Edexcel International AS/A Level

IG/IAL Chemistry: Bridging the Gap

Event code: YCH11-20IO7/0

First teaching in 2018, first assessment 2019

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Aims and objectives

- Many students struggle with the move from pre-16 to post-16 learning and this impacts upon their level of success

- During this session we will explore transition issues relevant to transfer from International GCSE to International Advanced level Chemistry, with the aim of 'hitting the ground running' – so that students are supported to develop the independent learning skills required

Learning objectives

During this session you will:

- Consider issues for students setting out on A level Chemistry
- Share best practice of what has worked well with students
- Explore strategies for enabling students to progress smoothly and develop successful independent learning skills
- Share ideas with other teachers

Question

What are the main hurdles faced by students transferring from International GCSE to International A level Chemistry?

Issues include:

- A big ‘step up’ in the difficulty of concepts covered
- A similar step up in mathematical skills required
- More need for students to learn and think independently
- Greater expectation for students to manage their own time and take leadership of their own learning
- The need to be able to ‘think outside the box’ and apply learning to solving problems set in a context different from that in which the ideas were learned.
- The need for students to ‘read around’ the topics

Are you, as teachers, sometimes part of the problem?

- Do sixth form students need less guidance, support and control within the classroom? "*They're nearly adults, their behaviour is not an issue, and they are pretty well organised and motivated*."
- Do you assume that they have the necessary language and skills to move themselves forward?
- Just because students are slightly older and have chosen your subject, do the demands of teaching them change dramatically?
- Are the challenges faced at teaching pre-16 (i.e. engagement, motivation, and lesson activity) equally applicable to sixth form teaching?

