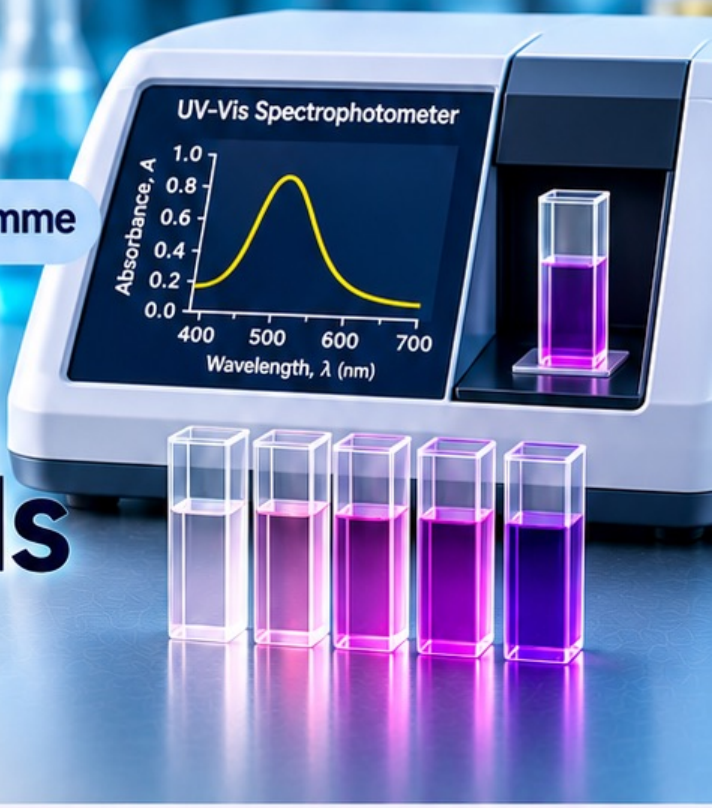
LearningSparks®
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Pre-IB Chemical Research Skills Programme



Chemical Research Skills

A Skills-Building Programme for Independent Chemical Investigation

Module 4 | Worksheets

Student Practice & Application

Module Focus

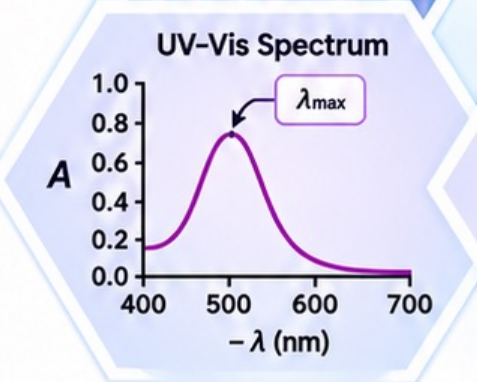
- Principles of UV-Vis spectrophotometry
- Understanding absorbance, transmittance and wavelength (λ)
- Applying the Beer–Lambert Law ($A = \varepsilon lc$)
- Constructing and using a calibration curve
- Determining the concentration of an unknown solution

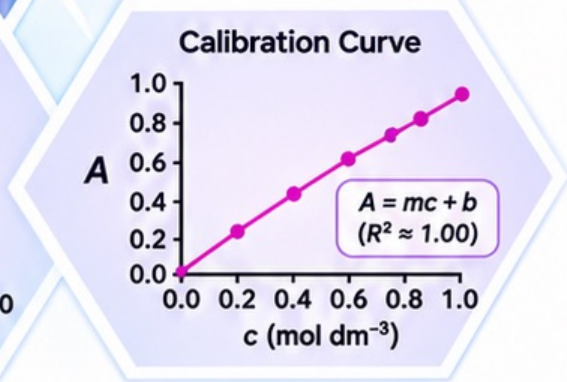


Beer–Lambert Law

$$A = \varepsilon lc$$

- A = Absorbance (no unit)
- ε = Molar absorptivity (L mol^{-1} cm^{-1})
- l = Path length (cm)
- c = Concentration (mol dm^{-3})





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Founder, LearningSparks Education Services
Creator of the CHIAM Framework™

Module 4 — Student Worksheets
Calibration Curves & UV–Vis
1-Minute Chemical Research Skills — Pre-IB Chemistry
Student: _____ **Date:** _____
Module goal: By the end of these worksheets, you should be able to explain UV–Vis measurements, construct and interpret calibration curves, apply the Beer–Lambert relationship, determine unknown concentrations, and evaluate the reliability of a calibration method.

Worksheet 1 — From Colour to Measurement
Consider these statements:
A. The solution is blue.
B. The solution became darker.
C. The absorbance at 620 nm is 0.48.
D. The calibration curve gives a concentration of 0.076 mol dm^{-3}.
Classify each statement.

