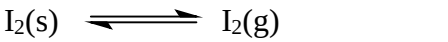
Thermodynamics Problems (calculator required)

1) Suppose that the following reaction was proposed for use in a battery:

a) Calculate $\varepsilon^o$ for the battery at 200°C, given that $\Delta H°_f(NO(g)) = 90.25$ kJ, $S°(N_2(g)) = 191.5$ J/K, $S°(NO(g)) = 210.7$ J/K, and $S°(O_2(g)) = 205.0$ J/K. **[-0.4372 V]**
b) Calculate $\varepsilon$ at 200°C if the pressure of the $O_2$, $N_2$, and NO gases are 1.00, 1.00, and 2.00 bar respectively. **[-0.4513 V]**

2) For the reaction:



a) Calculate $\Delta H^o$, $\Delta S^o$, and $\Delta G^o$ at 25°C given that $\Delta H°_f(I_2(g)) = 62.44$ kJ, $S°(I_2(s)) = 116.1$ J/K, and $S°(I_2(g)) = 260.6$ J/K. **[ΔH° = 62.44 kJ, ΔS° = 144.5 J/K, ΔG° = 19.4 kJ]**
b) At what temperature will the equilibrium pressure of iodine gas be 0.5000 bar? **[142.4°C]**

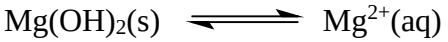
3) For the reaction:

a) Calculate $K_p$ at 50°C given that $\Delta H°_f(H_2O(l)) = -285.8$ kJ, $\Delta H°_f(H_2O_2(l)) = -187.8$ kJ, $S°(O_2(g)) = 205.0$ J/K, $S°(H_2O_2(l)) = 109.6$ J/K, and $S°(H_2O(l)) = 69.91$ J/K **[$1.32 \times 10^{19}$]**
b) If the reaction has attained equilibrium at 50°C, what should be the pressure of $O_2$ in a bottle containing (initially) $H_2O_2(l)$? **[$1.75 \times 10^{38}$ bar]**

4) For the reaction:

$K_{eq}$ = 600,000 at 25°C and 800,000 at 50°C. Calculate $\Delta H^o$ and $\Delta S^o$ for the rection. **[ΔH° = 9.2 kJ, ΔS° = 141.5 J/K]**

5) Calculate $K_{sp}$ for the reaction:



At 25°C and 50°C, given that $S°(OH^-(aq)) = -10.75$ J/K, $S°(Mg^{+2}(aq)) = -138.1$ J/K, $S°(Mg(OH)_2(s)) = 63.18$ J/K, $\Delta H°_f(OH^-(aq)) = -230.0$ kJ, $\Delta H°_f(Mg^{+2}(aq)) = -466.9$ kJ, and $\Delta H°_f(Mg(OH)_2(s)) = -924.5$ kJ **[$6.08 \times 10^{-12}$, $5.64 \times 10^{-12}$]**