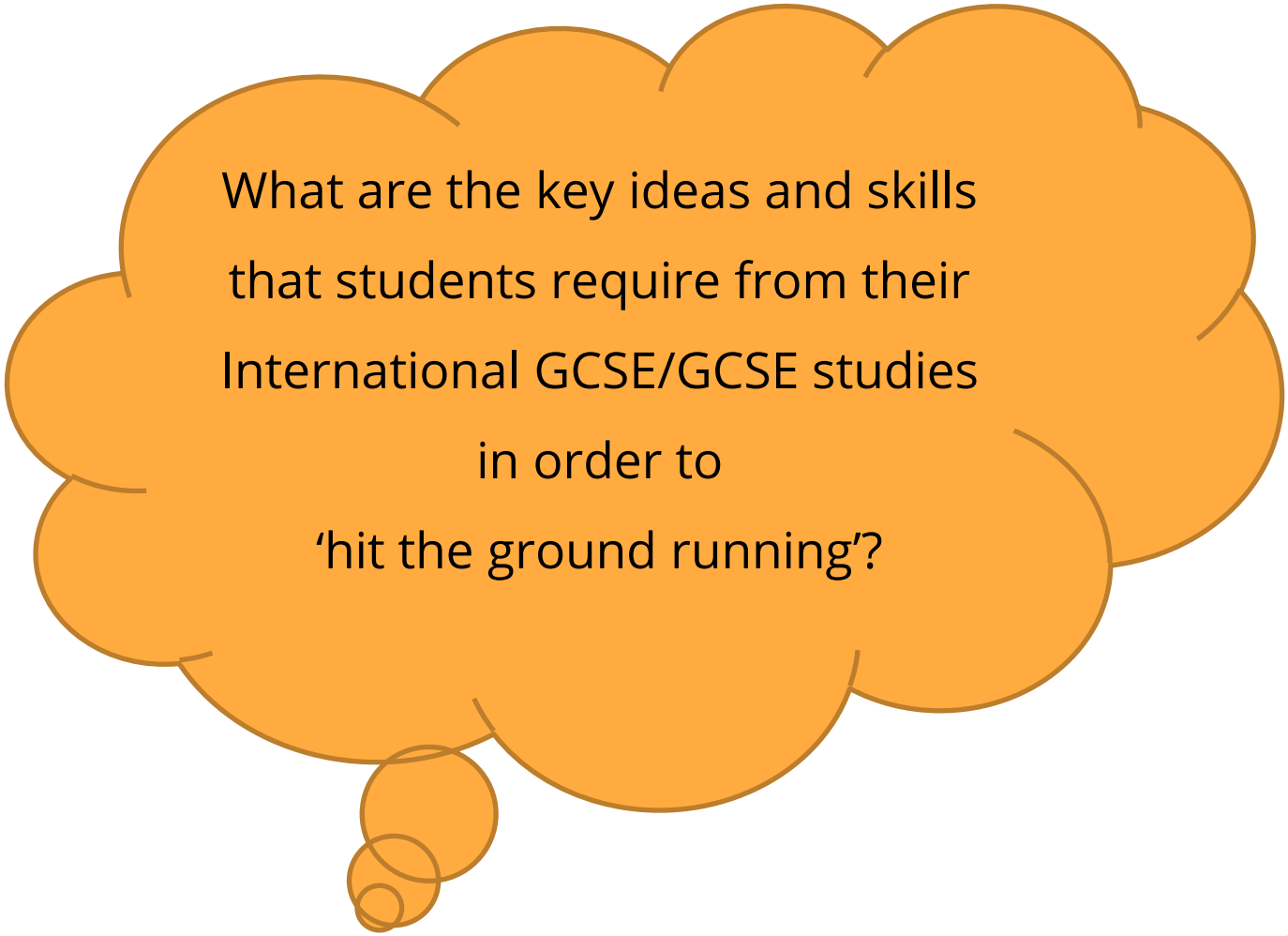
What Ofsted (UK) says

- **Ofsted's findings show that:**

  "effective teaching at sixth form level is based on the characteristics that teachers strive for at all levels – varied lesson planning, confident subject knowledge and student involvement."

From *Ofsted: A comparison of the effectiveness of level 3 provision in 25 post-16 providers*

What are the basics required?



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Key ideas and skills

- Atomic structure, formulae and bonding
- Quantitative analysis and equations
- Structure and properties

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Key ideas and skills

- Ability to visualise at a particulate level

  E.g. collision theory, simple structures, giant structures

- Ability to translate between different representations

  E.g. molecular formulae and displayed formulae
  diagrams and actual apparatus

- Numeracy – rearranging and using mathematical relationships

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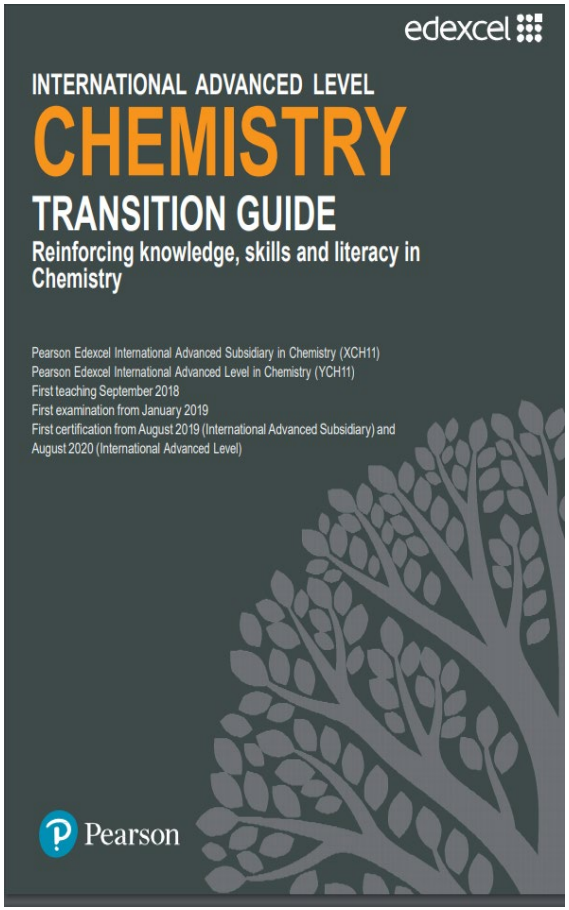
Testing and reinforcing key ideas and skills

- baseline assessments
- summary sheets
- student worksheets
- practice questions



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The dilemma of how to start?

- You, as teachers of Chemistry, want your students to be engaged and motivated by the subject
- You also want your students to raise their aspirations and to achieve more than they might have previously thought they could

The dilemma of how to start!

… but on the other hand…

- You want your students to be aware of the increased challenge of Advanced level study – and to quickly adopt the higher work rate required

- You probably also want students to be realistic about whether they have the ability to succeed – and to change quickly to an alternative course if success in Chemistry seems unlikely

Starting strategy

- You could make the first few lessons excessively ‘hard’ in order to persuade those with little resilience to drop out

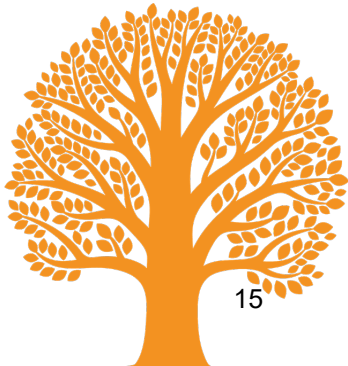
- However, a student’s assessment of his or her own potential is not always reliable and it is easy to lose bright but under-confident students and retain weak but arrogant ones

- So, should you make the first few lessons very easy?

Where would you start?

