

CHEM 482, sec 0102. Homework #2

Due date: Fri, March 12, 2004, 10am

A printed or hand-written homework (no electronic versions please) is due no later than 10am Fri, March 12, 2004. It can be handed in during the class (after the lecture). If you are unable to come to the class, please bring it to my office at any other time before the deadline.

1. (10 points) For 1 mole of Xenon gas (atomic weight = 131) at a temperature of 100 °C and 1atm pressure calculate the following:
  - (a) the values for the most probable and the RMS ( $\langle v^2 \rangle^{1/2}$ ) speed;
  - (b) the mean-free path;
  - (c) the average total number of collisions per second in this gas.
  - (d) how will your answer in (c) change if the temperature has been increased to 200°C at
    - (1) constant pressure;
    - (2) constant volume.
  
2. (10 points) Ubiquitin is a small protein with the molecular weight of 8500 Da (Da = 1 atomic unit). Assume that its shape can be approximated by a sphere. Calculate
  - (a) The frictional coefficient (translation) expected for ubiquitin molecule in water at 20°C (viscosity  $\eta=1.0$  centipoise);
  - (b) The translational diffusion coefficient for ubiquitin molecule at these conditions;
  - (c) The time it will take ubiquitin molecule to diffuse over a distance of 1 mm.
  - (d) Ubiquitin has a tendency to form a dimer ( $O \rightarrow OO$ ). Approximating the shape of the dimer by a prolate ellipsoid of revolution with the major radius = twice the radius of ubiquitin molecule, calculate the average distance that di-ubiquitin will travel over the same time.