

# Homework Set 4

CH 353, Vanden Bout, Summer 2009

## Chapter 6

D6.6, E6.2a, E6.4a, E6.5a (get best estimate from sketch), E6.10a, P6.3, P6.13

1

You make an ideal binary mixture of two liquids **A** & **B** and divide it into two parts. At a particular pressure, you test half the mixture. When heated it begins to boil at 60°C. The vapor above the boiling solution has 3 times as many moles of **A** compared to moles of **B** ( $P_A = 3P_B$ ). The vapor pressure of pure **A** and **B** are 550 Torr and 150 Torr respectively at 60°C. The second half of the solution is heated under a lower pressure, the mixture begins to boil at 40°C. At 40°C the vapor contains only 2.5 times as many moles of **A** than **B** ( $P_A = 2.5P_B$ ). The vapor pressure of pure **B** at 40°C is 100 Torr. What is the vapor pressure of pure **A** at 40°C? What is the pressure at which the solution begins to boil at 40°C?

2. Below is a table of the vapor pressures of benzene and toluene at a series of temperatures.

T (°C)	79.4	88	94	100	110
$P_{C_6H_6}^*$ (bar)	1.00	1.285	1.526	1.801	
$P_{C_7H_8}^*$ (bar)		0.508	0.616	0.742	1.000

Calculate the composition of the vapor and liquid of a mixture of benzene and toluene at these temperatures. Make a plot of the phase diagram for this mixture as temperature vs composition. If you were going to distill a mixture that was half benzene and half toluene (0.5 mole fraction each), at what temperature would the first drop of vapor form? What would the composition of the vapor be?

3. Proteins are biopolymers composed of a variety of amino acids. They fold from random conformations (“unfolded”) to very particular structures (“folded”) that give them biological function. If the reaction of a protein going from unfolded to folded is spontaneous at a given temperature, what do you know about  $\Delta G$ ,  $\Delta H$ ,  $\Delta S$ ? What would you predict would happen at a higher temperature?