



Practical Physical pharmacy/ Lab1

Expression of concentrations in pharmaceutical preparations



Solution, Solvent, and solute

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- ▶ The simplest solution (sugar + water)
- ▶ Which is the solvent and which is solute and why?
- ▶ what if adding a water droplet to a bag of sugar?



Solution, Solvent, and solute

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- A **solution** is a homogeneous mixture of two or more substances.
- The **solute** is the substance present in a smaller amount
- The **solvent** is the substance present in a larger amount.
- A solution may be gaseous (such as air), solid (such as an alloy), or liquid (seawater, for example)
- What determines the physical state of the solution? The solvent or the solute?(AN)

The concentration of a solution

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- ▶ What changes the concentration of the solution? And why?
 - ▶ a/ the solvent
 - ▶ b/the solute
- ▶ Solution concentration law =
$$\frac{\textit{Amount of solute}}{\textit{Amount of solution (solute+solvent)}}$$
- ▶ amount here means (mass, volume, moles, equivalents..etc)

Concentration expressions

➤ Molarity

➤ Molality

➤ Normality

➤ **Ratio :**

1/ Percentage

2/ Strength

The concentration of a solution

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- **Molarity** (M): is the number of moles of solute in 1 liter of solution volume

$$M = n \text{ (mol)} / V \text{ (l)}$$

- **Moles**: mass divided by molar mass for the substance

$$n = m \text{ (g)} / mm \text{ (g/mol)}$$

Q/Calculate number of moles contained in 0.25 g of Benzoic acid?

Q2/Due to temperature effect some favoring percent by mass over Molarity. How?

Molarity (M)

- ▶ Calculate the molarity of 0.25 g benzoic acid dissolved in 1.5 l ethanol?

M.wt=122 g/mole

The concentration of a solution

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- **Molality (m):** is the number of moles of solute in 1 kilogram of solution mass

$$m = n \text{ (mol)}/m \text{ (kg)}$$

Q/Calculate the molality of 0.25 g benzoic acid dissolved in 1.5 kg ethanol?

The normality of a solution

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- ▶ The **Normality** of a solution expresses the number of equivalents of solute contained in 1 L of solution
- ▶ normality of a solution can never be specified without knowledge about how the solution will behave.

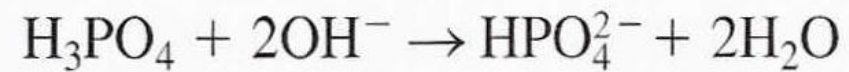
- ▶
$$N = \frac{eq}{V (l)}$$

- ▶
$$eq = \frac{n (mol)}{\eta}$$

- ▶ While η is the number of active units in the solute being dissolved.

Example

- ▶ Q/Calculate the Normality of (0.024 g) Phosphoric acid in (0.53 l), considering:



Ratio

- What is ratio? (A)
- Is a relationship between two quantities
- What is the most common ratio?

Percentage %

- Means how many solute molecules are spreading through 100 molecule of solvent

Percentage by **weight**

- Means how many **grams of** solute are spreading through **100 grams** of solvent

Percentage by **volume**

- Means how many solute **milliliters** are spreading through 100 **milliliters** of solvent

Percentage weight in volume

- Means how many grams of solute spreading through 100 milliliters of solvent

Milligram percent (mg %)

- Means how many solute **milligrams** are spreading through 100 **milliliters** of solvent

The other type of ratio

- The strength of solution: for only one single molecule of solute, how many molecules of solvent are come along with it
- (The number **1** is constant for comparing with others)
- Like 1:50
- Or 1:100
- Or 1:250
- Or 1:500
- Etc...
- Which solution is the most diluted among them?

To compare the two types of ratios together..

- ▶ Let us convert one of them to the other
- ▶ **Express 0.02% as a strength ratio?**

- **Examples:**

Express 0.02% as strength ratio?

0.02 \longrightarrow 100

1 part \longrightarrow x parts

$X = 1 * 100 / 0.02 = 5000$ parts

So ratio strength = 1: 5000

- **Examples:**

How many grams of dextrose are required to prepare 4000 ml of 5 % solution?

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How many grams of dextrose are required to prepare 4000 ml of 5 % solution?

$$\begin{array}{l} 5 \text{ g} \longrightarrow 100 \text{ ml} \\ X \longrightarrow 4000 \text{ ml} \end{array}$$

$$X = 4000 * 5 / 100 = 200 \text{ g}$$

Example:

- **How many grams of potassium permanganate should be used in preparing 500 ml of 1:2500 solution?**

Examples:

How many grams of potassium permanganate should be used in preparing 500 ml of 1:2500 solution?

First convert from ratio to percentage strength

$$\begin{array}{l} 1 \text{ part} \longrightarrow 2500 \text{ parts} \\ X \longrightarrow 100 \text{ parts} \end{array}$$

$$X \% = 1 * 100 / 2500 = 0.04 \text{ parts in } 100 \text{ parts} = 0.04 \%$$

$$\begin{array}{l} 0.04 \text{ gm} \longrightarrow 100 \text{ ml} \\ X \longrightarrow 500 \text{ ml} \end{array}$$

$$X = 0.04 \text{ gm} / 100 \text{ ml} * 500 = 0.2 \text{ gm}$$

Therefore 0.2 grams of potassium permanganate should be used in preparing 500 ml.

References

- ▶ MARTIN'S PHYSICAL PHARMACY AND PHARMACEUTICAL SCIENCES 6th edition
- ▶ *Fundamentals of Analytical Chemistry* Douglas Skoog 8th edition