

# B.Pharm Practical Notes

## Semester 03

### FirstHope

54 practical topics and guides, arranged by subject.

### Pharmaceutical Organic Chemistry II

20 topics

### Physical Pharmaceutics I

11 topics

### Pharmaceutical Microbiology

10 topics

### Pharmaceutical Engineering

13 topics

### How to Use These Notes

- Read the aim and principle before the practical.
- Record the actual findings or the provided simulation data.
- Use the calculations with the correct units and stated model.
- Review the precautions and viva questions after completing the record.

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# Recrystallization of an Organic Compound

Practical 01 | Pharmaceutical Organic Chemistry II

## Aim

To study Recrystallization of an Organic Compound, and interpret the recorded observations.

## Principle

- Recrystallization uses a suitable difference between hot and cold solubility to separate crystals from soluble impurities.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned impure solid, selected recrystallization solvent, heating bath and filtration apparatus.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Select the assigned solvent and document its hot/cold solubility behaviour.
2. Dissolve the material in the required minimum hot solvent under supervision.
3. Remove insoluble matter by the assigned hot-filtration arrangement if necessary.
4. Allow the solution to cool as directed so crystals form.
5. Separate crystals, wash with the specified cold solvent and dry appropriately.
6. Record mass and purity observations before and after purification.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Starting mass           | _____            |
| Hot-solution appearance | _____            |
| Crystal appearance      | _____            |
| Dry recovered mass      | _____            |
| Melting range           | _____            |

## Calculations and Interpretation

- Percentage recovery = dry recrystallized mass / initial impure mass  $\times$  100.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why avoid excessive solvent?

Too much solvent can retain more product in solution after cooling and reduce recovery.

### 2. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 3. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Steam Distillation of a Volatile Compound

Practical 02 | Pharmaceutical Organic Chemistry II

## Aim

To study Steam Distillation of a Volatile Compound, and interpret the recorded observations.

## Principle

- For substantially immiscible liquids, the total vapour pressure is the sum of the component vapour pressures; this permits co-distillation below the normal boiling point of the higher-boiling component.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Instructor-selected volatile material, steam-distillation apparatus, condenser and receiver.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the assigned volatile material and its compatibility with the demonstration.
2. Check the assembled steam-distillation path and condenser arrangement with the instructor.
3. Observe steam introduction and collection of the co-distillate under the approved conditions.
4. Record the collection interval and the appearance of the receiver contents.
5. Separate and identify the recovered phase using the assigned method.
6. Calculate recovery and explain the role of the two vapour-pressure contributions.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Feed identity           | _____            |
| Distillate volume       | _____            |
| Separated target mass   | _____            |
| Distillation behaviour  | _____            |
| Recovery                | _____            |

## Calculations and Interpretation

- Percentage recovery = recovered target mass / target mass initially present  $\times$  100.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Acid Value of an Oil

Practical 03 | Pharmaceutical Organic Chemistry II

## Aim

To determine Acid Value of an Oil, and interpret the recorded observations.

## Principle

- The acid value is the mass of potassium hydroxide, in mg, required to neutralize free acids in 1 g of oil.
- A standardized titrant reacts with the analyte according to a defined stoichiometric relationship.
- The calculation must distinguish direct titration from a blank-corrected or back-titration procedure.

## Materials and Apparatus

- Assigned oil, specified standardized reagents, blank reagents and oil-value glassware.
- Assigned test material, standardized titrant, specified solvent and indicator or endpoint detector.
- Burette, pipette, volumetric flask, conical flask and analytical balance.

## Method

1. Identify the analyte form, the reaction and the endpoint specified for the exercise.
2. Document titrant concentration or factor and prepare a reagent blank where the method requires one.
3. Measure the prescribed test portion and dissolve or treat it by the assigned analytical method.
4. Titrate to the specified endpoint while recording initial and final burette readings.
5. Repeat the determination with independently measured portions and retain all readings.
6. Apply blank, dilution and stoichiometric corrections before reporting the result.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Oil mass                | _____            |
| Titrant concentration   | _____            |
| Blank volume            | _____            |
| Test volumes            | _____            |
| Calculated oil value    | _____            |

## Calculations and Interpretation

- Acid value =  $(V - B) \times N \times 56.1 / W$ , in mg KOH/g.
- V and B are test and blank volumes in mL; N is titrant normality; W is oil mass in g.

### Worked Illustration

Illustration: W = 2.00 g, V - B = 1.00 mL and N = 0.100 eq/L give acid value =  $1.00 \times 0.100 \times 56.1 / 2.00 = 2.81$  mg KOH/g.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Condition volumetric apparatus and avoid burette-tip air bubbles.
- Use the endpoint and solvent assigned to the analyte; do not transfer a factor from another salt or hydrate.
- Keep direct and back-titration signs consistent and report concordance.

## Viva Questions

### 1. Why standardize a titrant?

Its actual concentration may differ from its nominal preparation concentration.

### 2. Why perform a reagent blank?

It measures reagent or solvent consumption unrelated to the analyte.

# Determination of Saponification Value of an Oil

Practical 04 | Pharmaceutical Organic Chemistry II

## Aim

To determine Saponification Value of an Oil, and interpret the recorded observations.

## Principle

- Saponification consumes alkali in ester hydrolysis and neutralization of free acids; a reagent blank establishes the initial alkali contribution.
- A standardized titrant reacts with the analyte according to a defined stoichiometric relationship.
- The calculation must distinguish direct titration from a blank-corrected or back-titration procedure.

## Materials and Apparatus

- Assigned oil, specified standardized reagents, blank reagents and oil-value glassware.
- Assigned test material, standardized titrant, specified solvent and indicator or endpoint detector.
- Burette, pipette, volumetric flask, conical flask and analytical balance.

## Method

1. Identify the analyte form, the reaction and the endpoint specified for the exercise.
2. Document titrant concentration or factor and prepare a reagent blank where the method requires one.
3. Measure the prescribed test portion and dissolve or treat it by the assigned analytical method.
4. Titrate to the specified endpoint while recording initial and final burette readings.
5. Repeat the determination with independently measured portions and retain all readings.
6. Apply blank, dilution and stoichiometric corrections before reporting the result.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Oil mass                | _____            |
| Titrant concentration   | _____            |
| Blank volume            | _____            |
| Test volumes            | _____            |
| Calculated oil value    | _____            |

## Calculations and Interpretation

- Saponification value =  $(B - S) \times N \times 56.1 / W$ , in mg KOH/g.
- B and S are blank and test acid-titration volumes in mL; W is oil mass in g.

