

PHARMACEUTICS-I

UNIT-2ND

• CHAPTER-1 PHARMACEUTICAL CALCULATIONS

• CHAPTER-2 POWDERS

• CHAPTER-3 LIQUID DOSAGE FORM

CHAPTER-1ST

- Pharmaceutical calculations →
Weight and Measures — Imperial and Metric system, Calculation involving percentage solutions, Alligation Proof spirit and Isotonic solutions based on freezing points and Molecular weights.

• 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 made in dosage calculation can harm a patient.

• Weights and Measures

During analysis, ingredients or substances are 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:

- ① The Imperial system — old
- ② The Metric system — modern

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i) Imperial System →

It is a very old system of weight and measures.

- It is firstly defined in British weights and measure act, (1824)
- It is not used to much, even in United states.
- In (1970s), this system was replaced by metric system.
- It is of two types :-

i) Avoirdupois System →

- It is used for commercial supply of bulk chemicals or other substances.
- Ounces/pounds are used as a standard units.

$$\begin{array}{l} 1 \text{ oz} = 437.5 \text{ gr (grain)} \\ 1 \text{ lb} = 16 \text{ oz (7000 gr)} \\ 1 \text{ pound avoirdupois} = 16 \text{ ounces} \end{array}$$

ii) Apothecaries System →

It was the first system to be used by physicians and pharmacists for measurement.

- This system originated in Greece.
- pints, quarts and gallons are used as units of volume.
- grains (gr) is taken as standard of weight.

1 pound apoth (lb) = 12 ounce

- for Weight
- ($\frac{3}{4}$) 1 ounce = 8 drachms / dram ($\frac{3}{4}$) 480 gr
- 1 dram = 3 scruples (s) or 60 grains
- 1 scruple = 20 grains
- (lb) 1 pound = 5760 grains

• for Volume

- 1 gallon = 4 quarts (8 pints)
- (qt) 1 quart = 2 pint (pt) or 32 fluid ounces
- 1 fluid ounce = 8 fluid drachms
- 1 fluid drachms = 3 fluid scruples / 60 minims
- 1 fluid scruple = 20 minims (m)

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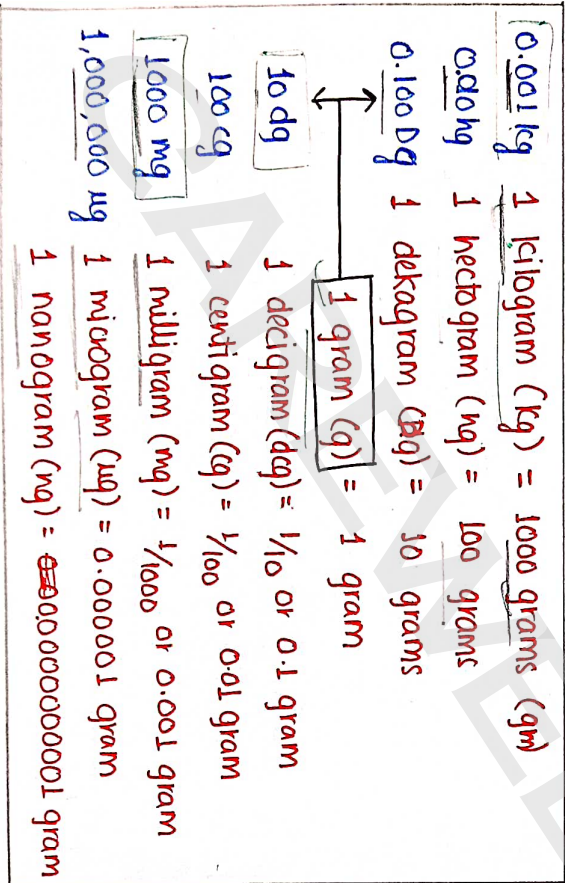
② Metric system →

It is created in France in 1799.

It is widely used system, used for measurement of weight and volume. It includes units i.e. meter, litre or grams.

- It is basically a decimal system in which the division and multiplication is done by 10.

- Kg (kilogram) is taken as standard unit.



