

Recognising Enthalpy Changes Involved in Born-Haber Cycles

Look at the following processes.

For each process, write the **name** and **symbol** for the enthalpy change and find its **value**.

- $\text{Ca}_{(s)} \rightarrow \text{Ca}_{(g)}$ name..... symbol.....=..... kJmol^{-1}
- $\text{S}^{-}_{(g)} + e^{-} \rightarrow \text{S}^{2-}_{(g)}$ name..... symbol.....=..... kJmol^{-1}
- $\text{Al}^{2+}_{(g)} \rightarrow \text{Al}^{3+}_{(g)} + e^{-}$ name..... symbol.....=..... kJmol^{-1}
- $2\text{Na}_{(s)} + \frac{1}{2} \text{O}_{2(g)} \rightarrow \text{Na}_2\text{O}_{(s)}$ name..... symbol.....=..... kJmol^{-1}
- $\frac{1}{2} \text{Br}_{2(l)} \rightarrow \text{Br}_{(g)}$ name..... symbol.....=..... kJmol^{-1}
- $\text{Mg}^{2+}_{(g)} + 2\text{F}^{-}_{(g)} \rightarrow \text{MgF}_{2(s)}$ name..... symbol.....=..... kJmol^{-1}
- $\text{Cl}_{(g)} + e^{-} \rightarrow \text{Cl}^{-}_{(g)}$ name..... symbol.....=..... kJmol^{-1}

Now work out values of the enthalpy changes of the following processes.

(Tip: You will need to think more carefully about these and consider signs!)

- $2\text{O}_{(g)} + 2e^{-} \rightarrow 2\text{O}^{-}_{(g)}$ symbol.....=..... kJmol^{-1}
- $2\text{Cl}_{2(g)} \rightarrow 4\text{Cl}_{(g)}$ symbol.....=..... kJmol^{-1}
- $\text{N}_{2(g)} + 3\text{H}_{2(g)} \rightarrow 2\text{NH}_{3(g)}$ symbol.....=..... kJmol^{-1}
- $3\text{Mg}^{+}_{(g)} \rightarrow 3\text{Mg}^{2+}_{(g)} + 3e^{-}$ symbol.....=..... kJmol^{-1}
- $2\text{Rb}_{(g)} \rightarrow 2\text{Rb}_{(s)}$ symbol.....=..... kJmol^{-1}
- $\text{F}^{-}_{(g)} \rightarrow \text{F}_{(g)} + e^{-}$ symbol.....=..... kJmol^{-1}
- $\text{Br}_{2(l)} \rightarrow 2\text{Br}_{(g)}$ symbol.....=..... kJmol^{-1}
- $\text{Br}_{2(g)} \rightarrow 2\text{Br}_{(g)}$ symbol.....=..... kJmol^{-1}
- $\text{Br}_{2(l)} \rightarrow \text{Br}_{2(g)}$ symbol.....=..... kJmol^{-1}

Take care with these! A bit of thinking involved

Try to construct a simple **Hess Cycle** involving these last three enthalpy changes.