Which topic or activity would you start with when teaching a group fresh from International GCSE/GCSE?

If you are an experienced teacher of IAL, which starting topics or activities have you found most successful?



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Start as you mean to go on...

Whichever topic you choose to begin with, teaching and learning styles and strategies should reflect practices that students need to adopt for success throughout the course

This will include some or all of:

- 'thinking hard' and problem-solving in new contexts
- student leadership of learning; time and resource management
- learning independently; background reading and flipped learning
- students presenting and sharing ideas with others

‘Thinking hard’ and problem-solving in new contexts

‘Learning happens when students have to think hard’

Prof Rob Coe *‘Improving Education: A Triumph of Hope Over Experience’ Durham University, 2013*

Students have to get used to the idea that many of the questions they are asked will not have instant answers – that they need to have thinking time, perhaps some opportunity to ‘think out loud’ whilst they share half-formed understanding with others – and perhaps that the ‘full’ answer is developed with contributions from two or more students each chipping in

We need to ask those questions as early as possible

‘Thinking hard’ activity

Think of the activity or topic you decided you would start your course with and devise a ‘thinking hard’ question you might ask students

Share your question in the chat box

Student leadership of learning – time and resource management

How do your students record and store their work?

- In a loose-leaf folder
- In exercise books
- “However they choose – I never look at it”

Are you being realistic in assuming that students will automatically know how to organise a record of their learning and adopt the right way to do so?

Student leadership of learning – time and resource management

If students use loose-leaf folders – how are they arranged?

Where do practical notes go?

Where do answers to go?

Student leadership of learning – time and resource management

If they use exercise books, what happens to loose sheet info – worksheets, results tables and graphs obtained from practicals and other documents?

Do they get stuck in, or tucked in like adverts in a magazine?

Learning independently

- In general students resist the temptation to ‘read around the subject’ – they will ‘do the homework’ but not often push themselves to go beyond that
- How could you establish good habits in this practice?
- Share your suggestions in the chat box

Learning independently

Background reading and flipped learning

1. Re-reading the notes of the day's Chemistry lessons
2. Pre-reading the next issue or topic coming up
3. Flipped learning online: **https://edpuzzle.com/home** (Video tutorials on You tube)

Coping with mole calculations

The basics

- Amount (mol) = mass (g) ÷ molar mass (g mol^{-1})
- Amount of gas (mol) = volume (cm^3) ÷ molar volume (cm^3 mol^{-1})
  [molar volume at rtp = 24 000 cm^3 mol^{-1}]
- Amount of solute in solution (mol)

  = volume of solution (dm^3) x concentration (mol dm^{-3})

Tip: Do not encourage an over-reliance on calculation 'triangles'. Students who use these find it difficult to answer questions when data are presented in different units, for example.

Coping with mole calculations

Calculations post (International) GCSE are more likely to be unstructured, particularly at A2

This is illustrated by the calculations on the next two slides

Coping with mole calculations

International GCSE Question

June 2019 Paper 2C Q8(b)(i), (ii) & (iii)

The concentration of NaClO(aq) in a solution of bleach is found by reacting it with hydrochloric acid.

The equation for the reaction is

$$NaClO(aq) + 2HCl(aq) \rightarrow NaCl(aq) + H_2O(l) + Cl_2(g)$$

An excess of dilute hydrochloric acid is added to 4.00 cm^3 of bleach solution.

60.0 cm^3 of chlorine gas is produced.

(b) (i) Calculate the amount, in moles, of chlorine gas produced.
Assume one mole of chlorine gas occupies 24 000 cm^3. **(2)**

(ii) Determine the amount, in moles, of NaClO in 4.00 cm^3 of bleach. **(1)**

(iii) Calculate the concentration, in mol/dm^3, of the bleach solution. **(2)**

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Coping with mole calculations

IAL Question

May 2019 Unit 1 Q24(b)

24 Airbags protect occupants by inflating when a car crashes.

Airbags rely on chemical reactions to produce large volumes of gases quickly. In some airbags, solid sodium azide (NaN_3) decomposes forming nitrogen gas and sodium as the only products.

(a) Write an equation for the decomposition of sodium azide. **(1)**
State symbols are not required.

(b) A passenger airbag requires 120 dm^3 of gas to fill it.

Calculate, using the ideal gas equation, the mass of sodium azide required to fill a passenger airbag in this reaction under standard conditions (101 000 Pa, 25°C).

