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PHARMACEUTICS – I

UNIT 2

TOPIC :

- **Pharmaceutical calculations :** Weights and measures– Imperial & Metric system, Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

Pharmaceutical Calculation

→ Pharmaceutical calculation is one of the most important area of study in pharmacy, because

- It helps in preparing and dispensing medications.
- It helps during analysis, to prepare chemicals or to finding results.
- An error harm a made in dosage calculation can patient.

Weights and Measures

- During analysis, ingredients or substances Calculated and measured accurately for preparing compounds. So, the substances are calculated in the form of weight.
- There are two system for weight and measure
  - The Imperial System (old)
  - The Metric System (modern)

Imperial System

→ This is an old system of weights and measures.

→ Weight is a measure of the gravitational force acting on a body and is directly proportional to mass.

→ The imperial system is divided in two parts for the purpose of measurement of weights.

→ These are

a) Avoirdupois system.

b) Apothecaries system.

(a) **Avoirdupois System:** Primary unit of weight is pound (LB) and all measures of mass are derived from the imperial standard pound thus,

(a) 1 pound (lb) = 16 ounce (oz)

b) 1 pound = 7000 grains

c) 1 ounce (oz) = 7000/16 = 437.3 grains

Here only weight is primarily used for compounding.

437.5 grain = 1 oz = 28.35 gm

7000 grain = 1 lb = 16 oz = 454 gm

1 kg = 2.2 lb

1 gr = 64.8 mg

(b) Apothecary System: Comprised of both volume and weight It is used for compounding and for preparing concentration for dilution In this system, weight is measured in grain and volume in Minim.

(i) Volume :

1 teaspoonful (tsp = 5 milliliters (ml) = 1 dram = 5 cubic centimeters (cc)

1 tablespoonful (tbsp) = 15 milliliters (ml)

29.57 milliliters (ml) = 1 fluid Ounce (fl oz)

473 milliliters (ml) = 1 pint (pt) = 16 fluid ounce (fl oz)

946 milliliters = 1 quart = 2 pints

3784 milliliters = 1 gallon = 8 pints = 128 fl oz

(ii) Weight:

1 grain = 64.8 mg

1 ounce = 31.1 gm = 480 grain

Metric System

→ The metric system is used for the measurement of weight and capacity.
→ The metric system in India was implemented from 1st April 1964 in pharmacy profession
→ This system was used the Indian pharmacopoeia
→ The metric system is an alternative system of measurement used in most countries as well as in the United States
→ The metric system is based on joining one of a series of prefixes including kilo- hecto- deka- deci- centi- and milli- with a base unit of measurement such as meter liter or gram.
→ Measurement of weight in metric system: A kilogram is the standard unit for measurement of weight and all other measures are derived from it

1 kilogram (kg) = 1000 grams

1 gram = 1000 mg

1 milligram (mg) = 0.001 gram

1 microgram (mcg) = 0.000,001 gram

1 hectogram (hg) = 100 grams

1 decagram (dag) = 10 grams

1 decigram (dg = 0.1 gram

1 centigram (cg) = 0.01 gram

Calculation involving percentage solutions

→ **Percentage Solutions :** It means " parts per hundred " It can be expressed as %

→ Eg : 10 percent – 10% = 10/100 10 parts per 100 parts

→ To make percentage, we have to multiply it with 100

→ During analysis, we have to compound solution of desired percentage strength

→ There are three types of percentage solution:

- Percentage weight by volume w/v).
- Percentage volume by volume (v/v).
- Percentage weight by weight (w/w)

Percentage Weight by Volume w/v :

$$\text{Concentration (expressed in \%)} = \frac{\text{Quantity or volume of solute}}{\text{Quantity or volume of preparation}}$$

Example :

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

Solution :

Let the quantity of solute be X

Using the formula

$$\text{Concentration} = \frac{\text{Quantity of solute}}{\text{Quantity of solution}}$$

$$5\% = X / 4000$$

Therefore X = 4000 x 5 / 100 = 200 gram of dextrose

Percentage Volume by Volume v/v:

$$\text{Concentration} = \frac{\text{Volume of solute}}{\text{Volume of preparation}}$$

$$\text{Specific gravity} = \frac{\text{Given weight}}{\text{Volume required}}$$

Example :

Q. How many ml of liquefied phenol should be used in compounding the following prescription?

Liquid Phenol - 2.5%

Calamine lotion - 240 ml

Solution:

Using the formula,

Concentration = Volume of solute / Volume of preparation

2.5 % = X / 240

X = 2.5 x 240 / 100

= 60 ml

Percentage Weight/Weight (w/w):

Concentration = Weight of solute / Weight of preparation

Example :

Q. How many grams of phenol should be used to prepare 240 g of 5% (w/w) solution in water?

Solution :

