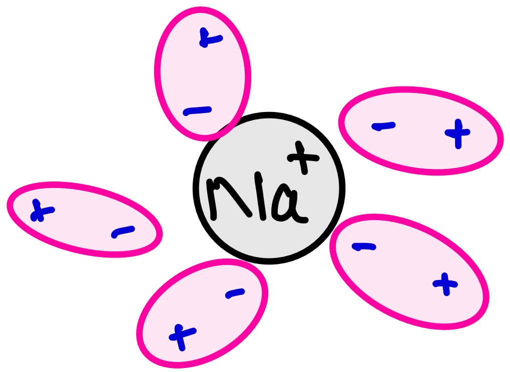
# Hydration and Hydration energy

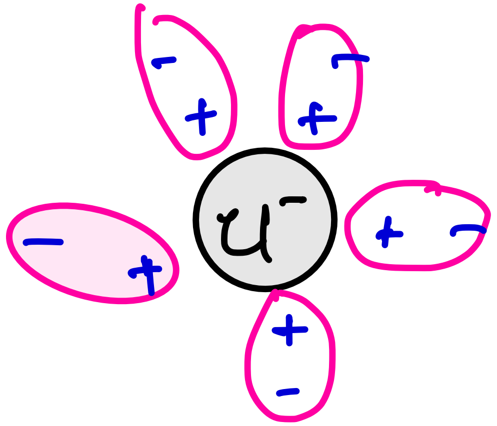
$Na^{+}_{(g)}$ + solvent → Polar / → non polar

$\overset{\delta+}{H} - \overset{\delta-}{Cl}$ ⟷ (+ −)

$Br_2 (l)$ $\quad \overset{\delta=0}{Br} - \overset{\delta=0}{Br}$

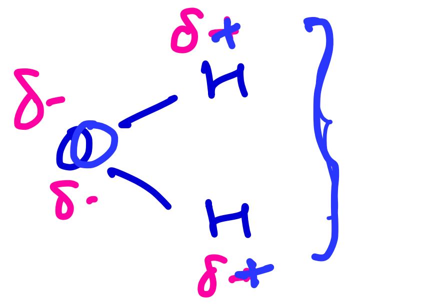
• When a gasseou ion is dissolved in a polar solvent these ions are surrounded by polar solvent due to which ion become stable. which release some amount of energy this process is called solvation and energy released is called solvation energy.



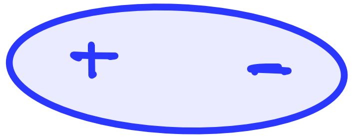
# CHEMICAL BONDING

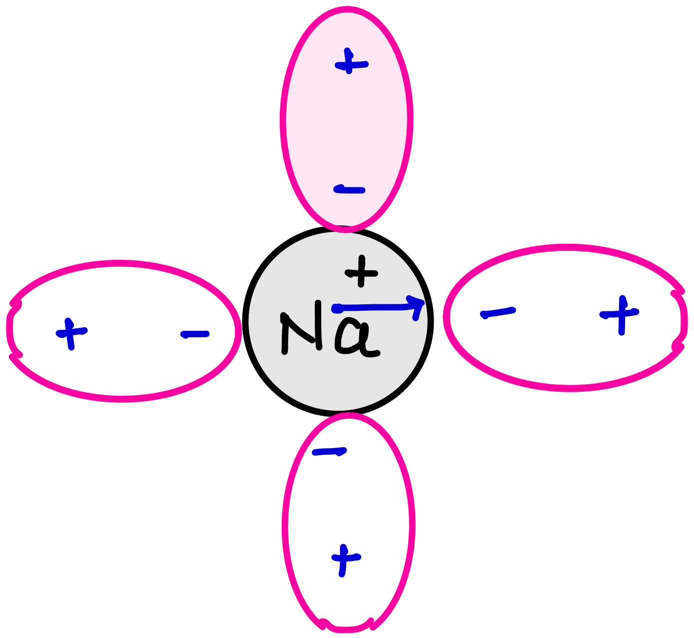
If solvent is water then solvation is known as hydration and solvation energy known as Hydration energy.

