5/6/15

# Lattice Energy

* Lattice energy is the enthalpy change when 1 mole of an ionic compound is formed from its gaseous ions under standard conditions. ($\Delta H_{latt}$ = -ve)

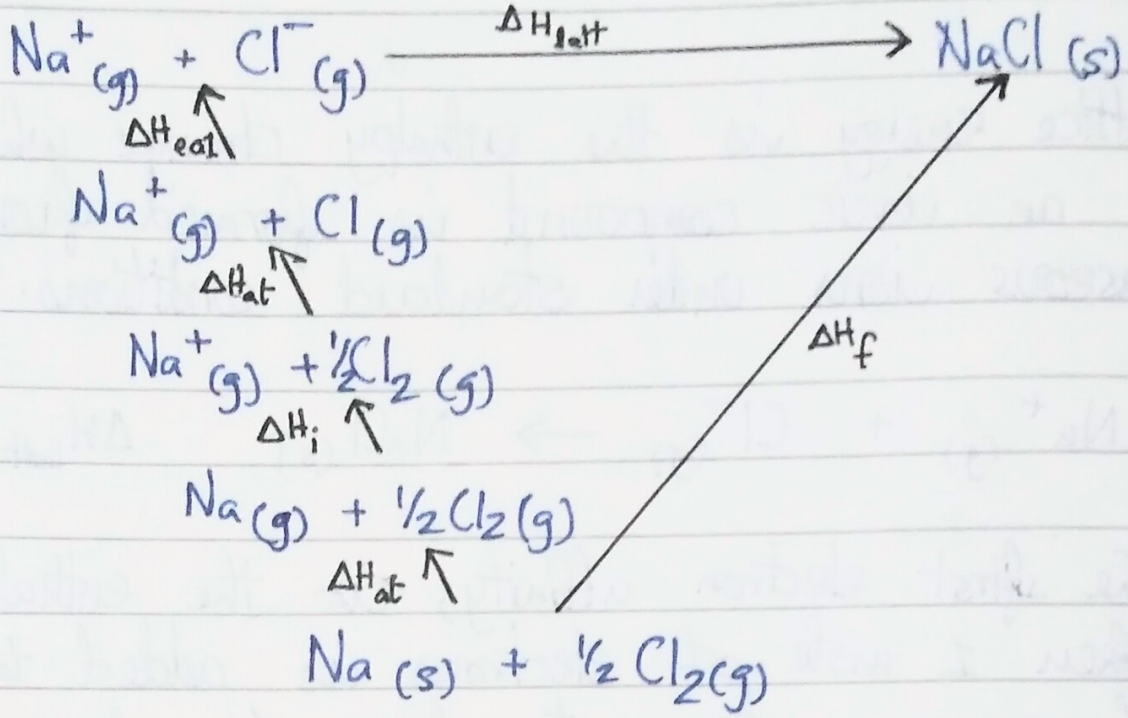
* $Na^+_{(g)} + Cl^-_{(g)} \rightarrow NaCl_{(s)}$ $\Delta H_{latt} = -787\ kJ/mol$

* The first electron affinity, is the enthalpy change when 1 mole of electrons is added to 1 mole of gaseous atoms to form 1 mole of gaseous $1^-$ ions under standard conditions.

