Solutions 6.2

Expressing Concentrations
Molarity
Molality
Mass %
Mole Fraction

Expressing Concentration

Four methods for expressing concentration:

$$\text{molarity } (M) = \frac{\text{moles solute}}{\text{liters solution}}$$

Molarity can change with temperature

$$\text{molality } (m) = \frac{\text{moles solute}}{\text{kg solvent}}$$

$$\text{mass \%} = \frac{\text{mass of component}}{\text{total mass of solution}}$$

The rest do not change with temperature

$$\text{mole fraction} = X_A = \frac{\text{moles A}}{\text{moles A} + \text{moles B} + \ldots + \text{moles Z}}$$

Ex1) Molarity (*M*)

Ex1) A 3.75g sample of NaCl is dissolved in water. The total volume of the solution is 768 mL. What is the molarity of the solution?

Ex2) Molarity (*M*)

Ex2) How many mL of 0.245 *M* NaOH are needed to deliver 1.75 moles NaOH.

Ex1) Molality (*m*)

Ex1) A 4.77 g sample of LiCl is dissolved in 320 mL of water. What is the molality of the solution?

Ex2) Molality (*m*)

Ex2) Find the molality of a 3.70 *M* solution of NaCl that has a density of 1.12 g/mL.

Step 1. Find mass of NaCl (assume 1 L of solution).

1 L solution×

Step 2. Find the mass of the solution

Ex2) Molality (*m*) (cont.)

Step 3. Find the mass of the solvent

Step 4. Find the molality of the solution

Ex) Mass %

Ex) The density of a 12.4 mass % solution of HCl is 1.17 g/mL. Find the molarity of the solution.

Step 1. Find moles of HCl (assume 100g of solution)

100 g solution×

Step 2. Find liters of solution

Ex) Mass % (cont.)

Step 3. Find the molarity of the solution

Ex) Mole Fraction

Ex) Find X_{KOH} in a 1.5 *m* solution of KOH.

Step 1. Find moles of KOH and H_2O

Ex) Mole Fraction (cont.)

Step 2. Find mole fractions

$$X_{KOH} = \frac{n_{KOH}}{n_{KOH} + n_{H_2O}} =$$