Physical Pharmacy Laboratory

2nd stage
College of Pharmacy

Lab.1 : Expression of concentrations in pharmaceutical preparations

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Ph.D in Pharmaceutics

2026 -2027

Semester: 1st

Introduction to Physical Pharmacy Laboratory

- Physical Pharmacy applies the principles of **physics and physical chemistry** to pharmaceutical systems.
- It helps us understand the **physical properties and behavior of drugs and dosage forms**.
- The laboratory allows students to verify theoretical concepts through **practical experiments and measurements**.

Physical pharmacy provides the scientific basis for many pharmaceutical processes:

- **Solubility and dissolution** → influence drug absorption.
- **Surface tension** → important in emulsions and suspensions.
- **Viscosity** → affects flow and administration of liquid preparations.
- **pH and buffers** → influence drug stability and solubility.
- **Partition coefficient** → related to drug distribution and membrane permeability.
- **Diffusion** → important in drug release and absorption.
- **Rheology** → important for creams, gels, suspensions, and other semisolids.

Basic Laboratory Skills

- During the practical sessions, students should develop the ability to:
  - Use **laboratory instruments correctly and safely**.
  - Measure mass, volume, temperature, pH, time, and other variables accurately.
  - Prepare solutions and pharmaceutical systems.
  - Record experimental observations systematically.
  - Perform **pharmaceutical calculations**.
  - Construct and interpret **graphs**.
  - Calculate and report experimental results.
  - Identify possible **sources of experimental error**.
  - Compare experimental findings with theoretical expectations.

Laboratory Safety & Good Laboratory Practice

- Students must follow basic **Good Laboratory Practice (GLP)**:
  - Wear a **lab coat** and appropriate personal protective equipment.
  - Keep the working area clean and organized.
  - Read the experimental procedure before starting.
  - Handle chemicals and glassware carefully.
  - Never pipette by mouth.
  - Label all prepared solutions correctly.
  - Do not eat or drink in the laboratory.
  - Dispose of chemical and biological waste appropriately.
  - **Never perform an experiment without understanding the procedure**.

Expression of concentrations in pharmaceutical preparations

- **Concentrationis** the amount (volume or mass) of solute that is present in a given amount (volume or mass) of solution
- **Solubility is defined in quantitative terms as;The concentration of solute in a saturated solution at a certain temperature,**
- **In a qualitative way, it can be defined as;The spontaneous interaction of two or more substances to form a homogeneous molecular dispersion**

Solutions and Solubility

Definitions

- **Solution**is a mixture of two or more components that form a single phase which is homogeneous down to the molecular level
- **Solvent:**it is the component that determines the phase of the solution it usually (but not necessarily) constitutes the largest proportion of the system.
- **Solutes:** it is the component that dispersed as molecules or ions throughout the solvent, i.e. they are said to be dissolved in the solvent

Solutions and Solubility

Definitions

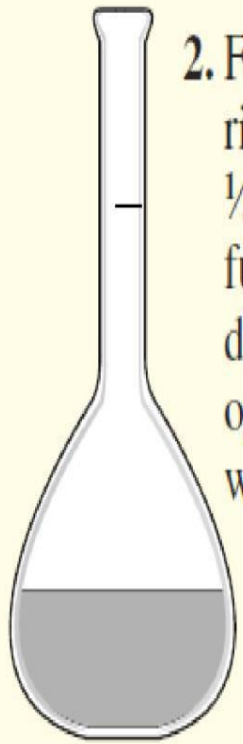
- **Saturated solution** is one in which the **solute in solution is in equilibrium with the solid phase**.
- **Unsaturated or subsaturated solution** is one containing the dissolved solute in a concentration **below that necessary for complete saturation**at a definite temperature.
- **Supersaturated solution** is one that contains **more of the dissolved solute than it would normally contain** at a definite temperature, were the undissolved solute present.

