Program	B. Pharmacy
Semester	1st semester
Subject /Course	General Pharmacy (Theory)
Subject/Course ID	BP 102T
Module No.	02
Module Title	Introduction to Pharmaceutical Calculations and Dosage Forms
Course coordinator	Dr. Gurjeet Singh

Learning Outcome of Module-

LO	Learning Outcome (LO)	Course Outcome Code
LO1	Apply the metric system and scientific notation to solve complex pharmaceutical calculations, including alligation, isotonic solutions, and proof spirits.	BP102.2
LO2	Calculate accurate drug dosages based on patient-specific factors such as age, body weight, and body surface area using posology principles.	BP102.2
LO3	Categorize various pharmaceutical dosage forms based on their physical state and intended routes of administration.	BP102.2
LO4	Differentiate between Active Pharmaceutical Ingredients (APIs) and excipients, identifying the ideal characteristics and importance of each.	BP102.2
LO5	Execute precise mathematical dilutions using percentage, ratio, and geometric dilution methods.	BP102.2

Module Content Table

No.	Topic
1.	Metric system of weights and measures; calculations based on alligation, proof spirit, isotonic solutions, dilute solutions (percentage and ratio) and geometric dilution; scientific notation of units and measures
2.	Posology: Definition and dose calculation based on age, body weight and body surface area.
3.	Posology: Definition and dose calculation based on age, body weight and body surface area.
4.	Introduction to Active Pharmaceutical Ingredients and Excipients: Definition, ideal characteristics and importance.

PHARMACEUTICAL CALCULATIONS: WEIGHTS AND MEASURES (IMPERIAL & METRIC SYSTEM)

In pharmacy practice, accurate measurement is the foundation of safe drug preparation and dispensing. Whether a pharmacist is compounding a formulation, calculating a dose, reconstituting a suspension, or measuring ingredients for a prescription, a precise understanding of weights and measures is essential. Traditionally, two systems have been widely used in pharmaceutical calculations—the **Imperial system** and the **Metric system**. Although the Metric system is now the global standard, knowledge of both remains important because many older prescriptions, reference books, and drug labels may still use Imperial units.

Metric System

The **Metric system** is the most widely accepted system in modern pharmacy due to its simplicity, decimal structure, and easy unit conversion. Units are based on multiples of 10, which reduces calculation errors.

Basic Units

- **Weight:** gram (g)
- **Volume:** liter (L)
- **Length:** meter (m)

Table: Common Metric Prefixes

Prefix	Symbol	Value
Kilo	kg	1,000 units
Hecto	h	100 units
Deca	da	10 units
Base Unit	—	1
Deci	d	0.1
Centi	c	0.01
Milli	m	0.001
Micro	μ	0.000001
Nano	n	0.000000001

Pharmacy-Relevant Conversions

- 1 kilogram (kg) = 1,000 g
- 1 gram (g) = 1,000 mg
- 1 mg = 1,000 mcg
- 1 liter (L) = 1,000 mL
- 1 mL = 1 cc (cubic centimeter)

Because of its decimal structure, converting between units simply requires shifting the decimal point.

Imperial System

The **Imperial system** (also called the Apothecary or British system) was historically used in medicine and pharmacy. Although it is less common today, it is still important for understanding old prescriptions, some drug concentrations, and certain household measurements.

Weight Units

- **Pound (lb)**
- **Ounce (oz)**
- **Dram (dr)**
- **Grain (gr)**

Important

Conversions

- **1 pound = 16 ounces**
- **1 ounce = 8 drams**
- **1 dram = 60 grains**
- **1 grain (gr) = approximately 65 mg** (commonly approximated as 60–65 mg in practice)

Example:

5 grains = 5 × 65 mg = 325 mg

This is why a common paracetamol tablet is 325 mg—it originated from the 5-grain standard.

Volume Units

- **Gallon**
- **Quart**
- **Pint**
- **Fluid ounce (fl oz)**
- **Fluid dram (fl dr)**
- **Minim**

Volume

Conversions

- **1 gallon = 4 quarts**
- **1 quart = 2 pints**
- **1 pint = 16 fl oz**
- **1 fl oz = 8 fl dr**
- **1 fl dr = 60 minims**

Imperial–Metric Cross Conversions These are widely used in pharmacy practice:

- **1 fl oz ≈ 30 mL**
- **1 pint ≈ 473 mL**
- **1 quart ≈ 946 mL**
- **1 gallon ≈ 3,785 mL (3.8 L)**
- **1 grain ≈ 65 mg**
- **1 ounce (weight) = 28.35 g**

Common Household Measurements Used in Pharmacy

These are often used for patient instructions:

- **1 teaspoon (tsp) = 5 mL**
- **1 tablespoon (tbsp) = 15 mL**
- **1 cup = 240 mL**

CALCULATIONS INVOLVING PERCENTAGE SOLUTIONS

Percentage solutions express the amount of solute in a 100-unit quantity of solution. They are widely used in pharmacy for preparing injections, disinfectants, oral liquids, and topical products.

Types of Percentage Solutions

(a) Weight/Volume Percent (w/v)

Used when a **solid** is dissolved in a **liquid**.

Definition: Amount of solute (g) in 100 mL of solution.

Formula:

$$\%\,w/v = \frac{\text{grams of solute}}{100\ \text{mL}}$$

Example:

Prepare 250 mL of a 4% w/v NaCl solution.

