

## 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  $\Delta H_f^0$  in terms of various enthalpy changes involved.
- Use your spreadsheet to calculate the enthalpy of formation for  $\text{KF}_{(s)}$ .

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

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

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

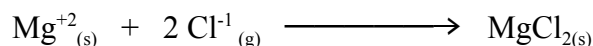
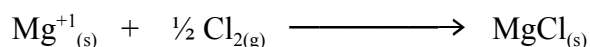
$$\Delta H^0_{\text{Electron affinity}} \text{F}_{(g)} = -349.7 \text{ kJ/mol.}$$

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

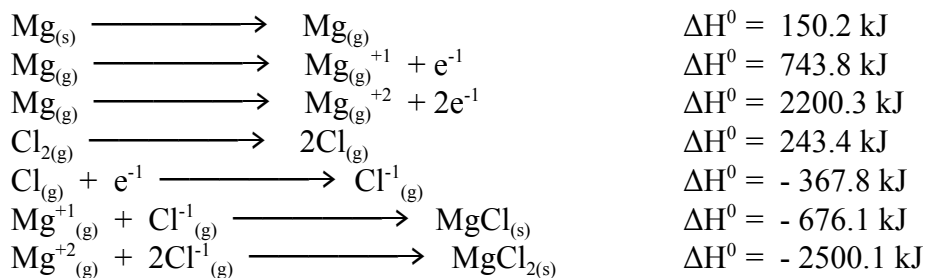
(Answer:  $-562.58 \text{ kJ mol}^{-1}$ )

Born-Haber cycle may also be used to **calculate  $\Delta H_f^0$  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  $\text{MgCl}$  and  $\text{MgCl}_2$ . Does this explain why  $\text{Mg Cl}$  is not known?