Program	B. Pharmacy
Semester	1st semester
Subject /Course	General Pharmacy (Theory)
Subject/Course ID	BP 102T
Module No.	04
Module Title	Monophasic and Biphasic Liquids
Course coordinator	Dr. Gurjeet Singh

Learning Outcome of Module-

LO	Learning Outcome (LO)	Course Outcome Code
LO1	Formulate monophasic liquids for internal use, such as syrups, elixirs, and linctuses, using official methods.	BP102.4
LO2	Differentiate between liquid preparations for external use, including liniments, lotions, gargles, and throat paints.	BP102.4
LO3	Distinguish between flocculated and deflocculated suspensions based on their physical stability and sedimentation rates.	BP102.4
LO4	Identify the appropriate emulsifying agents and tests required to identify the type of emulsion (O/W or W/O).	BP102.4
LO5	Select suitable preservatives and stabilizers (excipients) for liquid formulations to ensure shelf-life and efficacy.	BP102.4

Module Content Table

No.	Topic
1.	For internal use – aromatic waters, syrups, elixirs and linctus (definition and preparation).
2.	For external use and body cavities – liniments, lotions, throat paints, applications, gargles, mouthwashes, enemas, eye drops, ear drops, nasal drops and tinctures with examples.
3.	Study of official preparations- Introduction to excipients and methods of preparation.
4.	Suspensions- Definition and types (flocculated and deflocculated), advantages and disadvantages, formulation excipients and general methods of preparation.
5.	Emulsions- Definition and types, emulsifying agents, tests for identification of types of emulsions, formulation excipients and general methods of preparation

MONOPHASIC LIQUIDS: DEFINITIONS AND PREPARATIONS

Monophasic liquids are single-phase liquid dosage forms in which the drug is completely dissolved in a suitable solvent system. These preparations appear uniform throughout and do not require shaking before use. They are designed for internal, external, or mucosal administration, depending on their purpose and composition.

Monophasic liquids offer benefits such as easy dose adjustment, rapid absorption, and suitability for patients who have difficulty swallowing solid dosage forms. They may contain additional excipients like preservatives, flavors, colors, viscosity enhancers, and stabilizers to improve their safety, stability, and acceptability.

GARGLES

Gargles are aqueous liquid preparations intended to be used in the throat and oral cavity by holding the solution in the throat, swishing it around, and then expelling it without swallowing**.**

They are mainly used for:

- Relieving throat irritation and inflammation
- Reducing microbial load in mouth and throat
- Providing soothing or antiseptic action
- Managing infections such as pharyngitis or tonsillitis Gargles are usually supplied as:
- Ready-to-use solutions, or
- Concentrated forms that must be diluted with warm water before use.

Preparation of Gargles

The preparation of a gargle involves dissolving the active ingredient in a suitable

aqueous vehicle, adjusting pH, and adding excipients that enhance stability, taste, and patient compliance.

i. *Selection of Ingredients*

- **Active ingredients:** antiseptics (povidone-iodine, chlorhexidine), analgesic/anti-inflammatory agents, astringents, or soothing substances.
- **Vehicle:** purified water is commonly used.
- **Flavoring and sweetening agents:** to reduce bitterness and improve acceptability.
- **Colorants:** food-grade colors may be added for appearance.
- **Preservatives:** used when the formulation is aqueous and stored for long periods (e.g., sodium benzoate, parabens).
- **pH adjusters:** citric acid, sodium citrate, or other buffers to maintain throat-friendly pH.

ii. *Method of Preparation*

a) **Dissolve the active drug**
   - The active ingredient is dissolved in a portion of purified water.
   - If poorly soluble, a co-solvent like glycerin or alcohol may be used in small quantities.

b) *Add auxiliary agents*
   - Sweeteners and flavoring agents are added to improve taste.
   - Colorants are added in a very small quantity if needed.

c) *Adjust the pH*
   - pH is adjusted using buffering agents to ensure stability and reduce throat irritation.

d) *Make up the volume*

- The solution is diluted with purified water to the final desired volume.

e) *Filtration*

- The entire preparation is filtered to remove particulate matter, ensuring clarity.

f) *Packaging*

- The solution is filled into amber or fluted bottles to protect from light.
- Concentrated gargles are labeled with dilution instructions (e.g., "Dilute with equal volume of warm water before use").

g) *Labeling*

- **"**For gargling only. Do not swallow.**"**
- Storage instructions: "Store in a cool, dry place."

MOUTHWASHES

Mouthwashes are clear, flavored, aromatic liquid preparations intended for cleaning, deodorizing, and refreshing the oral cavity**.** They are used by swirling the liquid inside the mouth and then expelling it. Mouthwashes help reduce microbial load, maintain oral hygiene, control plaque, and provide a pleasant taste and breath freshness.

They may contain:

- Antiseptics
- Astringents
- Deodorizing agents
- Anti-plaque agents
- Flavors and sweeteners

Mouthwashes are not intended for swallowing and are mainly used for cosmetic or medicinal purposes.

Preparation of Mouthwashes

The preparation of a mouthwash focuses on solubilizing active ingredients, improving taste, and maintaining clarity and stability.