4 g in 100 mL → In 250 mL = (4 × 250)/100 = **10 g NaCl**.

(b) *Volume/Volume Percent (v/v)*

Used when **both solute and solvent are liquids**.

Definition: mL of solute in 100 mL solution.

Example:

Make 500 mL of 20% v/v ethanol solution:

20 mL in 100 mL → In 500 mL = 100 mL ethanol.

(c) *Weight/Weight Percent (w/w)*

Used mostly for **ointments, creams, gels**.

Definition: Grams of solute in 100 g of product.

(d) *Percentage Strength Conversion*

- **1% w/v = 10 mg/mL**

- **1% w/w = 10 mg/g**

ALLIGATION METHOD

Alligation is a simple arithmetic tool for mixing two concentrations to get a desired concentration.

(a) ***Alligation Medial (Average Strength)***

Used to find the **resulting concentration** after mixing two or more solutions.

Formula:

$$\text{Final strength} = \frac{\sum(\text{quantity} \times \text{strength})}{\sum \text{quantity}}$$

(b) ***Alligation Alternate (To find ratio of mixing)***

Used to find the **proportion of two strengths** needed to prepare a required strength.

Steps:

1. Write higher strength on top left.
2. Write lower strength bottom left.
3. Write required strength in between.
4. Subtract diagonally to get the ratio.

PROOF SPIRIT

Proof spirit is a historic alcohol measurement system based on the ability of alcohol to ignite.

Definition:

“N/100 over proof” or “under proof” indicates how much stronger or weaker

the alcohol is compared to standard proof spirit.

Standard Values

- **100° proof = 57.1% v/v alcohol**
- **Under-proof (U.P.)** → weaker ethanol
- **Over-proof (O.P.)** → stronger ethanol

Formula to Convert Proof Spirit to % Alcohol

$$\%\text{Alcohol} = \frac{\text{Proof degrees} \times 57.1}{100}$$

ISOTONIC SOLUTIONS

Isotonic solutions have the **same osmotic pressure** as body fluids (blood plasma, tears), ensuring that no cell swelling or shrinking occurs.

Two main methods are used for calculations:

4A. Method Based on Freezing Point

Depression Principle:

Body fluids freeze at **–0.52°C**.

To make a solution isotonic, its freezing point should also be reduced by **0.52°C**.

Formula:

$$\text{Amount of drug (isotonic)} = \frac{0.52 - \Delta T_f(\text{drug})}{\Delta T_f(1\%\ \text{NaCl})}$$

where

ΔTf = freezing point depression.

4B. Molecular Weight (i-value)

Method

Isotonic concentration depends on **number of particles**, not mass. Use **osmotic coefficient (i)** and molecular weight.

Formula (Van't Hoff):

$$\text{Osmotic pressure} = i \times \frac{w}{M}$$

To make isotonic, compare with NaCl (normal saline):

$$\text{Sodium chloride equivalent (E-value)} = \frac{17}{MW/i}$$

Here, **17 = isotonic equivalent of NaCl in mg/mL**.

POSOLOGY: DEFINITION AND FACTORS AFFECTING POSOLOGY

Posology refers to the science and study of **drug dosage**. It deals with determining the right amount of a drug that should be administered to a patient to achieve the desired therapeutic effect without causing harm. In other words, posology explains *how much* of a medicine should be given, *how often*, and *for how long*, keeping in mind the patient's age, weight, health condition, and several other factors. Choosing the correct dose is crucial because too small a dose may fail to produce any benefit, while too large a dose may lead to toxicity or severe side effects. Hence, posology ensures the safe and effective use of medicines.

Factors Affecting Posology

The dose of a drug cannot be the same for every patient. Several physiological, pathological, and external factors influence how much medicine a person should receive. Important factors affecting posology include:

1. ***Age of the Patient***
   - Drug doses differ for infants, children, adults, and elderly patients.
   - Children require smaller doses because their organs are still developing, while older people may need dose adjustments due to reduced organ function.
2. ***Body Weight***
   - Many drugs are prescribed on a **mg/kg** basis, especially in pediatrics.
   - Overweight or underweight individuals may need dose modifications to avoid toxicity or inadequate response.
3. ***Gender***
   - Biological differences may influence drug metabolism.
   - Hormonal variations in females and body composition differences between males and females can sometimes require dose adjustments.
4. ***Physiological Condition***
   - Pregnancy, lactation, menstruation, and old age can affect how the body handles drugs.
   - Pregnant and breastfeeding women need specially adjusted doses to protect both mother and baby.
5. ***Pathological Condition***
   - Diseases such as kidney failure, liver disorders, heart conditions, or severe

infections can affect how drugs are absorbed, metabolized, or eliminated.

- Patients with organ impairment often require reduced doses.

6. ***Tolerance***

- Repeated use of a drug can lead to tolerance, meaning the body becomes less responsive over time.
- Such patients may need higher doses to achieve the same effect.

7. ***Drug–Drug Interactions***

- When multiple medicines are taken, they may interact with each other.
- Some drugs increase the effect of others, while some reduce it, requiring dose adjustments.

8. ***Route of Administration***

- The dose may vary depending on whether the drug is given orally, intravenously, intramuscularly, or topically.
- For example, IV doses are usually lower because the drug enters the bloodstream directly.

