Nishant Jindal

CHEMICAL BONDING

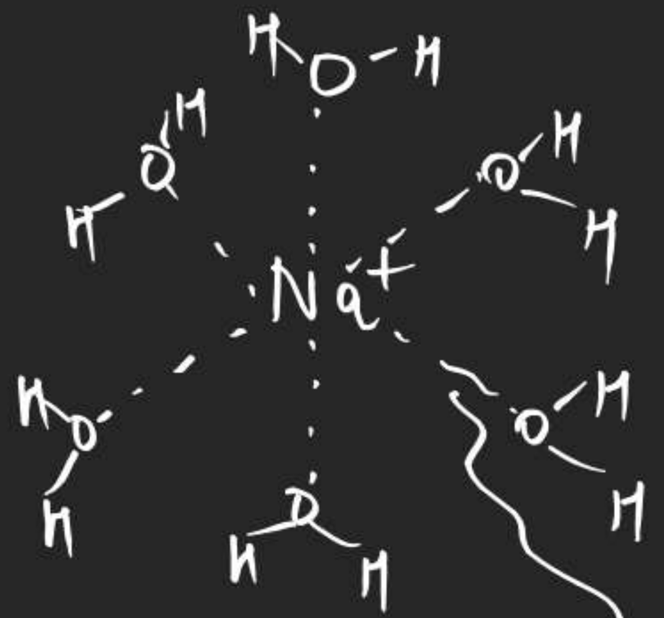
Solubility

$$F_{air} = \frac{K q_1 q_2}{r^2}$$

$$F_{air} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}$$

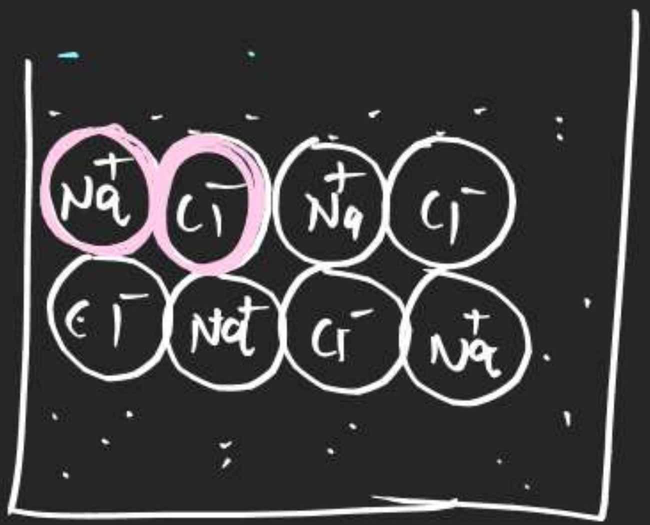
$$F_{water} = \frac{1}{4\pi\epsilon_0 (80)}\frac{q_1 q_2}{r^2}$$

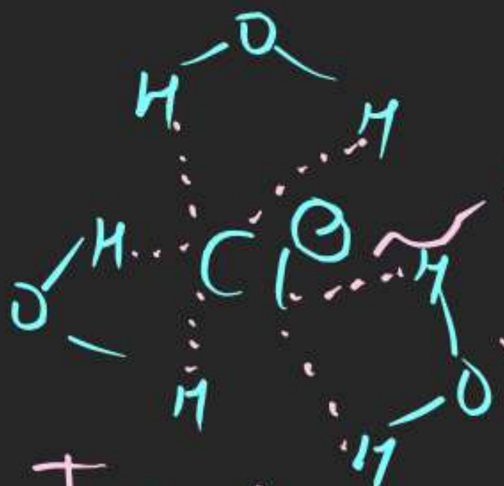
$$F_{water} = \frac{F_{air}}{80}$$



Ion-dipole

hydration energy





hydration energy

Ion-dipole

Nishant Jindal

Condition of solubility

$H.E > L.E$ then Ionic compound Soluble

$H.E < L.E$ then Ionic compound Insoluble

Nishant Jindal

L.E = amount of relesed energy when one of Ionic compound formed.

or

amount of required energy to break one mole of Ionic Compound.

$$L.E = -\frac{K q_1 q_2}{r}$$

$(r = r_c + r_a)$

r_c = radius of Cation

r_a = radius of anion.

