

## Methods for determining Solution Concentration

### Vocabulary:

Solute: The stuff being dissolved (e.g. salt)

Solvent: The dissolving medium (e.g. water)

Solution: The medium + stuff mixture (e.g. saline solution)

During the next few days, we will be considering **5 different methods for calculating solution concentration**. Use the chart below to record the equation, the necessary units and what circumstances the equation is helpful to us.

Method	Mathematical equation	What parts of the solution of being compared? (Think of this as a ratio)	Equation units	Steps needed to get numbers to correct form	When is it helpful?
Percent by volume ( $\frac{V}{V}$ )	$\frac{V_{\text{solute}}}{V_{\text{solution}}} \times 100\%$	Solute: Solution (solute + solvent)	$\frac{L}{L} \times 100\% =$ $\% \left(\frac{V}{V}\right)$	1) make sure all units match 2) add $V_{\text{solute}} + V_{\text{solvent}}$ to get $V_{\text{solution}}$	ex. 3% $H_2O_2$ daily life solutions mixing 2 liquids together
Percent by mass ( $\frac{m}{m}$ )	$\frac{\text{mass}_{\text{solute}}}{\text{mass}_{\text{solution}}} \times 100\%$	Solute: Solution (solute + solvent)	$\frac{g}{g} \times 100\% =$ $\% \left(\frac{m}{m}\right)$	1) make sure all units match (g or kg/kg) 2) add mass solute + mass solvent = mass solution	mixing a solid in a liquid daily life - the math is quick
Molarity	$\frac{\text{mol}_{\text{solute}}}{V_{\text{solution}}}$	Solute: Solution (solute + solvent)	$\frac{\text{mol}}{L} = M$ 6 M = 6 "molar" solution	1) g solute $\rightarrow$ mol solute 2) determine $V_{\text{solution}}$	Stoichiometry (ex. Save the World lab)
Dilutions		$M_1 V_1 = M_2 V_2$	$\left(\frac{\text{mol}}{L}\right) (L) = \left(\frac{\text{mol}}{L}\right) (L)$	stays the same	-- dilutions --
Mole fraction	$\frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}}$	solute solution	$\frac{\text{mol}}{\text{mol}}$ unitless	1) convert g $\rightarrow$ mol for each substance present 2) add $n_{\text{solute}} + n_{\text{solvent}}$ to find total moles	Partial pressures
Molality	$\frac{\text{mol}_{\text{solute}}}{\text{mass}_{\text{solvent}}}$	solute: solvent	$\frac{\text{mol}}{\text{kg}} = m$ 6 m HCl: 6 molar HCl	1) g solute $\rightarrow$ mol solute 2) $V_{\text{solvent}}$ in kg	Colligative properties

you don't have to know this

Add 3 mL to 100 mL water

% H<sub>2</sub>O<sub>2</sub> (v/v)

$$\frac{3 \text{ mL H}_2\text{O}_2}{103 \text{ mL solution}} \times 100\% = \boxed{3\% \text{ H}_2\text{O}_2 \text{ solution}}$$

Add 3g to 100 mL water

% NaCl (m/m)

$$\frac{3 \text{ g NaCl}}{103 \text{ g solution}} \times 100\% = 0.03 \times 100\% = \boxed{3\% \text{ NaCl}}$$

Add 3 mol to 100 mL water

M<sub>NaCl</sub>

$$\frac{3 \text{ mol NaCl}}{0.1 \text{ L solution}} = \boxed{30 \text{ M NaCl solution}}$$

m<sub>NaCl</sub>

$$\frac{3 \text{ mol NaCl}}{0.1 \text{ kg solution}} = \boxed{30 \text{ m NaCl solution}}$$

Example problems