9. ***Time of Administration***

- Some medicines work better when taken before meals, after meals, or at bedtime.
- The body's biological rhythm (circadian rhythm) can change drug response.

10. ***Environmental Factors***

- Climate, temperature, lifestyle, and occupation can influence drug response.
- For instance, people working in very hot climates may metabolize drugs faster.

11. ***Genetic Factors***

- Genetic makeup affects how enzymes metabolize drugs.
- Some individuals are "fast metabolizers," while others are "slow metabolizers," requiring dose modifications.

12. ***Severity of the Disease***

- Mild conditions need lower doses, whereas severe illnesses may require higher or emergency doses.

Posology is a critical field that ensures every patient receives the right amount of medication. Understanding the factors influencing dose helps healthcare professionals prescribe medicines safely, effectively, and individually tailored to each patient's condition.

PEDIATRIC DOSE CALCULATIONS

Calculating drug doses for children requires special care because their bodies handle medicines differently from adults. Factors such as organ maturity, metabolic rate, and body composition play a major role in how a drug acts in pediatric patients. To ensure safety and effectiveness, several formula-based methods are used to calculate pediatric doses. The most common approaches are based on age, body weight, and body surface area (BSA).

1. ***Dose Calculation Based on Age***

Age-based formulas are simple and widely used when only the child's age is known. These formulas estimate the dose by comparing the child's age to an average adult dose.

Young's Rule (for children above 1 year)

$$\text{Child dose} = \frac{\text{Age in years}}{\text{Age} + 12} \times \text{Adult dose}$$

$$\text{Child dose} = \frac{\text{Age in months}}{150} \times \text{Adult dose}$$

Fried's Rule (for infants below 1 year)

Cowling's Rule

2. ***Dose Calculation Based on Body Weight***

$$\text{Child dose} = \frac{\text{Age last birthday}}{24} \times \text{Adult dose}$$

Weight-based dosing is more accurate than age-based methods, especially in infants and young children. Most pediatric doses today are calculated using weight.

Formula (mg per kg body weight)

$$\text{Child dose} = \text{Dose per kg} \times \text{Body weight (kg)}$$

3. ***Dose Calculation Based on Body Surface Area (BSA)***

BSA-based dosing is considered the **most accurate** for pediatric patients because it correlates better with metabolic activity than age or weight alone. It is used for drugs with narrow safety margins such as **anticancer medications, corticosteroids, and antibiotics**.

Step 1: Calculate BSA using the Mosteller Formula

$$\text{BSA } (\text{m}^2) = \sqrt{\frac{\text{Height (cm)} \times \text{Weight (kg)}}{3600}}$$

Step 2: Calculate the dose

$$\text{BSA } (\text{m}^2) = \sqrt{\frac{\text{Height (cm)} \times \text{Weight (kg)}}{3600}}$$

(**1.73 m²** is the average adult body surface area.)

DOSAGE FORMS: INTRODUCTION

Medicines are rarely given in their raw chemical state. To make them suitable for the patient, safe to take, and effective at the intended site of action, drugs are prepared in specific forms**,** known as dosage forms**.** A dosage form is simply the physical form in which a drug is presented to the patient, along with supporting ingredients called excipients. These forms help in safe delivery, accurate dosing, and better patient acceptance.

Why Dosage Forms Are Needed

Drugs differ in taste, solubility, stability, and action, so they cannot all be used directly as powders. Dosage forms help in:

1. **Accurate dose administration** – They ensure the patient receives the correct quantity of medicine each time.
2. **Protection of the drug substance** – Some medicines break down when exposed to air, light, or stomach acid. Dosage forms protect them until they reach the desired site.
3. **Masking unpleasant characteristics** – Bitter, irritating, or foul-

smelling drugs can be coated or flavored.

4. **Controlled drug release** – Some medicines need slow, prolonged release or targeted delivery.
5. **Ease of handling and patient comfort** – Tablets, capsules, and syrups improve convenience compared to crude chemicals.

Thus, dosage forms act as vehicles for delivering medicines safely and efficiently.

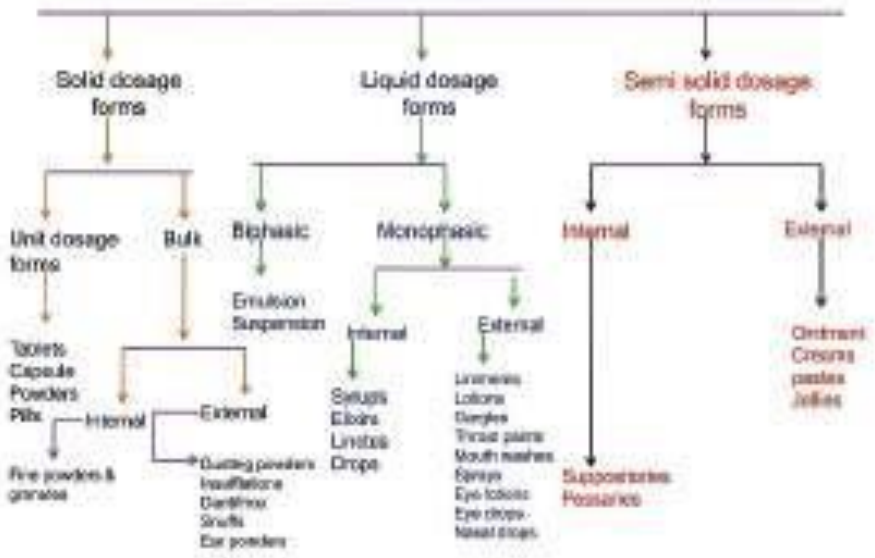
Components of a Dosage Form

Most dosage forms contain:

- **Active pharmaceutical ingredient (API)** – the actual therapeutic drug.
- **Excipients or additives** – substances that enhance stability, flow, flavor, appearance, or release properties (e.g., binders, diluents, preservatives, colorants).