1.Selection of Ingredients

a.Active Ingredients

Based on the intended therapeutic effect:

- **Antiseptics:** chlorhexidine gluconate, cetylpyridinium chloride
- **Anti-plaque agents:** triclosan
- **Astringents:** zinc salts
- **Deodorizing agents:** essential oils like eucalyptus, peppermint
- **Fluoride salts:** for anti-caries effect

b.*Vehicles*

- **Purified water** → main solvent
- **Co-solvents** (if needed): ethanol, glycerin, or propylene glycol to dissolve flavors or essential oils.

c.*Excipients*

- **Sweeteners:** sorbitol, saccharin sodium
- **Flavors:** mint, menthol, clove, lemon
- **Colorants:** permitted food-grade dyes
- **Preservatives:** sodium benzoate, parabens
- **Surfactants:** to solubilize essential oils and ensure clarity

2.Method of Preparation

Step 1: Dissolution of Ingredients

- Water-soluble ingredients (e.g., antiseptics, sweeteners, fluoride salts) are dissolved in purified water.
- Alcohol or glycerin is used to dissolve flavoring oils separately.

Step 2: Mixing of Solutions

- The alcoholic solution containing flavors is added **slowly** to the aqueous phase with continuous stirring to avoid precipitation or turbidity.
- Surfactants may be added to maintain clarity and solubilize essential oils.

Step 3: Adjusting pH

- pH is adjusted to a suitable level (usually around neutral or slightly acidic) to ensure stability, comfort, and microbial control.

Step 4: Make Up the Final Volume

- The solution is diluted to the required volume using purified water.

Step 5: Filtration

- The finished solution is filtered through a fine filter to obtain a **clear and particle-free mouthwash**.

Step 6: Packaging

- Mouthwashes are filled into **fluted, colored, or transparent bottles** with tight closures.
- Large volume preparations may be filled in plastic bottles for ease of use.

3. Labeling Requirements

- *"For oral rinsing only. Do not swallow."*
- Directions for use, such as rinsing for 30 seconds.
- Storage instructions: "Store in a cool, dry place."

THROAT PAINTS

Throat paints are viscous, concentrated liquid preparations intended for direct application to the mucous membranes of the throat**.** They adhere to the surface and provide prolonged local action**,** usually to relieve pain, irritation, or infection. They are applied using a cotton swab or applicator**.**

Preparation

Ingredients

- **Active agents:** antiseptics (iodine, phenol), analgesics, astringents
- **Base:** glycerin (provides viscosity and adhesion)
- **Co-solvents:** water or alcohol
- **Colorants/flavors:** optional
- **Preservatives:** if water is present

Method

1. Dissolve the active ingredient in a small quantity of alcohol or water.
2. Add glycerin to obtain the required thickness and adhesiveness.
3. Mix thoroughly until uniform.
4. Adjust the volume with glycerin or water.
5. Filter (if required) to remove impurities.
6. Pack in amber-colored bottles with “For external use only”.

EAR DROPS (OTIC SOLUTIONS)

Ear drops are sterile liquid preparations intended to be instilled into the external auditory canal**.** They may be used for:

- Treating infections

- Removing earwax
- Reducing inflammation or pain

Preparation

Ingredients

- **Drug:** antibiotics, analgesics, antifungals, wax-softening agents
- **Vehicle:** purified water, glycerin, propylene glycol, or oils
- **Stabilizers:** antioxidants for oily bases
- **Preservatives:** for multi-dose containers
- **Buffers:** to maintain comfortable pH

Method

1. Dissolve or disperse the drug in the chosen vehicle.
2. Adjust pH to reduce irritation.
3. Add preservatives and stabilizers.
4. Sterilize by filtration (aqueous bases) or heat (oil bases).
5. Fill in sterile, dropper-type containers.

Label

- "**For ear use only**".
- Warm before use (if needed) to avoid dizziness.

NASAL DROPS

Nasal drops are aqueous or oily sterile solutions intended for instillation into the nasal cavity to relieve congestion, deliver medications, or moisturize mucosa. Common drugs include decongestants (xylometazoline), antihistamines, antiseptics, and lubricants.

Preparation

Ingredients

- **Drug:** decongestant, antihistamine, antiseptic
- **Vehicle:** sterile water or oil
- **Isotonicity agents:** sodium chloride to avoid mucosal irritation
- **Buffers:** maintain physiological pH
- **Preservatives:** for multi-dose packs

Method

1. Dissolve the drug in sterile water or oil base.
2. Adjust isotonicity using NaCl.
3. Add preservatives and buffers.
4. Sterilize by membrane filtration.
5. Fill aseptically into sterile nasal-drop containers.

Label

- "**For nasal use only**".
- Do not share with others to avoid cross-infection.

ENEMAS

Enemas are liquid preparations introduced into the rectum for either therapeutic (relief of constipation, drug delivery) or diagnostic (bowel cleansing before procedures) purposes.

They may be aqueous, oily, or emulsion-based depending on the requirement.

Preparation

Ingredients

- **Drug or cleansing agent:** e.g., sodium phosphate (purgative), soap solution (evacuant), anti-inflammatory drugs
- **Vehicle:** warm water, oils (olive oil), glycerin
- **Lubricants:** aid administration
- **Stabilizers:** if emulsion-type

Method

1. Dissolve or disperse the active substance in warm purified water or oil.
2. Add surfactants or lubricants if required.
3. Mix thoroughly to ensure uniformity.
4. Filter aqueous enemas to remove particles.
5. Fill into enema bags, squeezable bottles, or disposable plastic units.

Label

- **“**For rectal use only**”.**
- Use immediately after opening.