### Worked Illustration

Illustration:  $B - S = 7.00$  mL,  $N = 0.500$  eq/L and  $W = 1.00$  g give 196.35 mg KOH/g.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Condition volumetric apparatus and avoid burette-tip air bubbles.
- Use the endpoint and solvent assigned to the analyte; do not transfer a factor from another salt or hydrate.
- Keep direct and back-titration signs consistent and report concordance.

## Viva Questions

### 1. Why standardize a titrant?

Its actual concentration may differ from its nominal preparation concentration.

### 2. Why perform a reagent blank?

It measures reagent or solvent consumption unrelated to the analyte.

# Determination of Iodine Value of an Oil

Practical 05 | Pharmaceutical Organic Chemistry II

## Aim

To determine Iodine Value of an Oil, and interpret the recorded observations.

## Principle

- The iodine value expresses halogen uptake as grams of iodine equivalent per 100 g of oil and is an index of unsaturation.
- A standardized titrant reacts with the analyte according to a defined stoichiometric relationship.
- The calculation must distinguish direct titration from a blank-corrected or back-titration procedure.

## Materials and Apparatus

- Assigned oil, specified standardized reagents, blank reagents and oil-value glassware.
- Assigned test material, standardized titrant, specified solvent and indicator or endpoint detector.
- Burette, pipette, volumetric flask, conical flask and analytical balance.

## Method

1. Identify the analyte form, the reaction and the endpoint specified for the exercise.
2. Document titrant concentration or factor and prepare a reagent blank where the method requires one.
3. Measure the prescribed test portion and dissolve or treat it by the assigned analytical method.
4. Titrate to the specified endpoint while recording initial and final burette readings.
5. Repeat the determination with independently measured portions and retain all readings.
6. Apply blank, dilution and stoichiometric corrections before reporting the result.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Oil mass                | _____            |
| Titrant concentration   | _____            |
| Blank volume            | _____            |
| Test volumes            | _____            |
| Calculated oil value    | _____            |

## Calculations and Interpretation

- Iodine value =  $(B - S) \times N \times 12.69 / W$ , in g iodine/100 g oil.
- Use the assigned iodometric method, thiosulfate normality and its prescribed blank; W is oil mass in g.

### Worked Illustration

Illustration:  $B - S = 4.00$  mL,  $N = 0.100$  eq/L and  $W = 0.500$  g give 10.15 g iodine/100 g oil.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Condition volumetric apparatus and avoid burette-tip air bubbles.
- Use the endpoint and solvent assigned to the analyte; do not transfer a factor from another salt or hydrate.
- Keep direct and back-titration signs consistent and report concordance.

## Viva Questions

### 1. Why standardize a titrant?

Its actual concentration may differ from its nominal preparation concentration.

### 2. Why perform a reagent blank?

It measures reagent or solvent consumption unrelated to the analyte.

# Preparation of Benzanilide by Acylation

Practical 06 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Benzanilide by Acylation, and interpret the recorded observations.

## Principle

- Aniline undergoes benzylation to form the amide benzanilide. The aromatic amine is the nucleophile and the benzoyl group is introduced by the assigned acylating reagent.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Aniline and the instructor-selected benzoylating reagent.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Phenyl Benzoate by Acylation

Practical 07 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Phenyl Benzoate by Acylation, and interpret the recorded observations.

## Principle

- Phenol is converted to the benzoate ester by O-acylation. The nucleophilic oxygen becomes part of the ester linkage.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Phenol and the instructor-selected benzoylating reagent.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Acetanilide by Acylation

Practical 08 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Acetanilide by Acylation, and interpret the recorded observations.

## Principle

- Acetylation of aniline converts the amino group to an acetamide group. This changes the functional-group behaviour without removing the aromatic ring.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Aniline and the assigned acetylating reagent.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of 2,4,6-Tribromoaniline

Practical 09 | Pharmaceutical Organic Chemistry II

## Aim

To prepare 2,4,6-Tribromoaniline, and interpret the recorded observations.

## Principle

- The amino group strongly activates aniline toward electrophilic aromatic substitution and directs substitution to ortho and para positions.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Instructor-demonstrated aromatic bromination materials.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Para-Bromoacetanilide

Practical 10 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Para-Bromoacetanilide, and interpret the recorded observations.

## Principle

- Protection of the amino group as an acetamide moderates its activating effect. Bromination of acetanilide can favour the para product under the assigned conditions.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Acetanilide and instructor-selected bromination reagents.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of 5-Nitrosalicylic Acid

Practical 11 | Pharmaceutical Organic Chemistry II

## Aim

To prepare 5-Nitrosalicylic Acid, and interpret the recorded observations.

## Principle

- Electrophilic aromatic nitration introduces a nitro group. The directing effects of the hydroxy and carboxyl substituents must be considered when identifying the product.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Salicylic acid and the instructor-demonstrated nitration system.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Meta-Dinitrobenzene

Practical 12 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Meta-Dinitrobenzene, and interpret the recorded observations.

## Principle

- A nitro substituent deactivates the aromatic ring and directs further electrophilic substitution mainly to a meta position.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Nitrobenzene and the instructor-demonstrated nitration system.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Benzoic Acid by Oxidation

Practical 13 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Benzoic Acid by Oxidation, and interpret the recorded observations.

## Principle

- Oxidation of the assigned benzyl starting material converts the benzylic carbon to a carboxyl group. Product identification must distinguish the acid from unchanged starting material.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Assigned benzyl starting material and oxidation reagents.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Benzoic Acid by Ester Hydrolysis

Practical 14 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Benzoic Acid by Ester Hydrolysis, and interpret the recorded observations.

## Principle

- Hydrolysis breaks an alkyl benzoate ester into a benzoic-acid component and an alcohol; the isolation conditions determine whether the acid or a benzoate salt is recovered.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Assigned alkyl benzoate and hydrolysis reagents.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

- Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
- Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
- Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
- Complete the prescribed work-up to separate the product from reaction liquids and by-products.
- Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
- Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Salicylic Acid by Ester Hydrolysis

Practical 15 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Salicylic Acid by Ester Hydrolysis, and interpret the recorded observations.

