Getting Ready to Teach International A Level Chemistry

Your Trainer Today is: TRAINERS NAME

Welcome to this Professional Development Training

Designed for teachers teaching or who are looking to teach the Pearson Edexcel International GCSE Chemistry Specifications.

- To understand how the qualification is devised
- To review the content of the qualification
- To understand the assessment of the qualification
- To explore how to plan the course and/or lessons
- To understand the question types for the qualification
- To understand the Assessment Objectives for the qualification
- To practise using the mark schemes using exemplar student work
- To identify the support available from Pearson

Agenda

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How the Qualification is devised

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Support

Welcome to Pearson

Welcome to Pearson Edexcel

We are the world's leading learning company and as the **UK's largest awarding organisation**, best placed to provide qualifications aligned to the British Educational System.

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10 million

We mark over 10 million exam scripts on behalf of the UK Department for Education each year.

70

We operate in 70 countries worldwide.

How the Qualification is devised

Structure of the qualification

- There are two separate qualifications available:
  - International AS (IAS)
  - International A Level (IAL)
- Both the IAS and the IAL are modular qualifications
- There are three units at IAS
- And a further three units at IA2

IAS Chemistry

- The qualification consists of three externally assessed units (Units 1, 2 and 3)
- This can be awarded as a separate IAS qualification or can contribute 50% towards the IAL qualification

IAL Chemistry

- This qualification has six externally assessed units
- It consists of the three IAS units (Units 1, 2 and 3) plus three IA2 units (Units 4, 5 and 6)
- Students wishing to achieve the IAL must therefore complete all six units

Content of the Qualification

Overview of the specification – IAS

UNIT 1	UNIT 2	UNIT 3
• Formulae, Equations and Amount of Substance • Atomic Structure and the Periodic Table • Bonding and Structure • Introductory Organic Chemistry and Alkanes • Alkenes	• Energetics • Intermolecular Forces • Redox Chemistry and Groups 1, 2 and 7 • Introduction to Kinetics and Equilibria • Organic Chemistry: Alcohols, Halogenoalkanes and Spectra	Students are expected to develop experimental skills, and a knowledge and understanding of experimental techniques, by carrying out a range of practical experiments and investigations while they study Units 1 and 2. This unit will assess students' knowledge and understanding of experimental procedures and techniques that were developed in Units 1 and 2.

Overview of the specification – IAL

UNIT 4	UNIT 5	UNIT 6
• Kinetics • Entropy and Energetics • Chemical Equilibria • Acid-base Equilibria • Organic Chemistry: Carbonyls, Carboxylic Acids and Chirality	• Redox Equilibria • Transition Metals and their Chemistry • Organic Chemistry: Arenes • Organic Nitrogen Compounds: Amines, Amides, Amino Acids and Proteins • Organic Synthesis	Students are expected to develop further the experimental skills and the knowledge and understanding of experimental techniques that they acquired in Units 1 and 2 (tests for anions and cations, gases and organic functional groups) by carrying out a range of practical experiments and investigations while they study Units 4 and 5. This unit will assess students' knowledge and understanding of the experimental procedures and techniques that were developed in Units 4 and 5.

Assessment of the Qualification

How is the content assessed?

IAS **Unit 1: Structure, Bonding and Introduction to Organic Chemistry**	***Unit code: WCH11/01**	
Externally assessed Written examination: 1 hour and 30 minutes Availability: January, June and October First assessment: January 2019 80 marks	40% of the total IAS	20% of the total IAL

Assessment overview
• This paper has two sections:
  ○ Section A: multiple choice questions
  ○ Section B: mixture of short-open, open-response and calculation questions.
• This paper will include a minimum of 18 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*).
• Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts.		

IAS **Unit 2: Energetics, Group Chemistry, Halogenoalkanes and Alcohols**	***Unit code: WCH12/01**	
Externally assessed Written examination: 1 hour and 30 minutes Availability: January, June and October First assessment: June 2019 80 marks	40% of the total IAS	20% of the total IAL

Assessment overview
• This paper has three sections:
  ○ Section A: multiple choice questions
  ○ Section B: mixture of short-open, open-response, calculations and extended-writing questions
  ○ Section C: contemporary context question.
• This paper will contain questions that require information from the Data Booklet (see *Appendix 9*).
• This paper will include a minimum of 18 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*).
• Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts.
• This paper may contain some synoptic questions which require knowledge and understanding from Unit 1.		

IAS **Unit 3: Practical Skills in Chemistry I**	***Unit code: WCH13/01**	
Externally assessed Written examination: 1 hour and 20 minutes Availability: January, June and October First assessment: June 2019 50 marks	20% of the total IAS	10% of the total IAL
Content overview Students are expected to develop experimental skills, and a knowledge and understanding of experimental techniques, by carrying out a range of practical experiments and investigations while they study Units 1 and 2. This unit will assess students' knowledge and understanding of experimental procedures and techniques that were developed in Units 1 and 2.		
Assessment overview • This paper may include short-open, open-response and calculation questions. • This paper will include a minimum of 6 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*). • Students will be expected to apply their knowledge and understanding of practical skills to familiar and unfamiliar situations.		

How is the content assessed?

IA2 Unit 4: Rates, Equilibria and Further Organic Chemistry	*Unit code: WCH14/01	
Externally assessed Written examination: 1 hour and 45 minutes Availability: January, June and October First assessment: January 2020 90 marks	40% of the total IA2	20% of the total IAL

Assessment overview

- This paper has three sections:
  - Section A: multiple choice questions
  - Section B: mixture of short-open, open-response, calculations and extended-writing questions
  - Section C: data or calculation question.
- This paper will contain questions that require information from the Data Booklet (see *Appendix 9*).
- This paper will include a minimum of 22 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*).
- Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts.
- This paper may contain some synoptic questions which require knowledge and understanding from Units 1 and 2.

IA2 Unit 5: Transition Metals and Organic Nitrogen Chemistry	*Unit code: WCH15/01	
Externally assessed Written examination: 1 hour and 45 minutes Availability: January, June and October First assessment: June 2020 90 marks	40% of the total IA2	20% of the total IAL

Assessment overview

- This paper has three sections:
  - Section A: multiple choice questions
  - Section B: mixture of short-open, open-response, calculations and extended-writing questions
  - Section C: contemporary context question.
- This paper will contain questions that require information from the Data Booklet (see *Appendix 9*).
- This paper will include a minimum of 18 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*).
- Students will be expected to apply their knowledge and understanding of experimental methods in familiar and unfamiliar contexts.
- This paper may contain some synoptic questions which require knowledge and understanding from Units 1, 2 and 4.

IA2 Unit 6: Practical Skills in Chemistry II	*Unit code: WCH16/01	
Externally assessed Written examination: 1 hour and 20 minutes Availability: January, June and October First assessment: June 2020 50 marks	20% of the total IA2	10% of the total IAL

Assessment overview

- This paper may include short-open, open-response and calculation questions.
- This paper will include a minimum of 6 marks that target mathematics at Level 2 or above (see *Appendix 6: Mathematical skills and exemplifications*).
- Students will be expected to apply their knowledge and understanding of practical skills to familiar and unfamiliar situations.