Although excipients do not have therapeutic action, they are essential for product quality and performance.

CLASSIFICATION OF DOSAGE FORMS



1. ***Solid Dosage Forms***

A. **Unit Dosage Forms**

These are solid preparations designed to deliver a precise, pre-measured amount of drug per unit, ensuring uniform dosing and convenient patient administration.

Tablets

Tablets are compressed solid units containing medicament with suitable excipients, formulated to disintegrate or dissolve in bodily fluids to release the active drug.

Capsules

Capsules are solid dosage units in which drug substances are enclosed within hard or soft gelatin shells to provide tasteless swallowing and controlled release of medication.

Powders

Powders are finely divided solid medicines intended for internal or external use, enabling rapid dissolution and flexibility in dosing.

Pills

Pills are small spherical solid preparations traditionally made by mass rolling techniques, designed to deliver active drugs orally in swallowable form.

Bulk Powders

Bulk powders consist of large-quantity solid preparations supplied without unit dose division, requiring measurement before use to achieve therapeutic administration.

Internal Use Bulk Powders

Internal powders are orally administered fine or granulated solids dissolved or dispersed in liquid to produce systemic pharmacological action.

External Use Bulk Powders

External powders are medicated fine solids applied to skin, mucosa, or cavities to deliver local therapeutic effect.

a) Dusting Powders

Dusting powders are finely micronized topical formulations applied to intact skin surfaces for protective, soothing, or antifungal actions.

b) Insufflations

Insufflations are dry powder preparations intended for direct blowing into body cavities like the ear, nose, or throat for localized therapeutic action.

c) Dentifrices

Dentifrices are powdered formulations used for cleaning, polishing, and deodorizing teeth to maintain oral hygiene.

d) Snuffs

Snuffs are nasal powder preparations inhaled to produce local or systemic pharmacological effects.

e) Ear Powders

Ear powders are finely divided medicaments instilled into the ear canal to treat infections or inflammation.

2. *Liquid Dosage Forms*

A. Biphasic Liquid Dosage Forms

Biphasic liquids are heterogeneous liquid systems containing two immiscible phases requiring agitation for uniform distribution before administration.

i) *Emulsions*

Emulsions are liquid biphasic systems where one liquid is dispersed in another immiscible liquid through an emulsifying agent to enhance stability and drug delivery.

iii) Suspensions

Suspensions are biphasic liquids wherein solid drug particles are dispersed in a liquid medium and require shaking before use for dose uniformity.

B. *Monophasic Liquid Dosage Forms*

Monophasic liquids are homogeneous solutions where active drugs are dissolved in suitable solvents for uniform distribution and ready absorption.

Internal Monophasic Liquids

These are oral solutions designed to deliver dissolved active medicaments systemically via rapid gastrointestinal absorption.

a) Syrups

Syrups are sweetened, viscous oral solutions used to enhance patient compliance while delivering dissolved medication.

b) Elixirs

Elixirs are clear, sweetened hydro-alcoholic oral solutions formulated to solubilize drugs requiring alcohol for stability or dissolution.

c) Linctus

Linctuses are viscous oral preparations intended for slow swallowing to soothe irritated mucosa, commonly used in cough management.

d) Drops

Oral drops are concentrated liquid medications administered in small measured volumes for pediatric, geriatric, or precision dosing.

External Monophasic Liquids

These are liquid solutions applied externally to skin or mucosal surfaces for localized therapeutic activity.

e) Liniments

Liniments are oily or alcoholic solutions rubbed onto skin to produce counter-irritant, analgesic, or stimulant effects.

f) Lotions

Lotions are thin liquid preparations applied externally to large skin areas for soothing, protective, or medicinal purposes.

g) Gargles

Gargles are aqueous solutions used to rinse the throat and oral cavity for antiseptic, soothing, or cleansing effects.

h) Throat Paints

Throat paints are concentrated medicated solutions applied locally to throat and oral mucosa for prolonged therapeutic action.

i) Mouth Washes

Mouth washes are liquid antiseptic or cleansing formulations swished in the oral cavity to maintain hygiene and reduce microbial load.

j) Sprays

Sprays are dispersion systems administered under pressure to deliver liquid or semi-solid medication as droplets over skin or mucosa.

k) Eye Lotions

Eye lotions are sterile irrigating solutions used to cleanse or soothe ocular tissues.

l) Eye Drops

Eye drops are sterile liquid preparations instilled into the conjunctival sac for local ophthalmic therapeutic action.

m) Nasal Drops

Nasal drops are sterile aqueous or oily medications instilled into the nostrils to achieve local or systemic nasal therapy.

