

Pharmaceutical calculations

Weights and measures

- Weights and measures are systems used to express the quantity, size, or weight of substances and objects.

There are two main systems of weights and measures: the **Imperial system** and the **Metric system**.

A. Imperial System

- The Imperial system, also known as the British Imperial system, originated in the United Kingdom and was widely used in British colonies and territories.
- The Imperial system uses a set of units for measuring length, weight, and volume. Some of the commonly used Imperial units include:

Length

- **Inch (in):** A unit of length equivalent to 2.54 centimeters
- **Foot (ft):** A unit of length equivalent to 12 inches or 30.48 centimeters
- **Yard (yd):** A unit of length equivalent to 3 feet or 36 inches or 0.9144 meters
- **Mile (mi):** A unit of length equivalent to 1,760 yards or 5,280 feet or 1.609 kilometers

Weight

- **Ounce (oz):** A unit of weight equivalent to 28.35 grams
- **Pound (lb):** A unit of weight equivalent to 16 ounces or 453.59 grams
- **Stone (st):** A unit of weight equivalent to 14 pounds or 6.35 kilograms
- **Hundredweight (cwt):** A unit of weight equivalent to 112 pounds or 50.80 kilograms (long hundredweight) or 100 pounds or 45.36 kilograms (short hundredweight)

Volume

- **Fluid ounce (fl oz):** A unit of volume equivalent to 29.57 milliliters (US) or 28.41 milliliters (UK)
- **Pint (pt):** A unit of volume equivalent to 16 fluid ounces or 473.18 milliliters (US) or 20 fluid ounces or 568.26 milliliters (UK)
- **Quart (qt):** A unit of volume equivalent to 2 pints or 0.946 liters (US) or 1.137 liters (UK)
- **Gallon (gal):** A unit of volume equivalent to 4 quarts or 3.785 liters (US) or 4.546 liters (UK)

B. Metric System

- The Metric system, also known as the International System of Units (SI), is a decimal-based system that is widely used worldwide for scientific, industrial, and everyday measurements.

- The Metric system uses a set of base units for measuring length, mass (weight), and volume, along with prefixes that indicate multiples or fractions of the base units. Some of the commonly used Metric units include:

Length

- **Millimeter (mm):** A unit of length equivalent to 0.001 meters
- **Centimeter (cm):** A unit of length equivalent to 0.01 meters
- **Meter (m):** The base unit of length in the Metric system
- **Kilometer (km):** A unit of length equivalent to 1,000 meters

Mass (Weight)

- **Milligram (mg):** A unit of mass equivalent to 0.001 grams
- **Gram (g):** The base unit of mass in the Metric system
- **Kilogram (kg):** A unit of mass equivalent to 1,000 grams
- **Tonne (t):** A unit of mass equivalent to 1,000 kilograms or 1,000,000 grams

Volume

- **Millilitre (mL) or Cubic centimetre (cm³):** A unit of volume equivalent to 0.001 liters
- **Liter (L):** The base unit of volume in the Metric system
- **Cubic meter (m³):** A unit of volume equivalent to 1,000 liters

Calculations involving percentage solutions

Percentage Solutions:

- These are solutions where the concentration of a solute in a solution is expressed as a percentage.
- In pharmacy, this typically refers to:
 - **Weight/Volume (w/v)**
 - **Weight/Weight (w/w)**
 - **Volume/Volume (v/v) percentages**

1. Weight/Volume Percentage (w/v):

- **Used for:** Solid substances dissolved in a liquid.
- **Definition:** Expressed as grams of solute per 100 mL of solution.
- **Calculation:**

$$\text{Weight/Volume Percentage (w/v)} = \left(\frac{\text{Weight of Solute (g)}}{\text{Volume of Solution (mL)}} \right) \times 100$$

➤ **Example:**

If 5 grams of a drug are dissolved in 250 mL of solution, the concentration is:

$$\left(\frac{5 \text{ g}}{250 \text{ mL}} \right) \times 100 = 2\% \text{ w/v}$$

2. Weight/Weight Percentage (w/w):

- **Used for:** Mixtures of two solid substances.
- **Definition:** Expressed as grams of solute per 100 grams of the total solution.
- **Calculation:**

$$\text{Weight/Weight Percentage (w/w)} = \left(\frac{\text{Weight of Solute (g)}}{\text{Total Weight of Solution (g)}} \right) \times 100$$

3. Volume/Volume Percentage (v/v):

- **Used for:** Solutions where both solute and solvent are liquids.
- **Definition:** Expressed as milliliters of solute per 100 mL of solution.
- **Calculation:**

$$\text{Volume/Volume Percentage (v/v)} = \left(\frac{\text{Volume of Solute (mL)}}{\text{Total Volume of Solution (mL)}} \right) \times 100$$

Weights and measures

Alligation

- Alligation is a method used in pharmacy to calculate the proportions of solutions of different strengths needed to achieve a desired concentration.
- It's useful in compounding and preparing pharmaceutical mixtures.

A. Alligation Medial

- This method calculates the average strength of a mixture based on the quantities and concentrations of the individual solutions.
- **Formula:**

- **Formula:**

$$\text{Average Strength (C)} = \frac{(Q_1 \times C_1) + (Q_2 \times C_2) + \dots}{Q_1 + Q_2 + \dots}$$

- Where:
 - C1, C2, ... = concentrations of the solutions
 - Q1, Q2, ... = quantities of the solutions

B. Alligation Alternate

- This method is used to mix two solutions of known concentrations to achieve a desired concentration.
- **Steps:**
 1. Place the stronger and weaker concentrations on opposite sides of a grid.
 2. Write the desired concentration in the middle.
 3. Subtract the desired concentration from both the stronger and weaker concentrations (ignoring negative signs) to determine the parts of each solution.
- **Example:**
 - To make 500 mL of a 10% solution using 15% and 5% solutions:

$$15 - 10 = 5 \quad \text{and} \quad 10 - 5 = 5$$
- This means equal parts of the two solutions should be mixed.

Proof spirit

- Proof spirit refers to the strength of alcohol in a solution, commonly used in beverages and pharmacy.

Definition:

- Proof spirit contains 49.28% alcohol by weight or 57.1% alcohol by volume.
- In the U.S., the formula for proof is:

$$\text{Proof} = 2 \times \text{Alcohol by Volume (ABV)}$$

- So, 50% ABV = 100 proof.

Dilution Calculations:

- Pharmacists may need to dilute alcohol to reach a specific proof using Alligation or proportional dilution.

Example:

- To dilute 95% alcohol (190 proof) to 40% alcohol (80 proof), calculate how much water to add using simple dilution methods.

Isotonic solutions

- An isotonic solution has the same osmotic pressure as body fluids, preventing cell damage by maintaining balance between fluids.

Isotonicity and Freezing Point Depression



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