Solution preparation steps

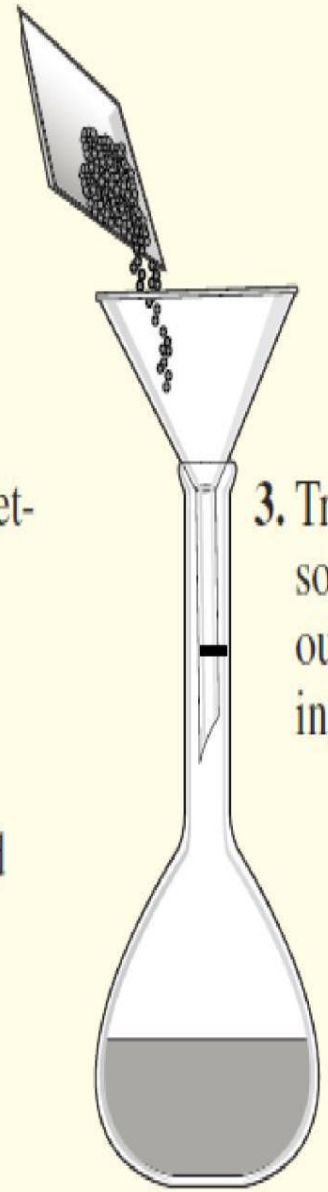
1. Weigh an appropriate amount of solute and place it in a beaker.
2. Add enough solvent and stir to dissolve
3. Transfer the solution to a volumetric flask.
4. Rinse the beaker with more solvent and transfer to the volumetric flask.
5. Add more solvent to the volumetric flask carefully until an accurately calibrated final volume is reached.
6. Stopper your volumetric flask and shake it then put a suitable label.



1. Weigh solid.



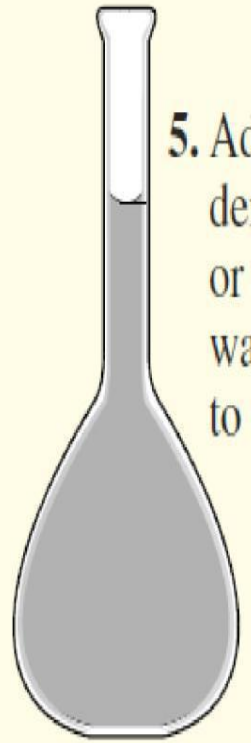
2. Fill volumetric flask ⅓–½ full with deionized or distilled water.



3. Transfer solid, wash out weighing dish.



4. Stir until dissolved. Add more water if necessary.



5. Add deionized or distilled water up to mark.

CONCENTRATION EXPRESSIONS

1.Percent by weight (%w/w) : Grams of solute in **100 g of solution**

for example: **A 10% by weight (% w/w) aqueous solution of glycerin**means

10 g of glycerindissolved in enough **water (90 g)** to make **100 g of solution**.

2.Percent by volume(%v/v) : Milliliters of solute in **100 mLof solution**

94.9% by volume (%v/v) of alcohol means

94.9 ml of alcohol in 100 ml ofsolution

3.Percent weight-in-volume(%w/v) : Grams of solute in **100 mL of solution**

4.Density= mass/ volume

CONCENTRATION EXPRESSIONS

Molar Concentration (Molarity)

- **Molarity (M)** = number of moles of solute per liter of solution.

  M = moles of solute /volume of solution (L)

  - **Example:**

    How many grams of NaCl are required to prepare **500 mL of 0.1 M NaCl**?