3. *Semi-Solid Dosage Forms*

A. Internal Semi-Solid Dosage Forms

These are shaped, semi-solid medicated masses intended for insertion into body cavities where they melt, soften, or dissolve to exert localized or systemic effects.

i) *Suppositories*

Suppositories are molded solid preparations inserted into rectal, vaginal, or urethral cavities, where they melt at body temperature to release drugs.

iii) Pessaries

Pessaries are vaginal semi-solid dosage units designed to deliver therapeutic agents for local action such as antifungal or antiseptic treatment.

b. External Semi-Solid Dosage Forms

These are semi-solid pharmaceutical preparations applied externally on skin or mucosa for localized drug delivery and protective effects.

i) *Ointments*

Ointments are greasy semi-solid formulations intended for topical application where they produce occlusive, emollient, or medicated effects.

ii) *Creams*

Creams are semi-solid emulsions with a lighter consistency designed for smooth spreading over skin to deliver active agents without excessive greasiness.

iii) *Pastes*

Pastes are stiff semi-solid preparations containing high solid content, applied topically to adsorb secretions and protect the skin.

iv) *Jellies*

Jellies are translucent, water-rich semi-solid systems applied to mucosal surfaces for soothing, lubricating, or medicated action.

Active Pharmaceutical Ingredients (APIs) and Excipients

The transformation of a chemical substance into a safe, effective, and stable medication is the core of pharmaceutical science. Every dosage form (tablet, capsule, injection) is essentially a combination of two distinct categories of components: the **Active Pharmaceutical Ingredient (API)** and the **Excipients**.

1. Active Pharmaceutical Ingredients (APIs)

Definition

An **Active Pharmaceutical Ingredient (API)** is the biologically active component of a drug product. It is the specific chemical compound or biological substance intended to furnish pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease. In simpler terms, the API is the "drug" itself that targets the physiological site to produce a healing effect.

Ideal Characteristics of an API

For an API to be successfully integrated into a medicine, it should ideally possess the following traits:

- **High Purity:** It must be free from synthesis-related impurities, heavy metals, and residual solvents.
- **Potency:** It should be effective at low doses to minimize the physical size of the dosage form.
- **Stability:** It must remain chemically and physically stable under various environmental conditions (light, heat, humidity).
- **Solubility and Permeability:** To be absorbed into the bloodstream, it must dissolve in biological fluids and cross cellular membranes.
- **Uniform Particle Size:** Crucial for ensuring that every tablet or dose contains the exact same amount of drug.
- **Safety Profile:** It should have a high therapeutic index, meaning the dose required for treatment is much lower than the dose that causes toxicity.

Importance of APIs

The API is the "engine" of the medication. Its importance includes:

1. **Therapeutic Effect:** It is solely responsible for curing or managing the condition.
2. **Dosage Determination:** The strength of the medication (e.g., 500mg Paracetamol) is defined by the amount of API.
3. **Regulatory Focus:** Most clinical trials and FDA/EMA regulations focus on the safety and efficacy of the API.

2. Pharmaceutical Excipients

Definition

Excipients are the "inactive" substances formulated alongside the API. While termed "inactive" because they do not have a medicinal effect on the disease, they are functionally essential. They serve as the vehicle or medium for the API.

Ideal Characteristics of an Excipient

An ideal excipient should be:

- **Pharmacologically Inert:** It must not have any medicinal effect of its own.
- **Chemically Compatible:** It must not react with the API or other excipients.
- **Non-Toxic:** It must be safe for human consumption or application.
- **Organoleptically Acceptable:** Should not have an unpleasant taste, odor, or color (unless intended).
- **Cost-Effective:** Must be economical for mass production.
- **Regulatory Approved:** Generally Recognized as Safe (GRAS).

Importance of Excipients

Without excipients, most APIs could not be administered. Their roles include:

1. **Bulk/Volume:** Many APIs are potent at doses as small as 1mg. Excipients (diluents) add bulk so the tablet is large enough to handle.
2. **Stability:** They protect the API from degradation by moisture or oxidation.
3. **Bioavailability:** Some excipients help the drug dissolve faster in the stomach, increasing absorption.
4. **Patient Compliance:** Flavors and coatings make bitter medicines easier to swallow.

3. Classification of Common Excipients

Category	Function	Examples
Diluents (Fillers)	Provide bulk to the tablet.	Lactose, Starch, Cellulose.
Binders	Hold the powder together to form a tablet.	PVP (Povidone), Acacia, HPMC.
Disintegrants	Help the tablet break apart in the stomach.	Croscarmellose sodium, Sodium starch glycolate.
Lubricants	Prevent the tablet from sticking to machinery.	Magnesium Stearate, Talc.
Glidants	Improve the flow of powder during manufacturing.	Colloidal Silicon Dioxide.
Coating Agents	Protect the drug or mask taste.	Shellac, Cellulose polymers.
Preservatives	Prevent microbial growth (mostly in liquids).	Benzyl alcohol, Parabens.

4. **The Synergy: API + Excipient = Dosage Form**

The relationship between the two is a delicate balance. A drug product is not merely a mixture but a **delivery system**.

- **Bioavailability Control:** By choosing specific excipients, scientists can create "Sustained Release" tablets that release the API slowly over 24 hours.
- **Protection:** Excipients can shield a sensitive API from the highly acidic environment of the stomach (Enteric Coating).
- **Solubilization:** For APIs that do not dissolve in water, surfactants (excipients) are added to "force" the drug into solution so the body can use it.