SYRUPS

Syrups are concentrated, viscous, sweetened liquid preparations that contain a high proportion of sugar, most commonly sucrose, dissolved in purified water. They may be:

- Medicated syrups, containing active pharmaceutical ingredients
- Flavored syrups, used as vehicles or sweetening agents

The high sugar concentration (around 66–67% w/w sucrose) acts as a preservative and provides a pleasant taste, making syrups particularly suitable for children and

elderly patients**.**

Preparation of Syrups

Syrups can be prepared by several methods depending on the nature of ingredients and the required clarity, stability, and flavor profile.

1. *Methods of Preparation*

A. **Solution with Heat**

This is the most common method. Sugar is dissolved in water using gentle heating.

Steps:

1. Heat purified water in a clean vessel.
2. Add sugar gradually with continuous stirring.
3. Maintain low heat until the sugar dissolves completely.
4. Cool the solution.
5. Add heat-sensitive substances (flavors, drugs, preservatives) after cooling.
6. Filter to ensure clarity.
7. Make up the final volume with purified water.

Note: High temperatures must be avoided to prevent caramelization of sugar.

B. **Solution without Heat (Cold Process)** Used for heat-sensitive drugs or ingredients.

Steps:

1. Sugar is placed in water and allowed to dissolve gradually with stirring.
2. This takes longer but prevents decomposition of sensitive components.
3. After complete dissolution, flavors and drugs are added.
4. The solution is filtered and made up to volume.

C. *Percolation Method*

Used when syrup contains medicinal substances that need extraction.

Steps:

1. Place sugar or drug-containing materials in a percolator.
2. Purified water is added to extract the soluble components.
3. Collect the percolate and adjust the sugar concentration.
4. Filter and add flavoring agents if required.

D. *By Addition of Medicinal Substances*

Sometimes medicated syrups are made by adding extracts or tinctures directly to simple syrup.

Steps:

1. Prepare simple syrup.
2. Add the medicinal tincture or extract.
3. Remove insoluble matter by filtration or clarification agents.

ELIXIRS

Elixirs are clear, sweetened hydroalcoholic solutions containing one or more active ingredients. They are designed for oral administration and are particularly useful for drugs that are poorly soluble in water but soluble in alcohol**.**

Elixirs are less sweet and less viscous than syrups, making them easier to swallow for adults and children.

Preparation

Ingredients

- **Active drug(s):** soluble in water or alcohol
- **Vehicle:** mixture of purified water and ethanol (hydroalcoholic base)

- **Sweeteners:** sucrose, sorbitol, or glycerin
- **Flavors:** peppermint, orange, cherry
- **Colorants:** optional, food-grade dyes
- **Preservatives:** parabens, sodium benzoate
- **Co-solvents:** propylene glycol or glycerin for solubility

Method

1. Dissolve alcohol-soluble ingredients in ethanol.
2. Dissolve water-soluble ingredients in purified water separately.
3. Combine the two solutions slowly with constant stirring to avoid precipitation.
4. Add sweeteners, flavors, colorants, and preservatives.
5. Adjust volume with water or ethanol as required.
6. Filter to ensure clarity and fill in well-closed bottles**.**

LINIMENTS

Liniments are liquid or semi-liquid preparations applied to the skin with rubbing**.** They are intended to provide local stimulation, analgesic, counter-irritant, or warming effect to muscles and joints.

Liniments are for external use only**.**

Preparation

Ingredients

- **Active drugs:** counter-irritants (camphor, menthol), analgesics (salicylates), essential oils
- **Vehicle/Base:** alcoholic solutions, oils (olive oil, mineral oil), or combinations

- **Additives:** stabilizers or antioxidants for oily liniments

Method

1. Dissolve or disperse the active ingredients in the selected base.
2. Ensure uniform mixing of oils and alcohol if both are used.
3. For suspension-type liniments, triturate and mix thoroughly.
4. Filter if needed to remove insoluble particles.
5. Fill in dark or opaque bottles with labeling "For external use only."

LOTIONS

Lotions are liquid preparations intended for external application without rubbing. They are used to soothe, protect, cleanse, or medicament the skin**.** Unlike liniments, lotions are typically **less viscous** and are applied by gentle spreading rather than vigorous rubbing.

Lotions can be aqueous, alcoholic, or emulsions**.**

Preparation

Ingredients

- **Active agents:** antiseptics, astringents, soothing agents (calamine, zinc oxide)
- **Vehicle:** purified water, alcohol, or combination
- **Suspending agents:** if particles are present (e.g., for calamine lotion)

- **Additives:** preservatives, stabilizers, and sometimes colorants or fragrances

Method

1. Dissolve water-soluble drugs in purified water.
2. If the preparation contains insoluble powders (e.g., calamine), triturate

with a little water or glycerin to form a smooth paste.

3. Add alcohol or co-solvents if required and mix thoroughly.
4. Adjust volume with purified water to achieve the final concentration.
5. Filter to remove lumps or impurities.
6. Fill into **well-labeled bottles** with instructions: “Shake well before use” if a suspension.

BIPHASIC LIQUIDS – SUSPENSIONS

A suspension is a biphasic liquid dosage form in which finely divided, insoluble solid particles are dispersed in a liquid medium (usually water, but sometimes oil or other suitable vehicles). Unlike solutions, the dispersed particles do not dissolve and may settle over time, forming a sediment that can be redistributed upon shaking**.**

Suspensions are particularly useful for drugs that are poorly soluble in water, allowing them to be administered orally, topically, or parenterally.

