

- 1) What is Gibb's Free Energy, and how is it used to determine spontaneity of a reaction or process?

- 2) Which term in the Free Energy equation is more significant at lower temperatures? At high T? Why?

- 3) For the following systems, determine ΔG at the given temperature and indicate its spontaneity. If the spontaneity depends on T, determine the temperature above or below (state which) which it becomes spontaneous.
 - a) $\text{HgS}(s) + \text{O}_2(g) \rightarrow \text{Hg}(l) + \text{SO}_2(g)$; $\Delta H = -238.6 \text{ kJ/mol}$; $\Delta S = +36.7 \text{ J/mol}\cdot\text{K}$; $T = 125^\circ\text{C}$

 - b) $\text{SiO}_2(s) + 2 \text{C}(\text{graphite}) + 2 \text{Cl}_2(g) \rightarrow \text{SiCl}_4(g) + 2 \text{CO}(g)$; $\Delta H = +32.9 \text{ kJ/mol}$; $\Delta S = +226.5 \text{ J/mol}\cdot\text{K}$; $T = 50.0^\circ\text{C}$

 - c) $2\text{NF}_2(g) \rightarrow \text{N}_2\text{F}_4(g)$; $\Delta H = -85 \text{ kJ/mol}$; $\Delta S = -198 \text{ J/mol}\cdot\text{K}$; $T = 500^\circ\text{C}$

 - d) $\text{N}_2(g) + 3 \text{Cl}_2(g) \rightarrow 2 \text{NCl}_3(g)$; $\Delta H = +460. \text{ kJ/mol}$; $\Delta S = -275 \text{ J/mol}\cdot\text{K}$; $T = 275^\circ\text{C}$

- 4) For which reactions a – d above could you predict the spontaneity based only on the signs of ΔH & ΔS ? Explain how the enthalpy and entropy changes indicate the direction of spontaneity.