Give your answer to an appropriate number of significant figures. **(6)**

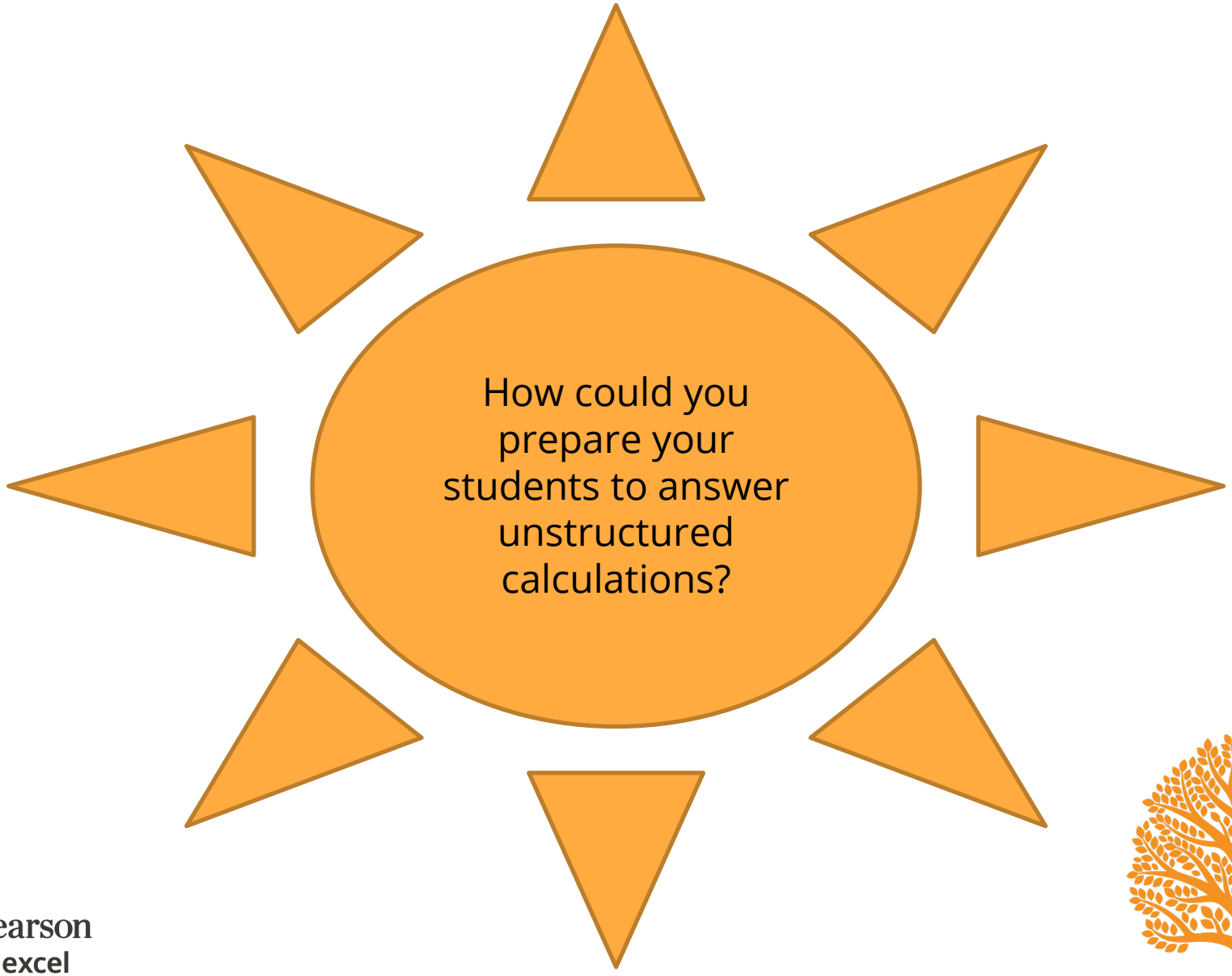
[$pV = nRT$ $R = 8.31\ J\ K^{-1}\ mol^{-1}$]

Coping with mole calculations

Coping with mole calculations

- Convert the volume to m^3
- Convert the temperature to K
- Rearrange the equation to make *n* the subject
- Substitute values of *p*, *V*, *R* and *T* into the equation
- Calculate the amount of N_2
- Use the chemical equation to determine the amount of NaN_3
- Calculate the molar mass of NaN_3
- Calculate the mass of NaN_3
- Give final answer to the appropriate number of significant figures

Coping with mole calculations



Coping with mole calculations

A possible approach:

- start with complete structuring
- gradually reduce the amount of structuring
- introduce unstructured calculations

More difficult mathematics!