Unit results

- No change to the UMS scale from the previous qualification
- Units 1, 2, 4 and 5 have a maximum of 120 UMS
- Units 3 and 6 have a maximum of 60 UMS

Units 1, 2, 4 and 5

Unit grade	**Maximum uniform mark**	**A**	**B**	**C**	**D**	**E**
	120	**96**	**84**	**72**	**60**	**48**

Units 3 and 6

Unit grade	**Maximum uniform mark**	**A**	**B**	**C**	**D**	**E**
	60	**48**	**42**	**36**	**30**	**24**

Qualification results

- IAS – total of 300 UMS
- IAL – total of 600 UMS

International Advanced Subsidiary (cash-in code: XCH11)

Qualification grade	**Maximum uniform mark**	**A**	**B**	**C**	**D**	**E**
	300	**240**	**210**	**180**	**150**	**120**

Students with a uniform mark in the range 0–119 will be Unclassified (U).

International Advanced Level (cash-in code: YCH11)

Qualification grade	**Maximum uniform mark**	**A**	**B**	**C**	**D**	**E**
	600	**480**	**420**	**360**	**300**	**240**

Students with a uniform mark in the range 0–239 will be Unclassified (U).

Specification Statements

Each topic and sub-topic in the specification contains several specification statements

For example:

Topic 4: Introductory Organic Chemistry and Alkanes

Related topics in Units 2, 4 and 5 will assume knowledge of this material.

4A: Introduction

Students will be assessed on their ability to:

4.1	understand the difference between hazard and risk
4.2	understand the hazards associated with organic compounds and why it is necessary to carry out risk assessments when dealing with potentially hazardous materials
4.3	be able to suggest ways in which risks can be reduced and reactions carried out safely, for example: i working on a smaller scale ii taking precautions specific to the hazard iii using an alternative method that involves less hazardous substances
4.4	understand the concepts of homologous series and functional group
4.5	be able to apply the rules of International Union of Pure and Applied Chemistry (IUPAC) nomenclature to: i name compounds relevant to this specification ii draw these compounds, as they are encountered in the specification, using structural, displayed and skeletal formulae *Students will be expected to know prefixes for compounds up to C_{10}*
4.6	be able to classify reactions as addition, substitution, oxidation, reduction or polymerisation
4.7	understand that bond breaking can be: i homolytic, to produce free radicals ii heterolytic, to produce ions
4.8	know definitions of the terms 'free radical' and 'electrophile'

ACTIVITY 1

Which specification statement is the following question assessing?

(ii) Explain how the electrical conductivity, high melting temperature and malleability of metals depend on their structure and bonding.

(3)

Electrical conductivity .....

.....

.....

High melting temperature .....

.....

.....

Malleability .....

.....

.....

ACTIVITY 2

This question evaluates specification statement 9.10:

‘Understand and explain how changes in temperature, pressure, and concentration qualitatively affect the position of equilibrium in a homogeneous system.’

Which equilibrium shifts to the right-hand side when the pressure in the system **decreases** at constant temperature?

☒ **A** $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

☒ **B** $F_2(g) + H_2(g) \rightleftharpoons 2HF(g)$

☒ **C** $C_6H_6(g) + 3H_2(g) \rightleftharpoons C_6H_{12}(g)$

☒ **D** $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

ACTIVITY 3

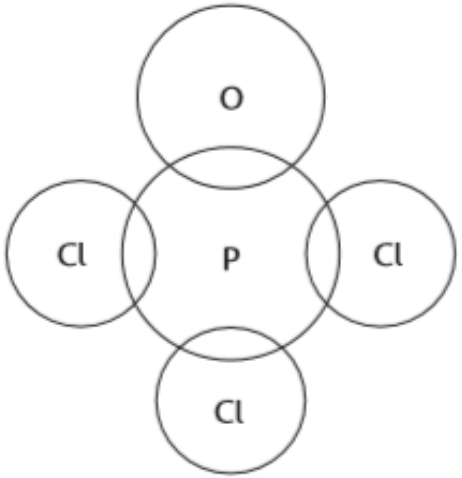
What are the essential points to include when answering the following two questions?

(c) The compound $POCl_3$ has a simple molecular structure.

(i) Complete the dot-and-cross diagram for the $POCl_3$ molecule.

Use crosses (×) for the phosphorus electrons, dots (•) for the chlorine electrons and circles (o) for the oxygen electrons.

(2)



(ii) Explain the shape of this molecule using the electron-pair repulsion theory.

(3)

ACTIVITY 3

(c)(i) Bonding pairs (1)

Non-bonding (lone) pairs on both O and Cl atoms (1)

(c)(ii) Shape of the molecule (1)

Regions of bonding electrons repel one another (1)
to adopt positions of minimum repulsion (1)

Planning the Course

Key document

The key document needed to deliver the course is:

The specification

This document is available on the Pearson Qualifications website

It is listed under ‘Course Materials’

How do I make sure I cover the content?

- Specification
- Schemes of work
- Lesson plans

Example Scheme of Work

weeks	Topic Area Aims and Learning Outcomes	Exemplar classroom activities, teaching points and suggested teaching resources	Integrated Transferable Skills
1	**Amount of substance** Know the terms atom, element, ion, molecule, compound, empirical formula and molecular formula Know that the mole (mol) is the unit for amount of a substance and be able to perform calculations using the Avogadro constant Be able to write balanced full and ionic equations, including state symbols, for chemical reactions Understand the terms: relative atomic mass, relative molecular mass, relative formula ,mass, molar mass, parts per million Be able to use experimental data to calculate empirical and molecular formulae	View video on Mole and Avogadro as part of 'Flip Learning' preparation, then use scaffolded worksheets to check understanding. e.g. http://www.youtube.com/watch?v=AsqEkF7hcII Students work in groups to carry out an experiment to confirm the empirical formula of a compound (e.g. copper oxide by reduction). Students work in groups to carry out an experiment to determine the number of water molecules in a hydrated salt (e.g. hydrated magnesium(II) sulfate). Play a 'spot the difference' game with cards showing all the key definitions. Design a spreadsheet to calculate relative molecular mass / relative formula mass from relative atomic masses.	Problem solving in calculations Analysis of results of experiments Interpretation of results of experiments Responsibility for carrying out practical work in a safe manner, following all safety requirements Teamwork and cooperation when working with others carrying out practical experiments Communication between members of a group carrying out experiments

Possible components of a lesson plan

While there are many formats for a lesson plan, most lesson plans contain some
or all of these elements, typically in this order:

- Title of the lesson
- Time required to complete the lesson
- List of required materials
- List of objectives (what the student is expected to know by the end of the lesson)

Possible components of a lesson plan

- The ‘lead-in’ to the lesson that focuses students on the lesson’s skills or concepts – this could include showing pictures or models, asking leading questions, or reviewing previous lessons

- An instructional component that describes the sequence of events that make up the lesson, including the teacher's instructional input and, where appropriate, guided practice by students to consolidate new skills and ideas

- Independent practice that allows students to extend skills or knowledge on their own

Possible components of a lesson plan

- A summary, where the teacher wraps up the discussion and answers questions
- A risk assessment where the lesson's risks and the steps taken to minimise them are documented
- An analysis component the teacher uses to reflect on the lesson itself, such as what worked and what needs improving

Practicals in the specification

- The specification contains 16 Core Practicals (8 at AS and 8 at A2)
- It is strongly recommended that students complete these Core Practicals in order to develop skills
- Other suggested practicals appear in the specification
- The suggested practicals are optional
- You may add – or substitute – your own practicals too!

