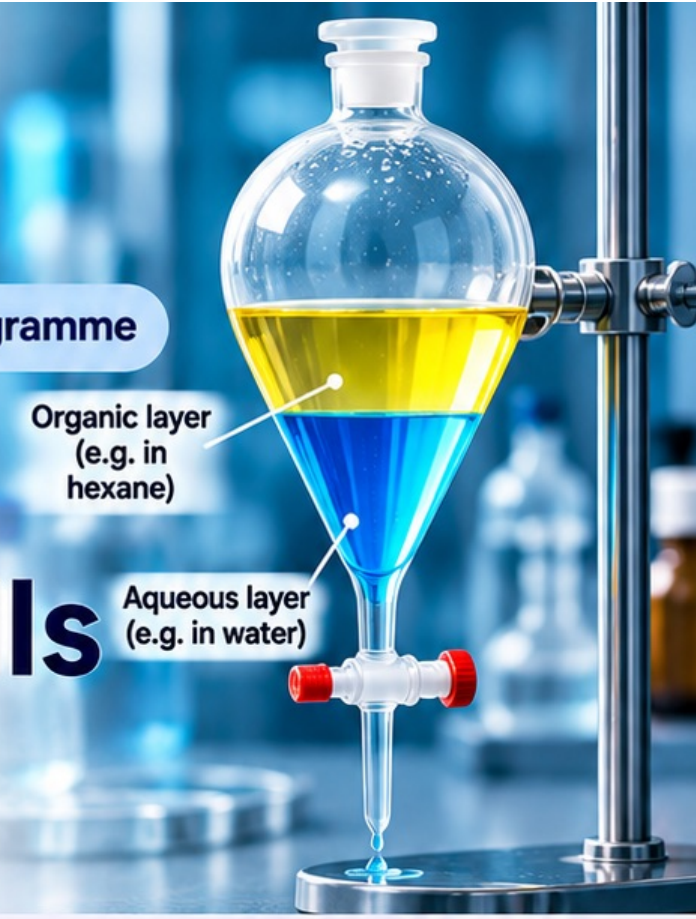
LearningSparks®
Education Services

Pre-IB Chemical Research Skills Programme

Chemical Research Skills



A Skills-Building Programme for Independent Chemical Investigation

Module 3 | Worksheets

Student Practice & Application

Module Focus

- Principles of liquid–liquid extraction
- Choice of suitable solvents
- Performing an extraction and separating the layers
- Purification and recovery of the product
- Analysis, yield and evaluation of the method

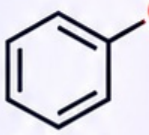




Key Concept

- Partitioning (different solubilities)
- Immiscible liquids (e.g. water and hexane)
- Separation using a separatory funnel

Example Application



Extraction of a phenolic compound (e.g. salicylic acid)

Sunny Chiam

IB Chemistry Specialist & Examiner-Level Educator
Founder, LearningSparks Education Services
Creator of the CHIAM Framework™

Module 3 — Student Worksheets
Dilution as a Research Tool
1-Minute Chemical Research Skills — Pre-IB Chemistry
Student: _____ **Date:** _____
Module goal: By the end of these worksheets, you should be able to calculate and prepare dilutions, distinguish direct from serial dilution, evaluate sources of error, and design an appropriate concentration series for a chemical investigation.

Worksheet 1 — What Happens During Dilution?
A solution contains dissolved solute particles.
Water is added to the solution.
Part A — Complete the statements
During dilution:
The amount of solute in the transferred sample:
☐ increases
☐ decreases
☐ remains constant
The total volume of solution:
☐ increases
☐ decreases
☐ remains constant
The concentration:
☐ increases
☐ decreases
☐ remains constant
Part B — Explain at particle level
Complete:
During dilution, solvent is added but no additional _____ is added.
The solute particles therefore become more _____ throughout a larger volume.
Consequently, the number of solute particles per unit volume _____.
Part C — Think carefully
A student says:
“Dilution means some solute has been removed.”
Is this correct?
☐ Yes
☐ No
Explain.

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Worksheet 2 — Where Does the Dilution Equation Come From?