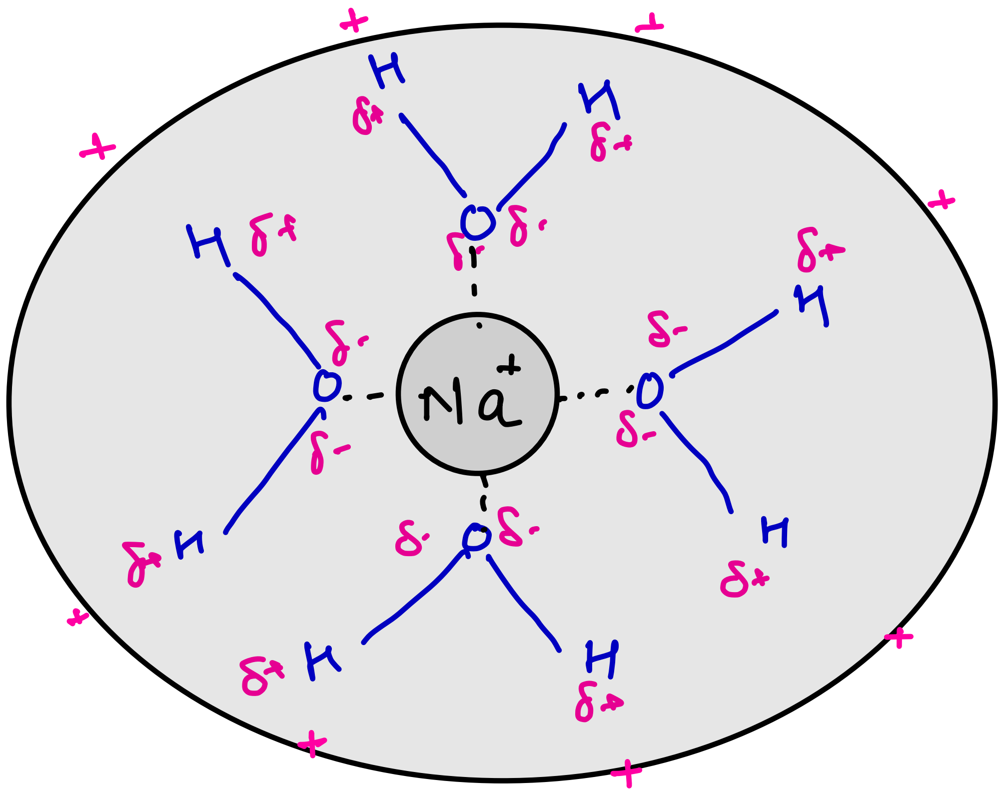


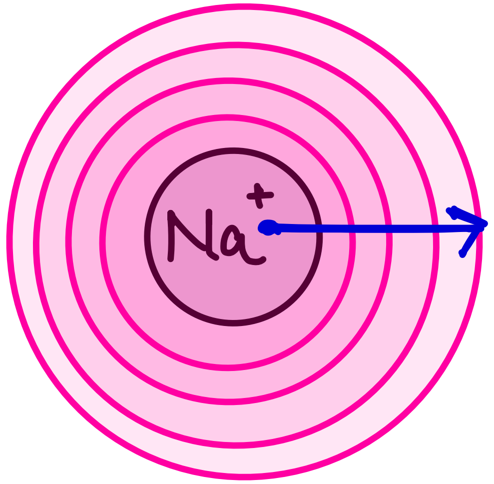

(i) $Na^+(g) + aq. \longrightarrow Na^+(aq.)$

gasseous ion — hydrated ion



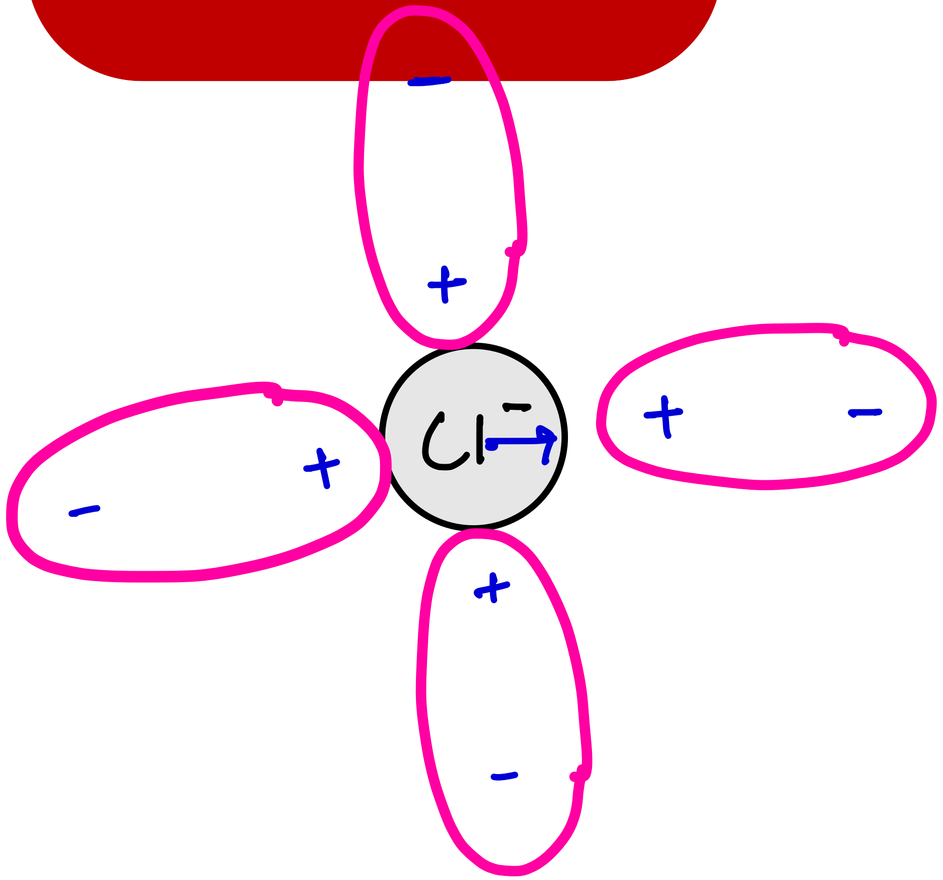



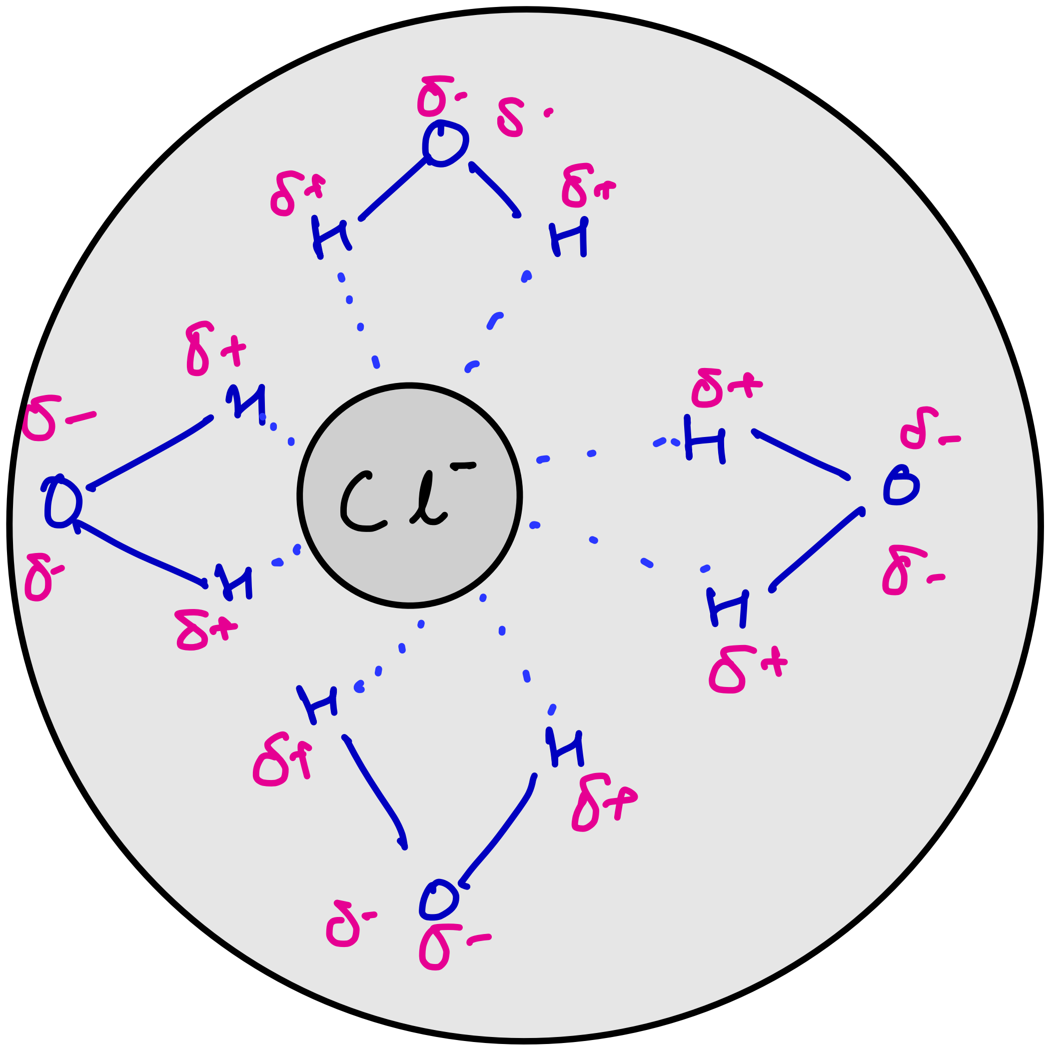



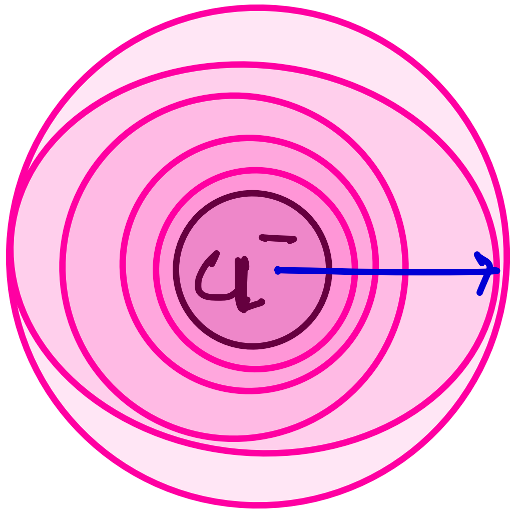

$R_{Na^+(g)} < R_{Na^+(aq.)}$

# CHEMICAL BONDING

$$Cl^-(g) + aq. \longrightarrow Cl^-(aq.)$$




$$R_{Cl^-(g)} < R_{Cl^-(aq.)}$$

**CHEMICAL BONDING**

- Higher the hydration higher hydration energy and Larger the hydrated radius.
