Unit 12 – Chapter 16: Thermodynamics **Name _____**

Assignment #4: Temperature Change and ΔG, ΔS Calculations **Period _____**

1) Discuss the effect of temperature change on the spontaneity of the following reactions at 1 atm.
   a. $Al_2O_{3(s)} + 2\ Fe_{(s)} \rightarrow 2\ Al_{(s)} + Fe_2O_{3(s)}$ $\Delta H^0 = +851.5$ kJ; $\Delta S^0 = +38.5$ J/K
   b. $N_2H_{4(l)} \rightarrow N_{2(g)} + 2\ H_{2(g)}$ $\Delta H^0 = -50.6$ kJ; $\Delta S^0 = 0.3315$ J/K
   c. $SO_{3(g)} \rightarrow SO_{2(g)} + ½\ O_{2(g)}$ $\Delta H^0 = 98.9$ kJ; $\Delta S^0 = +0.0939$ J/K

2) For the reaction: $SnO_{2(s)} + 2\ CO_{(g)} \rightarrow 2\ CO_{2(g)} + Sn_{(s)}$
   Calculate the temperature at which $\Delta G^0 = 0$.

3) For the decomposition for Ag_2O: $2\ Ag_2O_{(s)} \rightarrow 4\ Ag_{(s)} + O_{2(g)}$
   a. Obtain an expression for ΔG^0 as a function of temperature. Prepare a table of ΔG^0 values at 100-K intervals between 100 K and 500 K.
   b. Calculate the temperature at which ΔG^0 becomes zero.

4) Pencil "lead" is almost pure graphite. Graphite is the stable elemental form of carbon at 25^0C and 1 atm. Diamond is an allotrope of graphite. Given diamond: $\Delta H^0_f = 1.9$ kJ/mol; $S^0 = 2.4$ J/mol · K at what temperature are the two forms in equilibrium at 1 atm?
   C (graphite) ⟷ C (diamond)

5) Given the following data for bromine, estimate the normal boiling point of bromine.
   $Br_{2(l)} \longleftrightarrow Br_{2(g)}$
   $Br_{2(l)}$: $S^0 = 152.2$ J/mol · K
   $Br_{2(g)}$: $S^0 = 245.4$ J/mol · K $\Delta H^0_f = 30.91$ kJ/mol