

Concentration

A. Ways of Expressing the Concentration of a Solution

1. Mass Percent:

$$\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solute} + \text{mass of solvent}} \times 100\%$$

Example 1 Two grams (2.0 g) of salt are mixed with 50 grams of water. Find the mass % of the solution.

Solution $\text{mass \%} = \frac{2.0}{2.0 + 50} \times 100\% = 3.8\%$

Example 2 How many grams of salt must be added to 10 grams of water to create a 10% solution?

Solution $\text{mass \%} = \frac{\text{mass of solute}}{\text{mass of solute} + \text{mass of solvent}} \times 100\%$

$$10\% = \frac{x}{x + 10} \times 100\%$$

$$0.10 = \frac{x}{x + 10}$$

$$0.10(x + 10) = x$$

$$1 = 1x - 0.10x$$

$$x = 1/(0.90) = 1.1 \text{ g}$$

2. Grams per Liter (g/L) = grams of solute per liter of solution

Example If 30 grams of NaOH are dissolved and then diluted to 2.0 L with water, what is the concentration of the solution?

Solution $30\text{g}/2.0 \text{ L} = 15\text{g/L}$

3. **Molarity (M) = Moles per Liter (moles/L) = moles of solute per liter of solution (430 only)**

Example If 30 grams of NaOH are dissolved and then diluted to 2.0 L with water, what is the molar concentration (molarity) of the solution?

Solution $\frac{30 \text{ g} \div (23+16+1) \text{ g / mole}}{2.0 \text{ L}} = 0.375 \text{ mole/L or } 0.38 \text{ M.}$ *← Converts grams into moles*

B. Preparing a Solution from a Solid

Starting Material	Preliminary Calculation	Procedure
Solute and water have to be turned into a solution of known concentration.	Mass = CV, if C is in g/L for 430 : moles = CV, if C is in mol/L	<ol style="list-style-type: none"> 1. Mass the calculated amount of solid. 2. Dissolve in beaker containing less than the desired amount of solvent. 3. Transfer to a volumetric flask. 4. Dilute to the mark with solvent and mix.

Example 1 How do you prepare 250 mL of a 3g/L solution of NaCl?

Solution required mass = CV
 Mass = 3g/L (250/1000)L
 = 0.75g

1. Mass 0.75g of NaCl.
2. Dissolve in beaker containing less than the desired 250 mL of solvent.
3. Transfer to a 250 mL volumetric flask.
4. Dilute to the mark with water and mix.

C. Preparing a Solution from Another Solution Using Dilution

Starting Material	Preliminary Calculation	Procedure
An already prepared solution has to be diluted to create a less concentrated solution	$C_1V_1 = C_2V_2$ C_1 = concentration of original solution V_1 = volume actually used from original C_2 = final concentration of the newly prepared solution V_2 = volume of the new solution (it is total of the original volume and the volume of water added)	<ol style="list-style-type: none">1. Pipette the calculated amount into a volumetric flask of size V_2.2. Dilute to the mark with solvent.3. Mix.

Example A student needs to make 300 mL of a 2.0 g/L solution of HCl from a 5.0 g/L solution. How does he go about doing it?

Solution $C_1V_1 = C_2V_2$
 $5x = 2(0.300)$
 $x = \mathbf{0.120\ L}$

1. Pipette 120ml (0.120 L).
2. Transfer into a 300 mL volumetric flask.
3. Add water (dilute) to the mark and mix.