

## Chemistry - Solutions and Concentration

Terms we will use:

Concentration Ratios	
Concentration Description	Ratio
Percent by mass	$\frac{\text{Mass of the Solute}}{\text{Mass of the Solution}} \times 100\%$
Percent by volume	$\frac{\text{Volume of the Solute}}{\text{Volume of the Solution}} \times 100\%$
Molarity	$\frac{\text{Moles of the Solute}}{\text{Liter of Solution}}$
Molality	$\frac{\text{Moles of the Solute}}{\text{Kilogram of Solvent}}$
Mole Fraction	$\frac{\text{Moles of the Solute}}{\text{Moles of Solute} + \text{Moles of Solvent}}$

Example: What is the mass percent of lithium chloride when we add 4.5 g LiCl to 1.5 L of water? (recall the density of water is 1.0 g/ml)

Example: If we have a sample of bleach that contains 3.62% NaOCl, how many grams of the solute will be found in 1500.0 of the bleach?

Example: What is the percent by volume of a solution that contains 35 ml ethanol in 115 ml of water?

Example: A 2.18% isopropyl alcohol solution will contain how many ml of the alcohol in 1.1 L of solution?

$$\text{Molarity (M)} = \frac{\text{Moles of Solute}}{\text{Liter of Solution}}$$

Example: Calculate the molarity of a solution containing 40.0 g of glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) dissolved in 1.50 L of water.

Example: What is the molarity of a solution containing 22.5 g of  $\text{CaCl}_2$  in 500.0 ml of water?

Example: How many grams of silver nitrate need to be added to a 750.0 ml of water to make a 0.100 M solution of  $\text{AgNO}_3$ ?

Example: 62.25 grams of Potassium Iodide was added to enough water to make a 1.50 M solution. What was the volume of water added?

## Preparation of solutions and dilution

How do we actually make the solution?



Dilution equation:  $M_1V_1 = M_2V_2$

Example: An experiment requires 50 ml of a 1.5 M HCl. All that is found in the lab is 6.0 M HCl. What volume of the concentrated HCl needs to be added to enough water for the 50 ml of our required solution?

$$\text{Molality (m)} = \frac{\text{Moles of the Solute}}{\text{Kilogram of Solvent}}$$

Example: 10.0 g of  $\text{Na}_2\text{SO}_4$  is added to 1000.0 ml of water. What is the molality of the solution?

Example: We need a 0.50 molal solution of naphthalene ( $\text{C}_{10}\text{H}_8$ ) and have 500.0 grams of toluene as the solvent. How many grams of naphthalene will we use for the solution?

$$\text{Mole Fraction} = \frac{\text{Moles of the Solute}}{\text{Moles of Solute} + \text{Moles of Solvent}}$$

Example: What is the mole fraction of xenon gas in a mixture that contains 0.584 g of xenon, 86.40 g of argon, and 3.62 g of neon?

Example: A sodium hydroxide solution is found to be 22.8% by mass. What is the mole fraction of the solution?