## Principle

- Hydrolysis of an alkyl salicylate removes the ester alkyl group while retaining the phenolic group and aromatic carboxyl functionality.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Assigned alkyl salicylate and hydrolysis reagents.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

- Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
- Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
- Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
- Complete the prescribed work-up to separate the product from reaction liquids and by-products.
- Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
- Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of 1-Phenylazo-2-Naphthol

Practical 16 | Pharmaceutical Organic Chemistry II

## Aim

To prepare 1-Phenylazo-2-Naphthol, and interpret the recorded observations.

## Principle

- The assigned aromatic diazonium intermediate couples with an activated naphthol ring to create an azo linkage and an extended chromophore.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Instructor-demonstrated aniline-derived diazonium and naphthol coupling materials.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Benzil from Benzoin

Practical 17 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Benzil from Benzoin, and interpret the recorded observations.

## Principle

- Oxidation converts the secondary alcohol group of benzoin to a second carbonyl, producing the adjacent diketone benzil.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Benzoin and the assigned oxidation system.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Dibenzalacetone by Claisen-Schmidt Condensation

Practical 18 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Dibenzalacetone by Claisen-Schmidt Condensation, and interpret the recorded observations.

## Principle

- A crossed aldol condensation followed by dehydration links benzaldehyde-derived units to acetone and forms a conjugated product.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Benzaldehyde, acetone and the assigned condensation reagents.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Cinnamic Acid by Perkin Reaction

Practical 19 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Cinnamic Acid by Perkin Reaction, and interpret the recorded observations.

## Principle

- The assigned aromatic aldehyde undergoes the Perkin condensation to form an unsaturated aromatic carboxylic acid after work-up.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Benzaldehyde and the instructor-selected Perkin reaction system.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Preparation of Para-Iodobenzoic Acid

Practical 20 | Pharmaceutical Organic Chemistry II

## Aim

To prepare Para-Iodobenzoic Acid, and interpret the recorded observations.

## Principle

- Replacement of the amino group of para-aminobenzoic acid through the assigned diazonium substitution route introduces iodine while retaining the carboxyl group.
- A chemical transformation changes selected functional groups while retaining or constructing the required molecular skeleton.
- Product identity and purity require analytical evidence; appearance alone cannot establish either.
- Reaction record: draw starting material and product structures, mark the functional-group change, and retain the assigned stoichiometry.
- Characterization record: compare the assigned melting range, TLC or spectral evidence. A narrow melting interval can support purity but cannot alone establish complete identity.

## Materials and Apparatus

- Instructor-demonstrated para-aminobenzoic-acid substitution materials.
- Assigned starting materials and instructor-selected reagents.
- Balance, reaction glassware, stirring/heating arrangement, condenser where required, filtration equipment and identity/purity test apparatus.

## Method

1. Write the assigned reaction scheme and balance the transformation before calculating reagent requirements.
2. Identify the limiting reactant and document the approved reaction scale, solvent and conditions.
3. Observe the instructor-directed reaction sequence and record changes without substituting reagents or conditions.
4. Complete the prescribed work-up to separate the product from reaction liquids and by-products.
5. Purify the product by the assigned method, dry it appropriately and determine the recovered mass.
6. Record the assigned identity and purity observations and compare them with the expected product.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter          | Record / finding |
|----------------------------------|------------------|
| Starting-material amounts        | _____            |
| Limiting reactant                | _____            |
| Reaction observations            | _____            |
| Dry product mass                 | _____            |
| Identity and purity observations | _____            |

## Calculations and Interpretation

- Theoretical product mass = limiting-reactant amount (mol)  $\times$  product stoichiometric ratio  $\times$  product molar mass.
- Percentage yield = dry product mass / theoretical product mass  $\times$  100.

### Worked Illustration

Illustration: a theoretical product mass of 2.00 g and dry recovery of 1.50 g give 75.0% yield.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use the approved reaction conditions and suitable ventilation.
- Keep product, starting material and waste streams separately labelled.
- Calculate yield from dry product and the limiting reactant; never use wet mass as pure-product mass.

## Viva Questions

### 1. What is the limiting reactant?

The reactant whose available amount permits the smallest theoretical amount of product.

### 2. Does a high yield establish purity?

No. Residual solvent, impurities and unreacted material can increase recovered mass.

# Determination of Drug Solubility at Room Temperature

Practical 01 | Physical Pharmaceutics I

## Aim

To determine Drug Solubility at Room Temperature, and interpret the recorded observations.

## Principle

- Solubility is the equilibrium concentration of a solute in the specified solvent at a stated temperature.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned drug, solvent, equilibration vessel and the assigned concentration assay.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the drug form, solvent and measurement temperature.
2. Contact the assigned excess drug with the solvent using the instructor's equilibration arrangement.
3. Check the completed equilibration record and separate undissolved material without changing the solution concentration.
4. Measure a defined clear solution portion by the assigned concentration assay.
5. Correct for preparation/dilution and compare replicate equilibrium readings.
6. Report solubility with solvent, temperature and units.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Temperature                | _____            |
| Equilibration observations | _____            |
| Aliquot dilution           | _____            |
| Measured concentration     | _____            |
| Replicates                 | _____            |

## Calculations and Interpretation

- Solubility = measured equilibrium concentration  $\times$  dilution factor.
- State concentration units, solvent and temperature.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of pKa by Half Neutralization

Practical 02 | Physical Pharmaceutics I

## Aim

To determine pKa by Half Neutralization, and interpret the recorded observations.

## Principle

- For a monoprotic weak acid, the Henderson-Hasselbalch relation gives  $\text{pH} = \text{pKa}$  when the amounts of acid and conjugate base are equal.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned weak acid, standardized base, calibrated pH meter and titration glassware.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Measure the assigned monoprotic weak-acid portion and calibrate the pH meter.
2. Add the standardized base incrementally and retain the volume-pH readings.
3. Identify the equivalence volume from the appropriate titration-curve interpretation.
4. Read the pH at half that equivalence volume.
5. Estimate pKa from the half-neutralization pH under the stated weak-acid assumptions.
6. State the temperature and explain possible effects of concentration or nonideal behaviour.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter     | Record / finding |
|-----------------------------|------------------|
| Added base volume           | _____            |
| pH                          | _____            |
| Equivalence-volume estimate | _____            |
| Half-equivalence pH         | _____            |

## Calculations and Interpretation

- $\text{pH} = \text{pK}_a + \log_{10}([\text{A}^-]/[\text{HA}])$ .
- At half neutralization,  $\text{pK}_a = \text{pH}$  for the stated weak-acid model.