Advantages of Suspensions

1. **Improved Bioavailability**
    - Drugs that are poorly soluble in water can be administered effectively, enhancing **therapeutic action**.
2. **Ease of Swallowing**
    - Suitable for **children, elderly, and patients with difficulty swallowing tablets or capsules**.
3. **Flexibility in Dosing**
    - Dose can be **adjusted accurately** using calibrated spoons or syringes, which is useful for pediatrics and geriatrics.

4. *Masking Unpleasant Taste*
    - Flavoring agents can be incorporated to **mask the bitterness or odor** of active drugs.
5. *Stability of Drug*
    - Some drugs unstable in solution form are **more stable in suspension**, as the drug remains in solid state rather than dissolved.
6. *Prolonged Action*
    - Suspensions can be formulated to provide **controlled or sustained release** of the drug.

Disadvantages of Suspensions

1. **Physical Instability**
    - Particles may settle quickly, leading to **caking** that is difficult to redisperse.
2. *Dose Inaccuracy*
    - Improper shaking before administration may result in **uneven dosing**, especially if sediment forms at the bottom.
3. *Microbial Contamination*
    - Aqueous suspensions are prone to **microbial growth**, requiring preservatives.
4. *Complex Formulation*
    - Requires careful **particle size control, viscosity adjustment, and stabilizer addition** to maintain uniformity.
5. *Shorter Shelf Life*
    - Compared to solutions, suspensions often have a **limited storage period** due to sedimentation and potential chemical degradation.

6. *Unpleasant Mouthfeel*
    - Coarse particles may produce **gritty texture** and reduce patient compliance if not properly formulated.

Classification of Suspensions

Suspensions can be classified based on **route of administration, particle size, or intended use**.

A. *Based on Route of Administration*

1. **Oral Suspensions** – e.g., antacids, antibiotics
2. **Topical Suspensions** – e.g., calamine lotion
3. **Parenteral Suspensions** – e.g., injectable antibiotics
4. **Ophthalmic Suspensions** – e.g., eye drops containing insoluble drugs

B. *Based on Particle Size*

1. **Coarse Suspensions** – particle size > 10 μm
2. **Fine Suspensions** – particle size 1–10 μm
3. **Colloidal Suspensions** – particle size < 1 μm

C. *Based on Flocculation*

1. **Flocculated Suspensions** – particles form loose aggregates (flocs) that **settle rapidly but are easily redispersed**
2. **Deflocculated Suspensions** – particles settle slowly, forming **compact sediment that may be hard to redisperse**

Preparation of Suspensions

The goal is to **disperse insoluble solid particles uniformly** in a liquid medium and prevent caking or aggregation.

Steps in Preparation

1. **Particle Size Reduction**
    - Use trituration, milling, or micronization to reduce particle size for uniform dispersion.
2. *Wetting of Particles*
    - Hydrophilic or lipophilic drugs are wetted with suitable agents:
        - Water, glycerin, alcohol, or surfactants to prevent clumping.
3. *Dispersion*
    - Slowly add particles to the vehicle with continuous stirring to ensure **even distribution**.
4. *Addition of Suspending Agents*
    - Increase viscosity and maintain uniform suspension using:
        - Natural gums (acacia, tragacanth)
        - Cellulose derivatives (CMC, methylcellulose)
        - Synthetic polymers (polyvinylpyrrolidone, carbomers)

5. *pH Adjustment*
    - Stabilize drug and excipients and enhance compatibility.
6. *Preservatives and Flavoring*
    - Protect against microbial growth (sodium benzoate, parabens)
    - Mask unpleasant taste for oral use
7. *Filtration and Packaging*
    - Remove large particles or impurities; package in **well-closed bottles**.

Flocculated and Deflocculated Suspensions

A. **Flocculated Suspensions**

- **Definition:** Particles loosely aggregate into flocs that **settle rapidly** but do **not form hard cake**.
- **Advantages:** Easy to redisperse, uniform dosing.
- **Appearance:** Often slightly turbid due to floc formation.
- **Stabilization:** Use electrolytes, polymers, or surfactants to promote flocculation.

B. *Deflocculated Suspensions*

- **Definition:** Particles remain separate and settle slowly, forming **compact sediment (cake)** that is difficult to redisperse.
- **Disadvantages:** Risk of caking, uneven dosing.
- **Appearance:** Clear supernatant, slowly settling particles.
- **Stabilization:** Increase viscosity using suspending agents to prevent rapid sedimentation and caking.

Stability Problems of Suspensions

Suspensions are prone to several physical and chemical stability issues:

1. *Sedimentation*
    - Particles settle over time; rapid sedimentation may lead to caking.
2. *Caking*
    - Formation of hard, compact sediment that cannot be easily redispersed.
3. *Aggregation / Flocculation*
    - Uncontrolled flocculation may cause uneven particle size and sedimentation.
4. *Microbial Growth*
    - Aqueous suspensions are prone to contamination without preservatives.
5. *Chemical Degradation*
    - Drug may hydrolyze or oxidize in the aqueous medium.
6. *Ostwald Ripening*
    - Larger particles grow at the expense of smaller ones, affecting uniformity.

Methods to Overcome Stability Problems

1. **Use of Suspending Agents**
    - Increase viscosity to slow sedimentation (e.g., CMC, xanthan gum).
2. *Controlled Flocculation*
    - Add electrolytes or surfactants to promote **reversible flocculation**.
3. *Wetting Agents*
    - Improve particle dispersion and prevent clumping.

