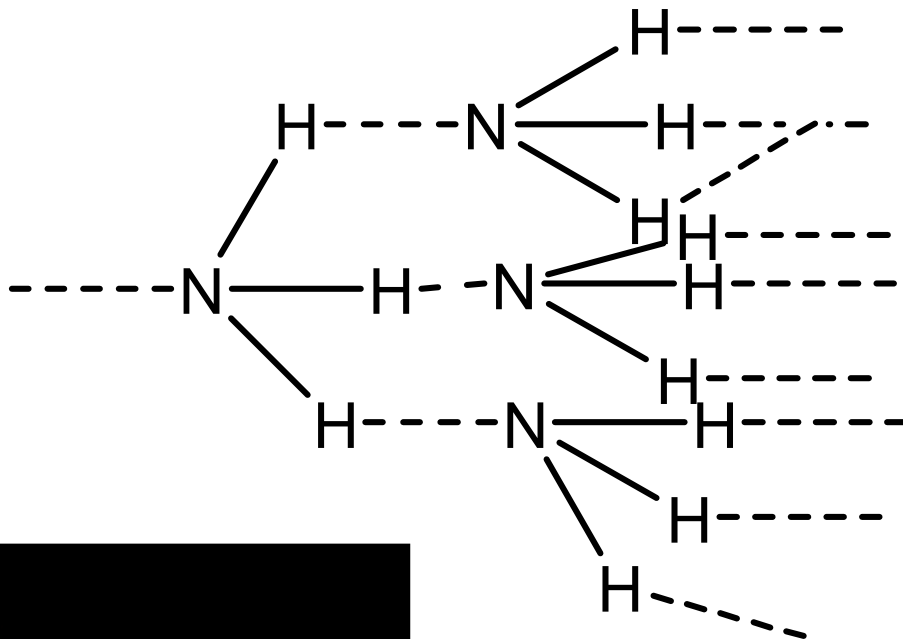
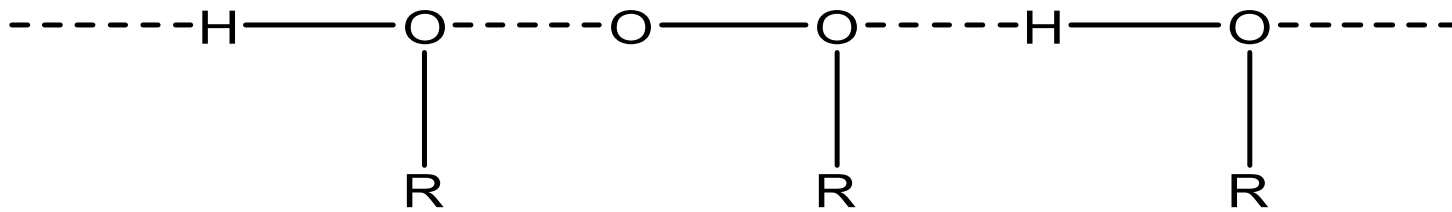


# Hydrogen bonding

- ❖ Types of hydrogen bonding
  - a **Intermolecular hydrogen bonding:**
    - The hydrogen bond that exists between atoms of two or more molecules of same substance is called **Intermolecular hydrogen bonding**
    - Some examples of such type of bonding are **HF** , **H<sub>2</sub>O** , **NH<sub>3</sub>** , **ROH** etc.

# Intermolecular hydrogen bonding

} Structures:





