SL & HL Questions on Hess's Law

1. State **(a)** the equation for the formation of ethane, C_2H_6, from its elements and then **(b)** determine the value for the standard enthalpy of formation of ethane given the following standard enthalpies of combustion. Carbon (graphite): – 394 kJ mol^{-1}, hydrogen: – 286 kJ mol^{-1} and ethane: – 1560 kJ mol^{-1}.

2. The values for the enthalpies of combustion of carbon (graphite) and hydrogen can be used to determine the enthalpy of formation of any hydrocarbon provided the enthalpy of combustion of the hydrocarbon in question is known.

i. The enthalpy of combustion of butane, C_4H_{10}, is – 2877 kJ mol^{-1}. Determine the enthalpy of formation of butane.

ii. The enthalpy of combustion of octane, C_8H_{18}, is – 5470 kJ mol^{-1}. Determine the enthalpy of formation of octane.

3. You are provided with the following information.

$H_2S(g) + 2O_2(g) \rightarrow H_2SO_4(l)$ $\quad \Delta H^{\ominus} = -236$ kJ

$H_2S(g) + 2O_2(g) \rightarrow SO_3(g) + H_2O(l)$ $\quad \Delta H^{\ominus} = -207$ kJ

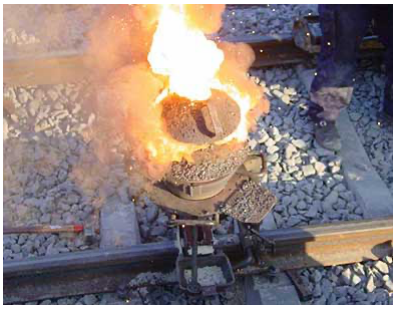
$H_2O(l) \rightarrow H_2O(g)$ $\quad \Delta H^{\ominus} = +44.0$ kJ

i. Use simultaneous equations to provide the value for the enthalpy change

$H_2SO_4(l) \rightarrow SO_3(g) + H_2O(g)$ $\quad \Delta H^{\ominus} = ?$ kJ

ii. Draw the energy cycle for the above sequence of reactions.

4. The thermite reaction (see right) involves the reaction of aluminium with iron oxide to form aluminium oxide.



$$Fe_2O_3(s) + 2Al(s) \rightarrow 2Fe(s) + Al_2O_3(s)$$

It is an extremely exothermic reaction and the heat produced can be used to weld railway lines together.

The enthalpies of formation of aluminium oxide and iron(III)oxide are – 1676 and – 825.5 kJ mol^{-1} respectively.

Determine the heat produced when 20 g of aluminium react completely with excess iron(III) oxide.