Statement	Observation	Measurement	Chemical result
A	☐	☐	☐
B	☐	☐	☐
C	☐	☐	☐
D	☐	☐	☐

Think
Why is:
"The solution became darker"
less useful scientifically than:
"The absorbance increased from 0.24 to 0.48 at 620 nm"?

Complete the chain
{Observation} → {_____} → {Calibration} → {_____}

Worksheet 2 — What Does UV–Vis Measure?
UV–Vis stands for:
UV: _____
Vis: _____
Approximate wavelength ranges:
{UV: }_____-_____nm} \{Visible: }_____-_____\ {nm}
Complete

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A UV–Vis spectrophotometer measures how strongly a sample _____ light at particular _____.

Light through a sample

Complete:

$$\boxed{\text{Incident light } (I_0) \rightarrow \text{Sample} \rightarrow \text{Transmitted light } (I)}$$

If the sample absorbs more light, the transmitted intensity I:

☐ increases

☐ decreases

☐ remains constant

Worksheet 3 — Transmittance and Absorbance

Transmittance is:

$$\boxed{T = \frac{I}{I_0}}$$

Absorbance is:

$$\boxed{A = -\log_{10} T}$$

Question 1

If:

$$I_0 = 100$$

and:

$$I = 50$$

calculate:

T=_____ \%T=_____\% A=_____

Question 2

If:

$$T = 0.10$$

calculate:

A=_____

Question 3

If:

$$T = 1.00$$

calculate:

A=_____

Complete

As transmittance decreases, absorbance generally:

☐ increases

☐ decreases

Absorbance has:

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☐ units of nm
☐ units of mol dm^{-3}
☐ no unit

Worksheet 4 — Understanding λ_{max}

A student scans a coloured solution at different wavelengths.

Wavelength / nm	Absorbance
420	0.12
460	0.25
500	0.44
540	0.68
580	0.51
620	0.29
660	0.14

Question 1

At which wavelength is absorbance highest?

lambda=_____nm

Question 2

Therefore:

λ_{max} Lambda max=_____nm

Question 3

What does λ_{max}mean?

Question 4

Why might measuring at or near λ_{max}be useful for quantitative analysis?

Worksheet 5 — Beer–Lambert Law

Complete:

$$\boxed{A = \varepsilon l c}$$

Symbol	Meaning	Unit
A	_____	_____
ε	_____	_____
l	_____	_____
c	_____	_____

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Part B

If wavelength and chemical species remain constant:

\varepsilon=\text{_____}

If the same type/path length of cuvette is used:

l=\text{_____}

Therefore:

\boxed{A\propto_____}

Complete

If concentration doubles under suitable Beer–Lambert conditions, absorbance should approximately:

☐ halve

☐ double

☐ remain constant

Worksheet 6 — Beer–Lambert Calculations

Question 1

A solution has:

$$\varepsilon = 125\ \text{dm}^3\ \text{mol}^{-1}\ \text{cm}^{-1}$$
$$l = 1.00\ \text{cm}$$
$$c = 0.00400\ \text{mol dm}^{-3}$$

Calculate absorbance.

$$A = \varepsilon l c$$

A=_____ {A=_____}

Question 2

A solution gives:

$$A = 0.600$$

Given:

$$\varepsilon = 200\ \text{dm}^3\ \text{mol}^{-1}\ \text{cm}^{-1}$$

and:

$$l = 1.00\ \text{cm}$$

calculate c.

c=_____mol dm^3

Question 3

A solution gives $A = 0.300$using a 1.00 cm path length.

If everything else remains constant but the path length becomes 2.00 cm, predict the absorbance.

\boxed{A=_____}

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Worksheet 7 — Why Does the Cuvette Matter?

Complete the table.

Situation	Possible effect on measurement
Fingerprint on optical face	_____
Bubble in light path	_____
Dirty cuvette	_____
Different path length	_____
Cuvette not filled sufficiently	_____
Contamination from previous sample	_____

Good technique

Tick good practice:

☐ Hold cuvette by optical faces

☐ Wipe optical faces before measurement

☐ Check for bubbles

☐ Keep orientation consistent where appropriate

☐ Use a scratched cuvette whenever possible

☐ Ensure sample covers the light path

Question

Why should the same path length be maintained?

Use Beer–Lambert law in your explanation.

Worksheet 8 — Choosing the Right Cuvette

Match each situation with the most appropriate statement.

A

Measurement in the visible region only.

B

Measurement deep into the UV region.

C

Cuvette material absorbs strongly at the wavelength being used.

Possible responses:

1. Quartz may be required.
2. Suitable glass or plastic may be acceptable.
3. The cuvette is unsuitable.

A: _____

B: _____

C: _____

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