Practical skills

- Students will be assessed on practical skills in Units 3 and 6
- This will include testing the skills of students in familiar and unfamiliar applications
- Students may be asked about planning, including risk management and the selection of apparatus, with reasons
- Other questions may cover data handling, including the use of significant figures, processing data and plotting graphs

Assessing practical skills Unit 3

- Unit 3 is a written practical examination, covering the skills and techniques developed during practical work in Units 1 and 2
- The unit content contains eight core practical activities
- The examination may include questions where students apply their knowledge to new practical situations
- Students should develop their practical skills by completing a range of different practicals that require a variety of different techniques
- Suggested practicals are included at the end of each topic

Assessing practical skills Unit 6

The points covered in Unit 3 also apply to Unit 6 except:

- Students are expected to develop experimental skills and knowledge and understanding of the necessary techniques by carrying out a range of practicals while they study Units 4 and 5, as well as the tests for anions and cations, gases and organic functional groups from Units 1 and 2

Question Types

Question types

The following question types will be set in Units 1, 2, 4 and 5:

- multiple choice with four alternative answers labelled, A, B, C and D
- short response with a mark range from 1 to 5
- extended writing worth 6 marks (only Units 2, 4 and 5)
- calculations

Questions in Units 3 and 6 will focus on practical skills

Multiple choice

Here is a typical multiple-choice question:

1 Which statement is **not** true for sodium chloride?

- ☒ **A** sodium chloride conducts electricity in aqueous solution
- ☒ **B** sodium chloride conducts electricity when molten
- ☒ **C** sodium chloride has a molecular structure
- ☒ **D** sodium chloride has a giant structure

(Total for Question 1 = 1 mark)

cross in box

line through cross in box

Short response

Here is a typical short response question:

22 This question is about fuels and polymers.

Used coffee grounds have been suggested as a carbon-neutral fuel to replace some fossil fuels.

(a) (i) Explain why coffee grounds might be considered a carbon-neutral fuel.

(2)

.....

.....

.....

.....

.....

.....

Extended writing

Here is a typical extended writing question:

*(b) Propan-1-ol is heated with a concentrated solution of acidified potassium dichromate(VI).

Explain how the conditions used affect the rate of the reaction **and** ensure that propanoic acid is the only organic product.

(6)

Indicative points

The following table shows how the marks should be awarded for indicative content:

Number of indicative marking points seen in answer	Number of marks awarded for indicative marking points
6	4
5-4	3
3-2	2
1	1
0	0

Indicative content

1. The higher the concentration (of acid or $Cr_2O_7^{2-}$) the higher the rate
2. Because the collision frequency increases
3. The higher the temperature the faster the rate
4. Because more particles have an energy greater than the activation energy / more successful collisions
5. Excess / concentrated oxidising agent ensures complete oxidation

Lines of reasoning

The following table shows how the marks should be awarded for structure and lines of reasoning:

The following table shows how the marks should be awarded for structure and lines of reasoning

	Number of marks awarded for structure of answer and sustained lines of reasoning
Answer shows a coherent logical structure with linkages and fully sustained lines of reasoning demonstrated throughout	2
Answer is partially structured with some linkages and lines of reasoning	1
Answer has no linkages between points and is unstructured	0

In general it would be expected that 5 or 6 indicative points would get 2 reasoning marks, and 3 or 4 indicative points would get 1 mark for reasoning, and 0, 1 or 2 indicative points would score zero marks for reasoning.

If there is any incorrect chemistry, deduct mark(s) from the reasoning. If no reasoning mark(s) awarded do not deduct mark(s).

Comment: Look for the indicative marking points first, then consider the mark for the structure of the answer and sustained line of reasoning.

Calculations

Here is a typical calculation:

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.
State symbols are not required.

(1)

(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.

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

(6)

ACTIVITY 4

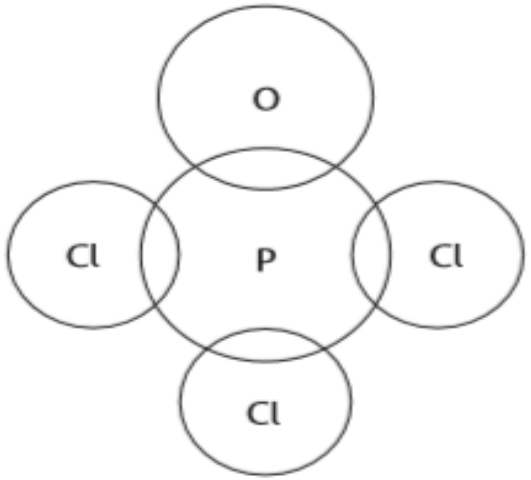
What are the essential points to include when answering the following two questions?

(c) The compound $POCl_3$ has a simple molecular structure.

(i) Complete the dot-and-cross diagram for the $POCl_3$ molecule.

Use crosses (×) for the phosphorus electrons, dots (•) for the chlorine electrons and circles (○) for the oxygen electrons.

(2)



(ii) Explain the shape of this molecule using the electron-pair repulsion theory.

(3)

ACTIVITY 4

(c)(i) Bonding pairs

Non-bonding (lone) pairs on both O and Cl atoms

(c)(ii) Shape of the molecule

Regions of bonding electrons repel one another to adopt positions of minimum repulsion

ACTIVITY 5

What is the answer to the following question?

Explain why iodine is very soluble in cyclohexane but is only slightly soluble in water

ACTIVITY 5

Cyclohexane and iodine form London forces between their molecules, so iodine is soluble in cyclohexane

Hydrogen bonds between water molecules are stronger than London forces between iodine and water molecules, so iodine is less soluble in the aqueous layer

Assessment Objectives

Why do we have Assessment Objectives?