## **b. Intramolecular hydrogen bonding**

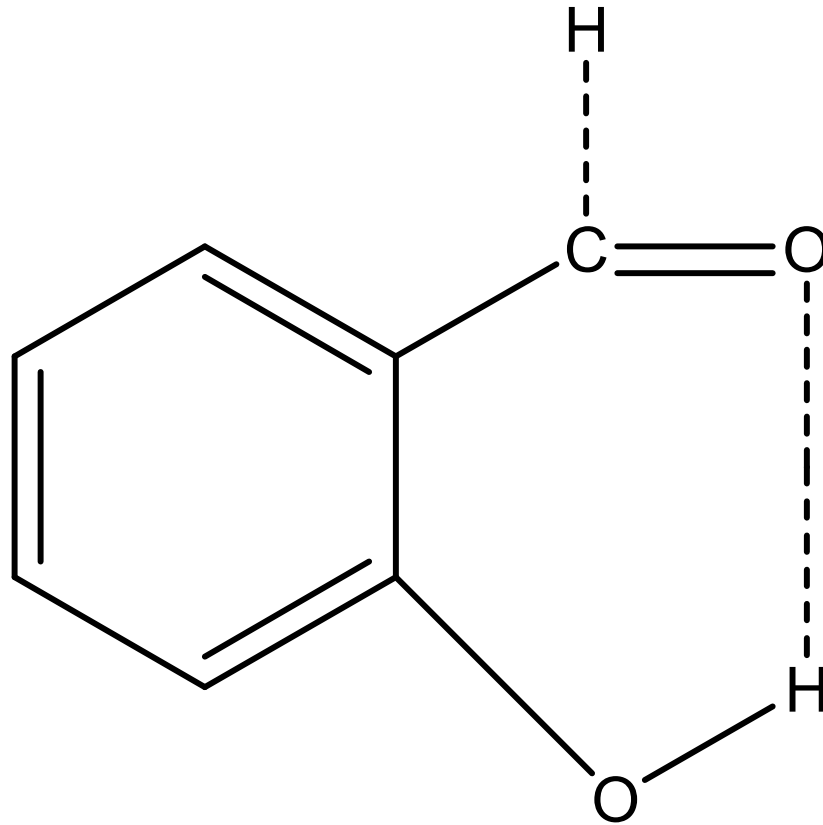
- The hydrogen bond that exists between atoms of the same molecule is called **Intramolecular hydrogen bonding**
- It is also referred as **internal hydrogen bonding**
- Such type of bonding is possible only if the **hydrogen** and more **electronegative atom** are present in the same molecule

# Intramolecular hydrogen bonding

- It results in cyclisation of molecules
- Organic compounds having electron withdrawing groups and hydrogen atom near each other shows such type of bonding
- Some examples of such type of bonding are salicylaldehyde, o-nitrophenol, o-chlorophenol etc.

# Intermolecular hydrogen bonding

} Structures:



Salicylaldehyde

# Effects or Consequences of Hydrogen Bonding

Hydrogen bonding has striking effects on the physical properties of the substances

## 1 Melting and boiling points:

} The compounds having the intermolecular hydrogen bonding have high melting and boiling points.

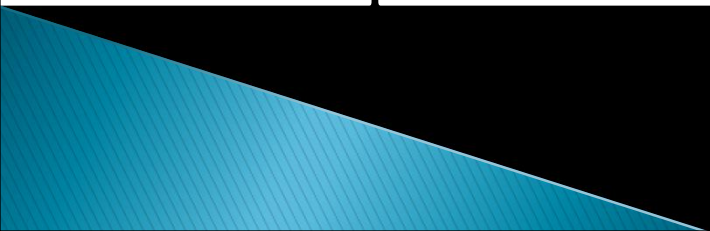
} Since molecules are associated with each other, more energy is required for their separation.

} Thus hydrides of fluorine (HF), oxygen( $\text{H}_2\text{O}$ ) and nitrogen( $\text{NH}_3$ ) have much higher melting and boiling points as compared to their analogues down the group

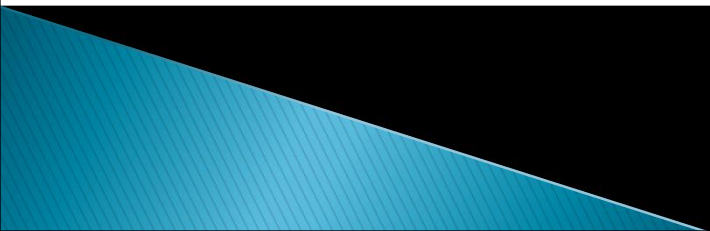
} Some examples are:

➤ Boiling point of HF is  $19.4^\circ\text{C}$  while those of  $\text{H}_2\text{S}$  and HBr are  $-85^\circ\text{C}$  and  $-67^\circ\text{C}$ .

## 2. Solubility:

- } Compounds showing the property of hydrogen bonding are highly soluble in water
  - } Alcohols are soluble in water ; ammonia is soluble in water as these molecules form hydrogen bonds with water molecules
  - } More tendencies of formation of hydrogen bond with water , more is the solubility of that compound in water
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### 3. **Viscosity:**

- } With increase in intermolecular hydrogen bonding, the association of molecules increases and hence the flow of molecules is restricted
  - } The resistance to flow of liquid is called as viscosity
  - } Glycerol is more viscous than glycol which is more viscous than ethanol
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*THANK YOU*