Handin Homework 1: Chemical Reactivity

1. In an osmotic pressure determination, the difference in height of the solution on one side of the membrane and the pure solvent on the other is 6.76 cm at 25.0°C. The density of the solution is 1.017 g mL^{-1}. (a). Calculate the osmotic pressure, π. (b). The osmotic pressure and solution concentration are related by $\pi = cRT$. Calculate the solution concentration in mol L^{-1}.

2. The mass of air in a 100.0 mL bulb at 20.0°C is 0.118 g. Calculate the mass density, the molar density, and the pressure in the bulb, in bar. Assume the gas ideal.

3. Air is not exactly an ideal gas. A good representation of the equation of state for air is:

$$PV = \left(1 + \frac{BP}{RT}\right) nRT$$

with B a small constant. Show that the pressure at altitude h for a gas behaving according to this equation of state is given by:

$$\ln\left(\frac{P}{P_o}\right) + \frac{B}{RT}(P - P_o) = -\frac{\mathcal{M}gh}{RT}$$

4. Three definitions of a reversible process are:

(a). A reversible process is one in which the system never deviates from equilibrium by more than an infinitesimal amount.

(b). A reversible process is not a real process, but a hypothetical succession of equilibrium states.

(c). A reversible process is one for which the system can be returned to its initial state with no net change in the surroundings.

Consider the melting of 1 mole of ice at 0°C as an example. Show how each of the three definitions is equivalent. [You may talk over this problem (and only this problem) in groups. However, make sure that you write your own answer. In other words, when you sit down to write your answer, you must be alone without any further consultation or written notes from anyone else. You may not compare written answers.]