Chemistry 2290, Winter 2012, G. Schreckenbach
Practice problems –8–

Phases

Engel and Reid, 2nd ed.:
Questions on concepts: Q8.2, Q8.5, Q8.6, Q8.9, Q8.11, Q8.15, Q8.17
Problems: P8.2, P8.5, P8.8, P8.13

Phases: Clapeyron and Clausius-Clapeyron Equations

Engel and Reid, 2nd ed.:
Problems: P8.14, P8.20, P8.21 *(part b is a bit harder)*, P8.24a (*and perhaps P8.24c*), P8.25, P8.29, P8.33, P8.36, P8.42

Solutions, Binary Phase Diagrams, Colligative Properties, etc. *(Engel, chapter 9)*

Engel and Reid, 2nd ed.:
Questions on concepts: Q9.1, Q9.6, Q9.7 *(a bit harder)*, Q9.10, Q9.14
Problems: P9.4, P9.5, P9.6, P9.7, P9.8, P9.9, P9.12, P9.14, P9.22, P9.24, P9.25, P9.33, P9.34

As stated, before, there are many other good examples in Engel & Reid. Again, then, if you want more practice, by all means do extra problems!

Solutions: Raoult's Law, Henry's Law etc.

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

LM42. What are the partial pressures of toluene (0.60 mole fraction) and benzene in a solution at 60.0ºC? What is the total pressure of the vapor? The vapor pressures of the pure substances at 60ºC are as follows: toluene, 0.185 bar; benzene, 0.513 bar.

LM43. Benzene and toluene form nearly ideal solutions. Given that, at 300K, the vapor pressures of the pure compounds are 3.572kPa (toluene) and 9.657 kPa (benzene), respectively, calculate the vapor pressure of a solution containing 0.60 mole fraction of toluene. What is the mole fraction of toluene in the vapor over the liquid?

LM44. An amalgam (*solution of metals*) of 1.152g of a metal dissolved in 100.0g of mercury is heated to boiling. The partial pressure of mercury vapor over the boiling mixture is 754.1 Torr and the total pressure is 768.8 Torr. Find the atomic weight of the metal and, therefore, its identity.

LM45. Henry's law constants K for N_2 and O_2 in water at 20.0ºC and 1.00 atm pressure are 7.58 x 10^4 atm and 3.88 x 10^4 atm, respectively. If the density of water at 20.0ºC is 0.9982 g cm^{-3}, calculate **(a)** the equilibrium mole fraction and **(b)** the concentration of N_2 and O_2 in water exposed to air at 20.0ºC and 1.00 atm total pressure. For this problem, assume that air is 80 mol % N_2 and 20 mol % O_2.

LM46. In a molar mass determination, 18.04g of the sugar mannitol was dissolved in 100.0 g of pure water. The vapor pressure of the solution at 298K was 2.291 kPa, having been lowered by 0.0410 kPa from the value for pure water. Calculate the molar mass of mannitol.

LM47. A liquid has a vapor pressure of 40.00kPa at 298.15K. When 0.080kg of an involatile solute is dissolved in 1.00 mol of the liquid, the new vapor pressure is 26.66kPa. What is the molar mass of the solute? Assume that the solution is ideal.

Solutions: Colligative Properties

Practice problems from Laidler/ Meiser

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

LM48. Assuming that commercially available automotive antifreeze is pure ethylene glycol *(it actually contains relatively small amounts of added rust inhibitors and a fluorescent dye that helps to differentiate a radiator leak from condensation from the air conditioner)*, in what ratio *by volume* will antifreeze and water have to be mixed in order to have a solution that freezes at -20.0ºC? What will be the boiling point of this solution at 1.00 atm pressure? (MW = 62.02 g mol^{-1}; density = 1.1088 g cm^{-3}; use a density of water of 1.00 kg/L.)

LM49. A 1.00m (molality, mol per kg of solution) solution of NaCl in water produces a freezing point depression of approximately 3.7K. How can we account for this observation. *(For this question, we will probably need to look up a few TD constants of water.)*

LM50. Using the van't Hoff equation, calculate the osmotic pressure developed if 6.00g of urea, $(NH_2)_2CO$, is dissolved in 1.00L of solution at 27.0ºC.

LM51. In an osmotic pressure experiment to determine the molar mass of a sugar, the following data were taken at 20.0ºC:

π (atm)	2.59	5.06	7.61	12.75	18.13	23.72
m_2/V (g/L)	33.5	65.7	96.5	155	209	259

Estimate the molar mass of the sugar. If the sugar is sucrose (M = 342 g mol^{-1}), estimate the percentage error, and consider ways of improving the accuracy of the experiment.

LM52. When 3.78g of a nonvolatile solute is dissolved in 300.0g of water, the freezing point depression is 0.646ºC. Calculate the molar mass of the unknown compound. *(For this question, we will probably need to look up a few TD constants of water.)*