Concentration = Weight of solute / Weight of preparation

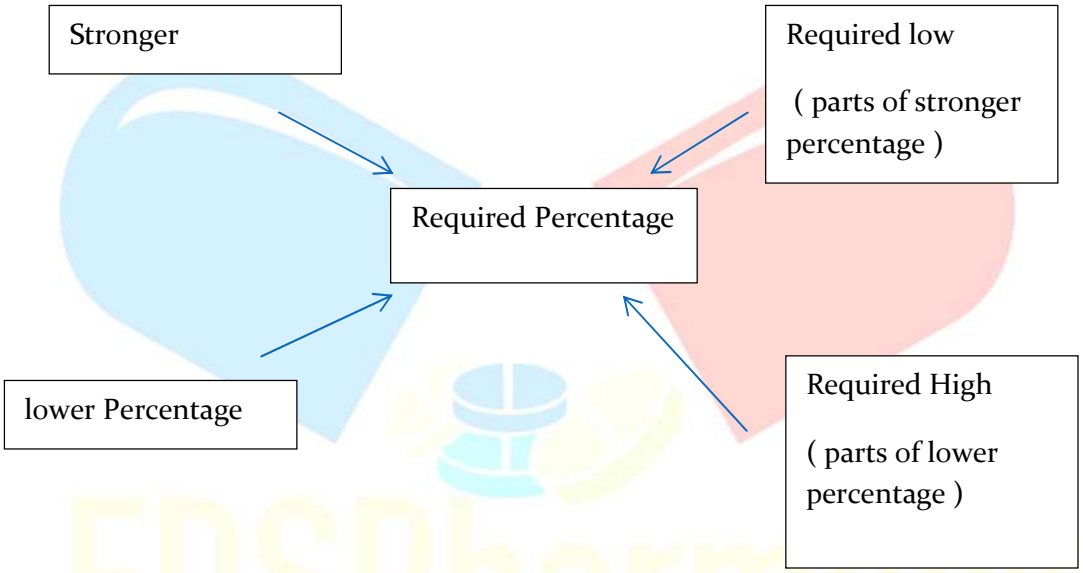
5 % = x/240

X = 5 x 240 / 100

12 g

Alligation Method

→ When the calculation involves mixing of two similar preparations of different strength in order to prepare intermediate strength the alligation method is used.



Example

How much 95% alcohol and how much 50% alcohol will be needed to attain 450 ml of 70% alcohol? (Based on Alligation Alternate)

Solution :

95% — 20 parts

70%

50% — 25 parts

Total 45 parts

Volume of 95% alcohol required is 20 x 450 / 45 = 200ml.

Volume of 50% alcohol required is 25 x 450 / 45 = 250ml.

Proof Spirit

→ It is the mixture of alcohol and water, in which the alcohol strength is generally calculated in terms of proof spirit.

→ It is used for the purpose of excise duty I,e. tax on alcohol sale

→ In India, 57.1 % v of C_2H_5OH (alcohol) are considered equal to 100 volume of proof spirit.

→ It is two types :

- If the strength of alcohol is more than 57.1 % then it is called Over Proof (O/P)
- If the strength of alcohol is less than 57.1 % then it is called Under Proof (U/P)

Example

Q. Find out the proof strength of alcohol which is 90%v/v and 30%v/v.

Solution:

90% v/v = 90 x 1.753 = 157.77

Thus proof strength = 157.77– 100 = 57.77° O/P (Over proof)

30% v/v = 30 x 1.753 = 52.59.

Thus proof strength = 52.59 -100 = - 47.41 i.e. 47.41° U/P (Under proof)

Isotonic Solutions

- These are those solution in which the solute concentration of one solution is same as the solute concentration of another solution.
- Iso means Same Tonic means Toxicity
- Eg : 0.9% w/v solution of Nacl
- The concept of isotonicity is used during preparation of medicaments / I.V. fluid for body
- Because, if the toxicity of these medicament is different than blood or body fluids, then they cause irritation or maybe serious damage.
- It is of Three Types :-
  - Hypertonic Solution : If the solute concentration of solution is greater than 0.9% Nacl solution.
  - Isotonic Solution : When the solute concentration of any solution is equal to 0.9% Nacl Solution.
  - Hypotonic Solution : When the solute concentration of solution is less than 0.9% Nacl Solution.

Freezing Point

→ This method is basically used for hypotonic solution.

→ In this, sodium chloride (adjusting solution) is added in solution to make it isotonic.

$$W\% = 0.52 - a / b$$

Where,

w = amount of adjusting substance

a = freezing of 1% solution of unadjusted solution

b = freezing of 1% solution of adjusted solution

Example :

Find the concentration of Nacl required to make 1.5% solution of boric acid isotonic with blood [freezing Point of Boric acid = 0.29°C, Nacl = 0.58°C]

Solution :

$$W = 0.52 - (0.29^{\circ} \times 1.5) / 0.58$$

$$= 0.52 - 0.43 / 0.58$$

$$= 0.09 / 0.58$$

= 0.15% or 0.15g in 100ml required.

Molecular Weight

- This method is basically used for hypertonic solution.
- % of adjusting substance (w) = 0.03M / N

Where, M = Gram molecular weight of substance

N = No. of ions into which the substance is ionized.

Example :

Q. find the concentration of Nacl required to produce a solution isotonic with blood plasma

Solution :

Molecular Weight of Nacl = 58.5

Ions = Nacl - Na^+ Cl^- - 2

% W = 0.03 x 58.5 / 2

= 0.88 % or 0.9%

9 gm Nacl dissolved in 1000 ml