4. *pH Adjustment and Buffers*
    - Maintain chemical stability and solubility.
5. *Preservatives*
    - Prevent microbial growth (e.g., parabens, sodium benzoate).
6. *Particle Size Reduction*
    - Smaller particles settle slowly, reducing caking.
7. *Proper Packaging*
    - Use wide-mouth bottles and label instructions to shake before use**.**

BIPHASIC LIQUIDS – EMULSIONS

An emulsion is a biphasic liquid dosage form in which one immiscible liquid is dispersed as small droplets (dispersed phase) throughout another liquid (continuous phase).

- The continuous phase surrounds the dispersed droplets.
- Emulsions are stabilized using emulsifying agents to prevent coalescence of droplets.

Example: Oil-in-water (O/W) and water-in-oil (W/O) emulsions.

Uses of emulsions:

- Oral administration of oils (cod liver oil)
- Topical application (creams, lotions)
- Parenteral nutrition (lipid emulsions)

Classification of Emulsions

Emulsions are primarily classified based on the **nature of the dispersed and continuous phases**, **therapeutic use**, or **route of administration**.

A. *Based on Dispersed and Continuous Phase*

1. **Oil-in-Water (O/W) Emulsion**
    - Oil droplets dispersed in water.
    - **Examples:** Milk, linseed oil emulsion.
    - Water is the external phase; easy to wash off; suitable for oral administration.
2. *Water-in-Oil (W/O) Emulsion*
    - Water droplets dispersed in oil.
    - **Examples:** Cold creams, certain ointments.
    - Oil is the external phase; greasy; more suitable for topical application.

B. *Based on Route of Administration*

1. **Oral Emulsions** – e.g., cod liver oil emulsion
2. **Topical Emulsions** – creams, lotions
3. **Parenteral Emulsions** – intravenous lipid emulsions

C. *Based on Physical Stability*

1. **Macroemulsions** – droplet size 0.1–100 μm, appear cloudy
2. **Microemulsions** – droplet size 0.01–0.1 μm, appear transparent
3. **Nanoemulsions** – droplet size <0.1 μm, enhanced stability

Emulsifying Agents

Emulsifying agents are **substances that stabilize emulsions by reducing interfacial tension** between the two immiscible liquids and forming a protective film around dispersed droplets.

Classification of Emulsifying Agents

1. **Natural Emulsifiers**

- **Acacia (gum arabic):** O/W emulsions; used in oral and topical formulations
- **Tragacanth, Agar, Pectin:** Stabilizers in pharmaceutical emulsions

2. *Semi-Synthetic Emulsifiers*
   - **Methylcellulose, Carboxymethylcellulose (CMC):** Increase viscosity; stabilize O/W emulsions
3. *Synthetic Emulsifiers*
   - **Span 20, Span 80, Tween 20, Tween 80:** Non-ionic surfactants for O/W or W/O emulsions
   - **Sodium lauryl sulfate, Cetyltrimethylammonium bromide:** Ionic surfactants
4. *Finely Divided Solids (Pickering Emulsions)*
   - **Colloidal silica, bentonite, magnesium hydroxide:** Stabilize emulsions by forming a physical barrier around droplets

Tests for Identification of Type of Emulsion

Determining whether an emulsion is **oil-in-water (O/W)** or **water-in-oil (W/O)** is important for stability, use, and patient acceptability.

1. *Dilution Test*

- An emulsion can be diluted **only with its continuous phase**.
- If the emulsion can be diluted with water → **O/W emulsion**.
- If it can be diluted with oil → **W/O emulsion**.

2. *Dye Solubility Test*

- A **water-soluble dye** (e.g., methylene blue) is added.
  - Uniform blue color → **O/W emulsion**.

- An **oil-soluble dye** (e.g., Sudan III) is added.
- Uniform red color → **W/O emulsion**.

3. *Electrical Conductivity Test*
   - Water conducts electricity; oil does not.
   - If the emulsion conducts electricity → **O/W emulsion**.
   - If it does not conduct electricity → **W/O emulsion**.
4. *Filter Paper Test*
   - A drop of emulsion is placed on filter paper.
   - Spreading with a water ring → **O/W emulsion**.
   - Greasy spot without spreading → **W/O emulsion**.
5. *Cobalt Chloride Test*
   - Cobalt chloride paper turns **blue to pink** in the presence of water.
   - Color change indicates **O/W emulsion**.

Methods of Preparation of Emulsions

1. **Dry Gum Method (Continental Method)**
   - Suitable for **O/W emulsions** using acacia.

Steps:

1. Triturate gum with oil in a dry mortar.
2. Add water all at once (in 4:2:1 ratio of oil:water:gum).
3. Triturate rapidly until a creamy white emulsion forms.
4. Add remaining ingredients and make up the volume.

2. *Wet Gum Method (English Method)*
   - Also used for **O/W emulsions**.

Steps:

1. First prepare mucilage of gum with water.
2. Add oil slowly in small portions with continuous trituration.

3. Continue until primary emulsion is formed.
4. Add remaining ingredients and adjust volume.

3. *Bottle Method*

- Suitable for **volatile or low-viscosity oils**.

Steps:

1. Place oil and gum in a dry bottle.
2. Shake vigorously.
3. Add water in portions with continuous shaking.
4. Complete the emulsion and add remaining ingredients.

4. *In-Situ Soap Method*

- Emulsifier is formed during preparation.

