

Cold Pack Temperature

A cold pack consists of NaNO_3 . When the pack breaks open the salt is released into water and causes cooling because of the endothermic reaction.

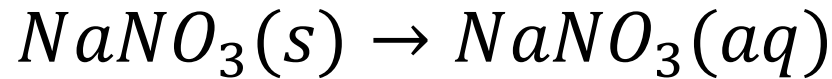
Given the enthalpy and entropy data below, what is the minimum temperature at which NaNO_3 will dissolve in water?

$$\Delta_{\text{soln}}H^\circ(\text{NaNO}_3) = +42.5 \text{ kJ/mol}$$

$$\Delta_{\text{soln}}S^\circ(\text{NaNO}_3) = +165 \text{ J/molK}$$

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The cross over temperature at which the process



is no longer spontaneous occurs when

$$\Delta_{solv}G^{\circ}(NaNO_3) = 0.$$

This temperature is:

$$T = \frac{\Delta_{solv}H^{\circ}(NaNO_3)}{\Delta_{solv}S^{\circ}(NaNO_3)}$$

$$T = \frac{42,500 \text{ J/mol}}{165 \text{ J/molK}} = 257.6 \text{ K}$$