    Mole = W / MW

    MW =0.1×0.5×58.5 = 2.925g

Molality (m):

m = moles of solute / kg of solvent

Experimental work

Prepare the following using suitable glassware and lab equipment:

1. 50 ml of 4 % (w/v) NaCl solution
2. 50 ml of 4 % (w/w) NaCl solution (density of solution = 1.027)
3. 50 ml of 5 % (v/v) alcoholic solution

Experimental work

50 ml of 4 % (w/v) NaCl solution

4.0 g of NaCl	**100 ml of solution**
X	**50 ml of solution**

X = 2g of NaCL

Amount of NaCl in 50 ml = 2 g

Solution preparation steps

1. Weigh 2 g of NaCl and place it in a beaker.
2. Add enough solvent and stir to dissolve
3. Transfer the solution to a volumetric flask (50 ml).
4. Rinse the beaker with more solvent and transfer to the volumetric flask.
5. Add more solvent to the volumetric flask carefully until an accurately calibrated final volume is reached (50 ml).
6. Stopper your volumetric flask and shake it then put a suitable label.

50 ml of 4 % (w/w) NaCl solution (density of solution = 1.027)

Density = mass / volume

1.027 = 100 / volume

∴ volume = 100 /1.027 = **97.371 ml**

4.0 g of NaCl	**97.371 ml of solution**
X	**50 ml of solution**

X= 2.054 g of NaCL

Amount of NaCl in 50 ml = 2.054

Solution preparation steps

1. Weigh **2.054 g of NaCl** and place it in a beaker.
2. Add enough solvent and stir to dissolve
3. Transfer the solution to a volumetric flask **(50 ml).**
4. Rinse the beaker with more solvent and transfer to the volumetric flask.
5. Add more solvent to the volumetric flask carefully until an accurately calibrated final volume is reached **(50 ml).**
6. Stopper your volumetric flask and shake it then put a suitable label.

50 ml of 5 % (v/v) Alcohol

5 ml of alcohol	100 ml of solution
X	50 ml of solution

X = 2.5 ml of alcohol

Volume of alcohol in 50 ml = 2.5 ml

Solution preparation steps

1. Transfer 2.5 ml of alcohol to a volumetric flask (50 ml).
2. Add water to the volumetric flask carefully until an accurately calibrated final volume is reached (50 ml).
3. Stopper your volumetric flask and shake it then put a suitable label.

Example 1

An injection contains 40 mg pentobarbital sodium in each milliliter of solution. What is the concentration in terms of % w/v of the solution?

0.040g of Phenobarbital — **1 ml of solution**

X — **100 ml of solution**

X = 4.0g

per cent by weight of NaCl= 4.0 g /100ml of solution = 4.0 %w/v

Example 2

A cough syrup contains 5 mg of brompheniramine maleate in each 5-mL dose. How many milligrams of brompheniramine maleate would be contained in a 120-mL container of the syrup?

5 mg of brompheiramine — **5ml of solution**

X — **120 ml of solution**

X = 120 mg

Amount of brompheiraminemaleate = 0.12 g = 120mg

Example 3

What is the percent by weight of NaCl if 1.75 g of NaCl is dissolved in 5.85 g of water.

Mass of NaCl = 1.75 g

Mass of water = 5.85 g

Mass of solution=1.75+5.85=7.60 g

1.75g of NaCl	**7.6 g of solution**
x	**100 g of solution**

x= 23.16g of NaCL

per cent by weight of NaCl= 23.0 g /100 g of solution

= 23.0 %w/w

% w/w = mass of solute/ mass of solution × 100

Practice problem

1.How many grams of zinc chloride should be used in preparing 5 L of the mouth wash containing 1/10% w/v of zinc chloride?

2.If an ophthalmic solution contains 10 mg of pilocarpine in each milliliter of solution, how many milliliters of solution would be needed to deliver 0.5 mg of pilocarpine?

3.How many milliliters of 0.9% w/v sodium chloride solution can be made from 325 g of sodium chloride?

4.If a physician orders 25 mg of a drug for a patient, how many milliliters of a 2.5% w/v solution of the drug should be used?

5.Calculate the numbers of milliliters of glacial acetic acid (density of glacial acetic acid = 1.05) required to prepare 1 L of 25% w/w acetic acid (density of solution =1.03) .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