a) Forty mol of butyraldehyde are mixed with 10 mol water at 1 bar and the system is boiled at constant pressure. Which phase boils off first?

b) With the overall composition of the previous part, how many phases are present and in what amounts (moles) when half of the total moles are in the vapor phase?

c) How many phases are present and in what amounts (moles) when half of the total moles are in the butyraldehyde-rich liquid?

Problem 8.14: At 100 °C, water (w) and nitrobenzene (n) are only partially miscible. At this temperature, the solubility of nitrobenzene in water is 0.147 mol %, while the solubility of water in nitrobenzene is 8.3 mol %.

a) Assuming that each liquid phase behaves ideally with respect to the concentrated species (that is, w 1, in the water-rich phase and n 1 in the nitrobenzene-rich phase), calculate the activity coefficient of each component at infinite dilution.

b) Show that if boiling occurs under constant pressure, the boiling temperature must remain constant until one of the two liquid phases completely evaporates.

c) One hundred mol of the water-rich phase are mixed with 100 mol of the nitrobenzene-rich phase at 100 °C and the pressure is adjusted until boiling starts. What is the pressure?

d) Calculate the composition of the vapor phase in the previous part.

e) If boiling continues indefinitely, which liquid phase will disappear first?

f) Draw a qualitative Pxy graph for this system at 100 °C. Show all the important features on the graph. The saturation pressure of nitrobenzene at 100 °C is 21 mmHg.

Problem 8.15: Glycerol(1) and acetophenone(2) are partially miscible. The bubble point of the two-liquid system at 140 °C is 0.15 bar. The mole fraction of acetophenone in the one liquid phase is 10%, in the other liquid phase 85%, and in the vapor 95%.

a) Draw a qualitative Pxy graph of this system. Place on the horizontal axis the mole fraction of the more volatile component. Annotate the graph properly, place all the available information on the graph, and identify the various phases.

b) Twenty mole of acetophenone are mixed with 60 mole of glycerol at 140 °C, 0.2 bar. How many phases are present? Show the state on the Pxy graph.

c) ~~The solution is~~ brought into boiling by reducing the pressure while keeping the temperature at 140 °C. Which phase boils off first? How much vapor is present at the point that the first liquid boils off?

d) How many phases are present when 8% of the original system is in the vapor and what is their composition?

Additional data: Saturation pressures at 140 °C: P_1^{sat} : 0.00313 bar; P_2^{sat} : 0.17 bar.

The solution of part b is