In the pharmaceutical industry, the API provides the **cure**, but the excipients provide the **delivery**. Understanding the physical and chemical properties of both is fundamental to "Pharmaceutics." As technology advances, the line between the two blurs with the rise of "Functional Excipients" that do more than just fill space—they actively ensure the drug reaches its target at the right time and in the right concentration.

Points to be Remember

- **Calculations:** Master the **Metric system**, calculations for **alligation**, proof spirit, and isotonic solutions. Understand "percentage and ratio" for dilute solutions.
- **Posology:** Remember that dose calculation isn't just one-size-fits-all; it is determined by **age, body weight, and body surface area**.
- **Dosage Form Classification:** Know the various routes of administration (oral, topical, etc.) and how dosage forms are categorized.
- **API vs. Excipients:** Distinguish between the **Active Pharmaceutical Ingredient** (the drug) and **Excipients** (inactive ingredients), including their ideal characteristics.

Multiple Choice Questions

Level 1: Remember (Knowledge)

5. **The metric unit for weight is:**

    A) Grain
    B) Gram
    C) Drachm
    D) Ounce **Ans: B**

6. **How many milliliters (ml) are in 1 fluid ounce (approximate)?**

    A) 15 ml
    B) 30 ml
    C) 60 ml
    D) 500 ml **Ans: B**

7. **'Posology' is the study of:**

    A) Drug prices
    B) Drug dosage
    C) Drug synthesis
    D) Plant anatomy **Ans: B**

8. **Which of the following is an example of a "Biphasic" dosage form?**

    A) Syrup
    B) Emulsion
    C) Tablet
    D) Elixir **Ans: B**

9. **A substance added to a formulation to give it bulk or facilitate its manufacture is called:**

    A) API
    B) Excipient
    C) Catalyst

D) Solvent **Ans: B**

10. **The abbreviation 'API' stands for:**

    A) Active Pharmaceutical Ingredient
    B) Associated Pharmacy Institute
    C) Applied Pharmaceutical Information
    D) Active Protein Indicator **Ans: A**

11. **The formula used to calculate pediatric dose based on age (for children under 12) is:**

    A) Young's Rule
    B) Clark's Rule
    C) Dilling's Rule
    D) Fried's Rule **Ans: A**

12. **Which route of administration provides 100% bioavailability?**

    A) Oral
    B) Intravenous
    C) Topical
    D) Rectal **Ans: B**

13. **How many grams are in 1 kilogram?**

    A) 100 g
    B) 1000 g
    C) 10,000 g
    D) 500 g **Ans: B**

14. **A 'Proof Spirit' contains what percentage of Ethyl Alcohol by volume in the UK/India standard?**

    A) 48.24%
    B) 57.1%
    C) 95%
    D) 100% **Ans: B**

Level 2: Understand (Comprehension)

11. **Why are excipients necessary in a dosage form?**

    A) They provide the therapeutic effect
    B) They ensure stability, safety, and palatability
    C) They make the drug more expensive
    D) They are always used to change the color only **Ans: B**

12. **Which of the following describes 'Geometric Dilution'?**

    A) Mixing two liquids of the same volume
    B) Mixing a potent drug with an equal amount of diluent step-by-step
    C) Adding all ingredients into a beaker at once
    D) Diluting a solution with 10 times the amount of water **Ans: B**

13. **What is the primary difference between a Syrup and an Elixir?**

    A) Syrups are alcoholic; Elixirs are aqueous

B) Syrups are viscous and sugary; Elixirs are hydro-alcoholic and clear
C) Syrups are for external use; Elixirs are for internal use
D) There is no difference **Ans: B**

14. **What does 'Isotonic' mean in pharmacy?**

A) A solution with the same pH as blood
B) A solution with the same osmotic pressure as body fluids
C) A solution that is very concentrated
D) A solution that contains only water **Ans: B**

15. **The term 'Alligation' is used to:**

A) Calculate the price of a drug
B) Find the proportion of two different strengths to get an intermediate strength
C) Measure the weight of a tablet
D) Determine the shelf life of a syrup **Ans: B**

Level 3: Apply (Application)

16. **Calculate the dose for a 5-year-old child if the adult dose is 500 mg (using Young's Rule):**

A) 125 mg
B) 147 mg
C) 166.6 mg
D) 200 mg **Ans: B** (Formula: $5/(5+12) \times 500$)

17. **How much 90% alcohol and 20% alcohol should be mixed to get 500 ml of 50% alcohol?**

A) 214.3 ml of 90% and 285.7 ml of 20%
B) 250 ml of each
C) 300 ml of 90% and 200 ml of 20%
D) 100 ml of 90% and 400 ml of 20% **Ans: A** (Using Alligation)

18. **If a patient needs 0.25 mg of a drug and the tablets available are 125 mcg, how many tablets should be taken?**

A) 1 tablet
B) 2 tablets
C) 0.5 tablet
D) 4 tablets **Ans: B**

19. **Calculate the 'Proof Strength' of 70% v/v alcohol:**

A) 22.5° O.P.
B) 22.5° U.P.
C) 122.5°
D) 70° **Ans: A** (Calculation: $70 \times 1.753 - 100 = +22.71$)

20. **Convert 2% w/v into mg/100ml:**

A) 2 mg
B) 20 mg
C) 200 mg
D) 2000 mg **Ans: D**

Level 4: Analyze (Analysis)