Example:

- Fatty acid + alkali → soap (emulsifying agent)
- Sodium soap → O/W emulsion
- Calcium soap → W/O emulsion

5. *Mechanical Method*

- Uses homogenizers or mixers.
- Produces fine and stable emulsions.
- Common in industrial manufacturing.

Stability Problems of Emulsions

Emulsions are physically unstable systems and may show the following problems:

1. *Creaming*

- Upward or downward movement of droplets due to density difference.
- Does not break emulsion but causes non-uniformity.

2. *Cracking (Breaking)*

- Complete separation of oil and water layers.

- Irreversible instability.

3. *Coalescence*
   - Small droplets merge to form larger droplets.
4. *Phase Inversion*
   - O/W emulsion changes to W/O or vice versa due to excess phase or temperature changes.
5. *Flocculation*
   - Droplets aggregate without merging.

Methods to Overcome Stability Problems

1. **Proper Selection of Emulsifying Agent**
   - Choose emulsifier with suitable **HLB value**.
   - Use correct concentration.
2. *Reduction of Droplet Size*
   - Homogenization reduces droplet size and improves stability.
3. *Increase Viscosity of Continuous Phase*
   - Use thickening agents like CMC, acacia, xanthan gum to reduce creaming.
4. *Temperature Control*
   - Avoid extreme temperature changes during storage.
5. *Use of Antioxidants and Preservatives*
   - Prevent chemical degradation and microbial growth.
6. *Controlled Phase Volume*
   - Avoid excess internal phase to prevent phase inversion.
7. *Proper Packaging and Labeling*
   - Use airtight containers.
   - Label with **“Shake well before use.”**

Points to be Remember

- **Internal vs. External:** Categorize liquids correctly. Internal includes syrups and elixirs; external includes liniments, lotions, and gargles.
- **Suspensions:** Understand the difference between **flocculated and deflocculated** systems.
- **Emulsions:** Focus on the types of emulsifying agents and the specific **tests used to identify** different types of emulsions.
- **Specialized Liquids:** Be familiar with formulations for body cavities, such as eye drops, ear drops, nasal drops, and enemas.

Level 1: Remember (Knowledge)

1. **Which of the following is a monophasic liquid dosage form for internal use?** A) Suspension B) Elixir C) Emulsion D) Liniment **Ans: B**
2. **The term 'Aromatic Waters' refers to saturated aqueous solutions of:** A) Sugar B) Volatile oils or aromatic substances C) Inorganic salts D) Alcohol **Ans: B**
3. **What is the primary difference between a lotion and a liniment?** A) Liniments are always aqueous B) Liniments are usually applied with friction; lotions are applied without friction C) Lotions are always alcoholic D) There is no difference **Ans: B**
4. **'Gargles' are intended for the treatment of:** A) Ear infections B) Throat infections C) Nasal congestion D) Eye irritation **Ans: B**
5. **A suspension consists of finely divided solid particles dispersed in a:** A) Solid medium B) Gaseous medium C) Liquid vehicle D) Semi-solid base **Ans: C**
6. **In an 'Oil-in-Water' (o/w) emulsion:** A) Water is the dispersed phase B) Oil is the dispersed phase C) Both are continuous phases D) Air is the dispersed phase **Ans: B**
7. **Which of the following is an example of an emulsifying agent?** A) Talc B) Acacia C) Starch D) Lactose **Ans: B**
8. **'Linctuses' are viscous liquid preparations used for:** A) Relief of cough B) Cleaning wounds C) Eye infections D) Ear wax removal **Ans: A**

9. **'Enemas' are administered through which route?** A) Oral |B) Rectal C) Nasal D) Aural **Ans: B**

10. **The sedimentation rate in a suspension is governed by:** A) Newton's Law B) Stokes' Law C) Boyle's Law D) Charle's Law **Ans: B**

Level 2: Understand (Comprehension)

11. **Why are 'Syrups' resistant to microbial growth?** A) They contain high concentrations of alcohol B) High osmotic pressure of sugar inhibits microbial growth C) They are always stored in a vacuum D) They contain heavy metals **Ans: B**

12. **What is the purpose of 'Flocculating agents' in a suspension?** A) To make the particles stick permanently |B) To form loose aggregates (flocs) that are easily redispersed C) To prevent the particles from settling at all D) To change the color of the suspension **Ans: B**

13. **Which test is used to identify the type of emulsion (o/w or w/o)?** A) Dilution test B) Dye test C) Conductivity test D) All of the above **Ans: D**

14. **Why should liniments not be applied to broken skin?** A) They are too expensive B) They contain irritants that can cause excessive pain or systemic absorption C) They will make the skin change color D) They only work on hair **Ans: B**

15. **What characterizes a 'Deflocculated' suspension?** A) Particles settle slowly but form a hard cake B) Particles settle rapidly and stay loose C) The liquid is always cloudy D) There is no sedimentation **Ans: A**

Level 3: Apply (Application)

16. **If you are formulating a suspension and want to decrease the rate of sedimentation, you should:** A) Increase the particle size B) Decrease the viscosity of the medium C) Increase the viscosity of the medium (using suspending agents) D) Decrease the density of the particles **Ans: C**

17. **Which emulsifying agent is most suitable for a 'Water-in-Oil' (w/o) emulsion?** A) Acacia B) Wool fat C) Sodium Lauryl Sulfate D) Tragacanth **Ans: B**

