

ICT: Thermodynamics: Use of a Spreadsheet

SCH4UE_08 - 09

- Construct a spreadsheet which would allow you to determine the enthalpy of formation of an ionic solid, $\text{MX}_{(s)}$, via a Born – Haber cycle from given data, using $\text{M}_{(s)}$ and $\text{X}_{2(g)}$.
- Write the expression for ΔH_f^0 in terms of various enthalpy changes involved.
- Use your spreadsheet to calculate the enthalpy of formation for $\text{KF}_{(s)}$.

$$\Delta H^0_{(\text{atomisation})} \text{K}_{(s)} = 90.00 \text{ kJ/mol}$$

$$\Delta H^0_{\text{Bond dissociation energy}} \text{F}_{2(g)} = 157.99 \text{ kJ/mol}$$

$$\Delta H^0_{(\text{Ionisation Energy})} \text{K}_{(g)} = 424.93 \text{ kJ/mol}$$

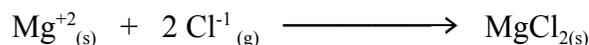
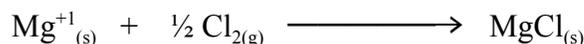
$$\Delta H^0_{\text{Electron affinity}} \text{F}_{(g)} = -349.7 \text{ kJ/mol.}$$

$$\text{Lattice energy (KF}_{(s)}) = -806.8 \text{ kJ/mol}$$

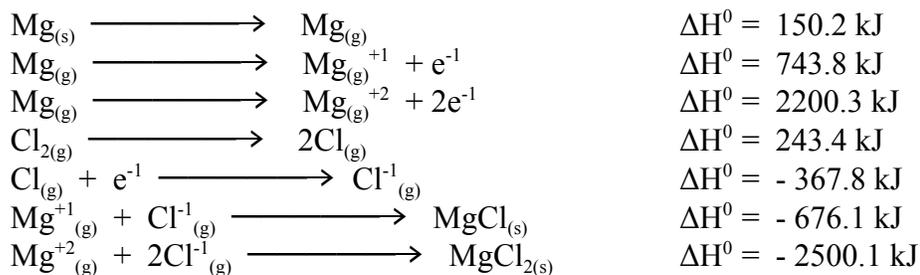
(Answer: $-562.58 \text{ kJ mol}^{-1}$)

Born-Haber cycle may also be used to **calculate ΔH_f^0 of a hypothetical compound** to see if it exists or why not, if both lattice energy and electron affinity are known.

- Construct another spreadsheet which would allow you to determine the enthalpy of formation of an ionic solid, $\text{MX}_{2(s)}$, via a Born – Haber cycle from given data, using $\text{M}_{(s)}$ and $\text{X}_{2(g)}$.
- Consider the formation of $\text{MgCl}_{(s)}$ and $\text{MgCl}_{2(s)}$ according to the following:



Given the following data:



- Use your spreadsheet to calculate the enthalpy of formation for each compound $\text{MgCl}_{(s)}$ and $\text{MgCl}_{2(s)}$.
(Answer: $\Delta H_f (\text{MgCl}) = -28.20 \text{ kJ mol}^{-1}$, $\Delta H_f (\text{MgCl}_2) = -641.8 \text{ kJ mol}^{-1}$)
- Discuss the relative stability of MgCl and MgCl_2 . Does this explain why Mg Cl is not known?