Chemistry 311

Physical Chemistry

Homework Assignment # 1

Due: Monday, September 20, 2004

1. This question makes use of Fig. 1.6 in the text book (p. 9). Assume that the liquid in the manometer has a density of 6.34 g/cm^3.
   (a) What is the pressure measured in Fig. 1.6(a) if h = 340 mm, and P_{atm} = 760 torr?
   (b) If h = 340 mm in 1.6(b), what is the pressure of the gas? Does the answer depend on P_{atm}?
2. A balloon filled with helium gradually shrinks and loses its buoyancy in air over several hours. Explain why this happens using the principles of the kinetic molecular theory. What qualitative statement can you make about the composition of the gas inside the balloon after several hours, assuming that it was 100% helium initially.
3. One mole of a gas at 5.69 bar and 288 K is found to be in a corresponding state with Methane at 4 bar and 300 K. From the table of critical constants given on p. 35 of the textbook, identify the gas.
4. (a) The Virial coefficient $B(T)$ of carbon dioxide is -149.7 cm^3 mol^{-1} at 0 ^{o}C. Compare its compressibility factor Z at this temperature and 1 bar with that of an ideal gas. [Hint: Substitute for V in terms of the ideal gas law on the right hand side of Eq. (1.117) to get an equation similar to Eq. (1.116); ignore terms containing P^2 and higher powers of P.]
   (b) Calculate the Virial coefficient $B(T)$ of Methane at 300K from its van der Waals constants (see Table 1.5), using the relationship obtained from Problem 1.55 of the textbook, and calculate the compressibility factor at 300 K and 1 bar.