2.1. Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.
Ans:
Mass of solution = Mass of C_6H_6 + Mass of CCl_4
= 22 g+122 g= 144 g
Mass % of benzene = 22/144 x 100 =15.28 %
Mass % of CCl_4 = 122/144 x 100 = 84.72 %

2.2. Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride.
Ans:
30% by mass of C_6H_6 in CCl_4 => 30 g C_6H_6 in 100 g solution
∴ no. of moles of C_6H_6,($^nC_6h_6$) = 30/78 = 0.385

(molar mass of C_6H_6 = 78g)
no. of moles of

$$CCl_4\ (n_{CCl_4}) = \frac{70}{154} = 0.455$$

$$x_{C_6H_6} = \frac{n_{C_6H_6}}{n_{C_6H_6} + n_{CCl_4}}$$

$$= \frac{0.385}{0.385 + 0.455} = \frac{0.385}{0.84} = 0.458$$

$$x_{CCl_4} = 1 - 0.458 = 0.542$$

2.3.Calculate the molarity of each of the following solutions: (a) 30 g of $CO(NO_3)_2.6H_2O$ in 4.3 L of solution (b) 30 mL of 0.5 M H_2SO_4 diluted to 500 mL.
Ans:
(a) Molar mass of $CO(NO_3)_2.6H_2O$=310.7 g mol^{-1}
no. of moles = 30/310.7 = 0.0966
Vol. of solution = 4.3 L
Molarity =0.0966/4.3 = 0.022M
(b) 1000 mL of 0.5M H_2SO_4 contain H_2SO_4 = 0.5 mole
30 mL of 0.5 M H_2SO_4 contain H_2SO_4
= 0.5/1000 x 30 = 0.015 mole
Volume of solution = 500mL=0.5 L
Molarity = 0.015/0.5 = 0.03M

2.4.Calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.
Ans:
0.25 Molal aqueous solution to urea means that
moles of urea = 0.25 mole
mass of solvent (NH_2CONH_2) = 60 g mol^{-1}
∴ 0.25 mole of urea = 0.25 x 60=15g

Mass of solution = 1000+15 = 1015g = 1.015 kg
1.015 kg of urea solution contains 15g of urea
∴ 2.5 kg of solution contains urea =15/1.015 x 2.5 = 37 g

2.5. Calculate (a) molality (b) molarity and (c) mole fraction of KI if the density of 20% (mass/mass) aqueous KI is 1.202 g mL^{-1}.
Ans:

20% aq. KOH solution ⇒ 20g of KI in 100g solution

$\therefore$ Mass of solvent $= 100 - 20 = 80\,g$

(i) $$\text{Molality} = \frac{\text{no. of moles of KI}}{\text{mass of solvent (kg)}}$$

$$= \frac{0.120}{0.080} = 1.5\text{mol kg}^{-1}$$

(ii) Density of solution $= 1.202\,g\,mL^{-1}$

$$\text{Volume of solution} = \frac{100}{1.202} = 83.2\text{mL}$$

$$= 0.0832\text{ L}$$

$$\therefore \quad \text{Molarity} = \frac{0.120}{0.0832} = 1.44\text{M}$$

(iii) No. of moles of KI $= 0.120$

$$n_{H_2O} = \frac{80}{18} = 4.44$$

$$x_{KI} = \frac{0.120}{0.120 + 4.44}$$

$$= \frac{0.120}{4.560} = 0.0263$$

2.6. H_2 S, a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of H_2S in water at STP is 0.195 m, calculate Henry's law constant.
Ans:
Solubility of H_2S gas = 0.195 m
= 0.195 mole in 1 kg of solvent
1 kg of solvent = 1000g

$$= \frac{1000}{18} = 55.55 \text{ moles}$$

$$\therefore\ x_{H_2S} = \frac{0.195}{0.195 + 55.55}$$

$$= \frac{0.195}{55.745} = 0.0035$$

– Pressure at STP $= 0.987$ bar

Applying Henry's law,

$$P_{H_2S} = K_H \times x_{H_2S}$$

$$\Rightarrow \qquad K_H = \frac{P_{H_2S}}{x_{H_2S}} = \frac{0.987}{0.0035} = 282\text{bar}$$

*********** END **********