Physical Pharmacy Laboratory
2nd stage
College of Pharmacy

Lab.2 : Concentration expressions (Experimental Work)

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Concentration expressions

- The concentration of solution can be **expressed** either in terms of quantity of solute in a definite volume of solution or as the quantity of solute in a definite mass of solvent or solution.
  - ***(%w/w):-*** grams of solutein100 gm.of solution.
  - ***(%v/v):-***ml of solutein100 ml solution.
  - ***(%w/v):-***grams of solute in100 ml of solution.
  - ***Milligram percent:-***mg of solute in100 ml solution.
  - **Molarity** (moles (gram molecular weight) of solute in 1 liter of solution
  - **Molality** (moles of solute in 1 kg 1000 gm) of solvent
  - **Normality** (N gram equivalent weight of solute in 1 liter of solution
  - **Mole fraction** (ratio of moles of one constituent (e g solute) of solution to the total moles of all constituents (solute solvent)
  - **Mole percent** moles of one constituent in 100 moles of solution, obtained by multiplying mole fraction by 100

Concentration Expression

Expression	Symbol	Definition
% Weight in Volume	%W/V	Grams of solute in 100 ml of solution.
% Volume in Volume	%V/V	Milliliters of solute in 100 ml of solution.
% Weight in Weight	%W/W	Grams of solute in 100 g of solution.
Milligram %	—	Milligrams of solute in 100 ml of solution.
part per million or billion	PPM, PPB	the number of parts of the agent per 1 million or 1 billion parts of the whole.
Molarity	M, C	Mole (gram molecular weights) of the solute in 1 liter of solution.
Molality	m	Mole of the solute in 1000 g of solvent.
Mole fraction	X, N	Ratio of the moles of one constituent (e.g. the solute) of a solution to the total moles of all constituents (solute & solvent).
Mole percent	—	Moles of one constituent in 100 moles of the solution (by multiplying mole fraction by 100).
Normality	N	Gram equivalent weight of solute in 1 liter of solution.

Normality (N)

- **Normality** expresses the concentration in **gram equivalents per liter**

$$N = \frac{\text{equivalents}}{\text{volume (L)}}$$

Molarity gram molecular weight of solute in 1 liter of solution

Equivalent weight = Molecular weight ÷ n-factor

$$Eq.Wt = \frac{MW}{n}$$

n is the equivalence factor.

For example : Molecular weight of anhydrous Na_2CO_3 ≈ **106 g/mol**

n = 2

Therefore:

$$Eq.Wt = \frac{106}{2} = 53\,g/eq$$

Sodium carbonate = Na_2CO_3

Molar mass:

- $Na_2 = 2 \times 22.99 = 45.98$
- $C = 12.01$
- $O_3 = 3 \times 16.00 = 48.00$

Total = 105.99 g/mol ≈ 106.0 g/mol

Molecular weight of Na_2CO_3 = 106 g/mol

Equivalent weight = Molecular weight ÷ n-factor

For acid–base reactions, Na_2CO_3 can react with **2 H^+**, so **n-factor = 2**.

$$\text{Equivalent weight} = \frac{106}{2} = 53\ \text{g/equivalent}$$

Question 1: Calculate the normality of a solution prepared by dissolving **5.3 g of Na_2CO_3** in **500 mL** of solution.

- Molecular weight of Na_2CO_3 = 106 g/mol
- Equivalent weight = 106 ÷ 2 = **53 g/eq**
- Weight = 5.3 g
- Volume = 500 mL = 0.5 L

Formula:

$$N = \frac{\text{Weight (g)}}{\text{Equivalent weight} \times \text{Volume (L)}}$$

$$N = \frac{5.3}{53 \times 0.5}$$

$$\boxed{N = 0.20\ N}$$

Question 2: How many grams of NaOH are required to prepare **250 mL of 0.1 N NaOH**?

Molecular weight of NaOH = 40 g/mol

Equivalent weight of NaOH = **40 g/eq**

$$\text{Weight} = N \times Eq.wt \times V$$

$$= 0.1 \times 40 \times 0.250$$

$$\boxed{= 1.0\ g}$$

Question 3: What is the normality of **0.5 M H_2SO_4**?

For H_2SO_4:

$N=M\times n$ where **n = 2**. $N=0.5\times 2 = 1$

Question 4: How much **2 N HCl** is required to prepare **250 mL of 0.5 N HCl**?

$$N_1V_1 = N_2V_2$$

$$2V_1 = 0.5 \times 250$$

$$V_1 = 62.5\,mL$$

Experimental work

Prepare the following solution using volumetric flasks and pipettes:

- 1. 50 ml of 0.5 M NaCL.
- 2. 50 ml of 2N NaCL.
- 3. 50 ml of 0.1N Na_2CO3.
- 4. 50 ml of 0.1 M Na_2CO3.
- 5. 50 gm of 2% w/w NaCL solution. (density of solution 1.09)
- 6. 50 ml of 10% v/v alcohol.

Suggested Laboratory Report

Title

- **Preparation Solutions of ( ) Using Volumetric Flasks and Pipettes**

Aim

- To prepare solutions of ( ) at specified concentrations using a ccurate volumetric techniques.

Principle

- Solutions of known concentration can be prepared by accurately measuring the required amount of solute and dissolving it in a suitable solvent, followed by adjustment to aknown final volume.

Apparatus

Chemicals

Calculations

Procedure

- Describe the preparation of each solution step-by-step.

Thank you