Sapna Gupta

Solutions – 4a Conversion of soln conc. units.

4. An aq. soln of ethylene glycol (CH_2OHCH_2OH, MW = 62.0 g/mol) is used as a coolant. The solution is 40.0% ethylene glycol by mass. The density of the soln is 1.05 g/mL. Calculate (a) molarity → mol/L (b) molality → mol/kg solv & (c) mol fraction of EG → mol EG / total mol.

Ans $40\% = \frac{40\text{ g EG}}{100\text{ g soln}}$, $d_{soln} = 1.05\text{ g/mL}$, $MW_{EG} = 62.0\text{ g/mol}$

1L

(a) molarity = mol solution / L soln.

→ mass of solution from % soln.

mass of solution $= 1\text{ L} \times \frac{1000\text{ mL}}{1\text{ L}} \times \frac{1.05\text{ g}}{\text{mL}} = 1050\text{ g soln}$.

$1050\text{ g soln} \times \frac{40\text{ g EG}}{100\text{ g soln}} = 420\text{ g EG}$.

$420\text{ g EG} \times \frac{1\text{ mol}}{62\text{ g}} = 6.77\text{ mol EG in 1L} = \frac{6.77\text{ mol}}{1\text{ L}} = 6.77\text{ M}$

(b) molality = mol EG / kg solv. → solvent → 6.77 mol

$1050\text{ g soln} - 420\text{ g EG} = 630\text{ g } H_2O \times \frac{1\text{ kg}}{1000\text{ g}} = 0.63\text{ kg}$

$6.77\text{ mol} / 0.63\text{ kg} = 10.7\text{ m}$

(c) $\chi_{EG} = \frac{\text{mol EG}}{\text{mol}_{EG} + \text{mol}_{H_2O}}$ ← 6.77 mol.

$630\text{ g } H_2O \times \frac{1\text{ mol}}{18\text{ g}} = 35\text{ mol } H_2O$

$\frac{6.77\text{ mol}}{(6.77 + 35)\text{ mol soln}} = 0.162$

Sapna Gupta

Solutions - 4a Conversion of soln conc. units.

An aq. soln of ethylene glycol (CH_2OHCH_2OH, MW = 62.0 g/mol) is used as a coolant. The solution is 40.0% ethylene glycol by mass. The density of the soln is 1.05 g/mL. Calculate (a) molarity (b) molality & (c) mol fraction of EG

(a) → mol/L (b) → mol/kg solv (c) → mol EG / total mol.

Ans

$40\% = \frac{40\,g\,EG}{100\,g\,soln}$, $d_{soln} = 1.05\,g/mL$, $MW_{EG} = 62.0\,g/mol$ [1 L]

(a) molarity = mol solution / L soln.
→ mass of solution from % soln.

mass of solution $= 1\,L \times \frac{1000\,mL}{1\,L} \times \frac{1.05\,g}{mL} = 1050\,g$ soln.

$1050\,g\,soln \times \frac{40\,g\,EG}{100\,g\,soln} = 420\,g\,EG$.

$420\,g\,EG \times \frac{1\,mol}{62\,g} = 6.77\,mol\,EG$ in 1 L $= \frac{6.77\,mol}{1\,L} = \boxed{6.77\,M}$

(b) molality $= \frac{mol\,EG}{kg\,solv.}$ → 6.77 mol.
kg solv. → solvent

$1050\,g\,soln - 420\,g\,EG = 630\,g\,H_2O \times \frac{1\,kg}{1000\,g} = 0.63\,kg$

$6.77\,mol / 0.63\,kg = \boxed{10.7\,m}$

(c) $x_{EG} = \frac{mol\,EG}{mol_{EG} + mol\,H_2O}$ ← 6.77 mol.

$630\,g\,H_2O \times \frac{1\,mol}{18\,g} = 35\,mol\,H_2O$

$\frac{6.77\,mol}{(6.77 + 35)\,mol\,soln} = \boxed{0.162}$