18. **A patient has a dry, irritating cough. Which dosage form is most appropriate?** A) Elixir B) Linctus C) Liniment D) Gargle **Ans: B**

19. **How would you prepare 'Chloroform Water IP'?** A) By boiling chloroform B) By dissolving chloroform in distilled water and shaking vigorously C) By mixing chloroform with alcohol first D) By using a centrifuge **Ans: B**

20. **In the 'Dry Gum Method' for preparing an emulsion, the ratio of Oil:Water:Gum for a fixed oil is:** A) 4:2:1 |B) 3:2:1 C) 2:2:1 D) 1:2:1 **Ans: A**

Level 4: Analyze (Analysis)

21. **Analyze the role of 'Humectants' (like Glycerin) in throat paints:** A) To make them dry faster B) To provide a sweet taste and keep the area moist for prolonged contact C) To kill bacteria directly D) To increase the volume **Ans: B**

22. **Compare 'Flocculated' and 'Deflocculated' suspensions. Which is better for long-term stability?** A) Deflocculated, because it looks better B) Flocculated, because although it settles faster, it is easily redispersed without caking C) Neither is stable D) Flocculated, because it never settles **Ans: B**

23. **Identify the cause of 'Creaming' in an emulsion:** A) Microbial growth B) Difference in density between the two phases (reversible) C) Complete separation of phases (irreversible) D) Using too much water **Ans: B**

24. **Why is 'Alcohol' used in the preparation of Elixirs?** A) To make the patient sleepy B) As a co-solvent to dissolve drugs that are poorly soluble in water C) To act as a flavoring agent D) To increase the weight of the liquid **Ans: B**

25. **What happens during 'Phase Inversion' in an emulsion?** A) The emulsion turns into a solid B) The o/w emulsion changes into a w/o emulsion (or vice versa) C) The emulsion changes color D) The drug precipitates **Ans: B**

Level 5: Evaluate (Evaluation)

26. **Evaluate the use of 'Syrups' for diabetic patients:** A) They are ideal B) They are contraindicated; "Sugar-free" alternatives (using sorbitol/aspartame) should be used C) They can be used if diluted with water D) They are only used for external application **Ans: B**

27. **Why is 'Cracking' (coalescence) considered a more serious failure than 'Creaming' in emulsions?** A) Creaming is more expensive to fix B) Cracking is irreversible and the drug cannot be redistributed uniformly C) Cracking only happens to cheap emulsions D) Creaming causes the bottle to break **Ans: B**

28. **Assess the necessity of 'Preservatives' in monophasic liquids like aqueous aromatic waters:** A) Unnecessary as they are self-preserving B) Necessary because water is a medium for microbial growth C) Only if they are stored in the sun D) Only if they contain sugar **Ans: B**

29. **Which is more critical for an 'Eye Drop' formulation?** A) Viscosity B) Sterility and Isotonicity C) Color D) Taste **Ans: B**

30. **Evaluate the 'Wet Gum Method' versus the 'Dry Gum Method' for emulsion stability:** A) Wet gum is always better B) Dry gum is generally quicker and more reliable for primary emulsion formation C) Neither works for fixed oils D) They result in different types of emulsions **Ans: B**

Level 6: Create (Synthesis)

31. **Propose a label warning for a 'Suspension':** A) "Store in a hot place" B) "SHAKE WELL BEFORE USE" C) "Do not swallow" D) "Keep away from children only" **Ans: B**

32. **If a drug is unstable in water but stable in oil, which emulsion type would you formulate for oral use?** A) w/o B) o/w (with drug in the oil droplets) C) Simple aqueous solution D) Elixir **Ans: B**

33. **Develop a method to increase the 'clinging' time of a Throat Paint:** A) Add more water B) Increase viscosity by adding Glycerin or Propylene Glycol C) Add a surfactant D) Filter it multiple times **Ans: B**

34. **How would you formulate a 'Mouthwash' intended for a refreshing effect?** A) Include Peppermint oil and Ethanol B) Include only water and sugar C) Include heavy oils D) Use a suspension of sand **Ans: A**

35. **Create a checklist for evaluating the stability of an emulsion over 30 days:** A) Check for phase separation, creaming, and microbial growth B) Check the weight of the bottle C) Check the color of the label D) Check the price **Ans: A**

Mixed Bloom's Levels (36-50)

36. **'Spirit' is a solution of volatile substances in:** A) Water B) Alcohol C) Glycerin D) Oil **Ans: B**

37. **'Nasal drops' should be isotonic with:** A) 0.5% NaCl B) 0.9% NaCl C) 2.0% NaCl D) 5.0% NaCl **Ans: B**

38. **Which of the following is a 'Natural' emulsifying agent from an animal source?** A) Acacia B) Gelatin/Lanolin C) Bentonite D) Tween 80 **Ans: B**

39. **'Ear drops' are usually prepared in which vehicle to increase contact time?** A) Pure water B) Glycerin or Propylene Glycol C) Dilute alcohol D) Chloroform **Ans: B**

40. **A 'Tincture' is typically prepared by:** A) Boiling B) Maceration or Percolation with alcohol C) Simple dissolution in water D) Freezing **Ans: B**

41. **'Zeta potential' is a measurement related to:** A) Emulsion color B) Stability of a suspension (electrical charge of particles) C) Weight of a tablet D) Price of a syrup **Ans: B**

42. **HLB (Hydrophilic-Lipophilic Balance) scale is used to classify:** A) Preservatives B) Surfactants/Emulsifying agents C) Suspending agents D) Flavoring agents **Ans: B**