Nishant Jindal

<u>Hydration energy</u> $\Rightarrow$ amount of released energy when one mole of Ionic compound completely dissolve in polar solvent then it is called Solvation energy. If water is taken as polar solvent then it is called Hydration energy.

$$H.E = K\left[\frac{q_1}{r_c} + \frac{q_2}{r_a}\right]$$

r_c = radius of cation

r_a = radius of anion

Nishant Jindal

CHEMICAL BONDING

$r_c \approx r_a$ Case - for monoatomic anion

$$L.E = \frac{1}{r_c + r_a}$$

$$L.E = \frac{1}{2r_c \uparrow}$$

$$H.E = \frac{1}{r_c} + \frac{1}{r_a}$$

$$= \frac{1}{r_c} + \frac{1}{r_c}$$

$$= \frac{2}{r_c \uparrow}$$

down the group $r_c \uparrow$ H.E $\downarrow$ L.E $\downarrow$

So down the group H.E > L.E

Hence Solubility $\uparrow$

LiF < NaF < KF < RbF < CsF

LiOH < NaOH < KOH < RbOH < CsOH

BeS < < BaS

BeO < < BaO

Case-II Solubility of Ionic compound Having polyatomic anion

$r_a >>> r_c$

$r_c = 1 \quad r_a = 10$

$L.E_1 = \frac{1}{1+10} = \frac{1}{11}$

$H.E_1 = \frac{1}{1} + \frac{1}{10} = \frac{11}{10}$

down the group

$r_c = 2 \quad r_a = 10$

$L.E_2 = \frac{1}{2+10} = \frac{1}{12}$

$H.E_2 = \frac{1}{2} + \frac{1}{10} = \frac{6}{10}$

$\Delta L.E = \frac{1}{12} - \frac{1}{11} = -1/132$

$\Delta H.E = \frac{6}{10} - \frac{11}{10} = -1/2$

down the group L.E ↓, H.E ↓

So L.E > H.E

hence solubility ↓ down the group

$LiClO_3 > \quad > CsClO_3$

$LiClO_4 > \quad > CsClO_4$

$LiNO_3 > \quad > CsNO_3$

$BeCO_3 > \quad > BaCO_3$

$BeSO_3 > \quad > BaSO_3$

$BeSO_4 > \quad > BaSO_4$

$BeS_2O_3 > \quad > BaS_2O_3$

$BeCrO_4 > \quad > BaCrO_4$

Note $I^\ominus / Br^- \Rightarrow$ Polyatomic due to size

$LiBr > \quad > CsBr$

A $\boxed{NaI > LiI > KI > RbI > CsI}$

Nishant Jindal

Case - III

no of cation > no of anions
then solubility ↑ down the group

$Li_2O < \quad < Cs_2O$

$Li_2CO_3 < \quad < Cs_2CO_3$

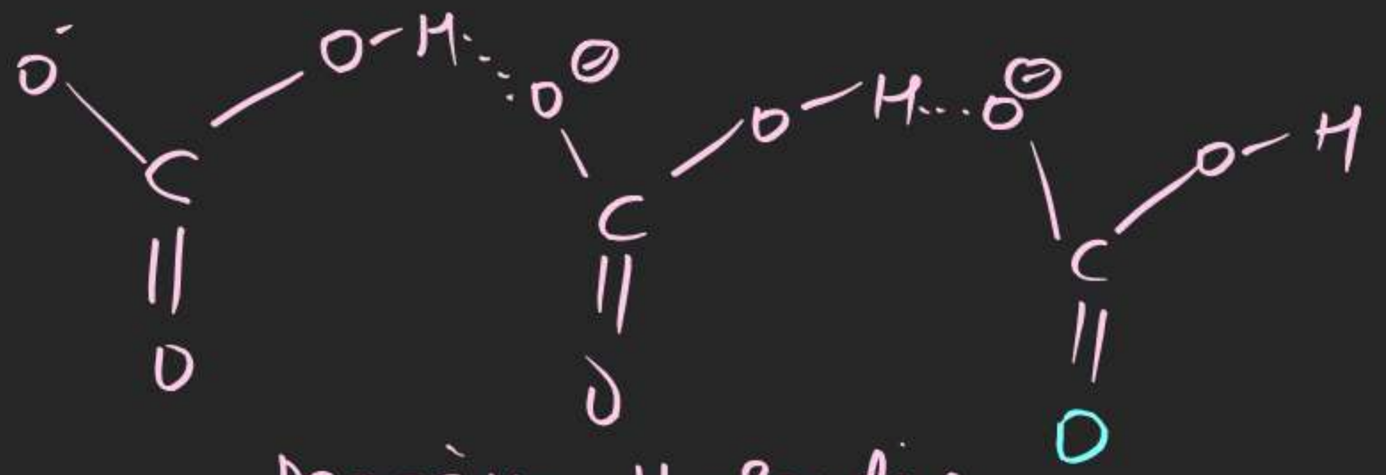
(Sparingly soluble)

