PHARMACEUTICAL CALCULATIONS

There are two systems of weights and measures:

(A) The imperial System.
(B) The metric System.

A) The Imperial System.

It is an old system of weights & measures.

→ Measurements of weights in imperial system.

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

~~two types~~

i) Avoirdupois system
ii) Apothecaries System.

i) Avoirdupois System:

In this system pound (lb) is taken as the standard of weight (mass).

1 pound avoir (lb) 16 (oz) avoir. oz is pronounced as ounce.
1 pound avoir (lb) 7000 grains (gr)

ii) Apothecary or Troy system:-

In this system grain (gr) is taken as the standard of weight (mass).

1 pound apoth (lb) 12 ounce (℥) 1 pound apoth (lb) = 5760 grains (gr)
1 ounce (℥) 8 drachms (ʒ)
1 drachms (ʒ) 3 scruples (℈)
1 scruple (℈) 20 grains (gr)

B) Metric System

'Kilogram' is taken as the standard weight (mass).

1 kilogram (kg)	1000 grams (g)	kilo = 1000 Greek word
1 hectogram (hg)	100 grams (g)	Hecto = 100 Greek "
1 dekagram (dg)	10 grams (g)	Deka = 10 " "
1 gram (g)	1 gram (g)	
1 decigram (dcg)	1/10 gram (g)	Deci = 1/10 Latin word
1 centigram (cg)	1/100 gram (g)	Centi = 1/100 Latin "
1 milligram (mg)	1/1000 gram (g)	milli = 1/1000 " "
1 microgram (ug, mcg)	10^{-6} gram (g)	Micro = 10^{-6}
1 nanogram (ng)	10^{-9} gram (g)	Nano = 10^{-9}

1 drop	0.06 ml
1 teaspoonful	5 ml
1 dust spoonful	8 ml
1 table spoonful	15 ml
1 wine-glassful	60 ml
1 teacupful	120 ml
1 tumblerful	240 ml

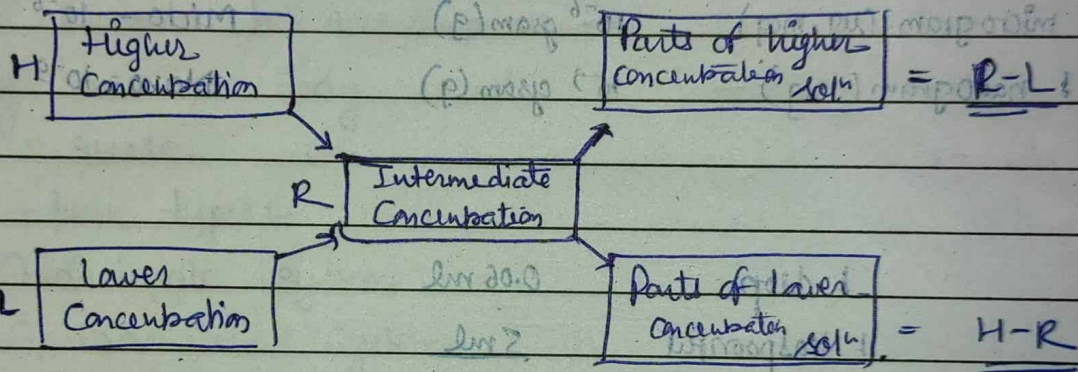
1 kilogram	2.2 pands (lb)
1 grain	65 mg
1 ounce apoth	30 g
1 pand avdr	450 g

• Calculation By Allegation Method :-

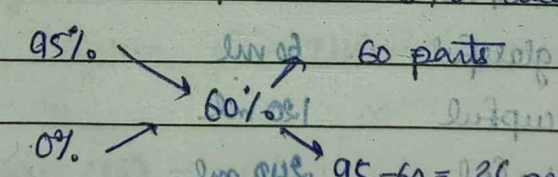
These types of calculations involve the mixing of two similar preparations, but of different strengths, to produce a preparation of intermediate strength.

The name is derived from the latin alligatio, meaning the act of attaching and hence refers to the lines drawn during calculations to bind quantities together.

