

General Chemistry II Chapter 15 Study Guide

- the total energy of the universe remains constant
 - $\Delta E_{\text{univ}} = \Delta E_{\text{sys}} + \Delta E_{\text{surr}} = 0$
 - ΔH is often used to approximate ΔE ; for enthalpy there is no zero point; we can only measure changes in enthalpy
- The total entropy of the universe increases
 - $\Delta S_{\text{univ}} = \Delta S_{\text{sys}} + \Delta S_{\text{surr}} > 0$
 - For entropy there is a zero point, and we can determine the absolute entropy values

Third law of thermodynamics:

- Third law of thermodynamics: the entropy of a perfect crystalline substance at absolute zero (0 K) is 0
 - $S_{\text{sys}} = 0$ at 0 K
- A "perfect" crystal has flawless alignment of all its particles; at absolute 0, the particles have minimum energy, so there is only one microstate

Entropy change in phase changes:

- Isothermal process (ex. Phase change): the change in entropy is equal to the heat that would be transferred, divided by the temperature:
 - $\Delta S = \Delta H / T$
- Consider the melting of 1 mol of an ice cube (molar enthalpy change of ice melting = $6.01 \times 10^3 \text{ J/mol}$) in the palm of your hand, determine the ΔS for the ice cube and for its surroundings:

$$\Delta S_{\text{sys}} = \frac{(1\text{mol})(6.01 \times 10^3 \text{ J/mol})}{273\text{K}} = 22.0 \frac{\text{J}}{\text{K}}$$

$$\Delta S_{\text{surr}} = \frac{(1\text{mol})(-6.01 \times 10^3 \text{ J/mol})}{310\text{K}} = -19.4 \frac{\text{J}}{\text{K}}$$

$$\Delta S_{\text{total}} = \Delta S_{\text{sys}} + \Delta S_{\text{surr}} = 22.0 - 19.4 = 2.6 \frac{\text{J}}{\text{K}}$$

Entropy change in isothermal expansion/compression:

- Entropy change for isothermal expansion/compression of a gas is:
 - $\Delta S_{\text{gas}} = nR \ln V_2 / V_1$
 - n = moles of gas
 - $R = 8.314 \text{ J/molK}$
 - V_1 = initial volume
 - V_2 = final volume
 - If volume is increased, $\Delta S_{\text{gas}} > 0$

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Léo Pomar



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