QUIZ 1

NAME (Print) Key Sign _____

Name of Grader _____ Grade _____

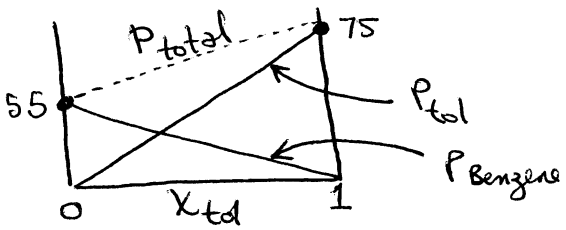
DO ANY 4 of the Following 6 problems

1) The vapor pressure of Toluene and Benzene are 75 torr and 55 torr respectively at 20C. Derive an equation that would define the total pressure as a function of the mole fraction of Toluene. Use this equation to draw a rough graph showing the individual and total vapor pressure at 20C. *Extra: Which solvent has a lower BP and why?* (Toluene since lower intermolecular forces also mean higher V.P)

$P_{Toluene} = X_t P^\circ_{Toluene}$; $P_{Benzene} = X_b P^\circ_{Benzene}$; $X_b + X_t =$

$P_{total} = P_{Toluene} + P_{Benzene} = X_{tol} P^\circ_{Toluene} + (1 - X_{tol}) P^\circ_{Benzene}$

$= 75 X_{tol} + (1 - X_{tol}) \cdot 55$



2) The Lattice Energy ΔH_1 for a salt is found to be **35kJ/mol**; the enthalpy for solvent-solvent interaction ΔH_2 is **17.1 kJ/mol**. The heat of solvation of the salt (ΔH_3) into this solvent is found to be **-38.3 kJ/mol**. Discuss the influence of added heat (temperature) on the solubility of this salt. Is this always true for this salt?

$\Delta H_{solution} = \Delta H_1 + \Delta H_2 + \Delta H_3 = +13.7$ kJ/mol

Since Positive — Heat of Dissolution is Endothermic

All Endothermic Reactions are pushed to Product by heat thus

Increasing Temp/Heat will increase solubility.

3) *True/False and Reason*: **All endothermic reaction are independent of temperature effects**

False: Endothermic reactions are always pushed to the Right (Product) by increasing Temperature.

4) The Henry constant for hydrogen cyanide is 1.35E-2 mol/(V*atm). At what pressure would the blood pressure of this gas equal a fatal level of 1 micro-molar? (Assume blood is solely water)

$S_g = kP_g$

$1 \times 10^{-6} = (1.35E\text{-}2)\,P_g$

$P_g = 7.4E\text{-}5$ (very low partial pressure to cause death)

5) Four beakers of equal volume are placed into a large sealed vessel. One container contained a 0.15M Calcium Nitrate Solution; the second contained a 0.2M Sodium Chloride Solution: the third contained 0.12M Aluminum Fluoride solution: while the last was pure water. After a week to reach equilibrium: what would be the order in the quantities of liquid in each of the containers and why?

Although Raoult's Law requires χ; Mole fraction is roughly proportional to molarity

$Ca(NO_3)_2 \rightarrow 3(0.15) = 0.45$ ②

$NaCl \rightarrow 2(0.2) = 0.4$ ③

$AlF_3 \rightarrow (4)(.12) = 0.48$ ① Most Water

Water $\rightarrow$ 0 ④ Least Water

6) A 0.1M NaOH aqueous solution has a density of 0.18g/ml. What is the molality and mole fraction of the solution with respect to NaOH? *Extra: How would one make this solution starting with solid sodium hydroxide and pure water?*

Volume × Density (solution)

$1000ml \times \frac{1.18g}{ml} = 1180g$ of solution

$1180g - 4g$ of NaOH

$1176g$ of solvent

$\frac{\#\text{moles of solute}}{\text{kg of solvent}}$ $\frac{0.1}{1.176kg} =$ **0.085 molately**

$\frac{0.1}{0.1 + \left(\frac{1176}{18.0}\right)}$ $\frac{0.1}{65.43} =$ **$0.0015 = \chi_{NaOH}$**