- Help make exams fairer year on year
- Provide structure for question paper writers
- Make sure that exams are about skills, not just about knowledge
- Can provide students with some reassurance about the types of questions they will be asked

Assessment Objectives

AO1	AO2a	AO2b	AO3
Demonstrate knowledge and understanding of science	Application of knowledge and understanding of science in familiar and unfamiliar contexts	Analysis and evaluation of scientific information to make judgements and reach conclusions	Experimental skills in science, including analysis and evaluation of data and methods

Assessment Objectives

AO1	AO2a	AO2b	AO3
Questions requiring students to recall and use information that you have taught them	Questions requiring students to apply what you have taught them, or to use skills	Questions requiring students to analyse and make judgements	Questions on practical work and associated practical skills, such as planning, drawing graphs, analysing data, evaluating methods

Typical AO1 questions

Covalent bonding is best described as the electrostatic attraction between

- ☐ **A** oppositely charged ions
- ☐ **B** positive ions and delocalised electrons
- ☐ **C** a shared pair of electrons
- ☐ **D** two nuclei and a shared pair of electrons

(a) Draw an electron density map for a molecule of oxygen. (1)

(b) Draw a diagram to show the shape of a water molecule. Give the bond angle. (2)

Typical AO2a questions

Which is the electronic configuration of the Sc^{3+} ion?

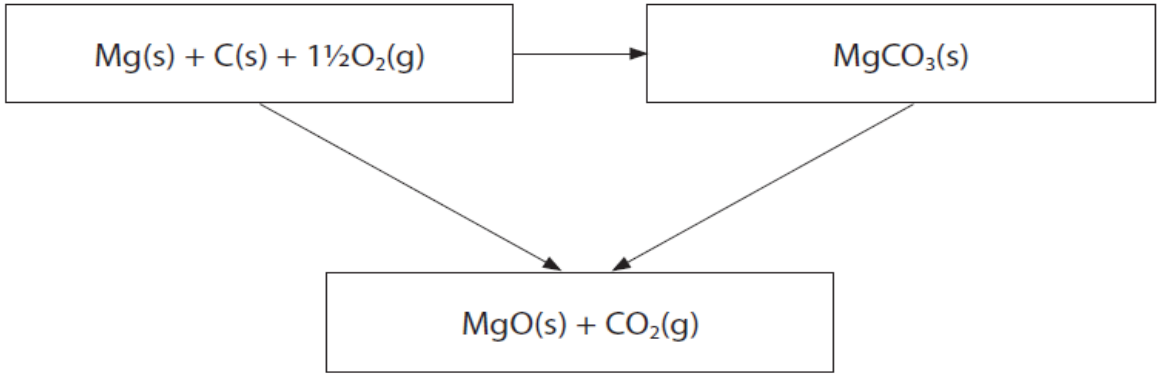
☒ **A** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

☒ **B** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5\ 3d^1$

☒ **C** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^1\ 4s^2$

☒ **D** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^4\ 4s^2$

The Hess cycle and data to calculate the enthalpy change for the thermal decomposition of $MgCO_3$ are shown.



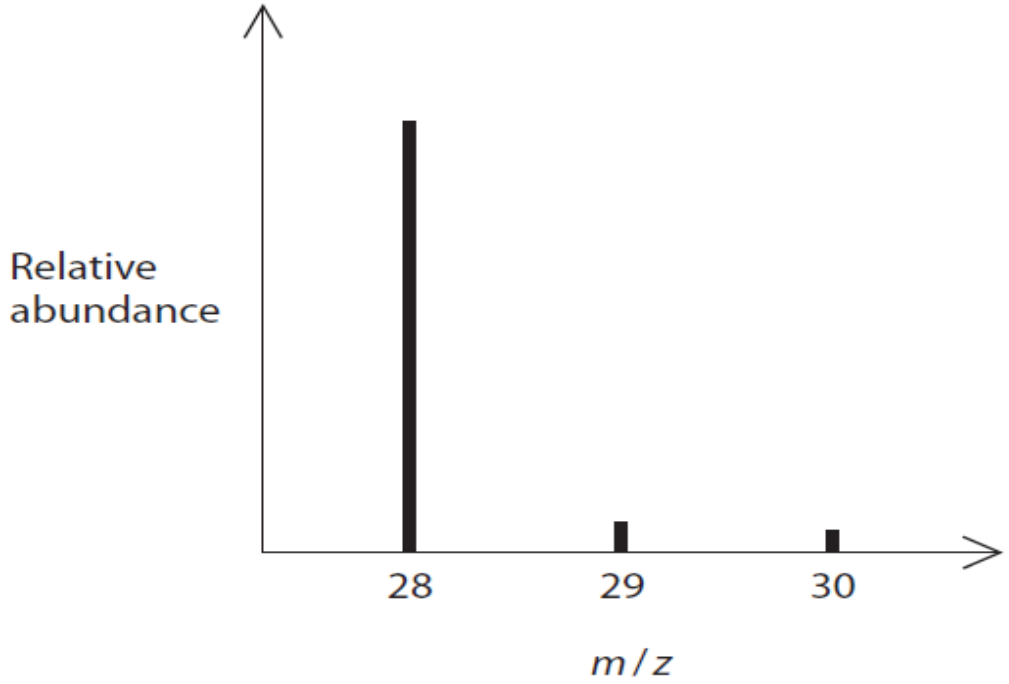
Compound	$\Delta_f H^{\ominus}$ / kJ mol^{-1}
$CO_2(g)$	−394
MgO(s)	−602
$MgCO_3(s)$	−1096

Calculate the enthalpy change for the thermal decomposition of $MgCO_3$.

(2)

Typical AO2b question

The mass spectrum of a sample of silicon is shown.



What is the **best** estimate for the relative atomic mass of silicon in this sample?

- ☒ **A** 28.0
- ☒ **B** 28.2
- ☒ **C** 28.8
- ☒ **D** 29.0

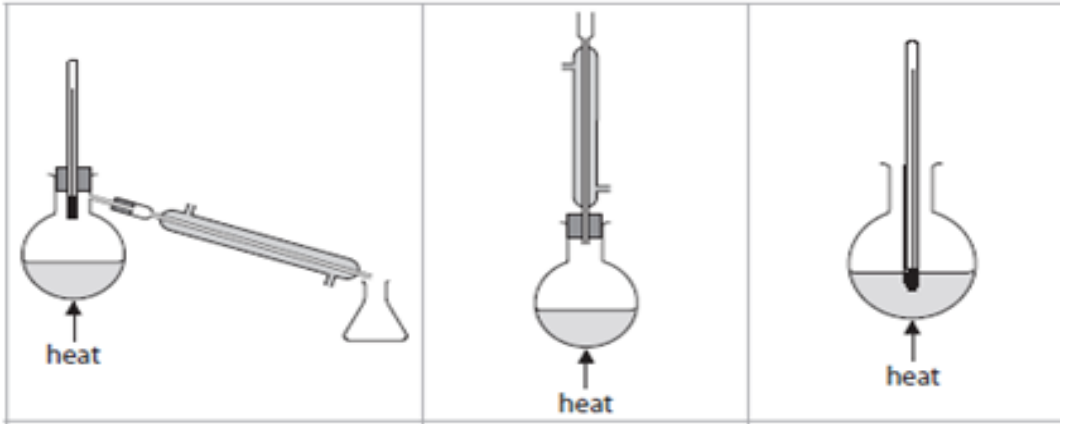
Typical AO3 question

A group of students was asked to investigate a liquid organic compound **A**.
They were told that it was an alcohol with molecular formula $C_4H_{10}O$.

