2.4. Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

Sol: Mass of required aqueous solution = 2.5 kg = 2500 g

∵ 0.25 moles of urea is dissolved in 1000 g of Water

Mass of Water = 1000 g

No. of ~~mole~~ of Urea = 0.25 mol.

Molar Mass of urea (H_2NCONH_2) = $4\times1 + 2\times14 + 1\times12 + 1\times16$

= 60 g mol^{-1}

No. of moles = $\frac{\text{Given mass}}{\text{Molecular mass}} \Rightarrow 0.25 = \frac{M}{60} \Rightarrow M = 60 \times 0.25$

$M = 15\ g$

Mass of solution = $1000 + 15 = 1015\ g$.

1015 g of aq. sol. contains urea = 15 g.

2500 g " " " " $\frac{15}{1015} \times 2500 = 36.95\ g$.

Mass of urea = 36.95 g

2.5) Calculate
a) Molality b) Molarity c) Mole fraction of KI if the density of 20% (mass/mass) aqueous KI is $1.202\ g\ ml^{-1}$.

Sol: Molar mass of KI = 39+127 = 166 g/mol.

Density = 1.202 g/ml.

Mass of solute = 20 g, Mass of sol. = 100 g.

Mass of solvent = 80 g. = 0.08 kg

$$d = \frac{M}{V} \Rightarrow 1.202 = \frac{100}{V} \Rightarrow V = 0.083\ L$$

$$\text{No of moles of KI} = \frac{\text{Given Mass}}{\text{Molar mass}} = \frac{20}{166} = 0.12$$

a) $$\text{Molality} = \frac{\text{Moles of KI}}{\text{Mass of solvent (kg)}} = \frac{0.12}{0.08} = 1.5\ m$$

b) $$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Vol. of sol.}} = \frac{0.12}{0.08} = 1.44\ M.$$

c) $$\text{Mole fraction} = \frac{\text{Mole of solute}}{\text{Moles of solute + Moles of solvent}} = \frac{0.12}{0.12+4.44}$$

$$= \frac{0.12}{4.56} = 0.026$$

a) Molality = 1.5m, b) Molarity = 1.44 M, Mole fraction = 0.026