Heat in Changes of State/Phase of Matter

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Heat of fusion/solidification

• Energy absorbed (gained) during melting or released (lost) during solidification (freezing)

• $\text{H}_2\text{O} (s) \rightarrow \text{H}_2\text{O} (l)$  \hspace{1cm} $\Delta H_{\text{fus}} = + 6.01 \text{ kJ/mol}$

• $\text{H}_2\text{O} (l) \rightarrow \text{H}_2\text{O} (s)$  \hspace{1cm} $\Delta H_{\text{solid}} = - 6.01 \text{ kJ/mol}$
Heat of vaporization/condensation

• Energy absorbed (gained) during vaporizing (evaporating) or released (lost) during condensation

\[ H_2O_{(l)} \rightarrow H_2O_{(g)} \quad \Delta H_{\text{vap}} = +40.7 \text{ kJ/mol} \]

\[ H_2O_{(g)} \rightarrow H_2O_{(l)} \quad \Delta H_{\text{cond}} = -40.7 \text{ kJ/mol} \]
Heat of Solution

• Energy absorbed during *exothermic reaction*
  \[ \text{H}_2\text{O} \]
  \[ \text{NaOH} \, (s) \rightarrow \text{Na}^+ \, (aq) + \text{OH}^- \, (aq) \]
  \[ \Delta H_{\text{soln}} = -445.1 \, \text{kJ/mol} \]

• Energy released during *endothermic reaction*
  \[ \text{H}_2\text{O} \]
  \[ \text{NH}_4\text{NO}_3 \, (s) \rightarrow \text{NH}_4^+ \, (aq) + \text{NO}_3^- \, (aq) \]
  \[ \Delta H_{\text{soln}} = +25.7 \, \text{kJ/mol} \]
Heat and Energy Change

- A: heating ice
- B: melting
- C: heating water
- D: vaporization
- E: cooling water
- F: