Chemistry 311

Physical Chemistry

Homework Assignment # 8

Due: Monday, November 8, 2004

1. The partial molar volumes of acetone (MW = 58.08 g mol^{-1}) and chloroform (MW = 119.37 g mol^{-1}), respectively, 74.166 cm^3 mol^{-1} and 80.235 cm^3 mol^{-1} for a solution in which the mole fraction of chloroform is 0.4693. What is the volume of 1.000 kg of this solution?

2. Commercial antifreeze is mostly ethylene glycol, mixed with small amounts of rust inhibitors and a fluorescent dye which makes it easy to detect radiator leaks. Assuming that commercial antifreeze is pure ethylene glycol (MW=62.07 g mol^{-1}, density=1.1088g mL^{-1}), in what proportion by volume should water and antifreeze be mixed to make a coolant solution that freezes at –20°C? Enthalpy of fusion of water = 6.008 kJ mol^{-1}.

3. One mole of benzene (component 1) is mixed with two moles of toluene (component 2). At 60 °C, the vapor pressures of benzene and toluene are 51.3 and 18.5 kPa, respectively. (a) As the pressure is reduced, at what pressure will boiling begin (first appearance of bubbles)? (b) What will be the composition of the first bubble of vapor?

4. At 1.013 bar pressure, propane boils at –42.1 °C and *n*-butane boils at –0.5 °C. The following vapor pressure data are available:

t(°C)	–31.2	–16.3
P(kPa) of propane	160	298.6
P(kPa) of *n*-butane	26.7	53.3

   Assuming that these substances form ideal binary solutions with each other, (a) calculate the mole fractions of propane at which the solution will boil at 1.013 bar pressure at –31.2 °C and at –16.3 °C. (b) Calculate the mole fractions of propane in the vapor in equilibrium with the liquid at the two temperatures. (c) Plot the temperature-mole fraction diagram at 1.013 bar using these data, and label the regions.