pH = – lg [H+] and [H+] = 10^{-pH}

As above with K_a and pK_a

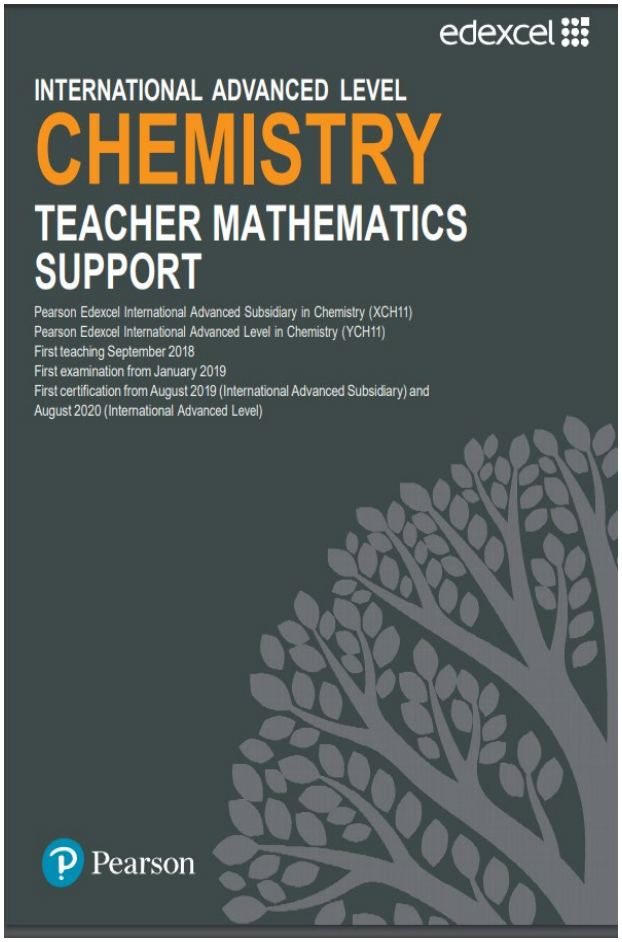
$$k = Ae^{(-\frac{E_a}{RT})}$$

OR $$\ln k = -\frac{E_a}{R}\frac{1}{T} + \ln A$$

Mathematical Skills

Support available

Teacher Mathematics Support



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Experimental skills

The specification lists 16 ‘Core Practicals’

These core practicals are selected because they provide opportunities to develop skills

They have **NOT** been chosen because they provide ‘perfect’ examples of experimentation or can be used to demonstrate a textbook ‘fact’

Experimental skills

The 16 core practicals should be used to allow students to develop their practical techniques and skills, and also to use their mathematical skills

It is expected that the course will include other practicals that also allow these techniques and skills to be introduced and practised but it is essential that the core practicals are given priority and emphasis

Experimental skills

Experimental skills will be tested in Units 3 and 6

Unit 3 covers the skills and techniques developed during practical work in Units 1 and 2

Unit 6 covers the skills and techniques developed during practical work in Units 4 and 5, as well as the tests for anions and cations, gases and organic functional groups from Units 1 and 2

Practical assessment areas

There are four broad areas of practical assessment:

- planning experimental work
- implementation of experimental work
- analysis of observations and data
- evaluation of methods

Planning experimental work

Students are expected to be able to plan experiments and investigations that will produce valid data

The basic ideas behind a valid plan are:

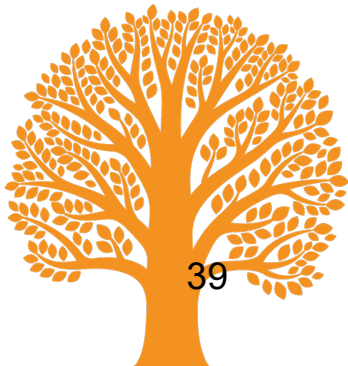
- identification of independent, dependent and control variables
- use of repeat readings
- consideration of the hazards involved and how to minimise them

IAL planning requires more detail, explanation and precision than International GCSE/GCSE

Implementing experimental work

Students are expected to be able to:

- Present their results appropriately, e.g. tables, including units
- Drawing diagrams of apparatus, e.g. filtration under reduced pressure, distillation, etc.
- Select and assemble apparatus and equipment that could be used
- Comment on numbers of repeats, appropriateness of ranges, etc.



Analysis of observations and data

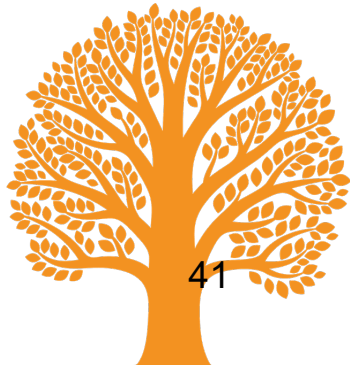
Students are expected to be able to:

- make deductions from observations obtain in both inorganic and organic analysis
- process data, for example by doing calculations or plotting appropriate graphs
- explain, discuss and evaluate data

Evaluation of methods

Students are expected to be able to:

- recognise procedural errors in methods
- suggest improvements that will lead to more accurate and/or precise measurements
- justify the improvements suggested
- calculate uncertainties in measurements, e.g. in using a burette, a pipette, a digital balance, etc.



