UNIT – 2

Pharmaceutical Calculations:

Weights and Measures - Imperial and Metric Systems:

1. **Imperial System:**
    - The Imperial system includes units such as ounces, pounds, grains, and fluid ounces. It is primarily used in the United States and some other countries.
    - Common Imperial weights include the ounce (oz) and pound (lb).
    - Common Imperial volumes include fluid ounces (fl oz) and pints.
2. **Metric System:**
    - The Metric system is the international standard for pharmaceutical measurements.
    - Common Metric weights include milligrams (mg), grams (g), and kilograms (kg).
    - Common Metric volumes include milliliters (mL) and liters (L).

Calculations Involving Percentage Solutions:

- Percentage solutions express the amount of a solute (e.g., active pharmaceutical ingredient) in a given volume of solution. The formula for calculating a percentage solution is:
    - % Solution = (Amount of Solute / Total Volume) x 100

Alligation:

- Alligation is a mathematical technique used to calculate the strength or concentration of a mixture or solution when two or more components with different concentrations are combined.
- Alligation can be used for dilution or mixing of solutions with varying concentrations.

Proof Spirit:

- Proof spirit is a measure of the alcohol content in alcoholic beverages, commonly expressed as "proof."
- In the U.S., proof is defined as twice the alcohol by volume (ABV). So, if a beverage is 40% ABV, it is 80 proof.

Isotonic Solutions Based on Freezing Point and Molecular Weight:

- Isotonic solutions are those that have the same osmotic pressure as body fluids and do not cause cells to shrink or swell.
- The freezing point and molecular weight of solutes can be used to determine if a solution is isotonic with body fluids. For example, the normal freezing point of blood

is around -0.52°C, and a solution with a similar freezing point would be considered isotonic.

Pharmaceutical calculations are essential in pharmacy practice to ensure the accurate preparation of medications and the appropriate dosing of patients. Understanding both the Imperial and Metric systems, percentage solutions, alligation, proof spirit, and isotonic solutions is crucial for pharmacists and healthcare professionals to provide safe and effective pharmaceutical care.

Powders:

Definition of Powders:

- Powders are solid dosage forms composed of finely divided drug substances and/or excipients. They are dry and typically free-flowing.

Classification of Powders:

1. **Simple Powders:** Contain only one drug substance. Examples include powdered aspirin and talcum powder.
2. **Compound Powders:** Contain a combination of two or more drug substances. They may be dispensed as is or used as components in the preparation of other dosage forms.
3. **Official Preparations:** Powders that are listed in pharmacopeias, such as the U.S. Pharmacopeia (USP) or British Pharmacopoeia (BP), and meet specified quality standards.

Advantages of Powders:

- Easy to manufacture and store.
- Provide flexibility in dosing and administration.
- Useful for drugs with poor solubility or stability in liquid forms.
- Can be converted into various dosage forms (e.g., tablets or capsules).

Disadvantages of Powders:

- Dosing accuracy may be challenging.
- Risk of inhalation when handling fine powders.
- Some patients find it difficult to swallow powders, especially if they have an unpleasant taste.
- Stability and homogeneity of the powder may be affected by humidity and exposure to air.

Types of Powders:

1. **Dusting Powders:** Fine powders applied externally to the skin to soothe, protect, or medicate.

2. **Effervescent Powders:** Contain a combination of an acid (e.g., citric acid) and a base (e.g., sodium bicarbonate) that effervesce when dissolved in water, creating a fizzy or effervescent solution.
3. **Efflorescent Powders:** Contain substances that lose water of crystallization when exposed to air, causing the powder to become dry or granular.
4. **Hygroscopic Powders:** Absorb moisture from the environment and may become sticky or form clumps.
5. **Eutectic Mixtures:** Mixtures of two or more substances that liquefy at a lower temperature than any of their individual components. They are often used in topical preparations.

Geometric Dilutions:

- Geometric dilution is a technique used in pharmaceutical compounding when mixing potent or low-dosage drug substances with a large amount of excipient (diluent). The goal is to ensure uniform distribution of the drug substance in the final mixture.
- The method involves mixing equal parts (by weight) of the drug substance and the diluent, and then repeating this process until all the drug substance is evenly distributed.

Powders are versatile pharmaceutical dosage forms that find applications in various medicinal and non-medicinal formulations. Understanding their classification, advantages, disadvantages, and specific types of powders is important for pharmacists, compounding pharmacists, and healthcare professionals to ensure accurate and safe use.

Liquid Dosage Forms:

Advantages of Liquid Dosage Forms:

1. **Ease of Administration:** Liquid dosage forms are generally easier to swallow, making them suitable for pediatric and geriatric patients or individuals with difficulty swallowing tablets or capsules.
2. **Precise Dosing:** Liquid forms allow for accurate and precise dosing. The volume can be measured exactly, ensuring the patient receives the intended amount of medication.
3. **Rapid Onset of Action:** Liquids are often absorbed more quickly than solid dosage forms, leading to a faster onset of action, which can be advantageous in certain clinical situations.
4. **Taste Masking:** Flavoring agents can be added to liquid formulations to improve taste and enhance patient compliance, especially in pediatrics.
5. **Flexible Dosing:** Liquid formulations can be adjusted to provide various doses, making them adaptable to individual patient needs.

Disadvantages of Liquid Dosage Forms:

1. **Stability Issues:** Liquid medications may have a shorter shelf life and be more prone to degradation compared to solid dosage forms.

2. **Volume and Storage:** Liquid dosage forms may require more space for storage, especially when used in hospitals and pharmacies.
3. **Dosing Errors:** There is a potential for dosing errors due to variations in dropper or syringe calibration, which can affect the accuracy of dosing.
4. **Palatability and Taste:** Some liquid medications have an unpleasant taste, which can lead to patient non-compliance, particularly in pediatrics.

Excipients Used in Formulation of Liquid Dosage Forms:

1. **Solvents:** The primary liquid component that dissolves the active pharmaceutical ingredient (API). Common solvents include water, glycerin, and propylene glycol.
2. **Preservatives:** Added to prevent microbial contamination. Examples include benzyl alcohol, methylparaben, and propylparaben.
3. **Flavoring Agents:** Used to improve the taste and palatability of the liquid. Flavors may be artificial or natural.
4. **Sweeteners:** Added to enhance sweetness. Examples include sucrose, sorbitol, and saccharin.
5. **Viscosity-Enhancing Agents:** Used to control the viscosity of the liquid and improve pourability. These include hydroxyethyl cellulose and xanthan gum.
6. **Coloring Agents:** Added for aesthetic purposes to provide color to the liquid.

Solubility Enhancement Techniques:

1. **Use of Co-solvents:** Addition of a second solvent to enhance the solubility of the API. Co-solvents are often organic compounds that are miscible with water.
2. **Particle Size Reduction:** Reducing the size of drug particles through techniques like micronization or nanosizing increases the surface area available for dissolution.
3. **Complexation:** Forming complexes with other substances (e.g., cyclodextrins) to increase the solubility of the API.
4. **Salt Formation:** Converting a poorly soluble drug into a more soluble salt form, such as a hydrochloride or sulfate salt.
5. **Lipid-Based Formulations:** Using lipids or oils as solubilizing agents for lipophilic drugs. Examples include self-emulsifying drug delivery systems (SEDDS).
6. **Solid Dispersions:** Formulating the drug with a water-soluble carrier to enhance its solubility and dissolution rate.

Solubility enhancement techniques are essential in formulating liquid dosage forms to ensure that the active pharmaceutical ingredient is in a soluble and bioavailable form. The choice of excipients and their proportions is critical in designing stable and effective liquid medications.