Concentration of Solutions

Molality – concentration of a solution based on mass of solvent

- Molality is often described as "molal"
- Molality is used when comparing properties of solutions related to vapor pressure and temperature changes.

$$\frac{\text{Amount of Solute (Mol)}}{\text{Mass of Solvent (kg)}} = \text{Molality } (m)$$

Concentration of Solutions

What is the molality of a solution containing 18.2 g HCl and 250 g of water?

$$18.2 \text{ g HCl} \left[\frac{\text{mol}}{36.5 \text{ g}}\right] = 0.5 \text{ mol HCl}$$

DO NOT FORGET 250 g = 0.25 kg

$$\frac{0.5 \text{ mol HCl}}{0.25 \text{ g Water}} = 1.99 \ m \text{ HCl}$$

Concentration of Solutions

Mr. Kearsley wants to make a 0.125 *m* solution of NaCl in 250 g of water. How many grams of NaCl should he add?

DO NOT FORGET 250 g = 0.25 kg

$$\frac{\text{X mol NaCl}}{\text{0.25 kg Water}} = 0.125 \ m \text{ NaCl}$$

Multiply both sides by 0.25 kg Water

$$(0.125 \ m \text{ NaCl})(0.250 \text{ kg Water}) = 0.031 \text{ mol NaCl}$$

$$0.031 \text{ mol NaCl} \left[\frac{58.5 \text{ g}}{\text{mol}}\right] = 1.83 \text{ g NaCl}$$

Making a Molal Solution

1. Calculate the mass of $CuSO_4 \cdot 5H_2O$ needed. To make this solution, each kilogram of solvent (1000 g) will require 0.5000 mol of $CuSO_4 \cdot 5H_2O$. This mass is calculated to be 124.8 g.
2. Add exactly 1 kg of solvent to the solute in the beaker. Because the solvent is water, 1 kg will equal 1000 mL.
3. Mix thoroughly.
4. The resulting solution has 0.5000 mol of solute dissolved in 1 kg of solvent.

Making a Molar Solution

How it is different than a molal solution

Copper(II) sulfate, $CuSO_4$, is one of the compounds used to produce the chemiluminescence in light sticks. To make a 0.5000 M $CuSO_4$ solution, you need 0.5000 mol of the hydrate, $CuSO_4 \cdot 5H_2O$, for each liter of solution. To convert this amount of $CuSO_4 \cdot 5H_2O$ to a mass, multiply by the molar mass of $CuSO_4 \cdot 5H_2O$ (mass of $CuSO_4 \cdot 5H_2O$ = 0.5000 mol × 249.68 g/mol = 124.8 g).

Add some solvent (water) to the calculated mass in the beaker to dissolve it, and then pour the solution into a 1.000 L volumetric flask.

Rinse the beaker with more water several times, and each time pour the rinse water into the flask until the solution almost reaches the neck of the flask.

Stopper the flask, and swirl thoroughly until all of the solid is dissolved.

Carefully fill the flask with water to the 1.000 L mark.

Restopper the flask, and invert the flask at least 10 more times to ensure complete mixing.

The solution that results has 0.5000 mol of $CuSO_4$ dissolved in 1.000 L of solution—a 0.5000 M concentration.