### Worked Illustration

Illustration: an equivalence volume of 20.0 mL makes the half-equivalence volume 10.0 mL. If its measured pH is 4.20 under the stated weak-acid model,  $\text{pK}_a$  is approximately 4.20.

The values in this illustration are for calculation practice.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Benzoic Acid Partition Between Benzene and Water

Practical 03 | Physical Pharmaceutics I

## Aim

To determine Benzoic Acid Partition Between Benzene and Water, and interpret the recorded observations.

## Principle

- The measured total-concentration distribution ratio depends on pH and possible association in the organic phase. It is not automatically the intrinsic partition constant of one molecular species.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Instructor-provided equilibrium phase solutions, assigned phase assay and closed partition apparatus.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Phase volumes           | _____            |
| Temperature             | _____            |
| Aqueous pH              | _____            |
| Organic concentration   | _____            |
| Aqueous concentration   | _____            |

## Calculations and Interpretation

- Observed distribution ratio  $D = \text{total concentration in organic phase} / \text{total concentration in aqueous phase}$ .
- Keep units equal. Explain ionization or dimerization before treating  $D$  as an intrinsic constant.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Iodine Partition Between Carbon Tetrachloride and Water

Practical 04 | Physical Pharmaceutics I

## Aim

To determine Iodine Partition Between Carbon Tetrachloride and Water, and interpret the recorded observations.

## Principle

- A distribution comparison uses equilibrium concentrations in two immiscible phases at the same temperature; added complexing solutes can alter the observed result.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Instructor-provided equilibrium phase solutions and the assigned iodine assay.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Phase identity             | _____            |
| Temperature                | _____            |
| Aliquot volumes            | _____            |
| Corrected assay readings   | _____            |
| Equilibrium concentrations | _____            |

## Calculations and Interpretation

- Distribution ratio = iodine concentration in organic phase / iodine concentration in aqueous phase.
- Correct phase aliquots for dilution and keep the specified chemical composition unchanged.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Sodium Chloride by Critical Solution Temperature

Practical 05 | Physical Pharmaceutics I

## Aim

To determine Sodium Chloride by Critical Solution Temperature, and interpret the recorded observations.

## Principle

- Salt changes the mutual-solubility behaviour of the phenol-water system. An empirical calibration relates the measured critical solution temperature to composition under specified conditions.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned phenol-water/salt demonstration, temperature measurement system and calibration records.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Mixture composition        | _____            |
| Clearing/clouding readings | _____            |
| Replicates                 | _____            |
| Calibration concentration  | _____            |

## Calculations and Interpretation

- Estimate NaCl composition from the calibration relating composition to CST.
- Use only the composition and temperature range represented by that calibration.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Surface Tension by Drop Count and Drop Weight

Practical 06 | Physical Pharmaceutics I

## Aim

To determine Surface Tension by Drop Count and Drop Weight, and interpret the recorded observations.

## Principle

- Drop methods compare liquid behaviour at the same capillary tip; density, temperature and drop-shape corrections affect the result.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Stalagmometer or drop apparatus, comparison liquid, balance and density readings.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Temperature             | _____            |
| Test/reference density  | _____            |
| Drop counts             | _____            |
| Mean drop masses        | _____            |

## Calculations and Interpretation

- Drop count:  $\gamma_x/\gamma_r = (\rho_x \times n_r)/(\rho_r \times n_x)$  for the same counted volume.
- Drop weight:  $\gamma_x/\gamma_r$  approximately equals mean drop-mass ratio when the same tip and appropriate corrections apply.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of HLB by Saponification Method

Practical 07 | Physical Pharmaceutics I

## Aim

To determine HLB by Saponification Method, and interpret the recorded observations.

## Principle

- For appropriate ester-type nonionic surfactants, the Griffin saponification relation estimates hydrophilic-lipophilic balance from saponification and fatty-acid acid values.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned ester surfactant, saponification data and acid-value data for the constituent fatty acid.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Surfactant identity     | _____            |
| Saponification value S  | _____            |
| Acid value A            | _____            |
| Calculated HLB          | _____            |

## Calculations and Interpretation

- $HLB = 20(1 - S/A)$ .
- Apply this empirical expression only to the surfactant class and acid-value basis for which it is valid.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Freundlich and Langmuir Adsorption Constants

Practical 08 | Physical Pharmaceutics I

## Aim

To determine Freundlich and Langmuir Adsorption Constants, and interpret the recorded observations.

## Principle

- Adsorption is calculated from the loss of dissolved solute after contact with a known adsorbent mass. Freundlich is empirical; Langmuir describes a stated idealized adsorption model.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Activated charcoal, assigned adsorbate solutions and concentration-assay apparatus.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter         | Record / finding |
|---------------------------------|------------------|
| Initial concentration $C_0$     | _____            |
| Equilibrium concentration $C_e$ | _____            |
| Solution volume $V$             | _____            |
| Charcoal mass $m$               | _____            |
| $q_e$                           | _____            |

## Calculations and Interpretation

- $q_e = (C_0 - C_e)V/m$ , with consistent concentration/volume units.
- Freundlich:  $\log(q_e) = \log(KF) + (1/n)\log(C_e)$ .
- Langmuir:  $C_e/q_e = 1/(q_{\max} KL) + C_e/q_{\max}$ .
- A fitted line alone does not prove the physical adsorption mechanism.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Critical Micelle Concentration

Practical 09 | Physical Pharmaceutics I

## Aim

To determine Critical Micelle Concentration, and interpret the recorded observations.

## Principle

- A change in a concentration-dependent property identifies the transition associated with micelle formation. The breakpoint is method- and condition-dependent.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned surfactant series and conductivity or surface-tension apparatus.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter  | Record / finding |
|--------------------------|------------------|
| Surfactant concentration | _____            |
| Temperature              | _____            |
| Measured property        | _____            |
| Breakpoint estimate      | _____            |

## Calculations and Interpretation

- Plot the chosen property against concentration or log concentration as appropriate.
- Estimate CMC from the intersection of the two fitted regions and state the units.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of PABA-Caffeine Complex by Solubility Method

Practical 10 | Physical Pharmaceutics I

## Aim

To determine PABA-Caffeine Complex by Solubility Method, and interpret the recorded observations.

