Chemistry 2290, Winter 2012, G. Schreckenbach
Practice problems –10–

Phases: Clapeyron and Clausius-Clapeyron Equations

Practice problems from Laidler/ Meiser

(Problems adapted from Laidler, Meiser, Sanctuary, Physical Chemistry, 4th ed., Houghton Mifflin)

LM37. The molar entropy of vaporization of water is 108.72 J K^{-1} at 760 Torr. The corresponding densities of liquid water and water vapor are 0.958 kg L^{-1} and 5.98 * 10^{-4} kg L^{-1}, respectively. Calculate the change of pressure for a one-degree change in temperature. *(You will have to use the molar mass of water.)*

LM38. Calculate the heat of vaporization of water at 373.15 K and 101.325 kPa using the Clausius-Clapeyron equation. The vapor pressure of water is 3.17 kPa at 298.a5 K. For comparison, the tabulated literature value *(not necessarily the exact number that you are going to get!)* is 40.57 kJ mol^{-1}.

LM39. Liquid water and vapor are in equilibrium at the triple point of water (0.00603 atm and 273.16 K). Assuming that the enthalpy of vaporization of water does not change over the temperature range considered, calculate the equilibrium vapor pressure of water at 373.15 K. ($\Delta_{vap}H^0$ = 40,656 J mol^{-1} at 1 atm.) *You could compare your results to the actual value – you know what it would be! – and thus see how good or otherwise the assumptions are.*

LM40. The vapor pressure of *n*-propanol is 1.94 kPa at 293 K and 31.86 kPa at 343 K. What is the enthalpy of vaporization?

LM41. The compound 2-hydroxybiphenyl (*o*-phenylphenol) boils at 286ºC under 101.325 kPa and at 145ºC under a reduced pressure of 14.0 Torr. Calculate the value of the molar enthalpy of vaporization. *(The literature value is 71.02 kJ mol^{-1}. The error of our calculation is fairly large – any ideas why?)*