LearningSparks®
Education Services

Pre-IB Chemical Research Skills Programme

Chemical Research Skills

A Skills-Building Programme for Independent Chemical Investigation



Module 2 | Worksheets

Student Practice & Application

Module Focus

- Accurate Measurement and Solution Preparation
- Use of Volumetric Glassware (e.g. volumetric flask, measuring cylinder, pipette)
- Preparing Standard Solutions
- Serial Dilution and Concentration Calculations



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Module 2 — Student Worksheets
Preparing Standard Solutions
1-Minute Chemical Research Skills — Pre-IB Chemistry
Student: _____ **Date:** _____
Module goal: By the end of these worksheets, you should be able to calculate, prepare and evaluate a standard solution using appropriate quantitative laboratory techniques.

Worksheet 1 — What Is a Standard Solution?
Part A — Complete the definition
A **standard solution** is a solution whose

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is accurately known.
Part B — Understanding concentration
A solution has a concentration of:

$$0.200\ \text{mol dm}^{-3}$$

Explain what this means in words.

Part C — Why do we need standard solutions?
Tick the applications in which an accurately known concentration could be important.
☐ Titration
☐ Calibration curve
☐ Quantitative chemical analysis
☐ Spectrophotometry
☐ Reaction-rate investigation
☐ Simply observing the colour of a chemical
Explain why an inaccurate standard solution could affect later experimental results.

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Worksheet 2 — Concentration, Amount and Volume

The fundamental relationship is:

$$\boxed{C = \frac{n}{V}}$$

Complete the table.

Symbol	Quantity	Common unit
C	_____	_____
n	_____	_____
V	_____	_____

Part A — Rearranging

Rearrange:

$$C = \frac{n}{V}$$

to make $n$the subject.

$$\boxed{n =}$$

Now make $V$the subject.

$$\boxed{V =}$$

Part B — Volume conversion

Complete:

1. $100.0\ \text{cm}^3$ =_____ dm^3
2. $250.0\ \text{cm}^3$ =_____ dm^3
3. $500.0\ \text{cm}^3$ =_____ dm^3
4. $25.0\ \text{cm}^3$ =_____ dm^3
5. $0.150\ \text{dm}^3$ =_____ cm^3

Part C — Why does it matter?

A student substitutes:

$$C = \frac{0.0250}{250}$$

and reports concentration in mol dm^{-3}.

Identify the error.

Correct the calculation if the solution volume is 250 cm^3.

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Worksheet 3 — From Mass to Concentration

For a solid:

$$n = \frac{m}{M}$$

and:

$$n = CV$$

Therefore:

$$\boxed{m = CVM}$$

Worked structure

You need to prepare **250.0 cm³ of 0.1000 mol dm⁻³ Na_2CO_3**.

Given:

$$M_r(\mathrm{Na_2CO_3}) = 106.0$$

Complete the calculation.

Step 1 — Convert the volume

250.0cm³ = _____dm³

Step 2 — Calculate moles

$$n = CV$$

n=(_____)(_____) therefore n=_____ mol

Step 3 — Calculate mass

$$m = nM$$

m=(_____)(_____) m=_____ g

Worksheet 4 — Calculation Practice

Show your working clearly.

Question 1

Calculate the mass of NaCl required to prepare:

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

of:

$$0.200\ \mathrm{mol\ dm^{-3}\ NaCl}$$

Given:

$$M_r(\mathrm{NaCl}) = 58.44$$

Answer: _____ g

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Question 2

Calculate the mass of KNO_3 required to prepare:

$$250.0\ \text{cm}^3$$

of:

$$0.1500\ \text{mol dm}^{-3}\ \text{KNO}_3$$

Given:

$$M_r(\text{KNO}_3) = 101.1$$

Answer: _____ g

Question 3

Calculate the mass of $CuSO_4$ required to prepare:

$$500.0\ \text{cm}^3$$

of:

$$0.0500\ \text{mol dm}^{-3}$$

Given:

$$M_r(\text{CuSO}_4) = 159.6$$

Answer: _____ g

Question 4 — Work backwards

A student dissolves **2.92 g NaCl** and prepares exactly:

$$250.0\ \text{cm}^3$$

of solution.

Given:

$$M_r(\text{NaCl}) = 58.44$$

Calculate the concentration.

$$\boxed{C = \ \text{mol dm}^{-3}}$$

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Worksheet 5 — Choose the Apparatus

For each task, select the **most appropriate** apparatus.

Possible apparatus:

Beaker • Measuring cylinder • Volumetric flask • Volumetric pipette • Burette • Dropper

Task	Most appropriate apparatus
Prepare exactly 250.0 cm^3 of standard solution	_____
Transfer exactly 25.0 cm^3 of solution	_____
Add titrant accurately during titration	_____
Hold solution while dissolving a solid	_____
Measure approximately 50 cm^3 of water	_____
Add the final few drops when approaching a calibration mark	_____

Think further

Why is a **250 cm^3 measuring cylinder** less suitable than a **250.0 cm^3 volumetric flask** for preparing a standard solution?

Challenge

Why does a volumetric flask have:

a large bulb?

a narrow neck?

only one calibration mark?

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