## Principle

- A phase-solubility plot compares drug solubility across ligand concentration. A simple AL plot can support a conditional 1:1 association model.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned PABA/caffeine phase-solubility data or supervised solutions and concentration assay.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Ligand concentration       | _____            |
| Total dissolved PABA       | _____            |
| Intrinsic solubility $S_0$ | _____            |
| Plot slope                 | _____            |

## Calculations and Interpretation

- For a valid 1:1 AL model:  $K = \text{slope} / [S_0(1 - \text{slope})]$ .
- Use molar units, slope below one and the stated pH/temperature; do not apply the expression to every plot shape.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Determination of Cupric-Glycine Complex by pH Titration

Practical 11 | Physical Pharmaceutics I

## Aim

To determine Cupric-Glycine Complex by pH Titration, and interpret the recorded observations.

## Principle

- Ligand binding can alter proton release and the titration curve. Comparison of metal-free and metal-containing systems helps interpret conditional complex formation.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned glycine/copper titration records, pH meter and control titration.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter   | Record / finding |
|---------------------------|------------------|
| Added titrant             | _____            |
| pH of ligand control      | _____            |
| pH of metal-ligand system | _____            |
| Assigned stoichiometry    | _____            |

## Calculations and Interpretation

- For an assumed ML complex, conditional  $K = [ML]/([M]_{\text{free}}[L]_{\text{free}})$ .
- Establish the relevant stoichiometry and free-species estimates before substituting values.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Microbiology Equipment and Processing

Practical 01 | Pharmaceutical Microbiology

## Aim

To study Microbiology Equipment and Processing, and interpret the recorded observations.

## Principle

- Distinguish heating, incubation, refrigeration, microscopy and airflow equipment by their function. A laminar-flow clean bench is not interchangeable with a biological safety cabinet.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Labelled demonstrations of incubator, aseptic hood, autoclave, hot-air sterilizer, freezer, refrigerator and microscope.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Equipment               | _____            |
| Working principle       | _____            |
| Controlled variable     | _____            |
| Application             | _____            |
| Operational check       | _____            |

## Calculations and Interpretation

- Create a function-to-equipment comparison; no numerical calculation is required.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Sterilization of Glassware and Culture-Media Principles

Practical 02 | Pharmaceutical Microbiology

## Aim

To study Sterilization of Glassware and Culture-Media Principles, and interpret the recorded observations.

## Principle

- Sterilization is a validated process, not merely exposure to heat. Load characteristics and material compatibility determine the choice of process.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Instructor-completed sterilization records, glassware demonstrations and prepared medium examples.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter  | Record / finding |
|--------------------------|------------------|
| Material/load type       | _____            |
| Process category         | _____            |
| Physical records         | _____            |
| Indicator interpretation | _____            |
| Medium purpose           | _____            |

## Calculations and Interpretation

- Interpret supplied physical and indicator records together; a changed indicator alone does not establish every part of process validity.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Subculture, Stabs and Slants - Demonstration Study

Practical 03 | Pharmaceutical Microbiology

## Aim

To study Subculture, Stabs and Slants - Demonstration Study, and interpret the recorded observations.

## Principle

- Subculture transfers an established culture to another medium. Stab and slant formats differ in surface area, geometry and observation purpose.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed demonstration images of labelled teaching cultures, stabs and slants.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Parent identity         | _____            |
| Medium format           | _____            |
| Demonstration stage     | _____            |
| Appearance              | _____            |
| Control interpretation  | _____            |

## Calculations and Interpretation

- Describe the purpose and appearance of each prepared format; no growth-rate calculation is required.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Simple, Gram and Acid-Fast Staining

Practical 04 | Pharmaceutical Microbiology

## Aim

To study Simple, Gram and Acid-Fast Staining, and interpret the recorded observations.

## Principle

- Simple staining emphasizes morphology. Gram staining differentiates cell-envelope staining behaviour; acid-fast staining examines retention of a primary dye after the assigned decolorization stage.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Instructor-supplied fixed slides or completed staining images with controls.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Stain type              | _____            |
| Cell shape/arrangement  | _____            |
| Observed colour         | _____            |
| Control colour          | _____            |
| Interpretation          | _____            |

## Calculations and Interpretation

- Compare morphology and staining pattern; do not identify a species from stain colour alone.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Pure-Culture Isolation by Streak-Plate Demonstration

Practical 05 | Pharmaceutical Microbiology

## Aim

To study Pure-Culture Isolation by Streak-Plate Demonstration, and interpret the recorded observations.

## Principle

- Progressive distribution on a prepared streak-plate demonstration can separate visible colonies. A colony appearance does not by itself prove purity or identity.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed labelled plate images and instructor-supplied purity-confirmation observations.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Streak region           | _____            |
| Distribution pattern    | _____            |
| Colony appearance       | _____            |
| Purity evidence         | _____            |
| Control status          | _____            |

## Calculations and Interpretation

- Explain why separated colonies are useful and why further identity/purity evidence is needed.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Antibiotic Assay by Cup-Plate and Related Methods

Practical 06 | Pharmaceutical Microbiology

## Aim

To study Antibiotic Assay by Cup-Plate and Related Methods, and interpret the recorded observations.

## Principle

- The supplied inhibition-zone data reflect antimicrobial activity under a defined test system. Potency estimation needs a suitable reference preparation and valid controls.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed teaching-zone measurements, antibiotic/reference labels and control records.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Preparation label       | _____            |
| Reference level         | _____            |
| Zone diameter           | _____            |
| Replicates              | _____            |
| Control status          | _____            |

## Calculations and Interpretation

- Use the supplied validated response model to estimate potency.
- Do not assume zone diameter is proportional to concentration or compare different test systems directly.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Motility by Hanging-Drop Demonstration

Practical 07 | Pharmaceutical Microbiology

## Aim

To study Motility by Hanging-Drop Demonstration, and interpret the recorded observations.