⊙ Metric Volume

1 kilolitre (KL)	= 1000 L (litre)
1 Litre (L)	= 1000 millilitre (ml)
1 litre (L)	= 1,000,000 µL (microlitre)

⊙ Metric length

1 km	= 1000 m (metre)
1 m	= 1000 mm (millimetre)
1 m	= 100 cm (centimetre)
1 cm	= 10 mm

⊙ Conversion table :-

1 kg	= 2.2 lb
1 oz	= 30 g
1 lb	= 450 mg
1 grain	= 65 mg

• for Weight

1 drop	= 0.06 ml
1 teaspoon	= 5 ml
1 tablespoonful	= 15 ml
1 teacupful	= 120 ml

• for Volume.

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o Calculation Involving Percentage Solutions

• Percentage → It means "parts per hundred"

It can be expressed as %

eg. 10 percent → 10% ⇒ $\frac{10}{100}$

10 parts per 100 parts.

- to make percentage, we have to multiply it with 100.

- During analysis, we have to compound solⁿ of desired percentage strength.

o It is of three types :-

- i) Weight in Volume percent (w/v)
- ii) Weight percent (w/w)
- iii) Volume percent (v/v)

i) Weight in Volume percent (w/v)

$$\% \text{ w/v} = \frac{\text{Weight of solute (in gm)}}{\text{Volume of solution (in ml)}} \times 100 \%$$

In this, the solute is weighed and the solvent is measured.

eg Calculate the quantity of sodium chloride required for 200ml of 0.9% solution.

⇒ $\% \text{ w/v} = 0.9\%$, solute = x

Volume = 200ml

²

$$x = \frac{200 \times 0.9}{100} =$$

1.8 gm of NaCl

$$0.9\% \times \frac{x}{200} \times 100$$

ii) Weight in weight solutions (% w/w)

In this, the solute and the solvent are measured by weight.

Weight percent (w/w) =

$$\frac{\text{Weight of solute}}{\text{Weight of solution}} \times 100 \%$$

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eg) What is the weight percent of glucose in

a solution made by dissolving 4.6 gm of glucose in 145.2 gm of water?

⇒ solvent = 145.2 gm (water) } solution
solute = 4.6 gm (glucose)

$$\text{weight \%} = \frac{4.6}{145.2 + 4.6} \times 100 \Rightarrow \frac{4.6}{149.8} \times 100 = 3.1\%$$

iii) Volume by Volume solution (% V/V)

In this, the solute and solvent are measured by volume.

$$\text{Volume percent (V/V)} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100\%$$

eg) Prepare 1000 ml of 5% V/V solution of ethylene glycol in water

⇒ % V/V = 5%, solute = 50, solution = 1000 ml

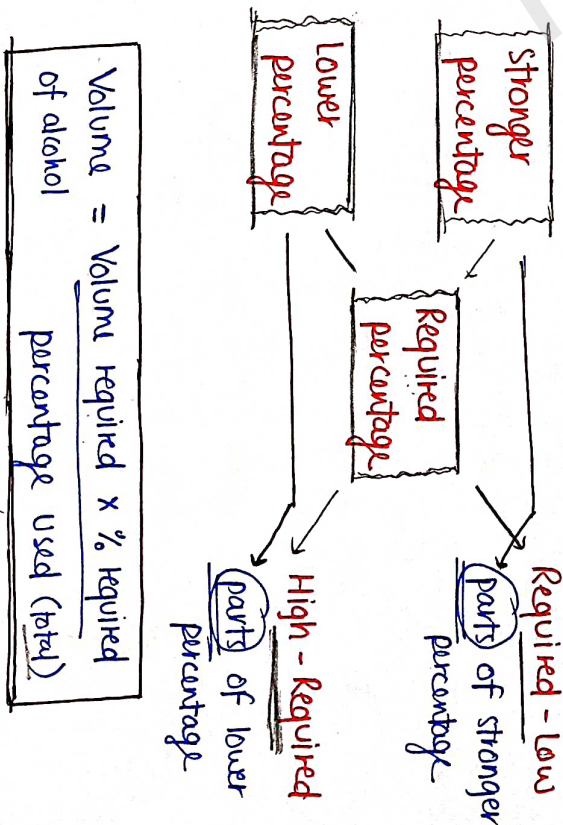
$$\% \text{ V/V} = \frac{\text{solute}}{\text{Volume}} \times 100, \quad 5 = \frac{x}{1000} \times 100$$

$$5 = \frac{x}{10}, \quad x = 5 \times 10 = 50 \text{ ml of ethylene glycol}$$

ALLIGATION

It is a method, when the calculation involves mixing of two similar preparation of different strength to produce a preparation of intermediate strength.

eg) 70% alcohol + 50% alcohol → 60% alcohol. so, find the amount of these alcohol used.