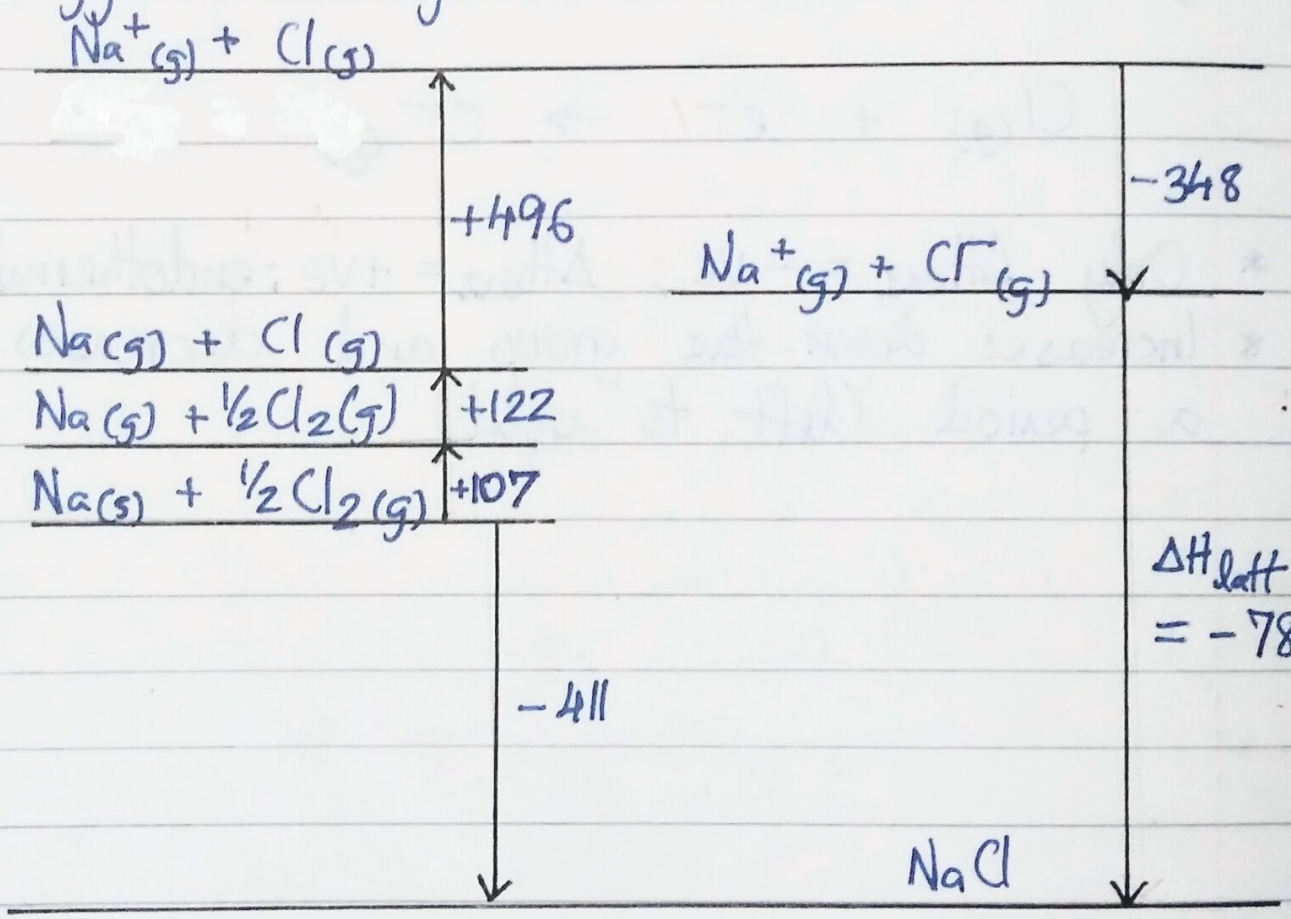
$$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$$

* Only $\Delta H_{ea1}$ = -ve ; $\Delta H_{ea2}$ = +ve : endothermic.
* Increases down the group and decreases across a period (left to right)

