Hess' Law

- The total enthalpy change for a chemical reaction is independent of the route of the reaction, provided the initial and final conditions are the same

example

- The energy released per mole of glucose combusted in a bomb calorimeter to produce CO2 and H2O is the same as that released by cellular respiration of glucose to give the same products

- The enthalpy change of a net chemical reaction is the **arithmetic sum** of the enthalpies of the individual reactions combined to make the net reaction

$$\Delta_{net}H^{o} = \Delta_1H + \Delta_2H + \Delta_3H + \Delta_4H + \ldots$$

$A + B \rightarrow E + G$	$\Delta rH = \Delta_1H$
$E + G \rightarrow L + M$	$\Delta rH = \Delta_2H$
$L + M \rightarrow Q + R$	$\Delta rH = \Delta_3H$
$Q + R \rightarrow Y + Z$	$\Delta rH = \Delta_4H$

Total = $A + B \rightarrow Y + Z$

$$\Delta_{net}H^{o} = \Delta_1H + \Delta_2H + \Delta_3H + \Delta_4H$$

Example:

- What is the standard molar enthalpy of **formation** of hexane, given the following information:

1. $C_6H_{14} + 19/2\ O_2 \rightarrow 6CO_2 + 7H_2O \quad \Delta H = -4162.9kJ$
2. $C + O_2 \rightarrow CO_2 \qquad \Delta H = -393.5kJ$
3. $H_2 + 1/2O_2 \rightarrow H_2O$

Example 2:

- What is the standard enthalpy change for the hydrogenation of benzene to make cyclohexane?
  $C_6H_6 + 3H_2 \rightarrow C_6H_{12}$

1. $C_6H_6 + 15/2O_2 \rightarrow 6CO_2 + 3H_2O$ $\Delta H = -3267.0kJ$
2. $C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$ $\Delta H = -3930.0kJ$
3. $H_2 + ½\ O_2 \rightarrow H_2O$ $\Delta H = -285.8kJ$