4 Preparation of Solutions

Purpose

The objective of this experiment is to learn how to prepare homogeneous solutions from a given solid or a liquid.

Theory

A solution is a homogeneous mixture composed of two or more substances. In such a mixture, a solute is dissolved in another substance, known as a solvent. An aqueous solution is a solution in which the solvent is water.

Concentration is the measure of how much of a given substance (solute) is mixed with another substance (solvent-water). The concept is limited to homogeneous solutions, where it refers to the amount of solute in a substance.

There are a number of ways to express concentration; the most commons are listed below.

Molarity (Molar concentration; M) denotes the number of moles of a given substance (n) per liter of solution (V).

$$Molarity = \frac{moles\ solute}{volume\ of\ solution\ in\ liters} \qquad c\ (M) = \frac{n}{V}\ \ (mol/L)$$

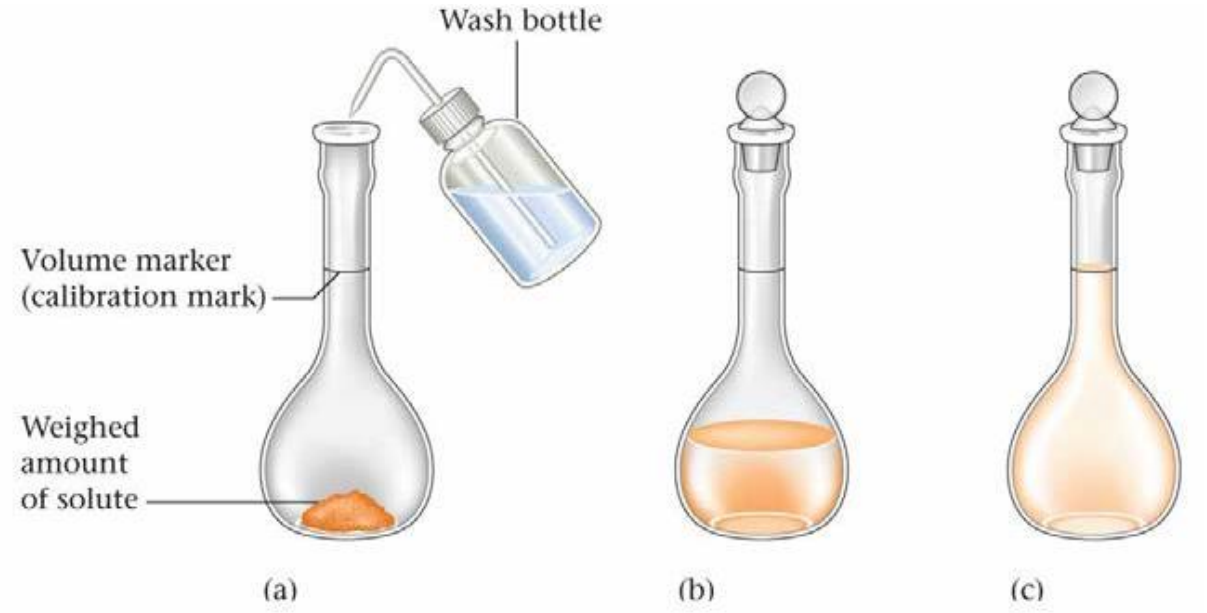

Figure 4.1. Preparing a solution of known concentration using a solid solute.

And other, common used expressions of concentration are **mass percentage** (denotes the mass of a substance in a mixture as a percentage of the mass of the entire mixture); mass-volume percentage, volumu-volume percentage. For example; 10 % NaCl solution includes 10 g NaCl and 90 g water (m/m percentage).

Solutions used routinely in the laboratory are often purchased or prepared in concentrated form (called stock solutions). Solutions of lower concentrations can then be obtained by adding water, a process called dilution.

$$M_0 V_0 = M_1 V_1$$

V_0 is the volume of the stock solution at concentration M_0 and V_1 is the required volume of a final solution with its final concentration M_1.

Figure 4.2. Diluting a solution.

CAUTION!: In diluting a concentrated acid or base, the acid or base should be added to water and then further diluted by adding more water. Adding water directly to concentrated acid or base can cause spattering because of the intense heat generated.

Experimental Procedure

Chemicals List	***Equipments***
NaCl Liquid Samples	Beaker Volumetric Flask Funnel Pipette Balance

In this experiment 3 solutions will be prepared from one solid and two liquids.

- 100 mL, 0.25 M NaCl solution
- 100 mL, 0.1 M $CuSO_4$ solution from 0.5 M $CuSO_4$ solution
- 250 mL, 0.2 M HCl solution from 37 % HCl solution (mass percent) d= 1.19 g/mL

Preparation of a solution from a solid

1. Calculate the mass of solid required for the preparation of solution.

2. Tare the balance before doing any measurement. The balance should read zero grams (0.00 g).

3. Weigh the solid you found from the calculation.

4. Carefully transfer the solid to the volumetric flask using a funnel. Do not lose any substance! Wash carefully the funnel with a small volume of distilled water.

5. Carefully fill the volumetric flask up to the volume mark.

Preparation of a solution from a liquid

1. Calculate the volume of liquid required for the preparation of solution.

2. Take the required amount of liquid from the stock solution with a pipette.

3. Carefully transfer the liquid to the volumetric flask. Wash the pipette with a small volume of distilled water.
4. Carefully fill the volumetric flask up to the volume mark.

Experiment 4 – Report (Page 1)

Name of the student:	Student ID:
Name and signature of the assistant:	Section & Date:

Data and Calculations

Preparation of a solution from a solid

(5 pts) Molarity of NaCl solution (M_{NaCl})	
(5 pts) Volume of NaCl solution (V_{NaCl})	
(5 pts) Molecular Weight of NaCl (MW_{NaCl})	
(10 pts) Mass of NaCl (m_{NaCl})	

Show all your calculations below:

Experiment 4 – Report (Page 2)

Name of the student:	Student ID:

Preparation of a solution from a liquid

100 mL, 0.1 M $CuSO_4$ solution from 0.5 M $CuSO_4$ solution

(5 pts) Molarity of $CuSO_4$ stock solution (M_{CuSO4})	
(5 pts) Molarity of $CuSO_4$ solution to be prepared (M_{CuSO4})	
(5 pts) Volume of $CuSO_4$ solution to be prepared (V_{CuSO4})	
(10 pts) Required volume of $CuSO_4$ solution (V_{CuSO4})	

Show all your calculations below:

Experiment 4 – Report (Page 3)

Name of the student:	Student ID:

250 mL, 0.2 M HCl solution from 37 % HCl solution (mass percent) d= 1.19 g/mL

(4 pts) Mass percentage of HCl solution	
(4 pts) Density of HCl solution	
(4 pts) Molecular Weight of HCl (MW_{HCl})	
(10 pts) Molarity of HCl stock solution (M_1)	
(4pts) Molarity of HCl solution to be prepared (M_{HCl}) (M_2)	
(4 pts) Volume of HCl solution to be prepared (V_{HCl}) (V_2)	
(10 pts) Required volume of HCl solution (V_{HCl}) (V_1)	

Show all your calculations below:

Experiment 4 – Report (Page 4)

Name of the student:	Student ID:

QUESTION

1. (10 pts) 25.0 mL of 0.50 M solution of NaOH was diluted to a final volume of 200.0 mL. What is the new concentration of this solution?