

Week 10 Problems

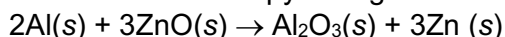
Section 63

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Conceptual Questions:

1. What is the second law of thermodynamics?
2. For any process, what are the four possible combinations of ΔS_{sys} and ΔS_{surr} ? Which of these correspond to always spontaneous or always non-spontaneous reactions? Under what conditions would the last two combinations be spontaneous?
3. What is the third law of thermodynamics?
4. For a gas phase reaction, how do you determine the sign of ΔS° ? How about for a phase change?
5. For a liquid, would you expect ΔS_{fusion} or $\Delta S_{\text{evaporation}}$ to be larger? Why?
6. True or False: High temperatures are favorable to a reaction both kinetically and thermodynamically? Explain.

1. Calculate the standard entropy change for the following reaction at 25 °C:



2. A certain reaction has $\Delta H^\circ = -19.5 \text{ kJ}$ and $\Delta S^\circ = 42.7 \text{ J K}^{-1}$.

- a. Calculate ΔG° for the reaction.
- b. Is the reaction spontaneous under standard conditions?

- 3a. Using the data given below, calculate ΔG° for the reaction: $2\text{SO}_2(g) + \text{O}_2(g) \rightarrow 2\text{SO}_3(g)$

- 3b. Is this reaction spontaneous as written under standard conditions?

- 3c. What is the equilibrium constant K for this reaction?

4. Calculate ΔG° for the process: $\text{C}(\text{diamond}) \leftrightarrow \text{C}(\text{graphite})$

Is the formation of graphite from diamond favored at 25°C? If so, why is it that diamonds do not become graphite on standing?

	ΔH_f°	S°	ΔG_f°
Al (s)		28.3 J/K•mol	
Al ₂ O ₃ (s)		50.99 J/K•mol	
ZnO (s)		43.9 J/K•mol	
Zn (s)		41.6 J/K•mol	
SO ₂ (g)			-300.4 kJ mol ⁻¹
O ₂ (g)			0 kJ mol ⁻¹
SO ₃ (g)			-370.4 kJ mol ⁻¹
C (diamond)	1.90 kJ mol ⁻¹	2.4 J/K•mol	
C (graphite)		5.69 J/K•mol	