43. **An HLB value of 8-16 indicates a:** A) Antifoaming agent B) o/w emulsifying agent C) w/o emulsifying agent D) Wetting agent **Ans: B**

44. **Which preparation is used for 'douches'?** A) Internal cleaning of body cavities (e.g., vaginal) |B) Relief of cough C) Skin irritation D) Ear wax **Ans: A**

45. **Which of the following is a characteristic of 'Biphasic' liquids?** A) They are perfectly clear B) They contain two immiscible phases C) They only contain one ingredient D) They cannot be shaken **Ans: B**

46. **What is the standard concentration of sugar in 'Syrup IP'?** A) 66.7% w/w B) 85.0% w/v C) 50.0% w/w D) 20.0% w/v **Ans: A**

47. **'Liniments' should never be applied to:** A) Intact skin B) Broken or inflamed skin C) Hairy skin D) The back **Ans: B**

48. **Which of the following is used to treat 'ear wax'?** A) Hydrogen Peroxide or Sodium Bicarbonate ear drops B) Alcohol C) Strong acid D) Sugar syrup **Ans: A**

49. **'Enemas' used to relieve constipation are called:** A) Nutritive enemas B) Evacuant enemas C) Diagnostic enemas D) Anesthetic enemas **Ans: B**

50. **The 'Primary Emulsion' is:** A) The final diluted emulsion B) The initial concentrated emulsion formed during preparation C) A failed emulsion D) An emulsion with no gum **Ans: B**

Objective Type (2 Marks - Remember/Understand)

1. Define 'Elixir'.
2. What is an 'Aromatic Water'?
3. Distinguish between a 'Lotion' and a 'Liniment'.
4. Define 'Suspension'.
5. What is an 'Emulsion'?
6. Name one emulsifying agent.
7. What is a 'Gargle'?
8. Define 'Syrup' according to IP.
9. What is a 'Tincture'?
10. Define 'Flocculated Suspension'.
11. What is 'Deflocculated Suspension'?
12. State the use of 'Throat Paints'.
13. What is an 'Enema'?
14. Name the test used to identify the type of emulsion.

15. Define 'Linctus'.
16. What are 'Eye Drops'?
17. Define 'Mouthwash'.
18. What is the role of a preservative in liquid dosage forms?
19. Give an example of a biphasic liquid.
20. Define 'Nasal Drops'.

Short Answer (5 Marks - Understand/Analyze)

1. Explain the preparation and uses of Elixirs.
2. Describe the differences between flocculated and deflocculated suspensions.
3. Discuss the various tests used for the identification of emulsion types.
4. Explain the formulation and uses of liniments and lotions.
5. Describe the preparation of syrups by the hot and cold methods.
6. Discuss the excipients used in the formulation of suspensions.
7. Explain the importance of emulsifying agents in emulsion stability.
8. Describe the preparation of aromatic waters.
9. Discuss the administration and use of enemas and douches.
10. Compare monophasic and biphasic liquid dosage forms.

Long Answer (10 Marks - Analyze/Evaluate)

1. Provide a detailed classification of liquid dosage forms for internal and external use.
2. Discuss the formulation, stability, and evaluation of pharmaceutical suspensions.
3. Explain the theories of emulsification and the factors affecting the stability of emulsions.
4. Elaborate on the preparation and storage of official liquid preparations like syrups, elixirs, and linctus.

5. Evaluate the role of various excipients in stabilizing biphasic liquid systems.
6. Analyze the preparation and clinical applications of gargles, mouthwashes, and throat paints.
7. Discuss the formulation and packaging requirements for ophthalmic and nasal preparations.
8. Compare the different methods of preparing emulsions and the equipment used.
9. Analyze the causes of instability in emulsions (creaming, cracking, phase inversion).
10. Describe the general methods of preparation for official tinctures and spirits.

Case-Based Learning (CBL)

1. **The "Shake Well" Label:** A patient complains their "milky" medicine (emulsion) has a clear layer on top.

- **Solution:** Explain **creaming**. The pharmacist must ensure the "Shake Well Before Use" label is prominent and explain that shaking redistributes the phases.

2. **Pediatric Syrup:** A mother wants to mix a bitter syrup with honey.

- **Solution:** Pharmacists use **Syrup IP** (66.7% w/w sucrose) because it acts as both a vehicle and a preservative due to high osmotic pressure, masking the taste naturally.

3. **Eye Drop Contamination:** A patient uses an eye drop bottle for 3 months.

- **Solution:** Advise the patient that ophthalmic drops must be discarded 28 days after opening due to the risk of microbial growth, even if they contain preservatives.

Problem-Based Learning (PBL)

1. **Emulsion Identification:** You are given an emulsion. How do you prove it is Oil-in-Water (O/W)?

- **Solution: Dilution Test** (dilutes with water), **Dye Test** (Water-soluble dye colors the continuous phase), or **Conductivity Test** (conducts electricity).

2. **Suspension Stability:** A suspension settles into a hard mass that won't redistribute.

- **Solution:** This is **Caking** in a deflocculated suspension. Solution: Use a flocculating agent to create loose "flocs" that settle fast but are easily redispersed.

3. **Solubility Enhancement:** How do you prepare Aromatic Waters?

- **Solution:** Distillation or Solution method (using talc as a clarifying agent to increase the surface area of the volatile oil for better dissolution).