

PRACTICAL WORK N°02

PREPARATION OF SOLUTIONS

I. Aims

- To prepare a solution by diluting a commercial or stock solution.
- To prepare a solution by dissolving a solid compound.

II. Theoretical background

- **Solution:** A solution is a condensed liquid phase composed of several constituents. It consists of a **solvent**, denoted by S (present in a greater quantity), and one or more **solutes**, denoted by S_i (where $i = 1, 2, 3$, etc.).

$$\text{Solution} = \text{Solute} + \text{Solvent}$$

There are two types of solutions:

- **Homogeneous solution:** Composed of a single phase; the constituents are miscible.
- **Heterogeneous solution:** Composed of two or more phases; the constituents are immiscible.

Note:

An **aqueous solution** is one in which the solvent is water.

- **Concentration of a Solution**

a. Molarity (M) or molar concentration:

It is the number of moles of solute per litre of solution ($\text{mol} \cdot \text{L}^{-1}$).

Example: A 1 M solution contains 1 mole of solute in 1 litre of solution.

$$M = C_n = \frac{n}{V}$$

b. Mass concentration (Cm) or mass titre:

It is the concentration expressed as the mass of solute per litre of solution, usually in $\text{g} \cdot \text{L}^{-1}$.

$$C_m = \frac{m}{V}; \text{M.M. (molar mass)} = \frac{C_m}{C_n}$$

c. What is Dilution?.

Dilution is the process of preparing a solution of lower concentration (called a *sub-solution*) from a more concentrated (stock or principal) solution.

Adding solvent (e.g., water) to a solution does not change the quantity of solute, but it does change the concentration of the solution.

$$n_1 = n_2 \quad \text{so} \quad N_1V_1 = N_2V_2 \quad \longrightarrow \quad C_1V_1 = C_2V_2$$

Safety Note

When a concentrated acid is diluted with water, heat is released. This heat can cause the water to boil and splatter, potentially leading to acid burns.

<<Always add acid to water, never water to acid, to prevent violent reactions and splashing>>

Therefore, when diluting a concentrated acid, a small amount of water should be added to the volumetric flask before introducing the concentrated solution. Mix carefully, then add more water until the solution reaches the calibration mark.

III. Purpose of the Manipulations

1. Preparation of 100 mL of a sulfuric acid (H_2SO_4) solution with a molar concentration of 1 M, using a concentrated acid of density $1.83 \text{ g}\cdot\text{mL}^{-1}$ and purity 95% by mass.
2. From this 1M H_2SO_4 solution, prepare 50 mL of a diluted solution with a mass concentration of $19.6 \text{ g}\cdot\text{L}^{-1}$. $M(\text{H}_2\text{SO}_4)=98\text{g/mol}$
3. Preparation of 100 mL of a potassium hydroxide (KOH) stock solution with a molar concentration of 0.1 M.

IV. Chemicals

Concentrated commercial H_2SO_4 (95%, $d = 1.83$).

Potassium hydroxide KOH pellets.

V. Work to Do

1. Preparation of 100 mL of 1 M Sulfuric Acid (H_2SO_4) Solution

Procedure:

1. Calculate the mass of solute (acid) required to prepare the Sulfuric Acid solution.
2. Determine the volume of concentrated acid needed, based on its purity and density.

3. Add a small amount of distilled water to a 100 mL volumetric flask.
4. Using a pipette, carefully add the calculated volume of concentrated acid to the flask.
5. Add distilled water up to the calibration mark, close the flask, and shake thoroughly to ensure complete mixing (see Diagram 01).