Developing Experimental Skills

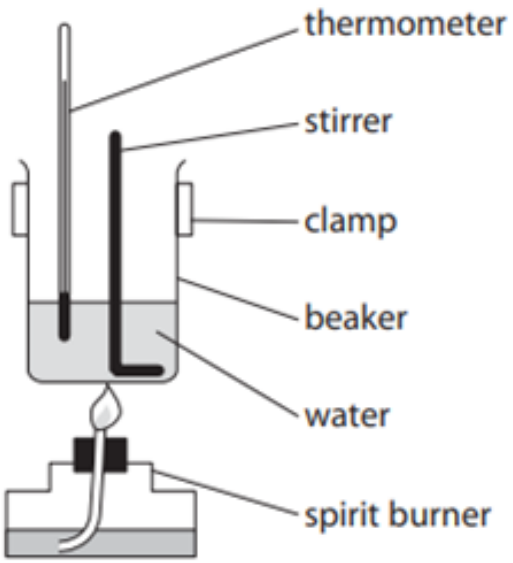
Independent thinking and evaluation

- Challenge students to think critically about a practical procedure from the start of the A level course
- Students need to realise that what has served them well at International GCSE/GCSE needs to be developed to achieve the same success later

Coping with questions on experimental skills

This is a question taken from Unit 3 October 2019

(d) The apparatus shown was used to find the enthalpy change of combustion of one of the liquids **C**, **D** or **E**.



(i) List all the measurements you would make in carrying out this experiment. (3)

(ii) Give **two** ways, other than changing the measuring instruments or repeating the experiment, in which the accuracy of the results using this apparatus could be improved. (2)

Coping with questions on experimental skills

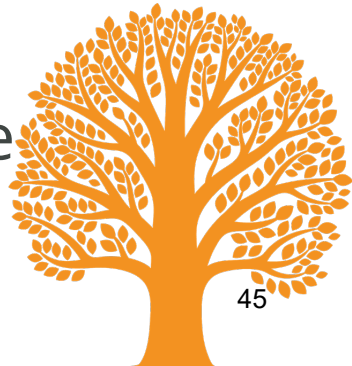
Here is the mark scheme for (d)(ii)

Question Number	Answer	Additional guidance	Mark
2(d)(ii)	An answer that makes reference to two of the following points: • putting a lid on the beaker (1) • putting a lid on the burner (before and after combustion) (1) • adding a draught shield around the apparatus / insulating the beaker (1) • using copper instead of a glass beaker (1)	Allow top or bung for lid Allow reweigh burner as soon as possible to prevent loss of liquid Do not award insulating the beaker with flammable material Do not award polystyrene cup Ignore any reference to changing apparatus or adding oxygen Ignore stirring the water Ignore changing the volumes of water Ignore burning more (or less) fuel Ignore not allowing the thermometer to touch the beaker Ignore distance of burner from the beaker Do not award drawing a temperature time graph Do not award a closed environment	(2)

Coping with questions on experimental skills

Here is the Examiner's report on (d)(ii)

- Responses on ways to improve the accuracy of the experiment in (d)(ii) were varied
- Most candidates recognised the need to prevent heat loss, but often careless language prevented marks being scored
- A common mistake was the use of a polystyrene cup
- Many candidates also suggested modifications such as using a greater volume of water, stirring the water or adjusting the distance between the burner and the beaker, all of which did not score



Definition of Terms

Match the following terms to their definition

	Term
1	Precision
2	Random error
3	True value
4	Accurate
5	Valid
6	Systematic error
7	Independent variable
8	Dependent Variable
9	Controlled Variable
10	Uncertainty

	Definition
A	A value that is close to the true value
B	Factors that would affect the experiment and so need to be maintained constant
C	Variable that is measured as a result of changing another
D	The variable that is under investigation and is changed by the experimenter
E	A measure of the closeness of repeated measurements.
F	An error that arises due to inconsistency in the experiment. Often causes anomalies.
G	An error that is repeated when each measurement is taken, for example if a balance always reads 0.1 g above the true value.
H	An investigation where all variables have been controlled and the results are reliable.
I	A measure of the range of values within which the true value lies.
J	The value that would be obtained under ideal conditions.

