

Lesson 28: Thermodynamics I

text: 451-466

what to know:

- what is meant by a spontaneous process and the two factors which determine spontaneity, §11-1
- concept of entropy and how entropy changes during various processes, §11-2
- third law of thermodynamics, absolute entropies, and the effect of temperature changes, §11-3
- second law of thermodynamics, §11-4
- Gibbs function (free-energy) and how it predicts spontaneity, §11-5, Trouton's Rule

questions:

1. Explain what is meant by a spontaneous process. Give two examples each of spontaneous and nonspontaneous processes.
2. In each pair of the substances listed, choose the one with the larger standard entropy per mole and give your reasons.
 - a. Li(s) or Li(l)
 - b. C₂H₅OH (l) or CH₃OCH₃ (l) (Hint: which one forms hydrogen bonds?)
 - c. Ar(g) or Xe(g)
 - d. CO or CO₂
3. Does the entropy increase, decrease or remain constant during the following processes?
 - a. a solid melts.
 - b. a liquid freezes.
 - c. a liquid vaporizes.
 - d. a solid sublimes.
 - e. NaCl(s) \rightleftharpoons NaCl(aq)
 - f. Fe(s)(25 °C) \rightleftharpoons Fe(s)(200 °C)
 - g. 2H₂(g) + O₂(g) \rightleftharpoons 2H₂O(g)
 - h. 2HgO(s) \rightleftharpoons 2Hg(l) + O₂(g)
 - i. H₂(g) + Cl₂(g) \rightleftharpoons 2HCl(g)
4. Explain why entropy is zero at 0 K.
5. Entropy is expressed in what units?
6. What do you know about the ΔS_{univ} for all spontaneous processes?
7. Explain how an endothermic process can be spontaneous?
8. How does ΔG relate to ΔS_{univ} and ΔH_{sys} to $\Delta S_{\text{surroundings}}$?
9. Explain why ΔG is zero for a process at equilibrium.
10. What can you say about ΔH_{sys} and $\Delta S_{\text{surroundings}}$ for an exothermic process?