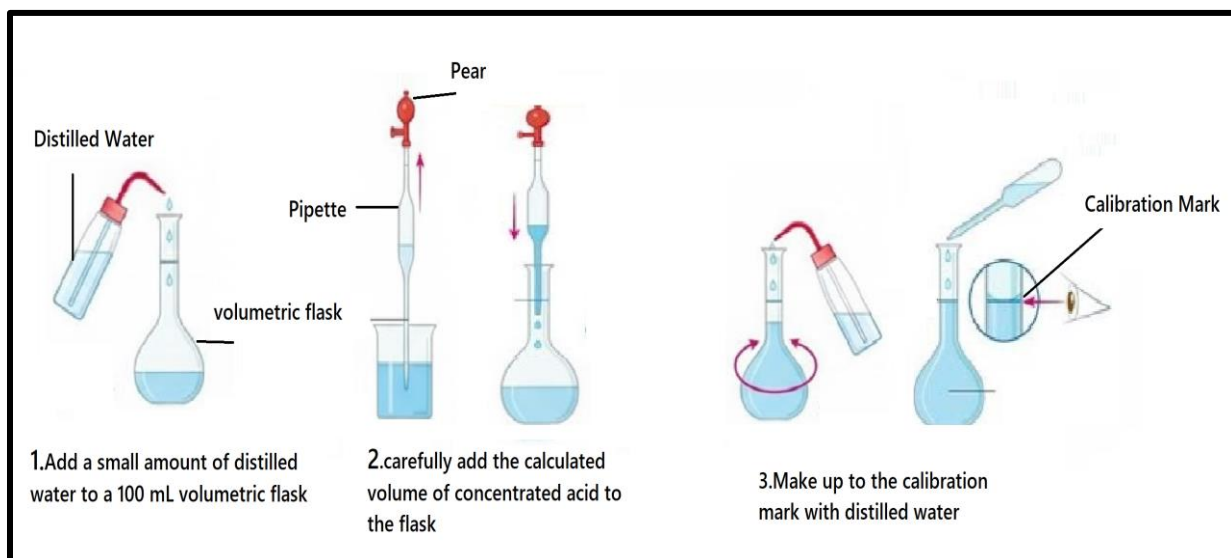


Diagram 01

2. Preparation of 50 mL of Sulfuric Acid Solution ($19.6 \text{ g} \cdot \text{L}^{-1}$)

Procedure:

1. Calculate the volume of the stock solution required to obtain the desired concentration. Using a graduated pipette, transfer the calculated volume of the stock solution into a 50 mL volumetric flask.
2. Add distilled water up to the calibration mark, close the flask, and shake thoroughly to ensure uniform mixing (see Diagram 02).