## Principle

- True motility shows directed movement relative to the surroundings. Brownian motion is random displacement and must not be classified as motility.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Instructor-provided completed movement videos or images with comparison material.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Movement direction      | _____            |
| Change in position      | _____            |
| Background movement     | _____            |
| Control observation     | _____            |

## Calculations and Interpretation

- Make a qualitative comparison between directed movement and Brownian motion.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Sterility Testing of Pharmaceuticals - Result Interpretation

Practical 08 | Pharmaceutical Microbiology

## Aim

To study Sterility Testing of Pharmaceuticals - Result Interpretation, and interpret the recorded observations.

## Principle

- A sterility test assesses a defined tested portion. Product inhibition and procedural contamination can invalidate the interpretation.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed teaching records for a pharmaceutical sterility test and method-suitability/negative controls.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Product/test portion    | _____            |
| Test approach           | _____            |
| Growth observation      | _____            |
| Control result          | _____            |
| Suitability result      | _____            |

## Calculations and Interpretation

- A valid absence-of-growth observation applies to the tested portion and conditions; it is not a mathematical guarantee for every unit in a batch.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Bacteriological Analysis of Water - Data Interpretation

Practical 09 | Pharmaceutical Microbiology

## Aim

To study Bacteriological Analysis of Water - Data Interpretation, and interpret the recorded observations.

## Principle

- Water microbiology uses defined indicator and enumeration methods. A result must retain its unit, dilution and detection limit.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed teaching datasets for water indicator tests or plate-count records.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter   | Record / finding |
|---------------------------|------------------|
| Water record              | _____            |
| Test method               | _____            |
| Dilution                  | _____            |
| Observed count or pattern | _____            |
| Control status            | _____            |

## Calculations and Interpretation

- When a valid count dataset is supplied:  $\text{count per mL} = \text{observed count} \times \text{reciprocal dilution} / \text{volume examined in mL}$ .
- For MPN, use the applicable table and stated tube/volume design rather than a plate-count equation.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Biochemical Tests - Teaching-Panel Interpretation

Practical 10 | Pharmaceutical Microbiology

## Aim

To study Biochemical Tests - Teaching-Panel Interpretation, and interpret the recorded observations.

## Principle

- Biochemical panels compare defined reaction patterns. Individual reactions support identification only within the specified test system and appropriate controls.
- Interpret the prepared teaching material using the biological or quality-control principle assigned to the exercise.
- Positive, negative and procedural controls determine whether an observation can be interpreted.

## Materials and Apparatus

- Completed teaching panels for carbohydrate use, catalase, oxidase, indole or other assigned tests.
- Instructor-supplied fixed slides, prepared demonstration images or completed teaching datasets.
- Appropriate viewing equipment, the assigned comparison/control records and an observation sheet.

## Method

1. Identify the question being tested and the teaching material supplied.
2. Review the labelled demonstration sequence and identify what each stage is intended to show.
3. Compare the supplied test observations with the relevant control observations.
4. Record the morphology, pattern or numerical endpoint specified for this exercise.
5. Explain the biological meaning of the observation and identify a control failure where present.
6. Write the conclusion only to the extent supported by the completed teaching observations.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Test name               | _____            |
| Test observation        | _____            |
| Positive control        | _____            |
| Negative control        | _____            |
| Interpretation          | _____            |

## Calculations and Interpretation

- Prepare a reaction-pattern table; avoid equating one positive result with a confirmed species.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use fixed, prepared or completed teaching material specified by the instructor.
- Preserve specimen labels and avoid interpreting an uncontrolled or mixed result as a verified identity.
- Handle biological material and contaminated waste only through the laboratory arrangements provided.

## Viva Questions

### 1. Why include a negative control?

It reveals an observation caused by background or contamination rather than the intended test.

### 2. What happens if a required control fails?

The affected test result cannot be accepted as a valid interpretation.

# Study of Radiation Constant of Surfaces

Practical 01 | Pharmaceutical Engineering

## Aim

To study Radiation Constant of Surfaces, and interpret the recorded observations.

## Principle

- Radiative power depends on absolute temperature and surface emissivity. A material-dependent fitted coefficient is not the universal Stefan-Boltzmann constant.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Brass, iron and painted/unpainted glass demonstration apparatus with heat-loss readings.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter     | Record / finding |
|-----------------------------|------------------|
| Surface                     | _____            |
| Area A                      | _____            |
| Temperature T               | _____            |
| Surrounding temperature Ts  | _____            |
| Corrected radiative power P | _____            |

## Calculations and Interpretation

- $P = \epsilon \times \sigma \times A(T^4 - T_s^4)$ , with temperatures in kelvin.
- Effective coefficient =  $P/[A(T^4 - T_s^4)]$  after the assigned non-radiative corrections.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Steam-Distillation Efficiency

Practical 02 | Pharmaceutical Engineering

## Aim

To study Steam-Distillation Efficiency, and interpret the recorded observations.

## Principle

- Define recovery efficiency separately from thermal efficiency; both require an explicit measured basis.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Steam-distillation teaching apparatus, feed and recovered-material mass records.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter         | Record / finding |
|---------------------------------|------------------|
| Initial recoverable target mass | _____            |
| Recovered target mass           | _____            |
| Collection interval             | _____            |
| Steam/energy records            | _____            |

## Calculations and Interpretation

- Recovery efficiency = recovered target mass / initially recoverable target mass × 100.
- A thermal efficiency needs a separate energy balance and cannot be inferred from recovery alone.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Overall Heat-Transfer Coefficient

Practical 03 | Pharmaceutical Engineering

## Aim

To study Overall Heat-Transfer Coefficient, and interpret the recorded observations.

## Principle

- A heat exchanger transfers energy across an area driven by a temperature difference. Flow arrangement determines the terminal differences used in the log-mean temperature difference.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned heat exchanger, temperature probes and flow-rate measurement.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter                | Record / finding |
|----------------------------------------|------------------|
| Hot/cold inlet and outlet temperatures | _____            |
| Mass flow                              | _____            |
| Heat-transfer area                     | _____            |
| Heat balance                           | _____            |

## Calculations and Interpretation

- $Q = \text{mass flow} \times \text{heat capacity} \times \text{temperature change}$ .
- $\text{LMTD} = (\Delta T_1 - \Delta T_2) / \ln(\Delta T_1 / \Delta T_2)$ .
- $U = Q / (A \times \text{LMTD})$ . When terminal differences are equal, LMTD equals that common difference.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Drying Curves for Calcium Carbonate and Starch

Practical 04 | Pharmaceutical Engineering

## Aim

To study Drying Curves for Calcium Carbonate and Starch, and interpret the recorded observations.