(a) A chemical test may be used to confirm the presence of the hydroxyl group in **A**.

Identify a suitable reagent for this test, giving the positive result. (2)

(b) The students suggested that oxidation of **A** would help to identify it.
The sets of apparatus shown below were provided for the students' use.



Apparatus 1	Apparatus 2	Apparatus 3

(i) Identify the reagent mixture that can be used to oxidise **A**. (1)

(ii) One student said that if **A** was a primary alcohol this could be shown by oxidising it to the corresponding aldehyde and testing the product.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer. (2)

(iii) A chemical test may be used to confirm the presence of an aldehyde.
Identify the reagent used, giving the positive result of the test. (2)

(iv) State whether or not a positive result for the test in (b)(iii), together with the molecular formula, would allow the alcohol **A** to be identified.
Justify your answer. (1)

(v) Another student said that if **A** was a secondary alcohol this could be shown by oxidising it to the corresponding ketone.

Identify which apparatus (1, 2 or 3) should be used for this oxidation.
Justify your answer. (2)

Activity 6: Assigning AOs

Assign an AO to each of the following questions on the next few slides

Activity 6

Assigning AOs

In a titration, a conical flask containing 10.00 cm^3 of 1.00 mol dm^{-3} sulfuric acid is fully neutralised by 25.00 cm^3 of 0.80 mol dm^{-3} potassium hydroxide.

(a) The titration is carried out using methyl orange as an indicator.
What would be the colour change at the end-point of the titration?

- ☒ **A** orange to red
- ☒ **B** red to orange
- ☒ **C** orange to yellow
- ☒ **D** yellow to orange

Activity 6

Assigning AOs

In a titration, a conical flask containing 10.00 cm^3 of 1.00 mol dm^{-3} sulfuric acid is fully neutralised by 25.00 cm^3 of 0.80 mol dm^{-3} potassium hydroxide.

(b) What is the concentration, in mol dm^{-3}, of the potassium sulfate solution produced by this reaction at the end-point, to 2 significant figures?

- ☒ **A** 0.010
- ☒ **B** 0.020
- ☒ **C** 0.29
- ☒ **D** 0.57

Activity 6

Assigning AOs

In a titration, a conical flask containing 10.00 cm^3 of 1.00 mol dm^{-3} sulfuric acid is fully neutralised by 25.00 cm^3 of 0.80 mol dm^{-3} potassium hydroxide.

(c) Information about the uncertainties in each reading used to measure the volumes of the solutions in this titration is shown.

Solution	Equipment used	Uncertainty / cm^3
sulfuric acid	pipette	±0.04
potassium hydroxide	burette	±0.05

Which statement is true?

- ☒ **A** the percentage uncertainty of the volume of sulfuric acid is more than the percentage uncertainty of the volume of potassium hydroxide
- ☒ **B** the percentage uncertainty of the volume of sulfuric acid is 0.8 %
- ☒ **C** the total percentage uncertainty is 0.8 %
- ☒ **D** the percentage uncertainty of the volume of potassium hydroxide solution is 0.2 %

Activity 6

Assigning AOs

Baking powder is added to cake mixtures to make cakes 'rise' by releasing a gas during cooking.

Baking powder contains an acidic derivative of tartaric acid and about 30% by mass of sodium hydrogencarbonate.

Baking powder releases the gas in two types of reaction during cooking, one of which is neutralisation.

(a) (i) Give the name of the second type of reaction.

(ii) Suggest why neutralisation does not occur in an unopened container of baking powder.

(b) (i) The acidic derivative of tartaric acid contains 20.8% potassium, 25.5% carbon, 2.66% hydrogen by mass and the rest is oxygen.

Calculate the empirical formula.

(ii) The acidic derivative of tartaric acid can be represented by the formula $H^+K^+A^{2-}$.

Write the equation for the neutralisation of sodium hydrogencarbonate by $H^+K^+A^{2-}$.

State symbols are not required.

Activity 6

Assigning AOs

Bromoethane was prepared from the reaction of ethanol with sulfuric acid and potassium bromide.

$$C_2H_5OH + H_2SO_4 + KBr \rightarrow C_2H_5Br + KHSO_4 + H_2O$$

Procedure

Step **1** 10.0 cm^3 of ethanol was placed in a round-bottomed flask.

Step **2** 10.0 cm^3 of concentrated sulfuric acid was added carefully and gradually to the ethanol in the flask.

Step **3** 12.0 g of potassium bromide was added to the reaction mixture in the flask.

Step **4** The flask was set up for distillation and heated gently.

Step **5** Water, ethanol and bromoethane were collected in a small beaker.

Step **6** The bromoethane was purified.

Step **7** The bromoethane was dried.

(a) Suggest why the flask in Step **2** was frequently placed in a stream of cold running water as the sulfuric acid was gradually added.

(b) The potassium bromide used in Step **3** was initially lumpy and not a fine powder. State the apparatus that would be suitable for breaking up the lumps of potassium bromide into a powder.

(c) Explain why an orange colour was seen in the round-bottomed flask when it was first gently heated in Step **4**.