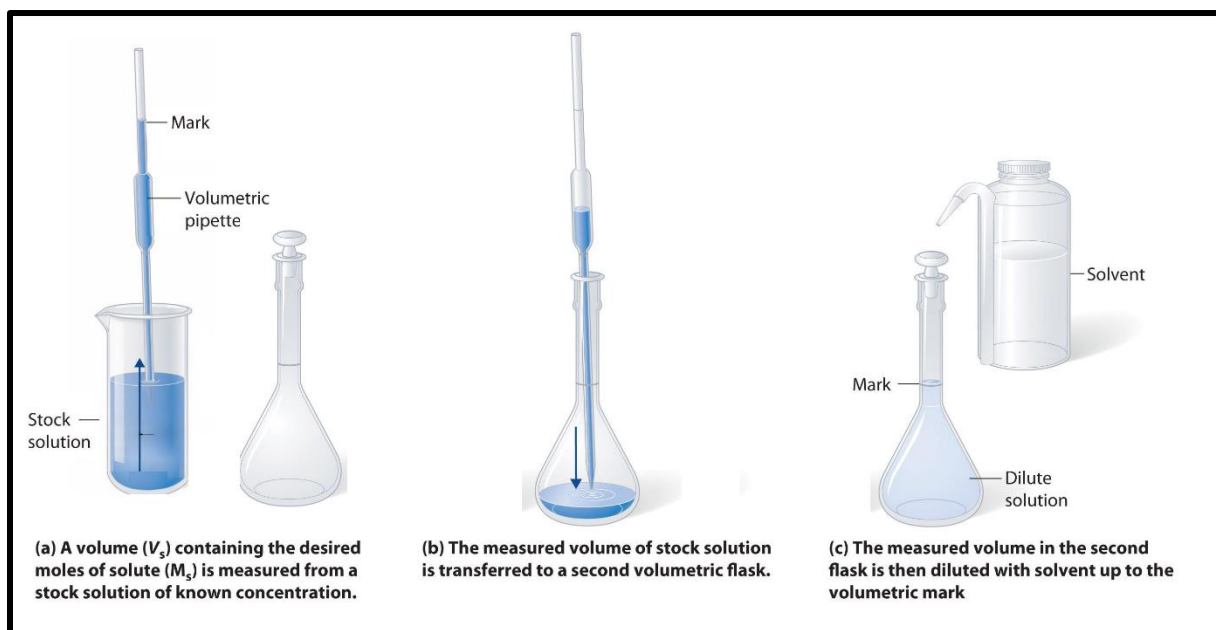


Diagram 02

3. Preparation of 100 mL of Potassium Hydroxide (NaOH) Solution (0.1 M)

Procedure:

1. Calculate the mass of potassium hydroxide (NaOH) required to prepare the desired solution. $M(\text{NaOH}) = 40 \text{ g/mol}$
2. Weigh the calculated mass carefully without touching it with your fingers (avoid contact with skin and eyes — this substance is highly corrosive).
3. Close the reagent bottle immediately after use to prevent the NaOH from absorbing moisture. (NaOH is a **Hygroscopic** component).
4. Add a small amount of distilled water to a 100 mL volumetric flask, then introduce the weighed NaOH.
5. Stir until the solid is completely dissolved, then add distilled water up to the calibration mark.
6. Close the flask and shake well to ensure complete mixing.

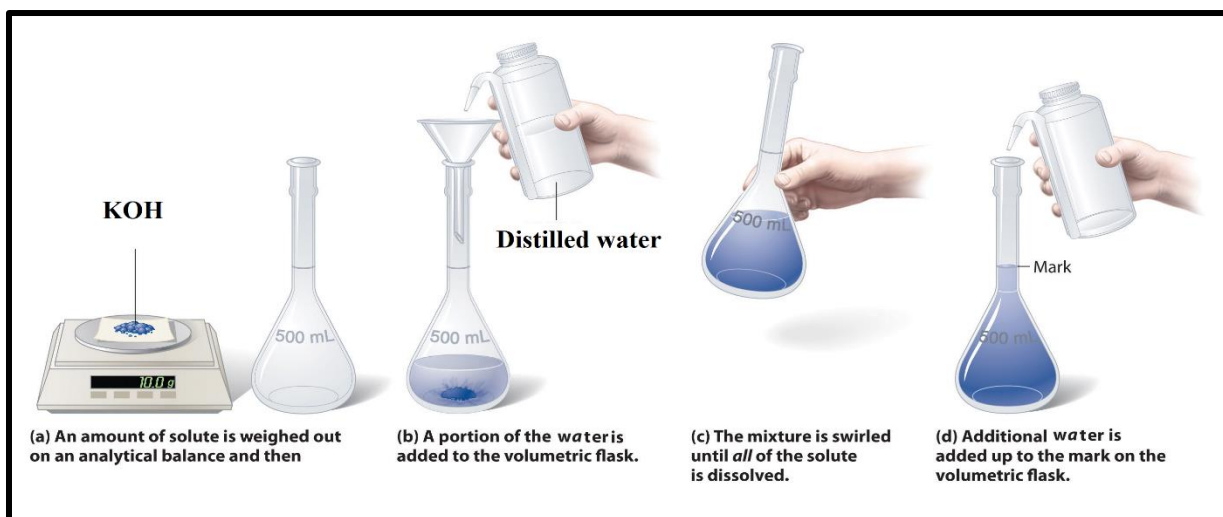


Diagram 03