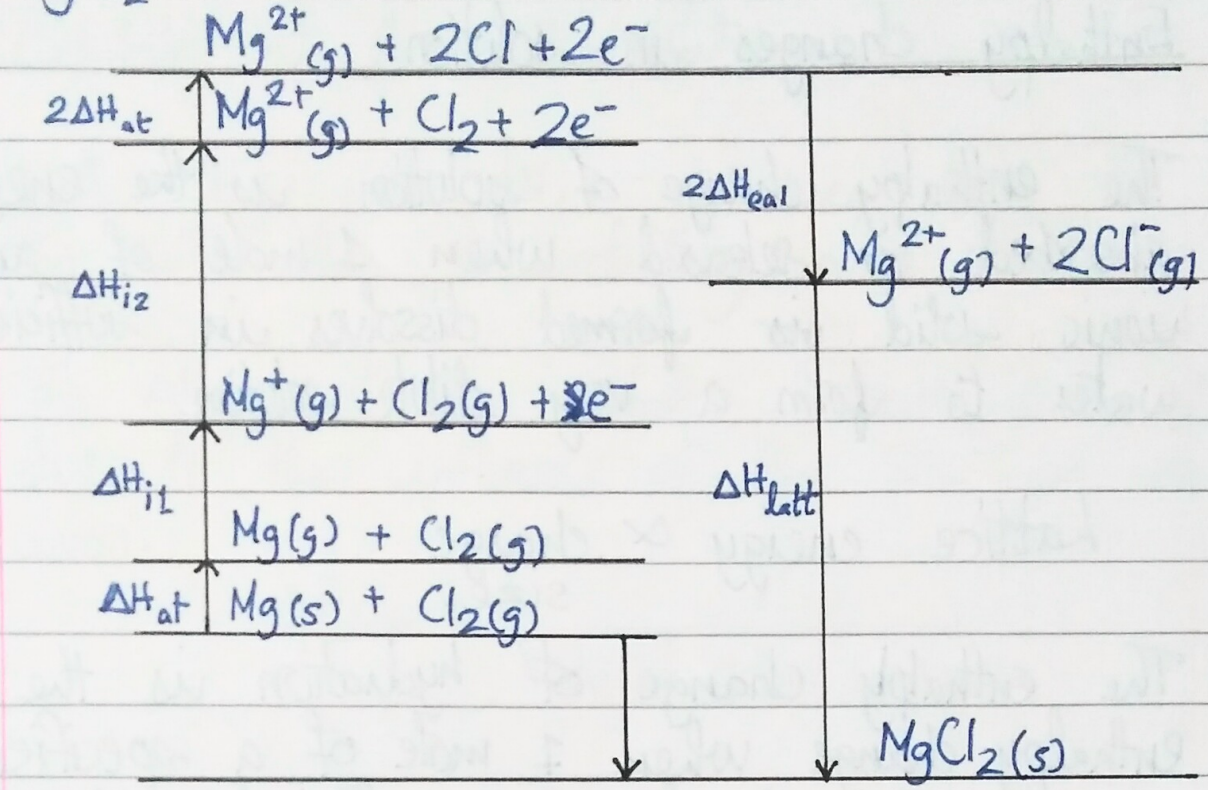
## * Born-Haber cycle



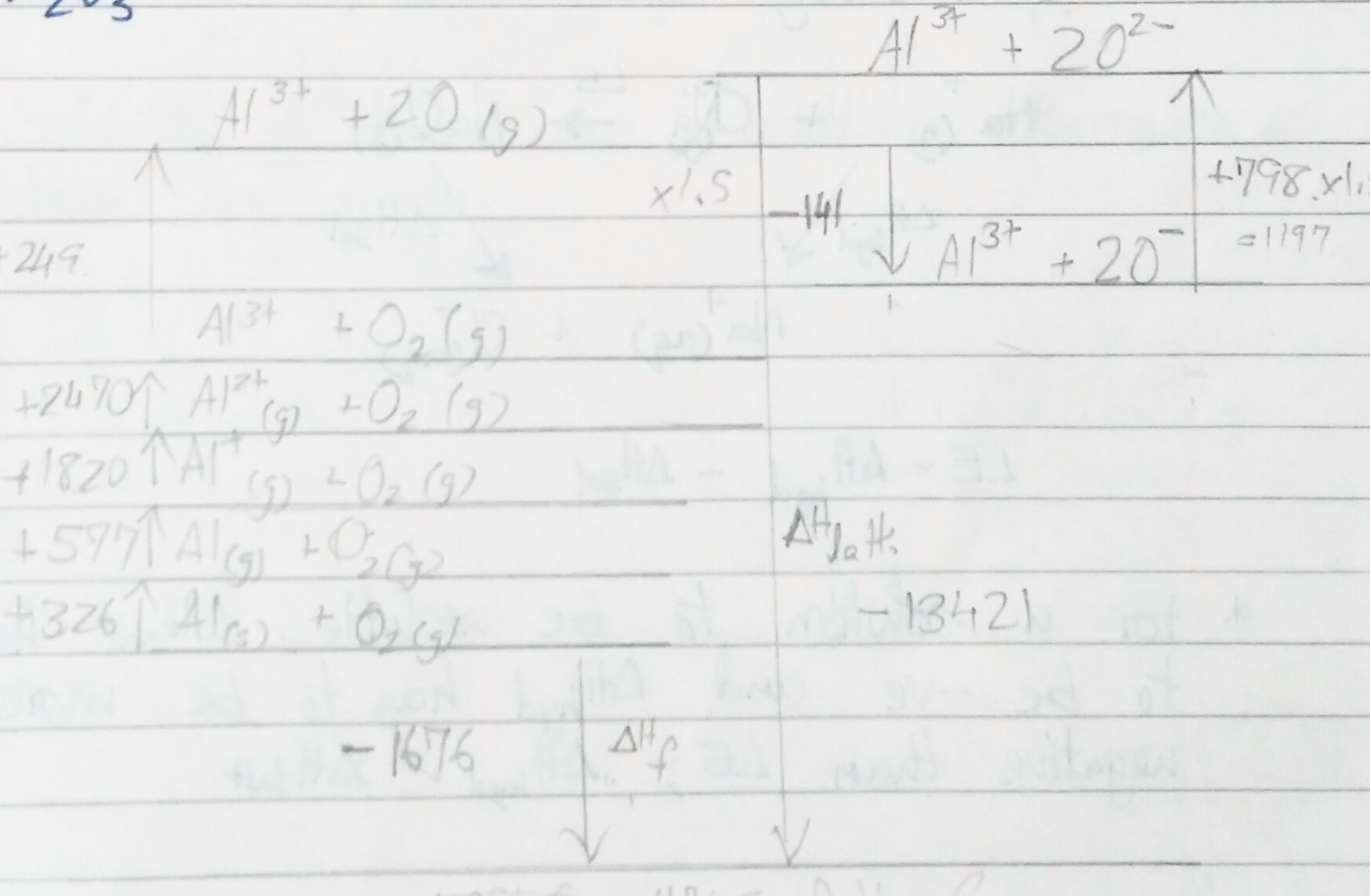

## * Energy level diagram.



## $MgCl_2$


$Mg^{2+}_{(g)} + 2Cl + 2e^-$
$2\Delta H_{at}$
$Mg^{2+}_{(g)} + Cl_2 + 2e^-$
$2\Delta H_{eal}$
$\Delta H_{i2}$
$Mg^{2+}_{(g)} + 2Cl^-_{(g)}$
$Mg^+_{(g)} + Cl_2(g) + 2e^-$
$\Delta H_{i1}$
$\Delta H_{latt}$
$Mg_{(g)} + Cl_2(g)$
$\Delta H_{at}$
$Mg_{(s)} + Cl_2(g)$
$MgCl_2(s)$

## $Al_2O_3$

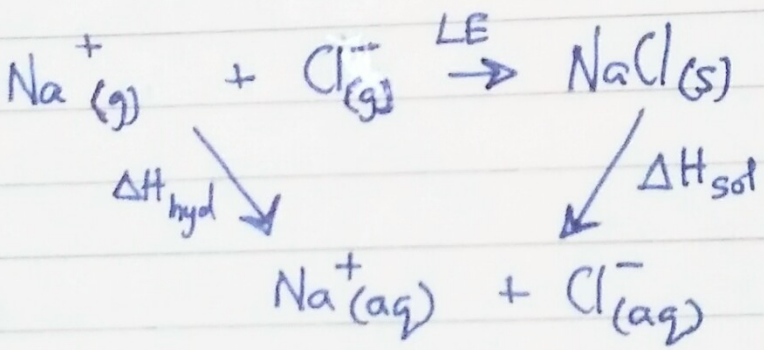

$Al^{3+} + 2O^{2-}$
$Al^{3+} + 2O_{(g)}$
$\times 1.5$
$-141$
$+798 \times 1.$
$= 1197$
$\times 1.5$ $+249$
$593.5$
$Al^{3+} + O_2(g)$
$\times 2$
$+2490$ $Al^{2+}_{(g)} + O_2(g)$
$+1820$ $Al^+_{(g)} + O_2(g)$
$+597$ $Al_{(g)} + O_{2(g)}$
$= 10386$
$+326$ $Al_{(s)} + O_2(g)$
$\Delta H_{latt.}$
$-13421$
$-1676$
$\Delta H_f$
$-1795.5$
$11245 + \Delta_a H = \epsilon$

6/6/15 # Enthalpy changes in solution

* The enthalpy change of solution is the energy absorbed or released when 1 mole of an ionic solid ~~is formed~~ dissolves in sufficient water to form a very dilute solution.

* Lattice energy $\propto \frac{\text{charge}}{\text{size}}$.

* The enthalpy change of hydration is the enthalpy change when 1 mole of a specified gaseous ions dissolves in sufficient water to form a very dilute solution.




$$LE = \Delta H_{hyd} - \Delta H_{sol}$$

