Chapter 5 Homework Questions

5.1 At 25 ^{o}C, the density of a 50% by mass of an Ethanol-Water solution is 0.914 g/cm^3. Given that the Partial Molar Volume of water in the solution is 17.4 cm^3/mol, calculate the Partial Molar Volume of Ethanol in the solution.
Note: M(Ethanol) = 46. g/mol , M(Water) = 18. g/mol.

5.2 The vapor pressure of pure benzene (C_6H_6, M=78) is 53.3 kPa at 60 ^{o}C. When 19. grams of an involatile organic compound is dissolved in 500 g of Benzene, the vapor pressure drops to 51.5 kPa.

Calculate the Molar Mass of the organic compound.

5.3 The freezing point of pure CCl_4(liq) is -22.9 ^{o}C and the Freezing Point Depression constant is 30 ^{o}C. When 100 grams of an unknown organic compound is added to 750 grams of CCl_4(l), the freezing point of the mixture is -33.4 ^{o}C

Calculate the Molar Mass of the organic compound.

5.4 The boiling point of pure benzene is 80.1 ^{o}C and the Boiling Point Elevation constant is 2.13 ^{o}C/m. When a sample of napthalene ($C_{10}H_8$) is dissolved in 600. grams of Benzene, the boiling point boiling point of the mixture is 81.3 ^{o}C.

How many grams of napthalene were dissolved in the benzene.

5.5 When 0.15 grams of an unknown compound is dissolved in 100 mL of aqueous solution, the measured osmotic pressure of the solution is 0.65 kPa at 25 ^{o}C. Calculate the molar mass of the unknown compound.

5.6 Consider two containers separated by a partition. Container A is of volume 5 L, and contains N_2(g) at 2.0 atm and 30 ^{o}C. Container B is of volume 10 L, and contains H_2(g) at 2.0 atm and 30 ^{o}C.

Calculate the Entropy of mixing and the Gibbs Energy of mixing when the partition between the two partitions is removed.

5.7 Air is a mixture of primarily 3 gases with composition:
$x_{N2} = 0.78$, $x_{O2} = 0.21$, $x_{Ar} = 0.01$

Calculate the Entropy of mixing when 5 moles of air of the above composition is prepared from the above pure gases.

5.8 The freezing point of 1-butanol is 25.8 ^{o}C and its depression constant is 8.2 ^{o}C/m. When 4.0 grams of acetonitrile (CH_3CN, M = 41) is dissolved in 650 grams of 1-butanol, the freezing point of the mixture is 21.5 ^{o}C.

Calculate the activity coefficient of acetonitrile in 1-butanol.