$NaHCO_3 < KHCO_3 < RbHCO_3 < CsHCO_3$

$NaHCO_3 \rightarrow Na^+ + HCO_3^-$

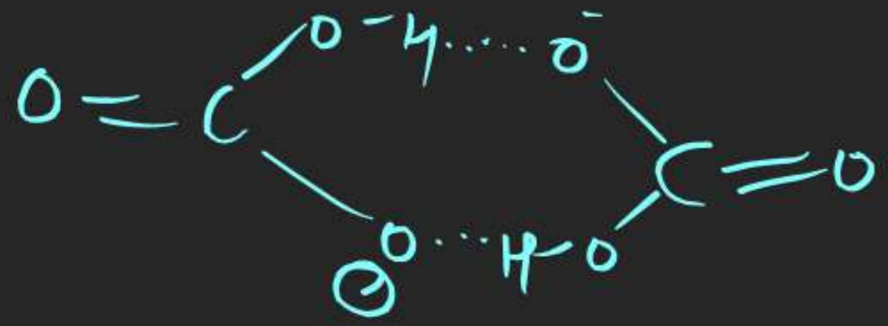
$HCO_3^- \rightarrow H^+ + CO_3^{2-}$

$NaHCO_{3(s)}$



Massive H-Bonding

[∞ - H Bonding] $(NaHCO_3)$



Compact H-Bonding

$KHCO_3$ | $RbHCO_3$ | $CsHCO_3$

Nishant Jindal

Case-IV

number of anion > no of Cation
then solubility ↑ down the group
but if number of Polyatomic
anion > no of Cation
then solubility ↓ down the group

$Be(OH)_2 < \quad < Ba(OH)_2$

$Be(NO_3)_2 > \quad > Ba(NO_3)_2$

$(X = Cl, Br, I)$ $BeX_2 > \quad > BaX_2$

CHEMICAL BONDING

$\boxed{\text{Keypoint}}$

* number of polyatomic anion $\geq$ number of cation

then solubility $\downarrow$

Nishant Jindal

$LiF < \quad < CsF$

$BeCO_3 >> BaCO_3$

$BeCrO_4 >> BaCrO_4$

$BeSO_4 >> BaSO_4$

$\boxed{Li_2CO_3 << Cs_2CO_3}$

$BeS_2O_3 >> BaS_2O_3$

$LiOH < \quad < CsOH$

$Be(OH)_2 < \quad < Ba(OH)_2$

$LiNO_3 >> CsNO_3$

$Be(NO_3)_2 >> Ba(NO_3)_2$

Nishant Jindal

Imp:

$MgF_2 < CaF_2 < SrF_2 < BaF_2 < BeF_2$

(oxalate) $MgC_2O_4 < CaC_2O_4 < SrC_2O_4 < BaC_2O_4 < BeC_2O_4$

$LiCl > NaCl > KCl < RbCl < CsCl$

Keypoint

$>\,><$ [X-Man]

$LiCl > CsCl > RbCl > NaCl > KCl$

Nishant Jindal

Solubility of Heavy metal Halides

Higher the polarisation then greater will be the solubility in nonpolar solvent and lesser will be the solubility in polar solvent

Order of solubility in polar solvent :-

$AgF > AgCl > AgBr > AgI$

$PbF_2 > PbCl_2 > PbBr_2 > PbI_2$

$HgF_2 > HgCl_2 > HgBr_2 > HgI_2$

Nishant Jindal

$\boxed{M.P} \propto L.E$

Order of M.P

$SnF_2 > SnCl_2$

$CaF_2 > CaCl_2 > CaBr_2 > CaI_2$

Nishant Jindal

Imp order of M.P

$AlF_3 > AlCl_3 > AlI_3 > AlBr_3$

$SnF_4 > SnI_4 > SnBr_4 > SnCl_4$

① $NaCl > KCl > RbCl > CsCl > LiCl$

② $NaF > KF > LiF > RbF > CsF$

③ $CaF_2 > MgF_2 > SrF_2 > BaF_2 > BeF_2$

④ $MgO > CaO > BeO > SrO > BaO$

⑤ $KI > NaI > RbI > CsI > LiI$

⑥ $BeX_2 < < BaX_2$ ($X = Cl, Br, I$)

Nishant Jindal

H·W

DPP →

Sheet

M·O·T → 3