Ch 20 – Entropy and Free Energy

Selected NChO Problems

1999-25.	**(A) — — low** "Spontaneous" means "Product-Favored". Three conditions will be product-favored, + + high, — + any temp, and — — low temp. Memorize these conditions.
1999-26.	**(D) $Cl_2(g) + 2HI(g) \rightarrow I_2(s) + 2HCl(g)$** "ΔS is negative" means getting ***less*** random, getting ***more*** orderly. Three moles of gas turning into one mole of solid and two moles of gas is getting less random.
1998-23.	**(C) one mol of $C_2H_6(g)$ at 25 °C** Ignore "one mol" and "25°C" since they are the same for all answers. Focus on the phases: (g) is more random then (l) or (s).
1997-26.	**(D) $NH_4NO_2(s) \rightarrow N_2(g) + 2H_2O(g)$** "ΔS° is the most positive" means the ***greatest increase in entropy*** or randomness. Both (C) $N_2O_4(g) \rightarrow 2NO_2(g)$ and (D) $NH_4NO_2(s) \rightarrow N_2(g) + 2H_2O(g)$ have increases in entropy, but a solid changing to 3 moles of gas is the *greatest increase in entropy*. Testing Tip: be sure to read all of the answers before making your choice.
1996-24.	**(C) II only** ΔS is negative means a decrease in entropy, an increase in orderliness. Judge each choice separately: ~~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
1996-25.	**(B) < 0 < 0 0 °C** which translates into **"— — low temp"** < 0 means —, > 0 means + Three conditions will be product-favored, + + high, — + any temp, and — — low temp. Memorize these conditions.
1995-21.	**(D) $Cl(g) + e^- \rightarrow Cl^-(g)$** Evaluate each answer individually: (A) $Al_2O_3(s) \rightarrow 2\ Al(s) + 3/2\ O_2(g)$ getting more random (solid → solid and gas) (B) $H_2O(s) \rightarrow H_2O(l)$ getting more random (solid → liquid) (C) $Cl_2(g) \rightarrow 2Cl(g)$ getting more random (one mole gas → two moles gas) (D) $Cl(g) + e^- \rightarrow Cl^-(g)$ **getting less random** (two particles → one)
1995-24.	**(B) Δ**S **positive, spontaneous at high temperatures only** Note that ΔH is positive. Treat this as two separate questions: $O_2(g) \rightarrow 2\ O(g)$ this is getting ***more*** random (1 mol gas → 2 mol gas) ∴ Δ**S +** When ΔH +, ΔS+, spontaneous at **high** temperatures only.
1995-25.	**(A) -109 kJ** 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. $\Delta G = 176 - 1000(0.285) = 176-285 =$ **-109 kJ**
1994-23.	**(C) entropy** "the temperature of the solution decreases" means Δ**H +**. The solid dissolves spontaneously, so one of these conditions must exist: Δ**H+,** Δ**S+, Temp is high** ΔH—, ΔS+, any temp ΔH—, ΔS—, Temp is low. The only spontaneous situation with ΔH+ is Δ**S+, that is, entropy drives this reaction.**