Chapter 7 –Practice Problems

Final Exam W2012

The normal boiling point of n-pentane is 36.1°C. At a temperature of 75°C, the vapour pressure of n-pentane is 310.5 kPa. The latent heat of vaporization of benzene at its normal boiling point of 80.1°C is 30.7 MJ/kmol. You have been given a liquid mixture containing 10 mol% benzene (M=78 g/mol) and 90 mol% n-pentane (M= 72.15 g/mol). Use the information provided to answer the following questions:

a) Determine the vapour pressure (in kPa) of pure n-pentane at 65°C.

b) Estimate the vapour pressure (in kPa) of pure benzene at 65°C.

c) Calculate the bubble point pressure (in kPa) of the liquid mixture at 65°C.

d) Determine the composition of the vapour phase in equilibrium whent the liquid mixture is at 65°C and at its bubble point pressure at this temperature.

e) You now have 10 kg of pure liquid benzene at a temperature of 4°C at a pressure of 1 atm. Determine the total heat energy required (kJ) to boil the substance entirely to a vapour at 100°C. Note: C_{pL} for benzene is 134.8 kJ/kmol.K and C_{pv} for benzene is 82.4 kJ/kmolK

Ans:

a) 238.428 kPa

b) 63.74 kPa

c) 220.94 kPa

d) y_1=0.971 (n-Pentane), y_2=0.029 (benzene)

e) 5461 kJ

Final Exam Winter 2015

A liquid mixture is formed by mixing 20 kg of n-hexane (C_6H_{14}) and 80 kg of n-octane (C_6H_{18}). The molar masses of n-hexane and n-octane are 86 kg/kmol and 114 kg/kmol respectively. The data available for the two liquids are shown in the table below:

Temperature (°C)	Vapor Pressure (mmHg)	
	n-hexane	n-octane
50	405.6	50.3
100	1844.4	351.1

a) Calculate the mole fraction of n-hexane and n-octane in the liquid.
b) Estimate the latent heat of vaporization of pure n-octane (kJ/kg).
c) Estimate the boiling point of pure n-octane at 200 mm Hg (in °C).
d) The liquid mixture (20 kg n-hexane and 80 kg n-octane) is maintained at 80°C. Calculate the following:
(i) Equilibrium (total) pressure (in mmHg)
(ii) Estimate the composition of the vapor in equilibrium with liquid

Ans:
a) x_1=0.25 (hexane) , x_2=0.75 (octane)
b) 341.74 kJ/kg
c) 84°C
d) 394.18 kPa, y_1=0.612, y_2=0.328

Final Exam W2016

A liquid binary mixture of acetone (25 mol%) and chloroform is at 60 kPa in a closed variable-volume container. Assume that both components follow Raoult's law. At 35°C, the vapor pressure of acetone is 46.3 kPa and the vapor pressure of chloroform is 36.4 kPa.
a) The pressure in the container is now slowly reduced to the bubble point pressure of the liquid mixture at 35°C. Determine this pressure and the composition of the vapor in equilibrium.
b) Determine the dew point pressure of a vapor mixture of acetone (25 mol%) and chloroform at 35°C and the composition of the liquid in equilibrium with the vapor at this conditions.
c) The pressure of the container is now set to 38.6 kPa at 35°C. Determine the vapor and liquid compositions.
d) The normal boiling point of acetone is 56°C. Estimate the latent heat of vaporization for acetone.
Ans:
a) 38.875 kPa, y_A=0.298, y_C=0.702 (A=Acetone, C= Chloroform)
b) 38.456 kPa, x_A=0.2076, x_C=0.7924 (A=Acetone, C= Chloroform)
c) x_A=0.223, x_C=0.777, y_A=0.267, y_C=0.733
d) 31.456 kJ/mol