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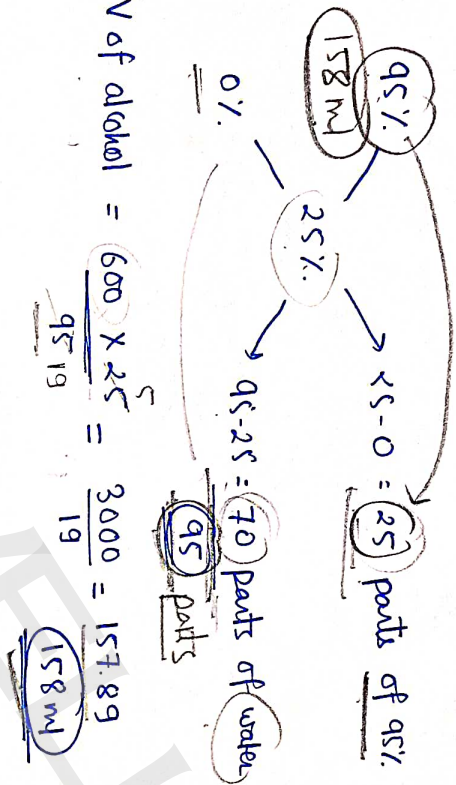
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Examples:

- ① Calculate the amount of 95% alcohol required to prepare 600 ml of 25% in water.



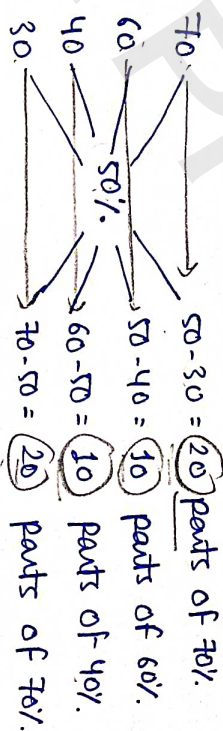
- ② How much ml of 20% dextrose in water and 50% dextrose in water are mixed to make 750 ml of 35% dextrose in water.
- ⇒
-
- 50%
 20%
 35%
 $50 - 35 = 15$ parts of 20%
 $35 - 20 = 15$ parts of 50%
 30 parts

• V. of dextrose - for 20% ⇒ V. required x % required

$$= \frac{750\text{ ml} \times 35}{30} = 375\text{ ml} \quad \text{same for } 50\%.$$

∴ same 15 parts.

- ③ Calculate the amount of 70%, 60%, 40% & 30% alcohol that should be mixed to get 50% alcohol.
- ⇒ Arrange in descending order



By mixing these parts, we will produce 50% alcohol.

- ④ How much ointment having a 10% drug concⁿ and 15% drug concⁿ must be used to make 1kg of a preparation containing 12.5% drug concⁿ.
- ⑤ Calculate the volume of each of 90%, 60%, 40% and water are required to produce 500 ml of 50% alcohol.

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• Alcohol dilution → mixing in alcohol

$$(H) \frac{\text{Volume of strong}}{\text{percentage}} = \frac{\text{percentage required}}{\text{Percentage higher}} (L)$$

(L) Volume Required = Percentage higher (H)

eg) calculate the amount of (95%) alcohol required to prepare 600ml of (25%).

$$\frac{x}{600} = \frac{25}{95}, \quad x = \frac{25 \times 600}{95}$$

$$x = 158 \text{ ml}$$

eg) If 500 ml of (90%) alcohol is diluted to 1000 ml, then calculate the % of diluted alcohol.

$$\frac{500}{1000} = \frac{x}{90}, \quad x = \frac{90 \times 500}{1000} = 45\%$$

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 the U.S.A. 50% (by volume) C_2H_5OH (alcohol) is considered to be 100 proof.

• But in India, (57.1) Volumes of C_2H_5OH (alcohol) are considered equal to 100 volume of proof spirit.