Command Words

Command words

What they are and why they are important

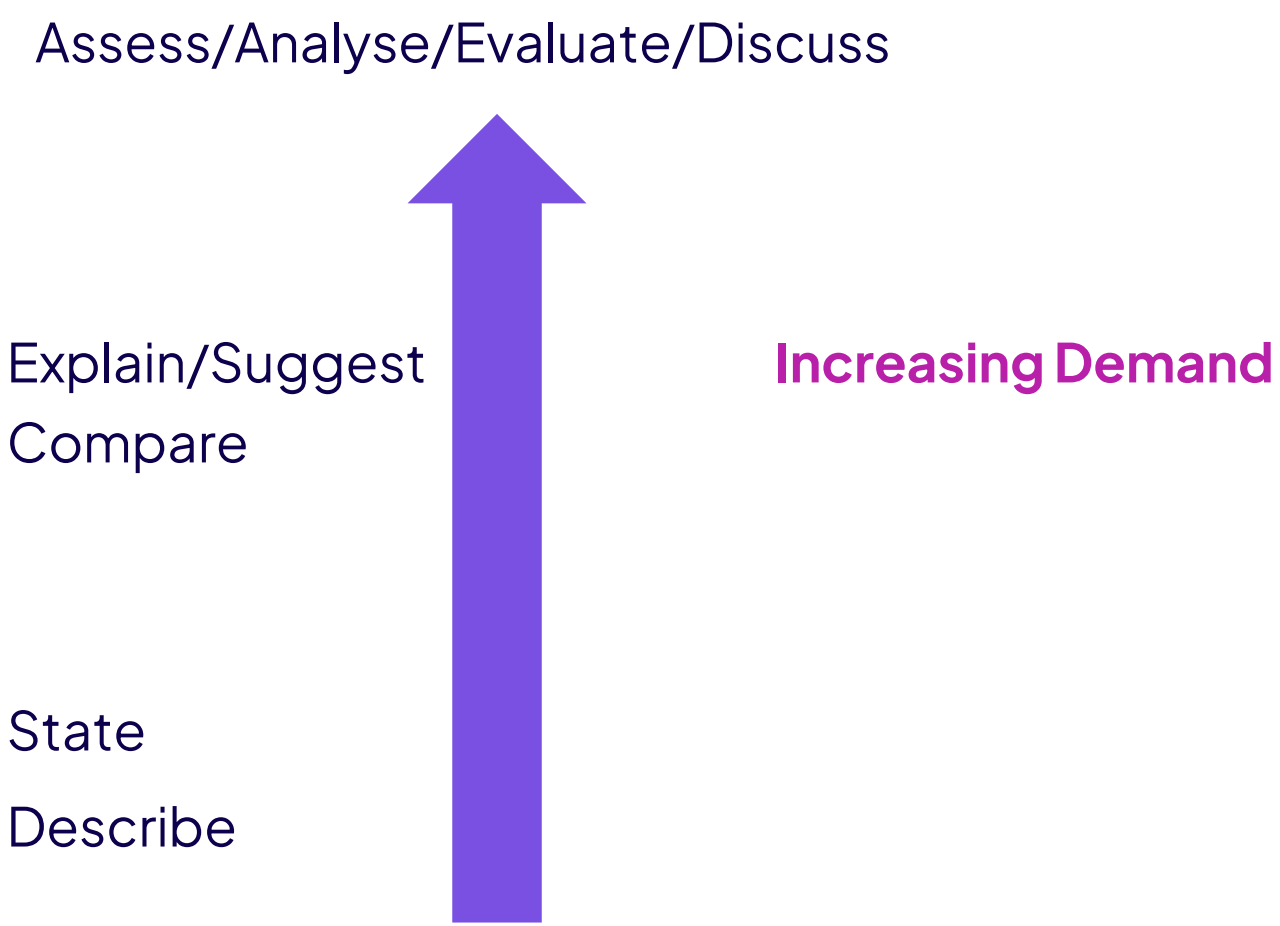
- Every question should have a command word.
- It is an instruction to candidates, telling them what we want them to write.
- It is critical that candidates know what each command word means so that they can answer the question effectively.
- Many candidates do not fully understand what each command word means – ‘describe’ and ‘explain’ are often confused with each other.
- All our qualifications in International GCSE sciences now use a common taxonomy for command words.
- These can be found in Appendix 5 at the back of the specification.
- Students can expect a range of command words across the demand range of the exam paper.

Command Words

Command word	Definition
Identify/state/name	Recall or select one or more pieces of information.
Define	State the meaning of a term.
Calculate	Produce a numerical answer, showing relevant working.
Label	Add a label/labels to a given resource, graphic or image.
Draw/plot	Create a graphical representation of geographical information.
Compare	Find the similarities and differences of two elements given in a question. Each response must relate to both elements and must include a statement of their similarity/difference.
Describe	Give an account of the main characteristics of something or the steps in a process. Statements in the response should be developed but do not need to include a justification or reason.
Explain	Provide a reasoned explanation of how or why something occurs. An explanation requires a justification/exemplification of a point. Some questions will require the use of annotated diagrams to support the explanation.
Suggest	Apply understanding to provide a reasoned explanation of how or why something may occur. A suggested explanation requires a justification/exemplification of a point.
Examine	Break something down into individual components/processes and say how each one individually contributes to the question's theme/topic and how the components/processes work together and interrelate.
Assess	Use evidence to determine the relative significance of something. Give consideration to all factors and identify which are the most important.
Analyse	Investigate an issue by breaking it down into individual components and making logical, evidence-based connections about the causes and effects or interrelationships between the components.
Evaluate	Measure the value or success of something and ultimately provide a substantiated judgement/conclusion. Review information and then bring it together to form a conclusion, drawing on evidence such as strengths, weaknesses, alternatives and relevant data.
Discuss	Explore the strengths and weaknesses of different sides of an issue/question. Investigate the issue by reasoning or argument.

Cognitive demand of command words

Some command words have different cognitive demands:



Assigning Command Words to AOs

A01	A02a	A02b	A03
Add/Label Complete Describe (straightforward known ideas) Draw Explain (a simple idea or reason) Give/State/Name State what is meant by Write (a familiar equation)	Calculate Comment on Deduce Evaluate Explain (for more complex ideas) Suggest Write (an unfamiliar or more complicated equation)	Comment on Deduce Evaluate Explain (for more complex ideas) Suggest	Any command word can be used

AO2 Questions

Why not look at AO1?

- AO1 is all about knowledge – and basic understanding
- This is not one that teachers can influence much…
- … students either go away and learn what you teach them, or they do not!
- BUT… remember that students should still recognise AO1 questions and not spend time going beyond AO1

Activity 7 AO2a in exams

Use the mark schemes shown on-screen to mark the student responses on the next slides

We will go through each question one at a time

Activity 7 AO2a in exams

This question is about silver.

Silver chloride decomposes in light. This reaction was used in the first photographic plates.

Write an equation for this decomposition.
Include state symbols. (2)

Answer	Additional Guidance
An answer that makes reference to the following points: • correctly balanced equation **(1)** • state symbols **(1)**	$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$ M2 dependent on M1 or near miss e.g. $AgCl_2$ or correct formulae but unbalanced equation

Activity 7 AO2a in exams

Student 1 $2AgCl(aq) \longrightarrow 2Ag(s) + Cl_2(g)$

Student 2 $2AgCl_3(s) \xrightarrow{light} 2Ag(s) + 3Cl(g)$

Student 3 $2AgCl(c) \xrightarrow{UV} 2Ag(s) + Cl_2(g) \uparrow$

Student 4 $2AgCl_{(s)} \rightarrow 2Ag^{(aq)}_{(s)} + Cl_{2(g)}$

Answer	Additional Guidance
An answer that makes reference to the following points: • correctly balanced equation **(1)** • state symbols **(1)**	$2AgCl(s) \rightarrow 2Ag(s) + Cl_2(g)$ M2 dependent on M1 or near miss e.g. $AgCl_2$ or correct formulae but unbalanced equation

Activity 7 AO2a in exams

Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.