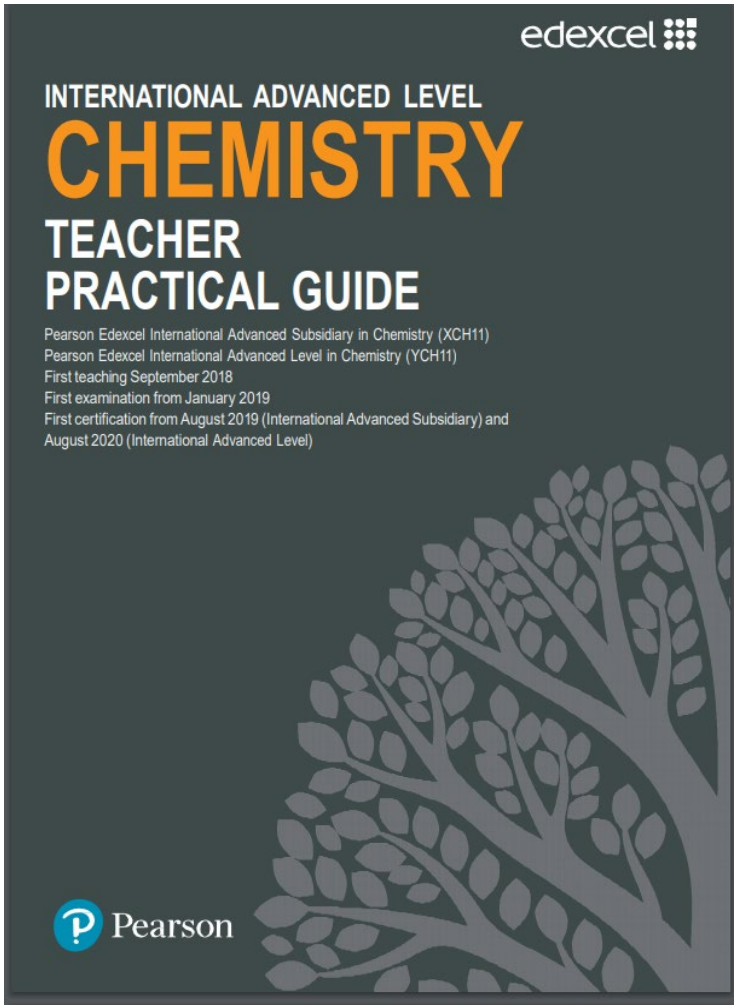
Definition of Terms

Term	Definition
Accurate	A value that is close to the true value
Controlled Variable	Factors that would affect the experiment and so need to be maintained constant
Dependent Variable	Variable that is measured as a result of changing another
Independent variable	The variable that is under investigation and is changed by the experimenter
Precision	A measure of the closeness of repeated measurements.
Random error	An error that arises due to inconsistency in the experiment. Often causes anomalies.
Systematic error	An error that is repeated when each measurement is taken, for example if a balance always reads 0.1 g above the true value.
Valid	An investigation where all variables have been controlled and the results are reliable.
Uncertainty	A measure of the range of values within which the true value lies.
True value	The value that would be obtained under ideal conditions.

1 E 2 F 3 J 4 A 5 H 6 G 7 D 8 C 9 B 10 I

Support for experimental skills

Teacher Practical Guide



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Organic mechanisms

Preliminary knowledge

- Translation between displayed, structural and skeletal formula
- Understanding of bonding pairs, lone pairs and unpaired electrons from bonding topics
- Understanding of bond polarity

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Organic mechanisms

Before the curly arrows

- Make sure that the structures of the reactants are clearly shown
- Focus on the key features of the reactants

  E.g.
  - functional groups
  - relevant dipoles
  - lone pairs
- Encourage students to describe what they think might happen

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Organic mechanisms

Add the curly arrows

- Annotate the mechanisms to emphasise understanding
- Use colours to emphasise different aspects of the mechanism
  E.g. red for curly arrows
  blue for nucleophiles
  green for electrophiles

