LearningSparks®
Education Services

Pre-IB Chemical Research Skills Programme

Chemical Research Skills

A Skills-Building Programme for Independent Chemical Investigation



Module 6 | Worksheets

Student Practice & Application

Module Focus

- Preparation of solutions with accurate concentration
- Using volumetric flasks correctly
- Measuring and transferring volumes with pipettes and burettes
- Good laboratory technique and reducing errors
- Calculations and concentration units (mol dm^{-3}, g dm^{-3}, % w/v)



Key Concepts

- Standard Solution
- Volumetric Flask
- Pipette & Burette
- Concentration Calculation
- Good Laboratory Practice

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Module 6 — Student Worksheets
Liquid–Liquid Extraction
Separating Chemicals Using Solubility & Partitioning
Student: _____
Date: _____
Module goal: Understand how differences in solubility, intermolecular interactions and partitioning can be used to separate chemical substances—and how to turn extraction into a quantitative research technique.

Worksheet 1 — Why Separate Before Measuring?
A real sample contains:

- analyte X
- water
- coloured impurity Y
- dissolved salts
- suspended material

A student wants to determine the concentration of X.
Question 1
Why might directly measuring the original sample be unreliable?

Question 2
Complete the analytical strategy:

Complex sample
↓
{_____}
↓
Measure analyte

Question 3
Complete:
Liquid–liquid extraction can be used to _____ a desired chemical species from other components before _____.

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Worksheet 2 — Miscible or Immiscible?

Classify each description.

Description	Miscible / Immiscible
Two liquids form one homogeneous phase	_____
Two liquids form two separate layers	_____
Water and ethanol	_____
Water and hexane	_____

Complete

Miscible means:

_____

Immiscible means:

_____

Question

Why must the two phases used in liquid–liquid extraction be sufficiently immiscible?

_____

_____

Worksheet 3 — Why Do the Layers Separate?

Water is highly polar and forms strong hydrogen-bonding interactions.

Hexane is non-polar and interacts mainly through London dispersion forces.

Question 1

Why do water and hexane not mix completely?

_____

_____

Question 2

Complete the common guideline:

\boxed{\text{“_____ dissolves _____”}}

Question 3

Is this guideline a complete scientific law?

☐ Yes

☐ No

Question 4

Write a more scientific statement.

A solute tends to dissolve better in a solvent when _____

_____

_____

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Worksheet 4 — Where Would the Solute Prefer to Be?

For each solute, predict the phase it is more likely to favour.

Solute A

Highly polar and capable of strong hydrogen bonding with water.

☐ Aqueous phase

☐ Non-polar organic phase

Reason:

Solute B

Mostly non-polar hydrocarbon molecule.

☐ Aqueous phase

☐ Non-polar organic phase

Reason:

Solute C

Contains both a large non-polar region and a small polar region.

Can you confidently predict its distribution from this information alone?

☐ Yes

☐ No

Explain:

Research lesson

Molecular structure can help us _____ solubility, but experimental evidence may still be needed to determine actual _____ behaviour.

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Worksheet 5 — Does All the Solute Move?

A student says:

"Compound X prefers the organic solvent, so after extraction all of X must be in the organic layer."

Question 1

Is this necessarily correct?

☐ Yes

☐ No

Question 2

Complete:

X(aq)→ X(_____)

Question 3

What does this equilibrium represent?

Question 4

Complete:

During extraction, the solute usually _____ between the two phases rather than moving completely into only one phase.

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Worksheet 6 — Understanding the Partition Coefficient

For compound X:

$$\boxed{K = \frac{[X]_{\text{org}}}{[X]_{\text{aq}}}}$$

Question 1

If:

$$K = 5.0$$

then:

[X](org) = _____[X]_(aq)

Question 2

Which phase does Xfavour?

☐ Aqueous

☐ Organic

Question 3

If:

$$K = 0.20$$

which phase does Xfavour?

☐ Aqueous

☐ Organic

Question 4

Complete:

If:

$$K > 1$$

Xfavours the _____ phase.

If:

$$K < 1$$

Xfavours the _____ phase.

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