21. **Comparing Clark's Rule and Young's Rule, which is generally considered more accurate?**

    A) Young's Rule (based on age)
    B) Clark's Rule (based on body weight)
    C) Both are exactly the same
    D) Neither is used today **Ans: B**

22. **Why is the 'Body Surface Area' (BSA) method preferred for calculating doses in chemotherapy?**

    A) It is easier to calculate
    B) It correlates better with physiological functions like metabolism and CO
    C) It only requires the patient's age
    D) It is a newer method **Ans: B**

23. **Analyze the role of 'Excipients' in a sustained-release tablet:**

    A) They act as a barrier to control the rate of drug release
    B) They help the tablet dissolve instantly
    C) They are used only to mask the taste
    D) They have no role in release kinetics **Ans: A**

24. **In Alligation, if the desired strength is higher than both available strengths:**

    A) The calculation is still possible
    B) The calculation is impossible
    C) You must use water to dilute
    D) You must add more powder **Ans: B**

25. **Identify the 'Incompatibility' risk in mixing an acidic drug with a basic excipient:**

    A) Physical change only
    B) Chemical reaction resulting in loss of potency
    C) Improvement in drug taste
    D) No change occurs **Ans: B**

Level 5: Evaluate (Evaluation)

26. **Evaluate the use of the Oral route for a drug that undergoes extensive first-pass metabolism:**

    A) It is the best route
    B) It is inefficient; an alternative route like IV or Sublingual should be considered
    C) It is only used for children
    D) It increases the drug's activity **Ans: B**

27. **Why must ophthalmic (eye) drops be isotonic with lachrymal secretions?**

    A) To make them more viscous
    B) To prevent irritation, pain, and tissue damage
    C) To change the color of the eye
    D) To increase the shelf life **Ans: B**

28. **Assess the importance of 'Ideal Characteristics' of an API:**

A) It should be unstable
B) It must be pure, stable, and have predictable bioavailability
C) It must be expensive
D) It should not dissolve in any solvent **Ans: B**

29. **Which factor is most critical when determining a dose for a geriatric (elderly) patient?**

A) Their height
B) Their reduced renal and hepatic clearance
C) Their appetite
D) Their gender **Ans: B**

30. **Is 0.9% w/v Sodium Chloride solution isotonic with human blood?**

A) Yes
B) No, it is hypotonic
C) No, it is hypertonic
D) Only at freezing temperatures **Ans: A**

Level 6: Create (Synthesis)

31. **Design a labeling instruction for a 'Concentrated' solution that needs to be diluted before use:**

A) "Apply directly to the skin"
B) "Shake well and swallow"
C) "Dilute with an equal volume of water before administration"
D) "Store in a cool place" **Ans: C**

32. **Propose a dosage form for a drug that is degraded by gastric acid (stomach acid):**

A) Simple Oral Tablet
B) Enteric-Coated Tablet
C) Oral Syrup
D) Effervescent Powder **Ans: B**

33. **Develop a plan to prepare 1 liter of 0.1% w/v Potassium Permanganate from a 5% w/v stock solution:**

A) Use 20 ml of stock and dilute to 1000 ml
B) Use 50 ml of stock and dilute to 1000 ml
C) Use 100 ml of stock and dilute to 500 ml
D) Use 5 ml of stock and dilute to 1000 ml **Ans: A** ($C1V1 = C2V2 \rightarrow 5\% \times V1 = 0.1\% \times 1000$)

34. **If a new drug has a very narrow therapeutic index, which dosage form would be safest for precise control?**

A) Bulk Powder
B) Controlled-release Capsule
C) Intravenous Infusion
D) Topical Cream **Ans: C**

35. **Create a justification for using 'Liquid Dosage Forms' for pediatric patients over 'Solid Dosage Forms':**

A) They are cheaper |B) They offer ease of swallowing and flexible dosing
B) They have a longer shelf life
C) They are easier to transport **Ans: B**

Mixed Bloom's Levels (36-50)

36. **One teaspoonful is equivalent to:**

A) 2 ml
B) 5 ml
C) 10 ml
D) 15 ml **Ans: B**

37. **One dessertspoonful is equivalent to:**

A) 5 ml
B) 8 ml
C) 15 ml
D) 30 ml **Ans: B**

38. **The 'Imperial System' unit for volume is:**

A) Liter
B) Gallon
C) Meter
D) Kilogram **Ans: B**

39. **Fried's Rule is used for infants up to the age of:**

A) 1 year (12 months)
B) 2 years
C) 5 years
D) 12 years **Ans: A**

40. **How much 95% alcohol is required to make 500 ml of 70% alcohol?**

A) 368.4 ml
B) 250.5 ml
C) 400.0 ml
D) 300.2 ml **Ans: A**

41. **Dilling's Rule formula is:**

A) (Age / 20) × Adult Dose
B) (Age / (Age+12)) × Adult Dose
C) (Weight in lbs / 150) × Adult Dose
D) (Age in months / 150) × Adult Dose **Ans: A**

42. **A 'saturated' solution is one where:**

A) No more solute can be dissolved at that temperature
B) The solute precipitates instantly
C) There is more solvent than solute
D) The solution is colored **Ans: A**

43. **What is the meaning of 'Dilute' solution?**

A) A solution containing a large amount of solute

B) A solution containing a small amount of solute relative to solvent
C) A solution that is frozen
D) A solution used only for cleaning **Ans: B**

