Chemical reactions involve energy changes.

The Nature of Energy

Kinetic Energy and Potential energy

Work and Heat

The First Law of Thermodynamics

The First Law of Thermodynamics says that energy is conserved. So energy that is lost by the system must be gained by the surroundings and vice versa.

Internal Energy

ΔE and Heat and Work
Heat, $q$, absorbed by the system and work, $w$, done on the system are both positive quantities. Both serve to increase the internal energy, $E$, of the system: $\Delta E = q + w$

**Endothermic and Exothermic Processes**

**Enthalpy**
(a) If the system absorbs heat, $\Delta H$ will be positive ($\Delta H > 0$). (b) If the system loses heat, $\Delta H$ will be negative ($\Delta H < 0$).

**Enthalpies of Reaction**

Reversing the reaction changes the sign but not the magnitude of the enthalpy change: $\Delta H_2 = -\Delta H_1$. 

<table>
<thead>
<tr>
<th>Reaction</th>
<th>Enthalpy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{CH}_4(g) + 2\text{O}_2(g)$</td>
<td>$\Delta H_1 = -890$ $\text{kJ}$</td>
</tr>
<tr>
<td>$\text{CO}_2(g) + 2\text{H}_2\text{O}(l)$</td>
<td>$\Delta H_2 = 890$ $\text{kJ}$</td>
</tr>
</tbody>
</table>
Ex 1  Hydrogen peroxide can decompose to water and oxygen by the reaction:

\[ 2 \text{H}_2\text{O}_2(\text{l}) \rightarrow 2 \text{H}_2\text{O}(\text{l}) + \text{O}_2(\text{g}) \quad \Delta H = -196 \text{ kJ} \]

Calculate the heat change when 5.00 g of H\textsubscript{2}O\textsubscript{2}(l) decomposes.

Ex 2  Consider the following reaction, which occurs at room temperature and pressure:

\[ 2 \text{Cl}(\text{g}) \rightarrow \text{Cl}_2(\text{g}) \quad \Delta H = -243.4 \text{ kJ} \]

Which has the higher enthalpy under these conditions, 2 Cl\textsubscript{(g)} or Cl\textsubscript{2}(g)?

Ex 3  When solutions containing silver ions and chloride ions are mixed, silver chloride precipitates.

\[ \text{Ag}^+(\text{aq}) + 2 \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s}) \quad \Delta H = -65.5 \text{ kJ} \]

(a) Calculate \(\Delta H\) for formation of 0.200 mol of AgCl by this reaction.

(b) Calculate \(\Delta H\) when 0.350 mmol of AgCl dissolves in water.