We know:

$$n = CV$$

Before dilution:

n_1=_____

After dilution:

n_2=_____

During dilution:

n_1=_____

Therefore:

C_1V_1=_____

and hence:

$$\boxed{C_1V_1 = C_2V_2}$$

Define each symbol

Symbol Meaning

C_1 _____

V_1 _____

C_2 _____

V_2 _____

Important question

Is V_2:

☐ volume of water added

☐ final total volume of diluted solution

Explain the difference.

_____

_____

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Worksheet 3 — Basic Dilution Calculations

Use:

$$\boxed{C_1V_1 = C_2V_2}$$

Question 1

Prepare:

$$100.0\ \text{cm}^3$$

of:

$$0.100\ \text{mol dm}^{-3}$$

solution from:

$$0.500\ \text{mol dm}^{-3}$$

stock.

$$(0.500)(V_1) = (0.100)(100.0)$$

V_1=_____cm³

Question 2

Prepare 250.0 cm³ of 0.200 mol dm⁻³ solution from 1.00 mol dm⁻³ stock.

V_1=_____cm³

Question 3

Prepare 50.0 cm³ of 0.0400 mol dm⁻³ solution from 0.200 mol dm⁻³ stock.

V_1=_____cm³

Question 4

25.0 cm³ of 0.400 mol dm⁻³ solution is diluted to a final volume of 100.0 cm³.

Calculate the new concentration.

C_2=_____ mol dm⁻³

Question 5

10.0 cm³ of a solution is diluted to 250.0 cm³.

Its final concentration is 0.0200 mol dm⁻³.

Calculate the original concentration.

C_1=_____ mol dm⁻³

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Worksheet 4 — What Does "Dilute to" Mean?

A student needs to prepare 100.0 cm^3 of diluted solution.

The calculation gives:

$$V_1 = 20.0\ \text{cm}^3$$

The student writes:

"Transfer 20.0 cm^3 stock solution and add 100.0 cm^3 water."

Question 1

What is wrong with this instruction?

Question 2

What should the instruction say instead?

Transfer _____ cm^3 of stock solution and dilute with water to a final volume of _____ cm^3.

Question 3

Another student writes:

"I need 100.0 − 20.0 = 80.0 cm^3 water."

Why is measuring exactly 80.0 cm^3 of water separately not the preferred volumetric procedure?

Complete:

In quantitative dilution, we control the final _____ of solution rather than simply measuring the amount of _____ added.

Worksheet 5 — Dilution Factor

The dilution factor can be expressed as:

$$\boxed{\text{Dilution factor} = \frac{C_1}{C_2}}$$

or:

$$\boxed{\text{Dilution factor} = \frac{V_2}{V_1}}$$

Question 1

A 0.500 mol dm^{-3} solution is diluted to 0.100 mol dm^{-3}.

Dilution factor:

{0.500}/{0.100}=_____

This is a _____-fold dilution.

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Question 2

10.0 cm^3 is diluted to 100.0 cm^3.

Dilution factor = {100.0}/{10.0} = _____

The final concentration is:

☐ 10 times the original

☐ one-tenth the original

☐ unchanged

Question 3

25.0 cm^3 is diluted to 250.0 cm^3.

Dilution factor = _____

If the original concentration is 0.800 mol dm^{-3}:

C_2=_____mol dm^{-3}

Worksheet 6 — Build a Direct Dilution Series

You have:

$$0.500 \text{ mol dm}^{-3}$$

stock solution.

You need **100.0 cm^3** of each concentration below.

Complete the table.

Target C_2/ mol dm^{-3}	Stock C_1/ mol dm^{-3}	V_1/ cm^3	Final V_2/ cm^3
0.100	0.500	_____	100.0
0.200	0.500	_____	100.0
0.300	0.500	_____	100.0
0.400	0.500	_____	100.0

Question

Draw arrows showing where each solution comes from.

Stock 0.500 mol dm^{-3}

↓ _____

↓ _____

↓ _____

↓ _____

Think

If the 0.200 mol dm^{-3} solution is prepared incorrectly, will the 0.300 mol dm^{-3} solution automatically be incorrect?

☐ Yes

☐ No

Explain.

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