UNIVERSITY CEU SAN PABLO
SCHOOL OF PHARMACY
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY

PROBLEMS OF PHYSICAL CHEMISTRY

2018-2019

LESSON 3

5. Calculate the change in pressure required to reduce the normal freezing temperature by 1 degree for:
a) water
b) a solvent A
Data: $R = 0.082\ l \cdot atm \cdot K^{-1} \cdot mol^{-1} = 1.987\ cal \cdot K^{-1} \cdot mol^{-1} = 8.314\ J \cdot K^{-1} \cdot mol^{-1}$
$\Delta\overline{H}_{m,A} = 97.7\ J \cdot mol^{-1}$; $\Delta\overline{H}_{m,H2O} = 79.7\ cal \cdot g^{-1}$; $T^{o}_{m,A} = 156\ K$; $M_A = 74.12\ g \cdot mol^{-1}$;
$\rho\ (H_2O_{(l)}) = 0.9998\ g \cdot ml^{-1}$; $\rho\ (H_2O_{(s)}) = 0.9168\ g \cdot ml^{-1}$; $\rho\ (A_{(l)}) = 0.715\ g \cdot ml^{-1}$;
$\rho\ (A_{(s)}) = 0.820\ g \cdot ml^{-1}$

6. The vapour pressures of solid and liquid HCN can be expressed by the following equations:

$$\text{Solid}: \quad \text{Log}_{10}\,P(\text{mmHg}) = 9.339 - \frac{1865}{T}(\text{K})$$

$$\text{Liquid}: \quad \text{Log}_{10}\,P(\text{mmHg}) = 7.745 - \frac{1453}{T}(\text{K})$$

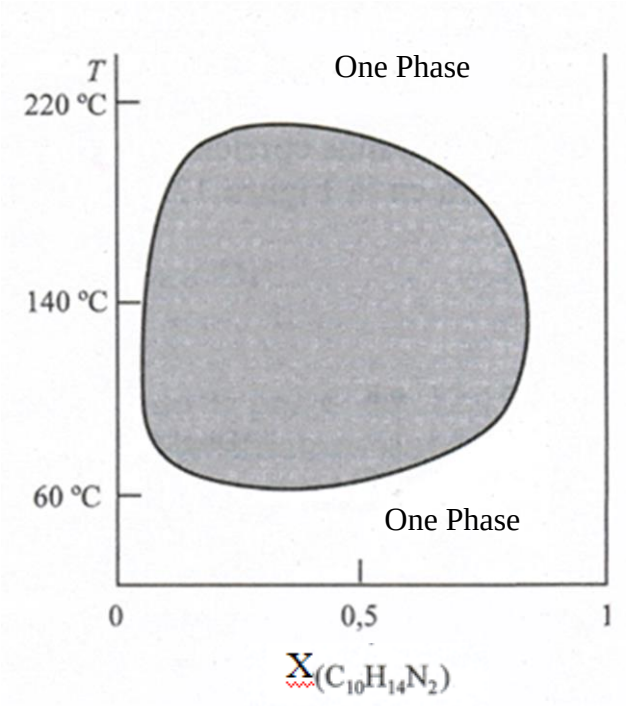
Determine:
a) the normal boiling point and the triple point
b) the sublimation, vaporization and melting heat of HCN
Data: $R = 0.082\ l \cdot atm \cdot K^{-1} \cdot mol^{-1} = 1.987\ cal \cdot K^{-1} \cdot mol^{-1} = 8.314\ J \cdot K^{-1} \cdot mol^{-1}$

7. Two liquids A and B form ideal solutions in equilibrium with vapour with ideal gas behaviour. At a certain temperature, P^{*}_{A} and P^{*}_{B} are 0.5 and 1 atm, respectively. Draw a diagram P vs. x, and represent the total vapour pressure and the partial vapour pressure of A and B as a function of X_B.

8. Use the following diagram to determine the masses of water and nicotine present in each phase, when 30 g of nicotine and 10 g of water are mixed at 80ºC and 1 atm. How would

the masses of water and nicotine change if temperature is raised to 140 ° C? And if pressure is changed?

Data: M ($C_{10}H_{14}N_2$) = 162 g·mol^{-1}; M (H_2O) = 18 g·mol^{-1}



9.- According to the following phase diagram, obtained for naphthalene and p-nitrotoluene, indicate:

a) The melting temperature of the two pure solids.

b) What represent the AB and BC curves and the B point?

c) What is the temperature when naphthalene starts to freeze in the cooling process of a mixture with $x_{p\text{-nitrotoluene}}$ = 0.20?

d) If the same solution is cooled to 40 ºC, what phases are present? What are their compositions? What is the relative amount?