## Principle

- A drying curve follows moisture content with time. The constant-rate and falling-rate regions depend on the material and drying conditions.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned drying demonstration, balance, timer and temperature records.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Time                    | _____            |
| Wet mass                | _____            |
| Dry-solid mass          | _____            |
| Moisture content        | _____            |
| Drying interval         | _____            |

## Calculations and Interpretation

- Dry-basis moisture  $X = (\text{wet mass} - \text{dry-solid mass}) / \text{dry-solid mass}$ .
- Approximate drying rate =  $-\text{dry-solid mass} \times \Delta X / (\text{area} \times \Delta t)$ .

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Moisture Content and Loss on Drying

Practical 05 | Pharmaceutical Engineering

## Aim

To study Moisture Content and Loss on Drying, and interpret the recorded observations.

## Principle

- Loss on drying measures mass lost under the assigned conditions and may include volatile substances other than water.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned material, weighing vessel, balance and specified drying apparatus.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Vessel tare             | _____            |
| Initial material mass   | _____            |
| Mass after drying       | _____            |
| Constant-mass checks    | _____            |

## Calculations and Interpretation

- $\text{LOD (\%)} = (\text{initial material mass} - \text{final material mass}) / \text{initial material mass} \times 100$ .
- State the method and basis; LOD is not always water-specific moisture.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Air Humidity by Wet/Dry Bulb and Dew Point

Practical 06 | Pharmaceutical Engineering

## Aim

To study Air Humidity by Wet/Dry Bulb and Dew Point, and interpret the recorded observations.

## Principle

- Wet-bulb depression reflects evaporative cooling. Psychrometric interpretation depends on air pressure and the appropriate measurement conditions.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Wet/dry bulb demonstration, pressure record and psychrometric chart or supplied dew-point data.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Dry-bulb temperature    | _____            |
| Wet-bulb temperature    | _____            |
| Pressure                | _____            |
| Dew point               | _____            |
| Relative humidity       | _____            |

## Calculations and Interpretation

- Relative humidity = actual water-vapour pressure / saturation vapour pressure at the dry-bulb temperature  $\times 100$ .
- Use the chart/calculation matching the stated pressure and ventilation.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Pharmaceutical Machinery: Construction and Working

Practical 07 | Pharmaceutical Engineering

## Aim

To study Pharmaceutical Machinery: Construction and Working, and interpret the recorded observations.

## Principle

- Compare compression in a rotary tablet press, coating in a fluidized bed, gas-driven size reduction in a fluid-energy mill and moisture removal in a dehumidifier.
- The construction and operating principle determine the function of the equipment.
- The practical distinguishes the input, working zone, controlled variables and output.
- Rotary tablet press: a feeder supplies dies on a rotating turret; punches perform filling, compression and ejection. Application: repeated tablet compression.
- Fluidized-bed coater: controlled air suspends the particles while an assigned spray deposits coating. Air distribution, atomization and drying balance affect the coat.
- Fluid-energy mill: high-velocity gas creates particle impacts/attrition in the milling chamber. The assigned classification arrangement separates the suitable product fraction.
- Dehumidifier: a condensation or desiccant system removes water vapour from air. Air temperature, moisture load and airflow affect its performance.

## Materials and Apparatus

- Labelled demonstrations or schematics of the four specified machines.
- Assigned equipment demonstration, labelled schematic or manufacturer-approved training material.
- Observation sheet and any instructor-supplied performance readings.

## Method

1. Identify the major components on the actual equipment or training diagram.
2. Trace the material, energy or signal path through the system.
3. Observe the instructor demonstration and note the purpose of each control.
4. Record the operating variables and the output relevant to the exercise.
5. Relate the equipment principle to its pharmaceutical application.
6. Summarize the variables that influence performance and the checks required before operation.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Machine                    | _____            |
| Major components           | _____            |
| Material path              | _____            |
| Operating variable         | _____            |
| Pharmaceutical application | _____            |

## Calculations and Interpretation

- Calculate a performance metric only when a suitable set of demonstration readings is supplied.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use equipment demonstrations and trained operation for moving, hot or pressurized components.
- Do not bypass guards, interlocks or the assigned operating limits.
- Distinguish operating performance from the appearance of the machine.

## Viva Questions

### 1. Why trace the material or energy path?

It connects the equipment construction to the process it performs.

### 2. Why are operating variables recorded?

They are needed to explain or reproduce the observed performance.

# Study of Sieve Analysis and Particle-Size Frequency Curves

Practical 08 | Pharmaceutical Engineering

## Aim

To study Sieve Analysis and Particle-Size Frequency Curves, and interpret the recorded observations.

## Principle

- A sieve stack separates a powder/granulation into size fractions. Distribution plots must state whether size is number-, mass- or another weighted basis.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned granulation, sieve stack, balance and sieve shaker.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Record the granulation mass and each sieve opening.
2. Observe sieving under the assigned conditions.
3. Weigh retained fractions and check the mass recovery.
4. Calculate each retained percentage on a consistent denominator.
5. Construct frequency and cumulative plots using the specified size convention.
6. Explain the principal size range and the meaning of the distribution weighting.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Sieve opening           | _____            |
| Retained mass           | _____            |
| Percent retained        | _____            |
| Cumulative fraction     | _____            |
| Mass recovery           | _____            |

## Calculations and Interpretation

- Percent retained =  $\text{retained mass} / \text{total recovered mass} \times 100$ .
- Cumulative percentages are obtained by adding successive fractions on a stated retained/passing basis.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Ball-Mill Size Reduction and Milling Laws

Practical 09 | Pharmaceutical Engineering

## Aim

To study Ball-Mill Size Reduction and Milling Laws, and interpret the recorded observations.