- Smaller ion move faster that has higher mobility or we can say higher Electrical conductivity

Factors Affecting Hydration energy :

$$(HE)_{Cation} \propto \frac{q_c}{r_c}$$

$$(HE)_{Anion} \propto \frac{q_a}{r_a}$$

$$\boxed{HE(A_x B_y) = x\ HE(A^{+y}) + y\ HE(B^{-x})}$$

Ex. $HE(AlCl_3) = HE(Al^{+3}) + 3\ HE(Cl^{-})$

# CHEMICAL BONDING

(i) charge on cation ($q_c$) increases HE increases

(ii) charge on Anion ($q_a$) increases HE increases

(iii) Radius of Anion (OR) cation increases HE decreases.

" Smaller become fatter" provided charge is same

$Li^+(aq.)$ $Na^+(aq.)$ Hydrated radius ⇒ $r_{Li^+(aq.)} > r_{Na^+(aq.)}$

Ex. Compare ionic mobility of ions in

1) $KCl(l)$ $NaCl(l)$ Anion is same

$r_{K^+(l)} > r_{Na^+(l)}$

ionic Mobility $NaCl(l) > KCl(l)$

# CHEMICAL BONDING

(ii) $KCl(aq.)$ $NaCl(aq.)$ $Cl^-$ (Anion) is common

$K^+(aq.)$ $Na^+(aq.)$ [ smaller become fatter]

ionic mobility $Na^+(aq) < K^+(aq.)$

ionic mobility $KCl(aq.) > NaCl(aq.)$

**Ex.** Compare electrical conductivity of following ions

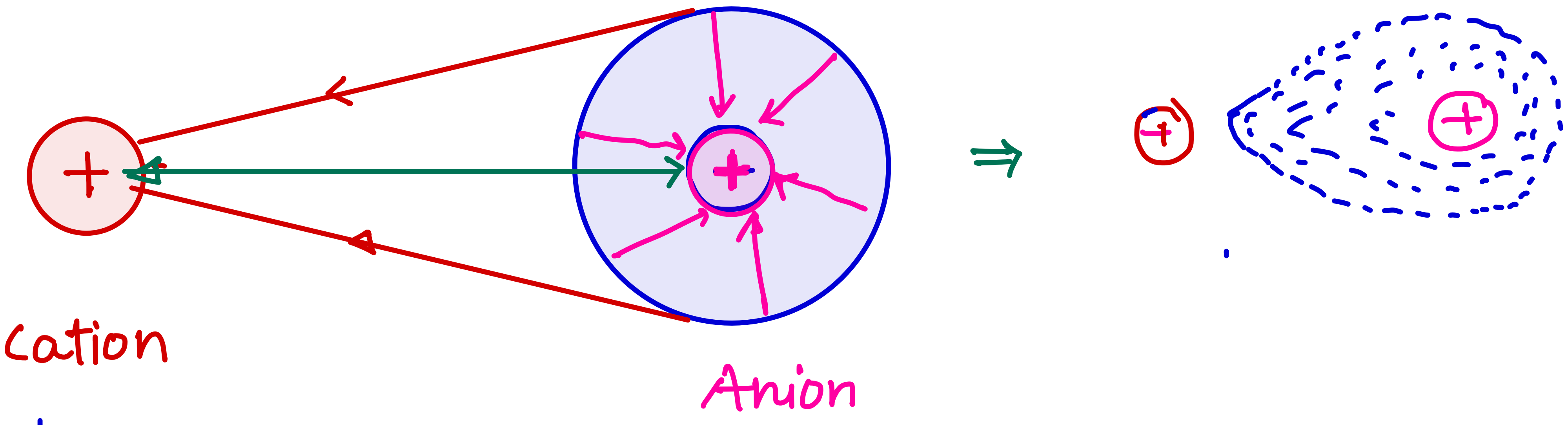
ionic mobility $Li^+(aq.) < Na^+(aq) < K^+(aq.) < Rb^+(aq.) < Cs^+(aq.)$ [smaller becom fatter)

