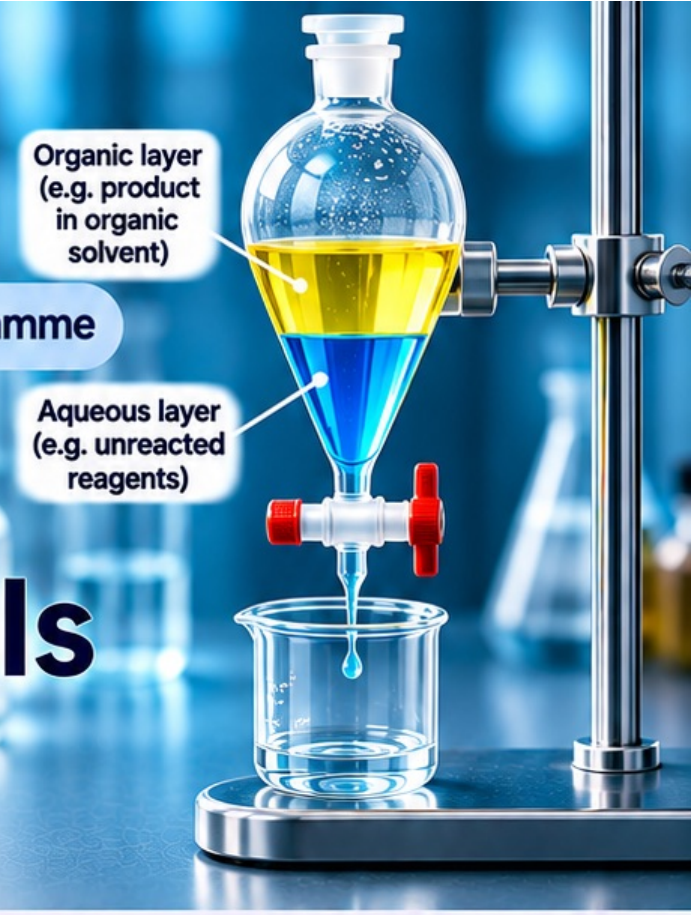
LearningSparks®
Education Services

Pre-IB Chemical Research Skills Programme



Chemical Research Skills

A Skills-Building Programme for Independent Chemical Investigation

Module 7 | Worksheets

Student Practice & Application

Module Focus

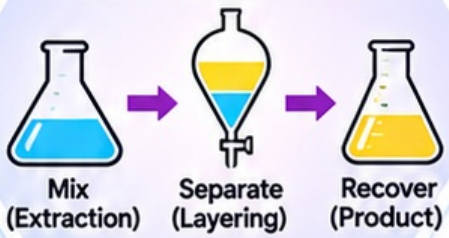
- Principles and techniques of liquid–liquid extraction
- Choice of suitable solvent and extraction conditions
- Performing the extraction and separating the layers
- Purifying and recovering the product
- Calculating yield and evaluating the effectiveness of the method



Key Concepts

- Distribution of a solute between two immiscible liquids
- Separation using a separatory funnel
- Recovery and purification of the desired product
- Yield and efficiency

Overall Workflow



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Module 7 — Student Worksheets
Standardisation & Primary Standards
How Do We Know the Concentration Is Really Correct?
Pre-IB Chemical Research Skills Programme
LearningSparks Education Services
Student: _____
Date: _____

Module learning goal

To understand how chemists establish reliable solution concentrations using primary standards, titration, stoichiometry and experimental evidence.

By completing these worksheets, students should progress from understanding the purpose of standardisation to calculating, evaluating and defending an experimentally determined concentration.

Prepare → Standardise → Calculate → Evaluate → Justify

Section A — Understanding Standards and Standardisation

Worksheet 1 — Intended vs Actual Concentration

A student prepares a sodium hydroxide solution intended to have a concentration of:

$$0.1000\ \text{mol dm}^{-3}$$

The student accurately calculates the required mass of NaOH and prepares the solution using a volumetric flask.

Question 1

Does this automatically guarantee that the actual concentration is exactly $0.1000\ \text{mol dm}^{-3}$?

☐ Yes

☐ No

Explain.

_____

_____

Question 2

Identify three reasons why the actual concentration might differ from the intended concentration.