• This means that "any alcoholic solution that contain 57.1% v/v alcohol is a proof spirit."

(57.1ml alcohol in 100 ml of water.)

$$100^\circ \text{ proof spirit} = 57.1\% \text{ v/v alcohol}$$

• It is of two types :-

① If the strength of alcohol is more than 57.1% then it is called **Over Proof** (o.p.p). °O/P

② If the strength of alcohol is less than 57.1% then it is called **Under Proof** (u.p.p). °U/P

• Conversion :-

conversion of proof spirit into percentage [OR] conversion of percentage into proof spirit.

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eg) Convert 90% v/v alcohol into proof spirit:

$$\rightarrow 57.1\% \text{ v/v alcohol} = 100 \text{ volume of proof spirit}$$

$$\underline{1\% \text{ v/v alcohol}} = \frac{100}{57.1} = \underline{1.753} \text{ volume of proof spirit}$$

$$\cdot \text{So, in } 90\% \text{ v/v} = (90 \times 1.753) - 100$$

$$= 157.77 \text{ volume of proof spirit}$$

$$= 157.77 - 100 = \underline{57.77 \text{ O/P}^\circ}$$

$$\cdot \text{for } 70\% \text{ v/v} = (70 \times 1.753) - 100$$

$$= 122.71 - 100 \Rightarrow \underline{22.71 \text{ O/P}^\circ}$$

eg) what strength of 30° O/P and 40° v/P

$$\rightarrow \text{for } 0\text{P} = \frac{100 + \text{Value}}{1.753}$$

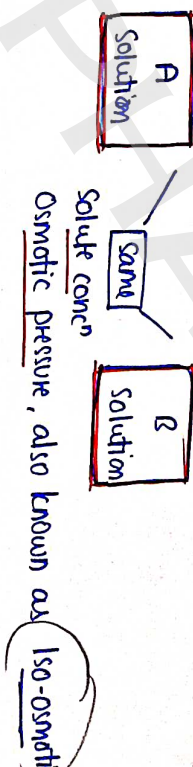
$$\text{for } 0\text{V/P} = \frac{100 - \text{Value}}{1.753}$$

$$\circ \text{for } 30^\circ \text{ O/P} = \frac{100 + 30}{1.753} = \frac{100 + 30}{1.753} = \frac{130}{1.753}$$

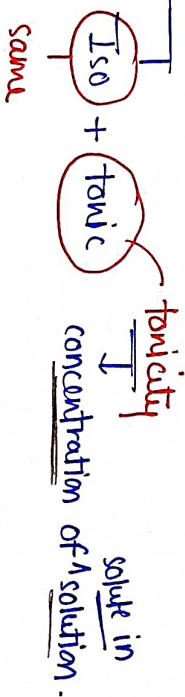
$$\circ \text{for } 40^\circ \text{ v/P} = \frac{100 - 40}{1.753} = \frac{60}{1.753} = \underline{34.23\% \text{ v/v}}$$

ISOTONIC SOLUTIONS

• These are those solution in which the solute concentration of one solution is same as the solute concentration of another solution.



• Isotonic



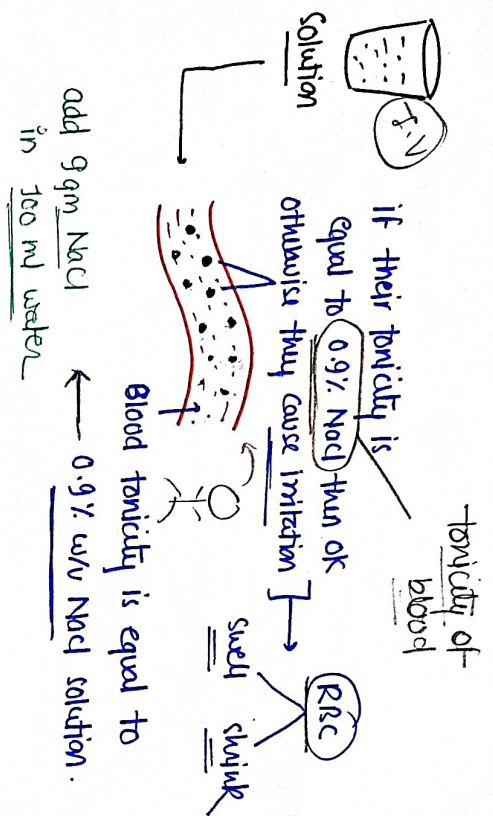
eg) 0.9% w/v solution of NaCl.

