Biophysical Chemistry – CH 4403 01
Assignment 2

Due Friday, September 5 (by 4:00 pm)

Please complete the answers to this assignment on separate pages and return it to Dr. Fitzkee's office (Hand Lab 3310) by 4:00 PM on September 5. Note that enthalpies of formation are given in Appendices A.5-7.

1. One mole of an ideal monatomic gas initially at 300 K is expanded from an initial pressure of 10 atm to a final pressure of 1 atm. Calculate ΔE, q, w, and ΔH and the final temperature T_2 for this expansion carried out according to each of the following paths. The molar heat capacity at constant volume for a monatomic gas is $\bar{C}_V = \frac{3}{2}R$. (10 points)

   (a) An isothermal, reversible expansion. (3 points)

   (b) An expansion against a constant external pressure of 1 atm in a thermally isolated (adiabatic) system. (4 points)

   (c) An expansion against zero external pressure (i.e., a vacuum) in an adiabatic system (3 points)

2. (a) Explain in plain English why an isothermal expansion of an ideal gas does not affect the energy of the system. (3 points)

   (b) The internal energy (E) of one mole of an ideal gas is approximately 3.7 kJ at 300K. Where does the energy come from to do work on the surroundings in question 1, part (a)? *Hint:* The first sentence of this question may or may not be relevant. (2 points)

3. A gas undergoes a small transition from P_1, V_1, to a new pressure and volume, P_2, V_2.

   (a) Write expressions for the *average* volume and pressure during the transition, P_{avg} and V_{avg}. Don't overthink this question – there is no physics involved here, just the definition of an average. (2 points)

   (b) If $\Delta(PV) = P_2V_2 - P_1V_1$, show that the following equation is true: (3 points)

$$\Delta(PV) = P_{avg}\Delta V + V_{avg}\Delta P$$

4. Tinoco chapter 2, question 1 (see table 2.2 in your book) (6 points)

5. Tinoco chapter 2, question 12 (8 points)

6. Tinoco chapter 2, question 16 (6 points)

7. Tinoco chapter 2, question 23 (5 points)

8. Tinoco chapter 2, question 30 (5 points)