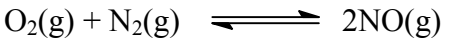
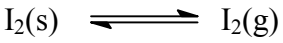
Chemistry 1210
Thermodynamics Problems

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



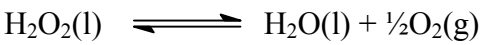
a) Calculate ε^o for the battery at 200°C, given that $\Delta H°_f(NO(g)) = 90.25$ kJ, $S°(N_2(g)) = 191.5$ J/K, $S°(NO(g)) = 210.7$ J/K, and $S°(O_2(g)) = 205.0$ J/K. **[-0.4372 V]**
b) Calculate ε at 200°C if the pressure of the O_2, N_2, and NO gases are 1.00, 1.00, and 2.00 atm respectively. **[-0.4513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

2) For the reaction:



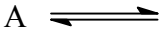
a) Calculate ΔH^o, ΔS^o, and ΔG^o at 25°C given that $\Delta H°_f(I_2(g)) = 62.44$ kJ, $S°(I_2(s)) = 116.1$ J/K, and $S°(I_2(g)) = 260.6$ J/K. **[$\Delta H° = 62.44$ kJ, $\Delta S° = 144.5$ J/K, $\Delta G° = 19.4$ kJ]**
b) At what temperature will the equilibrium pressure of iodine gas be 0.5000 atm?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

3) For the reaction:



a) Calculate the equilibrium constant 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 **[1.32×10^{19}]**
b) If the reaction has attained equilibrium at 50°C, what should be the pressure of O_2 in a bottle containing (initially) $H_2O_2(l)$? **[1.75×10^{38} atm]**

4) For the reaction:



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

5) Calculate K_{sp} for the reaction:

$Mg(OH)_2(s) \rightleftharpoons Mg^{2+}(aq) + 2OH^-(aq)$

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 **[6.08×10^{-12}, 5.64×10^{-12}]**