Method :-



⇒ **Ex:-** Prepare 600 ml of 60% v/v alcohol from 95% v/v alcohol.



Soln :- Higher Conc^{n} → 95%
Required " → 60%
Lower " → 0% (i.e. water)

So,
Volume of 60% alcohol soln = 600 ml

∴ the volume of 95% alcohol required.

$$\Rightarrow \frac{60}{35+60} \times 600 = \frac{60}{95} \times 600 = \frac{36000}{95} \approx 378.94$$

$$\approx \boxed{379 \text{ ml}}$$

• Percentage Calculations

• Weight in volume (w/v) :- Required to express concentration of solid into liquid.

$$\% \, w/v = \frac{\text{weight of solute (g)}}{\text{volume of solvent (ml)}} \times 100$$

• Weight in weight (w/w) :- Required to express concentration of a solid in solid.

$$\% \, (w/w) = \frac{\text{Weight of solute}}{\text{Weight of solvent}} \times 100$$

• volume in volume (v/v) :- Required to express concentration of a liquid in another liquid.

$$\% \, v/v = \frac{\text{Volume of solute}}{\text{Volume of solvents}} \times 100$$

• Dilution of Dosage forms :-

A concentrated soln can be diluted. Powders and other solid mixtures can be triturated or diluted to yield less concentrated forms. Because the amount of solute in the diluted soln or mixtures is the same as the amount in the concentrated soln or mixture, the following relationship applies to dilution problems.

Quantity of soln 1 (Q_1) × Concentration of Sol 1 (C_1) = $Q_2 \times C_2$;

$$\boxed{Q_1 C_1 = Q_2 C_2}$$

LIQUID DOSAGE FORM

Liquid dosage forms are designed to provide the maximum therapeutic response in a target population with the difficulty swallowing tablets and capsules and to produce rapid therapeutic effects.

"A sol" is a liquid preparation that contain one or more soluble chemical substance dissolved in a specified solvent".

Advantage of liquid dosage form:-

1) Easier to swallow therefore easier for children, old age, unconscious people.
2) May be designed for any route of administration.
3) More quickly effective than tablets and capsules. As drug become available immediatly for absorption.
4) Homogenous therefore give uniform doses than suspension or emulsion which need shaking.
5) Flexible dosing.

Disadvantage of liquid dosage form:-

1) Bulky, therefore difficult to transport and store.
2) Unpleasant tastes or odours are difficult to mask.
3) Needs an accurate spoon to measures the dose.
4) Less stable than solid dosage form. [colour change].
5) Some drugs poorly soluble.

Excipients used in formulation of liquid dosage form:-

Liquid formulations need a meticulous blend of ingredients to perform various finctions like wetting and solubilization, stabilization and to impart suitable colour, taste and viscosity.

① **Vehicles** (Vehicles) :- In pharmaceutical formulations, are the liquid bases that carry drug and other excipient in dissolved or dispersion medium.

- Aqueous vehicles: Water, hydro-alcoholic, polyhydric alcohols and buffers. These may be thin liquids, thick syrupy liquids, mucilages or hydro-colloidal bases.
- Oily vehicles: Vegetable oils, mineral oils, organic oily bases, or emulsified bases.

- **Aqueous** :-

i) **Water** :- It is the most useful solvent in the pharmacy. It should be clear, odourless and neutral with slight deviation in pH. Purified water USP is allowed for usage as vehicle for rescue impurity. and it is obtained by distillation, ion exchange process or Reverse Osmosis [RO].

ii) **Alcohol** (Ethyl alcohol) :- Next to water, alcohol is the most useful solvent in pharmacy. It is invariably used as hydro-alcoholic mixture that dissolves both water USP & Alcohol USP in soluble form.

- **Glycerol** :- It is an excellent solvent for minerals substances such as iodine, bromine etc. It is a good vehicle for applying these substance to the skin and to sores.
- It is clear, colorless liquid, with thick, syrupy consistency, oily to the touch, odorless, very sweet and slightly warm to the taste.
- It is also used to improve viscosity, taste & flavour and also used as a co-solvent to increase solubility of drug that show low solubity in water.