* For a solution to be soluble, $\Delta H_{sol}$ has to be -ve and $\Delta H_{hyd}$ has to be more negative than LE; $\Delta H_{hyd} > \Delta H_{latt}$

17/6/15 **Solubility of Group 2 sulfates.**

* Both $\Delta H_{hyd}$ and $\Delta H_{latt}$ decreases down the group. So, $\Delta H_{sol}$ also de solubility also decreases.

* The $\Delta H_{latt}$ of the sulfate decreases less steeply due to the influence of the $SO_4^{2-}$ ion on the anion.

$$\Delta H_{latt} \propto \frac{1}{\text{radii of cation \& anion}}$$

The sulphate ion has a much larger radius than any of the group 2 cations

* Solubility of the Group 2 sulfates decreases down the group.

## Ion Polarisation.

* The distortion of the electron cloud of anion due to the charge density of the cation in an ionic compound is called polarisation.

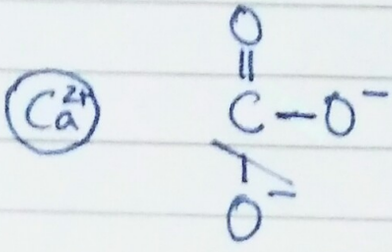
* Factors that affect polarisation:
  - charge density of cation

    $$\text{charge density} = \frac{\text{charge}}{\text{size}}.$$

  - size of anion: increase in polarisability with bigger anion.
  - size of cation: increase in polarisability with smaller cation.

* When polarisability is lesser, group 2 carbonates and nitrates are more thermally stable.
* Decomposition temperature increases down the group for group 2 carbonates and nitrates. This is because the cations become worser polarisers down the group.

* $CaCO_3 \xrightarrow{heat} CaO + CO_2$



* $2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$