Give your answer to 3 significant figures. (2)

Isotope	Abundance (%)
^{28}Si	91.07
^{29}Si	4.62
^{30}Si	3.00
^{32}Si	1.31

Answer	Additional Guidance
• expression (1) • evaluation and answer to 3 SF (1)	Example of calculation: $\frac{(28 \times 91.07) + (29 \times 4.62) + (30 \times 3.00) + (32 \times 1.31)}{(100)}$ = 28.1586 = 28.2 (3SF) Allow TE on minor slip if final answer 28 - 32 Correct answer scores 2 Allow g mol^{-1} / g/mol, Do not award any other units for M2 Comment: scroll to end of clip

Activity 7 AO2a in exams

Student 1

$$\frac{28 \times 91.07 + 29 \times 4.62 + 30 \times 3 + 32 \times 1.31}{100}$$

$\approx 28.159\%$

Answer		Additional Guidance
• expression • evaluation and answer to 3 SF	(1) (1)	Example of calculation: $\frac{(28 \times 91.07) + (29 \times 4.62) + (30 \times 3.00) + (32 \times 1.31)}{(100)}$ = 28.1586 = 28.2 (3SF) Allow TE on minor slip if final answer 28 - 32 Correct answer scores 2 Allow g mol^{-1} / g/mol, Do not award any other units for M2 Comment: scroll to end of clip

Activity 7 AO2a in exams

Student 2

$$\frac{28 \times 91.07 + 29 \times 4.62 + 30 \times 3 + 32 \times 1.31}{91.07 + 4.62 + 3 + 1.31} = 28.2\ g\ mol^{-1}$$

Answer	Additional Guidance
• expression **(1)** • evaluation and answer to 3 SF **(1)**	Example of calculation: $\frac{(28 \times 91.07) + (29 \times 4.62) + (30 \times 3.00) + (32 \times 1.31)}{(100)}$ = 28.1586 = 28.2 (3SF) Allow TE on minor slip if final answer 28 - 32 Correct answer scores 2 Allow g mol^{-1} / g/mol, Do not award any other units for M2 Comment: scroll to end of clip

Activity 7 AO2a in exams

Student 3

$$\frac{91.07 \times 28 + 29 \times 4.62 + 30 \times 3 + 32 \times 1.31}{100}$$

$$= 28.3 \text{ g mol}^{-1}$$

Answer	Additional Guidance
• expression **(1)** • evaluation and answer to 3 SF **(1)**	Example of calculation: $\frac{(28 \times 91.07) + (29 \times 4.62) + (30 \times 3.00) + (32 \times 1.31)}{(100)}$ = 28.1586 = 28.2 (3SF) Allow TE on minor slip if final answer 28 - 32 Correct answer scores 2 Allow g mol^{-1} / g/mol, Do not award any other units for M2 Comment: scroll to end of clip

Activity 7 AO2a in exams

Student 4

~~28×91.~~

28×0.9107 + 29×0.0462 + 30×0.03 + 32×0.0131 = 28.2

Answer	Additional Guidance
• expression **(1)** • evaluation and answer to 3 SF **(1)**	Example of calculation: $\frac{(28 \times 91.07) + (29 \times 4.62) + (30 \times 3.00) + (32 \times 1.31)}{(100)}$ = 28.1586 = 28.2 (3SF) Allow TE on minor slip if final answer 28 - 32 Correct answer scores 2 Allow g mol^{-1} / g/mol, Do not award any other units for M2 Comment: scroll to end of clip

Activity 7 AO2a in exams

Explain the trend in the first ionisation energies of Al, Si and P. (3)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (first ionisation energy) increases (for these elements)	**(1)**	
• because the electrons are removed from the same sub-shell	**(1)**	Accept 3p (sub-shell) Allow have the same shielding Ignore same shell / same orbital
• and the number of protons has increased (by 1 for each element)	**(1)**	Accept increased nuclear charge

Activity 7 AO2a in exams

Student 1

Al : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$

Si : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

P : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

The first ionisation energies generally increases from across the period from left to right Al —> P more ionisation energy is needed to remove the electron from Si because it is not paired and ~~more stable than Al so~~ therefore needs more energy to be removed and P needs more energy than Si because it is half filled in p subshell

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (first ionisation energy) increases (for these elements)	**(1)**	
• because the electrons are removed from the same sub-shell	**(1)**	Accept 3p (sub-shell) Allow have the same shielding Ignore same shell / same orbital
• and the number of protons has increased (by 1 for each element)	**(1)**	Accept increased nuclear charge

Activity 7 AO2a in exams

Student 2

From Al to P, the first ionisation energy increases due to an increase in the number of protons attracting the same number of outershell electrons leading to greater forces of attraction between the positive nucleus and the outer shell electrons. So more energy is needed to remove loosely bound electron.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (first ionisation energy) increases (for these elements)	**(1)**	
• because the electrons are removed from the same sub-shell	**(1)**	Accept 3p (sub-shell) Allow have the same shielding Ignore same shell / same orbital
• and the number of protons has increased (by 1 for each element)	**(1)**	Accept increased nuclear charge

Activity 7 AO2a in exams

Student 3

First ionisation energy increases. Across a period, from Al to P, first ionisation energy increases as there are more protons, increasing the nuclear charge. Shielding electrons remain relatively constant. Hence effective nuclear charge increases. Electron to be removed is pulled closer and more attracted to the nucleus. More energy needed to remove the electron.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (first ionisation energy) increases (for these elements)	**(1)**	
• because the electrons are removed from the same sub-shell	**(1)**	Accept 3p (sub-shell) Allow have the same shielding Ignore same shell / same orbital
• and the number of protons has increased (by 1 for each element)	**(1)**	Accept increased nuclear charge

Activity 7 AO2a in exams

Student 4

Al has the lowest first ionisation energy, because it has the lowest no. of protons. Therefore, the nuclear effective charge is less. Nuclear charge increase from Al to Si to P because the number of protons increases. ~~and as a result~~ nuc Therefore, the first ionisation of

P > Si > Al

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• (first ionisation energy) increases (for these elements)	**(1)**	
• because the electrons are removed from the same sub-shell	**(1)**	Accept 3p (sub-shell) Allow have the same shielding Ignore same shell / same orbital
• and the number of protons has increased (by 1 for each element)	**(1)**	Accept increased nuclear charge

Activity 8 AO2b in exams

Use the mark schemes shown on-screen to mark the student responses on the next slides

We will go through each question one at a time

Activity 8 AO2b in exams

Pure silver cups are too soft so small amounts of copper are added to make an alloy.