• Propylene Glycol:- It is an outstanding solvents for many organic compands.
• Used as for flavouring & dyes in cosmetics, toothpastes, shampoo and mouthwashes.

2. Solubilizers

(i) Wetting Agents and Surfactants :-
• Used to create a homogenous dispersion of solid particles in a liquid vehicle.
eg :- Aqueous vehicle → Alcohol, glycerin etc. are frequently used to facilitate the removal of adsorbed air from the surface of particles.
• Non-Aqueous → mineral oil is commonly used as a wetting agent.

• Typically, hydrophobic API particles are not easily wetted even after the removal of adsorbed air. Hence, it is necessary to reduce the interfacial tension b/w the particles and the liquid vehicle by using a surface active agents [surfactants].
eg :- Sodium lauryl sulphate . etc.

(ii) pH Modifiers and Buffering Agents :-
The pH of an oral liquid formulation is a key point in many regards. Control of the formulation pH, could prevent large changes during storage. Therefore, most formulation utilize a buffer to control potential change in the soln pH.

(iii) Suspending Agents and Viscosity-modifying agents
One of the most crucial factors involving in formulating a pharmaceutical suspension is the selection of an appropriate suspending agent. Suspending agent impart viscocity and thus retard particle sedimentation.

(iv) Preservatives :- It prevent the growth of microorganism during the product's manufacture and shelf life, although it may be most desirable to develop a 'preservative-free' formulation to address the increasing concern about the biological activity of these compands.

OR

- It is a substances that are used for keeping food, drugs, chemicals, medicines etc, in good conditions for long duration.

eg :- Benzoates, Phenol, Alcohol etc.

- Stabilizers

i) Antioxidants :- It can be compands that can reduce a drug that has been oxidized, or compands that are more readily oxidized than the agents they are to protects (oxygen scavengers).

eg :- Acetone, Ascorbic acid, Cysteine, Sodium thiosulphate etc.

- Special Emphasis on Organolephic additives.

i) Flavouring agents :-

They are used to improve the taste of the product either by providing a more pleasant taste or by masking the unpleasant taste.

eg :- Glycerin, Mint, fruit, honey etc.

ii) Sweetening Agents :- Material that are used to impart sweetness to a preparation are referred to as sweetening agents. four primary tastes, (sweet, sour, bitter, saline)

eg :- Sucrose, Saccharin sodium, glycerin, dextrose etc.

iii) Colaring Agents :- Used for colouring of drug. The colouring agents are included in the dosage form not only to improve the attractiveness of the product but also to enable easy product identification, particularly in ~~poisonin~~ poisonous materials.

eg :- Chlorophyll, carotenoids, anthocyanins etc.

V. Imp :- Technique for solubility Enhancement

When the solubility of substance in aqueous media is limited ; various technique have been used in attempt to improve solubility and dissolution rates of poorly water soluble drug.

1) PH Adjustment :-

Poorly water soluble drug with parts of the molecules that can be protonated (base) or deprotonated (acid) may potentially be dissolved in water by applying a pH change.

2) Co-solvency method :-

By the adding water miscible solvent in which the drug has good solubility, the solubility of a poorly water soluble drug can be increased frequently. know as co-solvent also known as solvent bleeding.

ex :- ~~water~~, Alcohol, acetic acid, Glycerin, ethanol etc.

3) Particle size reduction :-

The solubility of drug is often intrinsically related to drug particle size ; as a particle size become smaller, the surface area to volume ratio increases. The larger surface area allow greater interaction with the

solvent, which cause an increase in solubility.

4) Solid dicpersion :-
In 1961, Sekiguchi and Obi first introduce the solid dispersion to increase the dissolution and oral absorption of poorly water soluble drugs.
In solid dispersion, A poorly soluble drug dispersed in a highly soluble solid hydrophilic matrix, which enhances the dissolution of the drug which can yield eutectic [non-molecular level mixing] or solid solution. [molecular level mixing] products.

5) Hydrotropy method :- In this method, By adding large amount of secondary solute increase the aqeous solubility of water insoluble drug.