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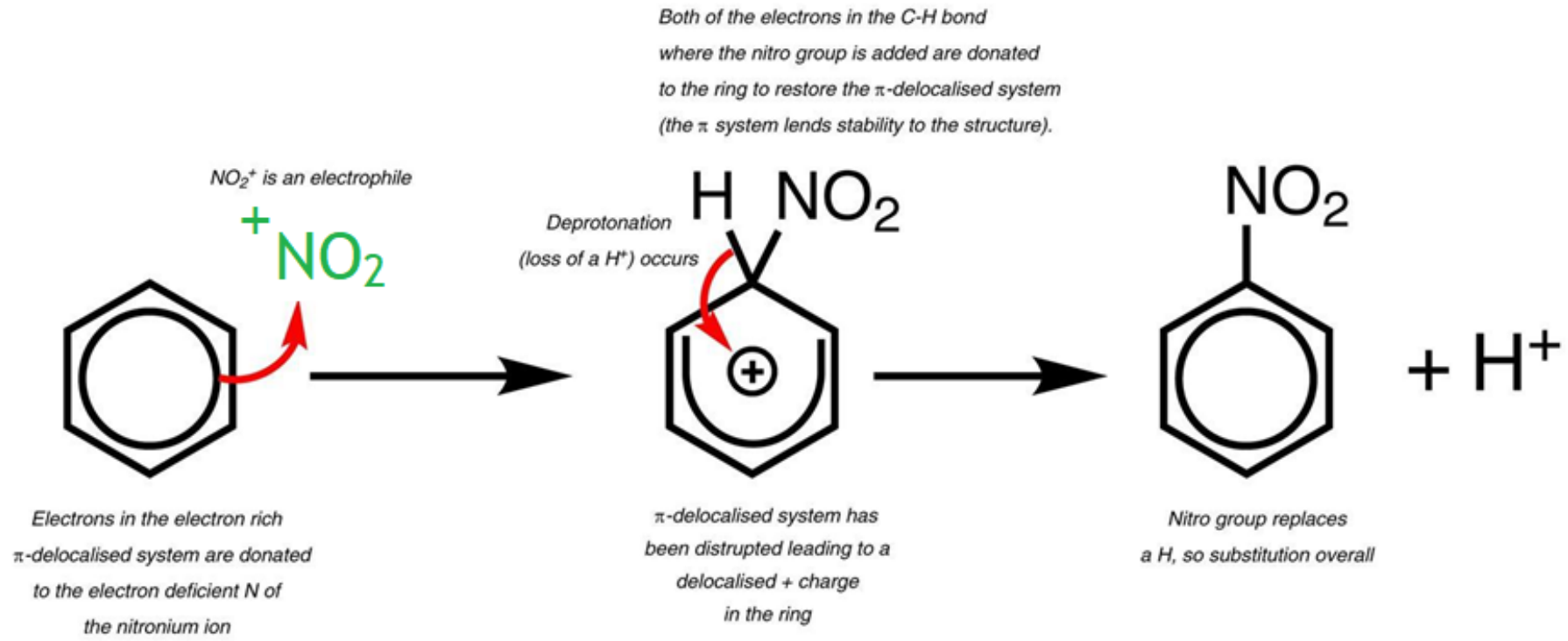
Organic mechanisms

Example of annotation



from https://edu.rsc.org/ideas/teaching-organic-mechanisms/3010691.article

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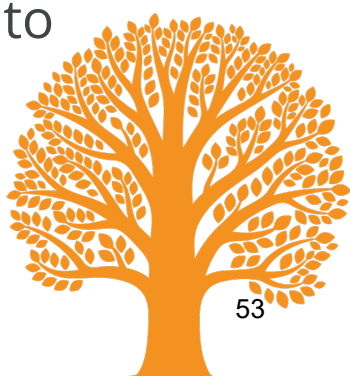
Students presenting ideas to others

"If you can't explain it simply, you do not understand it well enough."

Albert Einstein

- Consider building into students' learning frequent opportunities for them to share their work and ideas with the rest of the group
- Students are often self-conscious and will try – at first – to avoid doing this
- If you can provide a safe, supportive environment for this to happen and then insist that it does, students will be encouraged to take part



Building more independent learners

- Encourage students to take responsibility for prior knowledge
- ‘Jigsaw’ tasks
- Make time to allow lessons where you adopt more of a ‘coaching’ role, than a ‘director’ role
- C3B4UCM

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Building more independent learners

- ‘Snowball’ explanations – encourages peer to peer discussion / collaboration
- Access to reference material – hard copy or online
- Use open questioning
- Have scaffolding ready

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Building more independent learners

Possible lesson strategies

- Envoys
- Choices – differentiation by task
- Interviewing
- Exam question lucky dip

Some content adapted from:

https://www.tes.com/sites/default/files/tes_strategies_to_develop_independent_learners.pdf

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Next steps

Think of THREE things you might try or do differently as a result of ideas we have discussed today?

(You will not be asked to share these)

Share in the chat box **ONE** thing you would like to do as soon as you return to your classroom or department?

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Summary

To maximise the chances of an effective transition from International GCSE/GCSE to IAL we can use strategies in our classroom to:

- ensure prior knowledge is secure
- check key ideas little and often
- review and amend our teaching schemes to help counter misconceptions / deal with new content
- look to use effective and efficient feedback

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Your Subject Advisor

Irine Muhiuddin

Twitter: @PearsonSciences

Email or live chat

You can sign up for Irine's
e-updates by completing this online form

We also have an online community especially for Science teachers.

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Evaluation

Please fill in an evaluation form!

Thank you for participating.

Find out more about us at:
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ALWAYS LEARNING