

Ch 20 – Entropy and Free Energy

Selected NChO Problems

1999-25.	<p>(A) — — low</p> <p>“Spontaneous” means “Product-Favored”. Three conditions will be product-favored, ++ high, — + any temp, and — — low temp. Memorize these conditions.</p>
1999-26.	<p>(D) $\text{Cl}_2(\text{g}) + 2\text{HI}(\text{g}) \rightleftharpoons \text{I}_2(\text{s}) + 2\text{HCl}(\text{g})$</p> <p>“$\Delta S$ is negative” means getting <i>less</i> random, getting <i>more</i> orderly. Three moles of gas turning into one mole of solid and two moles of gas is getting less random.</p>
1998-23.	<p>(C) one mol of $\text{C}_2\text{H}_6(\text{g})$ at 25°C</p> <p>Ignore “one mol” and “25°C” since they are the same for all answers. Focus on the phases: (g) is more random than (l) or (s).</p>
1997-26.	<p>(D) $\text{NH}_4\text{NO}_2(\text{s}) \rightleftharpoons \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$</p> <p>“$\Delta S^\circ$ is the most positive” means the <i>greatest increase in entropy</i> or randomness. Both (C) $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$ and (D) $\text{NH}_4\text{NO}_2(\text{s}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ have increases in entropy, but a solid changing to 3 moles of gas is the <i>greatest increase in entropy</i>. Testing Tip: be sure to read all of the answers before making your choice.</p>
1996-24.	<p>(C) II only</p> <p>ΔS is negative means a decrease in entropy, an increase in orderliness. Judge each choice separately:</p> <p>I. Sugar is dissolved in water more random II. Steam is condensed less random / more orderly III. CaCO_3 is decomposed into CaO and CO_2 more random</p>
1996-25.	<p>(B) $< 0 < 0 < 0^\circ\text{C}$ which translates into “— — low temp”</p> <p>< 0 means —, > 0 means + Three conditions will be product-favored, ++ high, — + any temp, and — — low temp. Memorize these conditions.</p>
1995-21.	<p>(D) $\text{Cl}(\text{g}) + \text{e}^- \rightleftharpoons \text{Cl}^-(\text{g})$</p> <p>Evaluate each answer individually:</p> <p>(A) $\text{Al}_2\text{O}_3(\text{s}) \rightarrow 2\text{Al}(\text{s}) + 3/2\text{O}_2(\text{g})$ getting more random (solid \rightarrow solid and gas) (B) $\text{H}_2\text{O}(\text{s}) \rightarrow \text{H}_2\text{O}(\text{l})$ getting more random (solid \rightarrow liquid) (C) $\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$ getting more random (one mole gas \rightarrow two moles gas) (D) $\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$ getting less random (two particles \rightarrow one)</p>
1995-24.	<p>(B) ΔS positive, spontaneous at high temperatures only</p> <p>Note that ΔH is positive. Treat this as two separate questions: $\text{O}_2(\text{g}) \rightarrow 2\text{O}(\text{g})$ this is getting <i>more</i> random (1 mol gas \rightarrow 2 mol gas) $\therefore \Delta S +$ When $\Delta H +$, $\Delta S +$, spontaneous at high temperatures only.</p>
1995-25.	<p>(A) -109 kJ</p> <p>Two steps... calculate ΔS at 298K (standard temperature) $\Delta G = \Delta H - T\Delta S$ so... $91.2 = 176 - (298)(\Delta S)$ $\Delta S = (176-91.2)/298 = 0.285$ Assume that ΔS does not change with temperature (a good assumption, by the way). Calculate ΔG at 1000 K. $\Delta G = 176 - 1000(0.285) = 176-285 = \mathbf{-109\text{ kJ}}$</p>
1994-23.	<p>(C) entropy</p> <p>“the temperature of the solution decreases” means $\Delta H +$. The solid dissolves spontaneously, so one of these conditions must exist: $\Delta H +$, $\Delta S +$, Temp is high $\Delta H -$, $\Delta S +$, any temp $\Delta H -$, $\Delta S -$, Temp is low. The only spontaneous situation with $\Delta H +$ is $\Delta S +$, that is, entropy drives this reaction.</p>