1. What is the molar free energy change associated with diluting a 1 M solution of glucose to 0.01 M? (5 points)
   A) \(-RT \ln 100\)  
   B) \(-RT \ln 10\)  
   C) 0  
   D) \(+RT \ln 10\)  
   E) \(+RT \ln 100\)

2. Describe the activity of water in a 1.0 \(\times 10^{-5}\) M glucose solution. (5 points)
   A) 1.0 \(\times 10^{-5}\)  
   B) 1.0 \(\times 10^{5}\)  
   C) exactly 1.00  
   D) slightly more than 1.0  
   E) slightly less than 1.0

3. Which of the following aqueous solutions has the highest osmotic pressure? (5 points)
   A) 0.5 M NaCl  
   B) 0.5 M Glucose  
   C) 0.05 M CaCl\(_2\)  
   D) 1.0 M HCl  
   E) 0.01 M TiCl\(_5\)

4. Chemical A has a pure vapor pressure of 89.3 torr. Calculate the vapor pressure of this chemical if solute with mole fraction 0.215 is added. (5 points)
   A) 89.3 torr  
   B) 21.5 torr  
   C) 19.2 torr  
   D) 70.1 torr  
   E) 113.8 torr

Do either one problem from 5 or 6 and one from 7 or 8.

5. An important reaction in visual excitation is the activation of an enzyme that catalyzes the hydrolysis of guanosine triphosphate.
   \[
   \text{GTP} + \text{H}_2\text{O} \rightarrow \text{GDP} + \text{P}_i \quad K_{298} = 1.9 \times 10^5
   \]
   If typical concentrations of GTP, GDP and P\(_i\) in the retinal rod cell are 50 mM, 5 mM and 15 mM respectively (standard state activity is 1M), calculate \(\Delta G_{298}\) for the above reaction. If this solution were allowed to come to equilibrium, calculate final GTP, GDP and P\(_i\) concentrations. (20 points)

6. In general, native proteins are in equilibrium with denatured forms:
   \[
   \text{protein (native)} \leftrightarrow \text{protein (denatured)}
   \]
   For ribonuclease, the following data for the two forms were determined for a total protein concentration of 1.00 \(\times 10^{-3}\) M. At 50°C native concentration was 9.97 \(\times 10^{-4}\) M and denatured was 2.57 \(\times 10^{-6}\) M while at 100°C native concentration was 8.60 \(\times 10^{-4}\) M and denatured was 1.40 \(\times 10^{-4}\) M. Calculate \(\Delta H^\circ\) and \(\Delta S^\circ\) for this reaction, assuming it to be independent of temperature. (20 points)

For water: \(\Delta H_{\text{vap}} = 40660\) J mol\(^{-1}\), \(\rho_1 = 1.00\) g cm\(^{-3}\), \(\Delta H_{\text{melt}} = 6007\) J mol\(^{-1}\), \(\rho_2 = 0.915\) g cm\(^{-3}\)
1 atm = 760 torr, 1.000 J = 9.869 cm\(^3\) atm, \(R = 0.082057\) L atm mol\(^{-1}\) K\(^{-1}\) \(\Delta H_{\text{fus}} = 8.31451\) J mol\(^{-1}\) K\(^{-1}\)

7. A carbohydrate solution containing 0.921 g of carbohydrate per 100.0 mL of solution has an osmotic pressure of 9.12 torr at 30°C and 1 atm pressure. Calculate the boiling point of this solution as well as the molecular weight of the carbohydrate. (20 points)

8. A chemical (MW = 263 amu) has a liquid density of 2.0 g/mL at the normal melting temperature of 145°C and \(\Delta H_{\text{fus}} = -3025\) J/mol. What is the density of the solid if the compound first crystalizes at 150°C under compression at 8.0 atm of pressure? (20 points)

Using a short essay answer the following question:
9. Define what is meant by the activity of a solute and compare this with the concentration of solute. (5 points)