44. **Which dosage form is intended for 'Systemic' effect via the skin?**

A) Cold Cream
B) Transdermal Patch
C) Dusting Powder
D) Calamine Lotion **Ans: B**

45. **What is the freezing point of blood and lachrymal fluid?**

A) $0°C$
B) $-0.52°C$
C) $-1.0°C$
D) $100°C$ **Ans: B**

46. **How many grains make 1 gram?**

A) 15.43 grains
B) 60 grains
C) 1 grain
D) 437.5 grains **Ans: A**

47. **A 'Parenteral' dosage form is administered:**

A) By mouth
B) By injection
C) Through the ear
D) On the skin **Ans: B**

48. **Which excipient is used to mask the bitter taste of a pediatric syrup?**

A) Lubricant
B) Flavoring agent/Sweetener
C) Disintegrant
D) Glidant **Ans: B**

49. **'Scientific notation' for 0.0005 is:**

A) 5×10^{-3}
B) 5×10^{-4}
C) 5×10^{4}
D) 0.5×10^{-3} **Ans: B**

50. **The 'Bioavailability' of a drug is:**

A) The total cost of the drug
B) The rate and extent to which the active ingredient reaches systemic circulation
C) The time it takes to manufacture the drug
D) The color of the drug **Ans: B**

Objective Type (2 Marks - Understand/Apply)

1. Define 'Posology'.
2. State the formula for Young’s Rule for child dose calculation.
3. What is an 'Active Pharmaceutical Ingredient' (API)?
4. Define 'Isotonic Solutions'.
5. What is the 'Alligation' method used for?
6. List two ideal characteristics of an excipient.
7. Define 'Proof Spirit'.
8. Convert 5% w/v into a ratio strength.
9. What is 'Geometric Dilution'?
10. Name two routes of drug administration.
11. Define 'Body Surface Area' (BSA) in dose calculation.
12. Give an example of a solid dosage form.
13. What is a 'Dilute Solution'?
14. Mention the importance of excipients in dosage forms.
15. What is the metric equivalent of 1 fluid ounce?
16. Define 'Percentage' in pharmaceutical calculations.
17. Why is age a factor in posology?
18. Define 'Scientific Notation'.
19. What are 'Liquid Dosage Forms'?
20. State Clark’s Rule for dose calculation.

Short Answer (5 Marks - Apply/Analyze)

1. Explain the classification of dosage forms based on their physical state.
2. Discuss the factors influencing the dose of a drug (Posology).
3. Solve a calculation involving the Alligation method to prepare a specific concentration.

4. Describe the metric system of weights and measures used in pharmacy.
5. Compare the advantages and disadvantages of oral vs. parenteral routes of administration.
6. Explain the concept of Proof Spirit with a numerical example.
7. Discuss the importance and ideal characteristics of APIs.
8. Explain the methods used to make solutions isotonic with blood plasma.
9. Illustrate the concept of Geometric Dilution with an example.
10. Differentiate between excipients and active ingredients.

Long Answer (10 Marks - Analyze/Evaluate)

1. Classify dosage forms in detail and explain the rationale behind developing different types of formulations.
2. Discuss various rules for pediatric dose calculation based on age, body weight, and surface area.
3. Provide a detailed account of pharmaceutical calculations involving percentages, ratios, and alligation.
4. Analyze the role of excipients in drug stability and bioavailability.
5. Evaluate the significance of tonicity in the preparation of ophthalmic and parenteral products.
6. Describe the routes of administration and how they influence the choice of dosage form.
7. Analyze the challenges in posology for geriatric and pediatric patients.
8. Discuss the evolution of the metric system and its standardization in global pharmacy.
9. Evaluate the importance of proper measurement and weighing techniques in dispensing.
10. Elaborate on the definition, importance, and classification of pharmaceutical excipients.

Case-Based Learning (CBL)

1. **Pediatric Dosing:** A 5-year-old child weighing 20 kg needs a dose of a drug where the adult dose is 500 mg.

- **Solution:** Use Young's Rule: .

2. **Route Selection:** A patient is unconscious and vomiting. The doctor suggests an oral syrup.

- **Solution:** The pharmacist should recommend a Parenteral (IV) or Rectal route, as the oral route is contraindicated in unconscious or vomiting patients.

3. **API vs. Excipient:** A manufacturer wants to make a tablet smaller but the active drug is only 5 mg.

- **Solution:** Explain the role of **Diluents** (excipients). Since the API dose is too small to handle, excipients provide the necessary bulk to make a finger-sized tablet.

Problem-Based Learning (PBL)

1. **Alligation Method:** Mix 90% alcohol and 40% alcohol to prepare 500 ml of 70% alcohol.

- **Solution:** Using alligation: (70-40) = 30 parts of 90%; (90-70) = 20 parts of 40%. Ratio 3:2. Total parts = 5. (3/5)*500 = 300 ml of 90%; (2/5)*500 = 200 ml of 40%.

2. **Isotonicity:** Calculate the amount of NaCl needed to make a 1% solution of a drug (E-value = 0.20) isotonic.

- **Solution:** of NaCl per 100 ml.

3. **Proof Spirit:** Convert 70% v/v alcohol to proof strength.

- **Solution:** Multiply % by 1.753. . This is over proof (O.P.).