Chemistry 2720 Fall 2001 Assignment 5

Due: Tuesday, Oct. 9, 9:25 a.m.

1. The standard enthalpies of formation of liquid and gaseous $TiCl_4$ are, respectively, -804.16 and $-763.2\,\mathrm{kJ/mol}$. $TiCl_4$ boils at 408 K. The heat capacities of the two phases can both be expressed in the form

   $$\bar{C}_P = A + BT + CT^2 + DT^3 + E/T^2$$

   where $\bar{C}_P$ is in $\mathrm{JK^{-1}mol^{-1}}$ and T is in Kelvin. For the liquid, $A = 143.048$, $B = 7.600362 \times 10^{-3}$, $C = 1.530575 \times 10^{-6}$, $D = -5.38376 \times 10^{-10}$ and $E = -20638$. For the vapor, $A = 106.8573$, $B = 1.049482 \times 10^{-3}$, $C = -2.843 \times 10^{-7}$, $D = 2.4257 \times 10^{-11}$ and $E = -1043516$.

   (a) Calculate the enthalpy of vaporization at the boiling point. [10 marks]

   (b) Calculate the entropy of vaporization at the boiling point. [3 marks]

2. 20 g of iron metal at 85°C is placed in an insulated container with 80 g of water at 4°C.

   (a) Calculate the final temperature of the system. [4 marks]

   (b) Calculate the entropy change for the iron-water system. Is the result in accord with the second law of thermodynamics? [8 marks]

3. Appendix C of your textbook gives the molar entropy of liquid water at a few temperatures. While preparing this assignment, I discovered that one of them was badly wrong. Which one? [10 marks]

   Note: I'm looking for an answer based on calculations from values available in Appendix C, not an appeal to authority.