Calculate the mole fraction of ethanol in octane in a 10% by mass mixture. You may assume that the density of the mixture is 0.71 gm/cm^3.

Calculate the mole fraction of ethanol in octane in a 10% by mass mixture. You may assume that the density of the mixture is 0.71 gm/cm^3.

Solution: This problem involves conversion of a mass fraction. Since volume does not enter in to the solution the density is irrelevant. Instead, we can write

$$x_2 = \frac{mf_2/M_{m,2}}{mf_1/M_{m,1} + mf_2/M_{m,2}}$$

Where mf_2 and mf_2 are the mass fractions of solvent and solute, respectively. $M_{m,1}$ and $M_{m,2}$ are the molar masses.

Calculate the mole fraction of ethanol in octane in a 10% by mass mixture.

Upon substitution we find

$$0.215 = \frac{0.1/46}{0.9/114 + 0.1/46}$$

Where we have made the calculation of the molar masses for octane

$$\mathrm{M_{m,1}} = 8(12) + 18 = 114 \ amu$$

and ethanol

$$\mathrm{M_{m,2}} = 2(12) + 16 + 6 = 46 \ amu$$