## Principle

- Kick, Rittinger and Bond relate energy to different size measures and ranges. Mill critical speed describes the idealized balance between centrifugal and gravitational effects.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Ball-mill demonstration, feed/product size records and power/energy data.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Feed size d1            | _____            |
| Product size d2         | _____            |
| Net energy              | _____            |
| Mill diameter D         | _____            |
| Ball diameter d         | _____            |

## Calculations and Interpretation

- Kick:  $E = KK \ln(d1/d2)$ .
- Rittinger:  $E = KR(1/d2 - 1/d1)$ .
- Bond-form relation:  $E = KB(1/\sqrt{d2} - 1/\sqrt{d1})$ ; keep the coefficient and size units together.
- Ideal critical speed in rpm:  $N_c = (60/2\pi)\sqrt{2g/(D - d)}$ , with lengths in metres and g in  $m/s^2$ .

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Colloid Mill, Planetary Mixer, Fluidized-Bed Dryer and Freeze Dryer

Practical 10 | Pharmaceutical Engineering

## Aim

To study Colloid Mill, Planetary Mixer, Fluidized-Bed Dryer and Freeze Dryer, and interpret the recorded observations.

## Principle

- These devices illustrate shear-driven dispersion, planetary mixing, convective drying and sublimation-based drying respectively.
- The construction and operating principle determine the function of the equipment.
- The practical distinguishes the input, working zone, controlled variables and output.
- Colloid mill: a close rotor-stator working zone provides high shear for dispersion and emulsification.
- Planetary mixer: the mixing tool rotates while travelling around the vessel; this combined movement can process viscous materials.
- Fluidized-bed dryer: a gas distributor supports an agitated particle bed for convective heat and mass transfer, with suitable exhaust filtration.
- Freeze dryer: freezing precedes primary drying by sublimation under reduced pressure; secondary drying removes remaining bound moisture. The condenser collects water vapour.

## Materials and Apparatus

- Instructor demonstrations or labelled working diagrams of the four devices.
- Assigned equipment demonstration, labelled schematic or manufacturer-approved training material.
- Observation sheet and any instructor-supplied performance readings.

## Method

1. Identify the major components on the actual equipment or training diagram.
2. Trace the material, energy or signal path through the system.
3. Observe the instructor demonstration and note the purpose of each control.
4. Record the operating variables and the output relevant to the exercise.
5. Relate the equipment principle to its pharmaceutical application.
6. Summarize the variables that influence performance and the checks required before operation.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Device                  | _____            |
| Working zone            | _____            |
| Energy input            | _____            |
| Controlled variable     | _____            |
| Application             | _____            |

## Calculations and Interpretation

- Calculate a performance metric only when a suitable set of demonstration readings is supplied.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Use equipment demonstrations and trained operation for moving, hot or pressurized components.
- Do not bypass guards, interlocks or the assigned operating limits.
- Distinguish operating performance from the appearance of the machine.

## Viva Questions

### 1. Why trace the material or energy path?

It connects the equipment construction to the process it performs.

### 2. Why are operating variables recorded?

They are needed to explain or reproduce the observed performance.

# Study of Factors Affecting Filtration and Evaporation Rates

Practical 11 | Pharmaceutical Engineering

## Aim

To study Factors Affecting Filtration and Evaporation Rates, and interpret the recorded observations.

## Principle

- Filtration depends on pressure, viscosity and flow resistance; evaporation rate depends on heat/mass transfer and the available driving force.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Assigned filtration/evaporation demonstration and controlled comparative readings.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter    | Record / finding |
|----------------------------|------------------|
| Test variable              | _____            |
| Filtrate/evaporated amount | _____            |
| Time                       | _____            |
| Area                       | _____            |
| Temperature/pressure       | _____            |

## Calculations and Interpretation

- Rate = amount collected or evaporated / collection time.
- Compare one intended variable at a time while recording the other operating conditions.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Effect of Time on Crystallization

Practical 12 | Pharmaceutical Engineering

## Aim

To study Effect of Time on Crystallization, and interpret the recorded observations.

## Principle

- Supersaturation drives crystallization, while nucleation and crystal growth affect the number and size of recovered crystals over time.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Instructor-selected crystallization demonstration, timed observations and mass/size records.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Time                    | _____            |
| Temperature             | _____            |
| Crystal appearance      | _____            |
| Crystal size            | _____            |
| Recovered mass          | _____            |

## Calculations and Interpretation

- Plot the assigned crystallization observable against time.
- Percentage recovery =  $\text{dry recovered mass} / \text{initial recoverable solute mass} \times 100$ .

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

A change in conditions may alter the measured property independently of the intended variable.

### 2. Why retain replicate readings?

They show repeatability and help identify an anomalous measurement.

# Study of Blend Uniformity with a Double-Cone Blender

Practical 13 | Pharmaceutical Engineering

## Aim

To study Blend Uniformity with a Double-Cone Blender, and interpret the recorded observations.

## Principle

- Uniformity assessment compares representative locations and a suitable analyte marker. Average content can be acceptable while spatial variability remains large.
- The property is obtained from a defined observable under controlled conditions.
- Replicate measurements, instrument checks and consistent units are needed before comparison.

## Materials and Apparatus

- Blender demonstration and location-specific assay records.
- Assigned test material and calibration or comparison material.
- The apparatus specified for this property, a balance or volumetric equipment where relevant, and a record sheet.

## Method

1. Identify the measured property, units and controlled variables before setting up the apparatus.
2. Check the instrument, zero or calibration and record the relevant operating conditions.
3. Prepare a representative measured portion without changing its intended composition.
4. Obtain the readings specified for the property and repeat under the same conditions.
5. Calculate the required property, including corrections stated for the apparatus or method.
6. Summarize the replicate results and explain the effect of the variable studied.

## Observation Record

Complete this record using actual laboratory findings or the provided teaching data.

| Observation / parameter | Record / finding |
|-------------------------|------------------|
| Blend time              | _____            |
| Location                | _____            |
| Marker concentration    | _____            |
| Mean                    | _____            |
| Standard deviation      | _____            |

## Calculations and Interpretation

- $CV (\%) = \text{standard deviation} / \text{mean} \times 100$  for a nonzero mean.
- Report the course-defined uniformity index separately with its stated definition; CV is a descriptive variability metric.

## Result

Record the actual finding, calculated value with units where relevant, and a conclusion supported by the observations.

Finding: \_\_\_\_\_

Conclusion: \_\_\_\_\_

## Precautions

- Keep temperature and test conditions consistent across comparative readings.
- Record raw readings before rounding calculated values.
- Do not compare results obtained with different methods as if they were interchangeable.

## Viva Questions

### 1. Why control the test conditions?

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