• The concept of isotonicity is used during preparation of medicaments/iv fluids for body.

- Because, if the tonicity of these medicaments is different than blood or body fluids, then they cause irritation or maybe serious damage.

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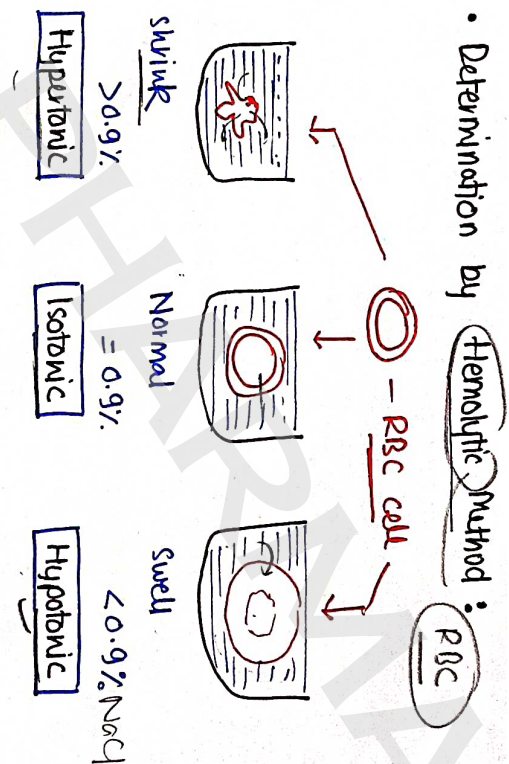


So, isotonic solution are those solution which contain 0.9% w/v solution of NaCl.

OT is of three types :-

- i) Hypertonic solution → If the solute concentration of solution is greater than 0.9% NaCl solution.
- ii) Isotonic solution → When the solute concentration of any solution is equal to 0.9% NaCl solution.
- iii) Hypotonic solution → When the solute concentration of any solution is less than 0.9% NaCl solution.

penetrative → Hypo + Hyper



Method of adjusting tonicity :-

If the tonicity of solution is not isotonic, then we have to make it isotonic.

- two methods :-
- i) freezing point method
 - ii) Molecular weight method
 - i) freezing point method →

This method is basically used for hypotonic solution.

In this, Sodium Chloride (adjusting soln) is added in solution to make it isotonic.

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$$w\% = \frac{0.52 - a}{b}$$

isotonic

where, $w\%$ = amount of adjusting substance (NaCl)

a = freezing of 1% solution of unadjusted solⁿ

b = freezing point of 1% solⁿ of adjusting solⁿ.

freezing point of = freezing point of drug + freezing point of adjusting substance.

eg) find the concⁿ of NaCl required to make

1.5% solⁿ of boric acid isotonic with blood.

[f.p. of boric acid \rightarrow -0.29°C , NaCl \rightarrow -0.58°C]

$$w = \frac{0.52 - (0.29 \times 1.5)}{0.58} = \frac{0.52 - 0.43}{0.58} = \frac{0.09}{0.58}$$

= 0.15% or 0.15g in 100ml required.

eg) for 1% solⁿ of cocaine hydrochloride.

$$w = \frac{0.52 - 0.09}{0.58} = \frac{0.43}{0.58}$$

= 0.74% or 0.74gm in 100 ml

ii) Molecular weight method \rightarrow

This method is basically used for hypertonic solution.

% of adjusting substance (M) = $\frac{0.03M}{N}$

where, M = Gram molecular weight of substance
 N = No. of ions into which the substance is ionized.

eg) find the concⁿ of NaCl required to produce

a solⁿ isotonic with blood plasma.

\rightarrow Molecular weight of NaCl = 58.5

ions = NaCl \rightarrow $\text{Na}^+\text{Cl}^- \rightarrow 2$

$$\% M = \frac{0.03 \times 58.5}{2}$$

= 0.88% or 0.9% or 0.9gm in 100 ml

9 gm NaCl dissolved in 100ml.

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