TP No. II. Preparation of solutions.

Goals:

1. Become familiar with a certain number of practical operations, knowledge of which is necessary in a chemistry laboratory, awareness of the care and attention given to the equipment used as well as its cleanliness. The accuracy of the results obtained depends on all these factors.
2. List the causes of errors in volumetric measurements, give the order of magnitude of the relative uncertainties and choose the number of significant figures.

1. Theoretical notions.

A solution is a condensed liquid or solid phase formed from several constituents; a solvent and solutes. The solvent S and the solute Si (i= 1, 2, 3,..). In a solution, the solvent is always a greater quantity than the solute. We can obtain two types of solution:
1- Homogeneous solution: there is a single phase; the constituents are miscible,
2- Heterogeneous solution: it is formed from two to several phases (the constituents are immiscible or immiscible, partially miscible).

Dilution of a solution of known concentration.

During dilution, the quantity of material in the solute is conserved. The starting solution is called the mother solution and the final solution is called the daughter solution. What volume to take from the S_1 solution to prepare S_2?.

Solution S_1 **: Mother solution** $N_1 > N_2$ Dilution → Solution S_2 : daughter **Solution (**N_2)

Number of moles $n_1 = N_1 . V_1$ $n_2 = N_2 . V_2$ with $V_1 < V_2$

There is conservation of the quantity of matter of the solute: $n_1 = n_2$, so : $\mathbf{N_1 . V_1 = N_2 . V_2}$
N.B: An aqueous solution is a solution whose solvent is water.

V.2. Concentration of a solution.

The concentration of a solution can be expressed by: 1) Molarity (M or C), 2) Normality (N), 3) Mass titer (T), 4) Molality (M).

Molarity (M):

It is the number of moles of solute per liter of solution (mol. L^{-1}). (0.1M is 0.1 mole of solute per liter of solution). It is the number of moles of compound dissolved in one liter of solution, M=C, in mol/L. C = n/V, in (mol/L), n: number of moles=$V/_{Vmolar}$, V_{molar} (mL/mol), V(mL): Volume of the solution.

Reminders:

Mole: measures the quantity of matter, it is the mass in grams of (NA) real molecules, NA: it is Avogadro's number which is equal to: 6.023. 10^{23} mol^{-1}.
Normality (N): it is the number of equivalents per liter of solution, 1 equivalent = 1 mole of charge.
In the case of an acid: it is the number of H^+ per liter of solution.
In the case of a base: it is the number of OH^- per liter of solution.
Examples: dissociation of sulfuric acid $H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$
1 mole → 2 equivalents
If $[H_2SO_4] = C$ we will have $N = 2\,C$

$H_3PO_4 \longrightarrow 3H^+ + PO_4^{3-}$ If $[H_3PO_4] = C$ we will have N=3 C

0.1 M $\longrightarrow$ 0.3 M of H^+ or 0.3 M de PO_4^{3-} or 0.3 équivalent

Normality = **equivalent number** x Molarity, N **= n.M= n.C , n=number of (H^+, OH^-, e^-)**

So; N: It is the effective or real concentration of a solution

In the case of a salt: $BaCl_2 \longrightarrow 2\,Cl^- + Ba^{2+}$

0.1M is equivalent to a normality of 0.2 N

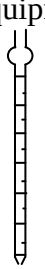
Generally: $A_mB_n \longrightarrow m\,A^{Z+} + n\,B^{Z-}$, $(nZ^- = mZ^+)$, $N = M.\,mZ^+ = M.\,nZ^-$

Mass titer: This is the weight concentration expressed in mass unit per liter of solution generally expressed in $g.L^{-1}$ or mg/L.

Molality: This is the number of moles of solute per Kg (1000g) of solvent.

2. Materials used in the laboratory.

Equipment commonly used in manipulations



graduated pipette

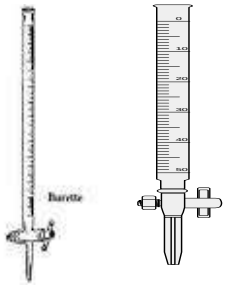
pipette gauged

eprouvette

beaker

flask gauged

erlenmeyer



burettes

pissette

dropper

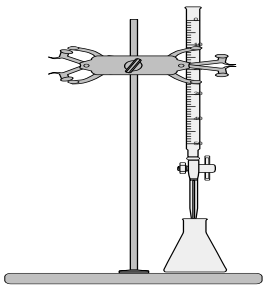
hotplate stirrer

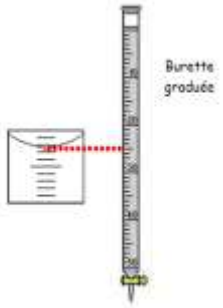
3. Reading a graduation

a) Whether with: A eprouvette, a graduated pipette, a gauged pipette, or a burette, it is necessary to know how to read a graduation (the meniscus).

b) Using the burette, indicate precisely the method for reading a graduation or adjusting the level to the gauge line.

c) Use of a volumetric pipette





4.Preparation of a solution.

A) preparation of a solution by dilution of a stock solution

1/ Goal. The aim of this manipulation is to prepare a solution by diluting a concentrated stock solution.

2/ Operating mode.

We wish to prepare 100 mL of an HCl solution (0.1 N), note the data on the label of the concentrated HCl product (d=1.18, purity 37%).

1. Determine (calculate) the volume V to be taken from the stock solution.
2. Take the volume "V" using the pipette, pour it into the gauged flask, work under the hood and wear gloves.
3. Completed to 100 ml with distilled water (still under the hood).

B/ preparation of a solution by dissolving a solid compound.

1/ Goal. The aim of this manipulation is to prepare a solution by dissolving a solid compound.

2/ Operating mode.

We want to prepare 100 mL of a NaOH solution (0.1 N).

1. Determine the mass "m" of NaOH necessary to make the solution.
2. Weigh the mass "m", put it in the gauged flask.
3. Completed to 100 mL with distilled water.