6) Self-emulsifying System :-
Self emulsifying drug delivery system [SEDDS] or Self micro-emulsifying drug delivery system [SMEDDS] are the important methods to improve the solubility and bioavaility of poorly water ~~drug~~ soluble drug.
SEDDS are defined as isotopic mixture natural and synthetic oil, solid or liquid surfacant or alteratie, one or more hydrophilic solvent and co-solvent/surfacent.
SEDDS produce emulsion with a droplet size 100-300 while SMEDDS form transparent micro-emulsion with a droplet size less than 50 nm.

7) Complexation :-

It is the association b/w two or more molecules to form a aqueous non-bonded entity with a well defined stochiometry. In complexation relatively weak forces such as london forces, hydrogen bonding and hydrophobic interactions involved.

- Mechanism of hydrotropes :-

Hydrotropes are the compound having both an anionic group and a hydrophobic aromatic ring or ring system.

→ mechanism is related to complexation which involves interaction b/w lipophilic drugs and the hydrotropic agents such as Urea, sodium benzoate, etc..

eg :-

Gliptizide :- Sodium benzoate, Sodium acetate, Sodium salicylate

Solid Dosage form

- Unit Dosage form
  - Tablets
  - Capsules
  - Powders
  - Pills
- Bulk Dosage form
  - Internal
    - fine Powder
    - Granules & effervescant powders
  - External
    - Dusting powder
    - Insufflations
    - Snuff
    - Dentifrices [tooth powders]

These are those solid dosage form when drug are to be administrated orally in dry state, tablets, capsules and some are in bulk powder meant fore external & internal.

Powders

POWDERS

A pharmaceuticals powder is a mixture of finely divided drugs or chemicals and meant for external and internal use, it is in dry form & solid dosage form.

They are available in crystalline or amorphous form.

- Advantage of Powders.
  - → Powders are one of the oldest dosage form and are used both internally & externally.
  - → These are more stable than liquid dosage form
  - → It has less chances of incompatibility as compared to liquid dosage form.
  - → Easy to store than other form.

Disadvantages

- Drugs having bitter, nausears and unpleasant taste cannot be dispensed in powdered form.
- Quantity less than 100 mg cannot be weigh eas
- Drugs may affected by atmospheric conditions.
- The dispensing of powder is time consuming

Method of preparations of Powders

We can prepared powder by mixing two or more ingredients in a suitable vehicle to make a stable powder mixes.

Mixing of Powder

(1) Spatulation → In this method, mixing of powder is done by the movement of a spatula throughout the powder on a sheet of paper or on a porcelain tile. It is mostly useful in mixing of small quantity of powders or those substance who liquefy or form eutechic mixture

(2) Trituration → It is used both to reduce particles size and mix powdys. If particles size reduction is desired along with mixing of powder, we use pestle mortar whose inner surface is rough.

(3) Tumbling → It is the process of mixing of powders in a large containers rotated by an electric motors.

imp.

difference

- **Simple powder and Compound powders**

(a) • Simple ⇒ A simple powder contain only one ingredient either in crystalline or amorphous form. When the powder is in crystalline form, it is reduced to fine powder, weighed the powder and divided into no. of doses and wrapped as individual doses.

Ex ⇒

Rx	
Aspirin	300 mg
Make powder	

Direction ⇒ One powder to be taken after every eight hour
Method ⇒ Powders the aspirin and weigh the required quantity of aspirin. Weigh 300 mg of aspirin for each powder. Wrap each doses in individual powder paper. Prepare six such powder and dispense it.

(b) • Compound ⇒ Compound powder contain two or more than two ingredient (substances) which are mixed together and then divided into desired number of individual doses. which are dispensed into each powder paper.

ex ⇒ Dispense eight powder of A.P.C.

Rx	
Aspirin	300 mg
Paracetamol	150 mg
Caffeine	50 mg
Make a powder	

Direction ⇒ One powder to be taken when need arises.
method ⇒ weigh each ingredient. mix with ascending or their weigh. Weigh 500 mg of mixed powder. wrap each dose in individual paper & dispense it.