Ex. Compare hydrated radius for.

$Na^+(aq) < Mg^{+2}(aq) < Al^{+3}(aq.)$ hydration $\propto q_c$

# Co-valent Nature in Ionic Bond

- polarisation | Fajan's Rule




Polarisation power $\propto \frac{q_c}{r_c}$

Polarisibility $\propto q_a \cdot r_a$

polarisation = polarising power + polarisibility $\propto$ Co-valent character.

# CHEMICAL BONDING

- When Cation and Anion comes closer to form Crystal Lattice following type of forces observed

- Attraction b/w Cation and Electron density of Anion
- Attraction b/w Nucleus of Anion and Electron density of Anion
- Repulsion b/w Cation and nucleus of Anion.

Due to these unballanced force Electron charge density get distorted. this distortion is called polarisation. Higher the polarisation higher the Co-valent character in compound.

polarisation = polarising power of cation + polarisibility of Anion

**CHEMICAL BONDING**

# Factors Affecting Polarisation ($\phi$)

$$\phi \propto \frac{q_c}{r_c} + q_a \cdot r_a$$

(Polarisation)

① • charge of cation ($q_c$) increases then polarising power increases and polarisation increases so co-valent character increases.

② • charge on Anion ($q_a$) increases then polaricibility increases so polarisation increases then co-valent character increases

(iii) Radius of Cation ($r_c$) increases polarising power decreases polarisation decreases so Co-valent character decreases.

iv) Radius of Anion ($r_a$) increases polarisibility increases so polarisation increases so covalent character increases

** Imp Cation having psuedo inert gas configuration has more polaring power than cation having inert gas electronic configuration.

Inert gas: $Na^+$, $K^+$
2,8 2,8,8
(Ne) (Ar)

$Cu^+$ $Zn^{+2}$
2,8,18, 2,8,18 ) pseudo inert gas configuration

$Ag^+$ $Cd^{+2}$
$Au^+$ $Hg^{+2}$

**CHEMICAL BONDING**

$\phi = \frac{q_c}{r_c} + q_a r_a$

Ex. Arrange the following in increasing order of ionic character.

(i) $\overset{+2}{Fe}O$, > $\overset{+3}{Fe_2}O_3$ [ $q_c \uparrow$ polarisation $\uparrow$ Covalen $\uparrow$ ]

(ii) $\overset{+2}{Pb}Cl_2$ > $\overset{+4}{Pb}Cl_4$ [ $q_c \uparrow$ " " ]

(iii) $Na_2\overset{-2}{O}$ > $Na_2\overset{-2}{S}$ [ $r_a \uparrow$ polarisation $\uparrow$ Covalent $\uparrow$ ]

(iv) $Ag\overset{-1}{F}$ > $Ag\overset{-1}{Cl}$ > $Ag\overset{-1}{Br}$ > $Ag\overset{-1}{I}$ $r_a \uparrow$, $\phi \uparrow$

v) $ZnCl_2$ < $CaCl_2$ [ pseudo inert gas configuration ]

vi) $\overset{+2}{Sn}Cl_2$ > $\overset{+4}{Sn}Cl_4$ [ $q_c \uparrow$, $\phi \uparrow$, ]

vii) $\overset{+1}{Na}Cl$ > $\overset{+2}{Mg}Cl_2$ > $\overset{+3}{Al}Cl_3$

**CHEMICAL BONDING**

## Application

- A compound having higher polarisation will show more intense colour.

## Polarisation

$r_a \uparrow$ Polarisation $\uparrow$

$AgF^{-1} < AgCl^{-1} < AgBr^{-1} < AgI^{-1}$

| $AgF$ | $AgCl$ | $AgBr$ | $AgI$ |
|---|---|---|---|
| Colourless | white | Yellowish white | yellow |