1. _____
2. _____
3. _____

Question 3

Complete:

Calculated concentration ≠ necessarily _____ concentration

Research thinking

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Why is this distinction important when preparing solutions for quantitative chemical analysis?

_____

_____

_____

Worksheet 2 — What Is a Standard Solution?

Question 1

Complete the definition.

A standard solution is a solution whose _____ is accurately _____.

Question 2

Which statements are correct?

☐ A standard solution must always be highly concentrated.

☐ A standard solution has an accurately known concentration.

☐ Standard solutions are useful in titration.

☐ Every solution prepared using a volumetric flask is automatically a standard solution.

☐ Standard solutions can be used to determine unknown concentrations.

Question 3

Give two applications of standard solutions.

1. _____
2. _____

Question 4

Explain why a standard solution must have a reliable concentration.

_____

_____

Worksheet 3 — Two Routes to a Known Concentration

Complete the following pathways.

Route A — Direct preparation

Suitable primary standard

↓

[Accurate _____]

↓

[Dissolve and make up to known _____]

↓

Standard solution

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Route B — Standardisation

Solution of approximate concentration
↓
_____ against a reliable standard
↓
Calculate actual _____

Question

What is the main difference between these two routes?

Worksheet 4 — What Makes a Good Primary Standard?

A primary standard should possess several important properties.
Complete the table.

Property	Why is it important?
High purity	_____
Stable in air	_____
Not significantly hygroscopic	_____
Known chemical composition	_____
Relatively high molar mass	_____
Predictable reaction stoichiometry	_____

Question 1

Why is a substance that absorbs moisture from the atmosphere generally unsuitable as a primary standard?

Question 2

Why might a relatively high molar mass be advantageous?

Question 3

Complete:
A primary standard must allow the number of _____ to be determined reliably from its measured _____.

Worksheet 5 — Why Is NaOH Commonly Standardised?

Solid sodium hydroxide can absorb moisture and react with carbon dioxide in air.
The reaction with carbon dioxide is:

$$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$$

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Question 1

Why can moisture absorption affect the reliability of a weighed NaOH sample?

Question 2

What effect could reaction with atmospheric carbon dioxide have on the composition of the solid?

Question 3

A student weighs NaOH pellets and prepares a solution labelled:

$$0.1000\ \text{mol dm}^{-3}$$

Should the student automatically assume this is its accurately established concentration?

☐ Yes

☐ No

Question 4

What experimental process could be used to determine its actual concentration?

Worksheet 6 — Primary Standard or Standardised Solution?

Classify each description.

Description	Classification
A highly pure, stable substance suitable for accurate direct weighing	_____
A NaOH solution whose concentration has been determined by titration	_____
A solution whose concentration is accurately known	_____
A substance used as the initial reliable reference for quantitative analysis	_____

Question

Explain why a primary standard and a standardised solution are not the same thing.

Worksheet 7 — Standardisation Does Not Change the Concentration

A student prepares NaOH intended to be:

$$0.1000\ \text{mol dm}^{-3}$$

After standardisation, the concentration is determined as:

$$0.0976\ \text{mol dm}^{-3}$$

Question 1

What is the experimentally established concentration?

_____mol dm^3

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Question 2

Did standardisation physically change the solution concentration to the intended value?

☐ Yes

☐ No

Question 3

Which value should be used in subsequent quantitative calculations?

☐ $0.1000\ \text{mol dm}^{-3}$

☐ $0.0976\ \text{mol dm}^{-3}$

Complete

Standardisation determines the _____ concentration of a solution. It does not automatically _____ that concentration.

Section B — Understanding Titration

Worksheet 8 — Titration Vocabulary

Match each term to its description.

Term	Description
Aliquot	_____
Titrant	_____
Titre	_____
Analyte	_____
Endpoint	_____
Equivalence point	_____

Use the following descriptions:

A. The experimentally observed point at which the titration is stopped.

B. The substance being determined.

C. The solution delivered from the burette.

D. A precisely measured portion of solution.

E. The volume delivered from the burette during titration.

F. The theoretical point where reactants have combined in the required stoichiometric ratio.

Question

Why is it important to distinguish endpoint from equivalence point?

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