Explain why copper makes the silver less malleable. (2)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• the layers / ions / atoms slide less well (over each other)	**(1)**	Do not award layers can not slide (over each other)
• because copper ions / atoms are smaller than silver ions / atoms	**(1)**	Allow copper ions and silver ions have different sizes Do not award just copper is smaller than silver Ignore comments about strength of metallic bonds or just copper ions disrupting the lattice

Activity 8 AO2b in exams

Student 1

As copper is add, the layer between the atom don't slip much easily and therefore it becomes difficult to break the intermolecular forces ~~bet~~ hence it makes ~~s~~. and copper is an alloy which is ~~strong~~ difficult to break compared to the metals.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• the layers / ions / atoms slide less well (over each other)	**(1)**	Do not award layers can not slide (over each other)
• because copper ions / atoms are smaller than silver ions / atoms	**(1)**	Allow copper ions and silver ions have different sizes Do not award just copper is smaller than silver Ignore comments about strength of metallic bonds or just copper ions disrupting the lattice

Activity 8 – AO2b in exams

Student 2

an alloy has different size of cations, which makes them harder to slide over each other, ~~and~~ ~~because~~ hence increase strength, which requires higher energy to break.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• the layers / ions / atoms slide less well (over each other)	**(1)**	Do not award layers can not slide (over each other)
• because copper ions / atoms are smaller than silver ions / atoms	**(1)**	Allow copper ions and silver ions have different sizes Do not award just copper is smaller than silver Ignore comments about strength of metallic bonds or just copper ions disrupting the lattice

Activity 8 AO2b in exams

Student 3

the size of copper is different thang silver. So the ~~&~~ copper ion atoms stay between the layers of silver, to avoid ~~bre~~ the layers from sliding puss eachotherr.

Answer	Additional Guidance
An explanation that makes reference to the following points: • the layers / ions / atoms slide less well (over each other) **(1)** • because copper ions / atoms are smaller than silver ions / atoms **(1)**	Do not award layers can not slide (over each other) Allow copper ions and silver ions have different sizes Do not award just copper is smaller than silver Ignore comments about strength of metallic bonds or just copper ions disrupting the lattice

Activity 8 AO2b in exams

Student 4

→ different types of atoms present in the structures.

→ so layers cannot slide pass over eachother & making the electrostatic forces of attraction between the layers stronger due to TOF copper atoms. Hence alloy is harder / brittle. & less malleable.

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• the layers / ions / atoms slide less well (over each other)	**(1)**	Do not award layers can not slide (over each other)
• because copper ions / atoms are smaller than silver ions / atoms	**(1)**	Allow copper ions and silver ions have different sizes Do not award just copper is smaller than silver Ignore comments about strength of metallic bonds or just copper ions disrupting the lattice

AO2 in exams

Some questions for you to think about

Teaching approaches:

Is it better to present facts or to teach principles? Why?

Questioning styles:

Is it better to ask closed or open questions? Why?

Assessment activities:

Is it better to set formative or summative assessments? Why?

Exam preparation:

What else could you do to prepare your students to answer the AO2 exam questions?

AO2: Question styles

- Think about one of the topics that you teach which often has AO2 questions in exams
- What sorts of questions do you ask in class when teaching this topic?
- How do these questions help students to prepare for AO2 questions?

AO2: Homework activities

- Why do you set homework?
- What sort of questions/problems do you set?
- What do you expect students to gain from the questions that you set?
- Will what they gain help them to answer AO2 questions?

AO3 Questions

What is AO3?

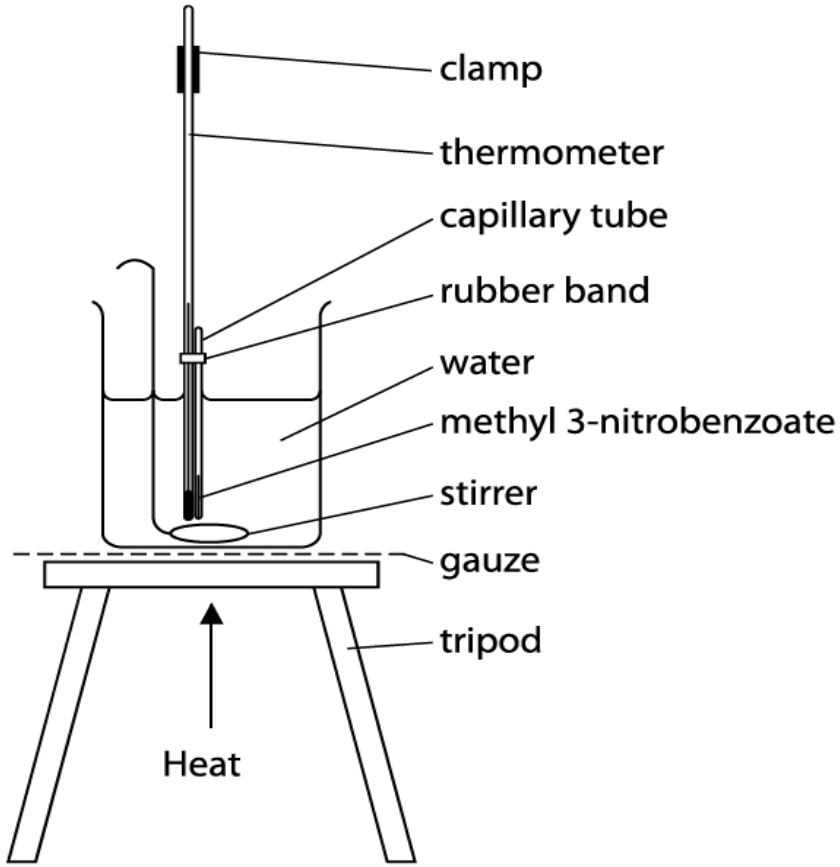
- AO3 assesses the practical skills and understanding gained by students as they undertake practical work
- AO3 questions may require RECALL of practical techniques and understanding or APPLICATION of these to new situations
- AO3 may also involve the use of experimental data, and the evaluation of experimental methods or results

AO3: Recall of practical technique

The melting temperature of methyl 3-nitrobenzoate is 77 °C.

Describe how the students should use the apparatus shown to determine the melting temperature **range** of a sample of their crystallised methyl 3-nitrobenzoate.

(3)



AO3: Analysis of results

The inorganic compounds **A** and **B** contain the same Group 2 cation but different anions.

(a) Two tests were carried out on **A**. The observations made for each test are recorded in the table.

(i) Complete the statements in the inference column in the table by writing the names or formulae of the ions.

(3)

Test	Observation	Inference
Dilute sulfuric acid was added to an aqueous solution of **A**	A white precipitate formed	Two possible **cations** in **A** are ....
A sample of **A** was heated in a test tube A glowing splint was held in the mouth of the test tube	A brown gas was evolved The splint relit	The **anion** in **A** is .....

(ii) There were two gases evolved when **A** was heated; a brown gas **C**, and a gas **D** which relit the glowing splint.
Identify the gases **C** and **D** by giving their name or formula.

(2)

Gas **C** .....

Gas **D** .....

AO3: Analysis of results

The equation for the reaction between iodine and propanone in acidic solution is

$$I_2(aq) + CH_3COCH_3(aq) \rightarrow CH_3COCH_2I(aq) + H^+(aq) + I^-(aq)$$

The order of reaction with respect to iodine was investigated using a titration method.

The concentration of hydrogen ions and propanone were in large excess. 30 cm^3 of acidified aqueous propanone was added to a flask containing 30.0 cm^3 of 0.020 mol dm^{-3} aqueous iodine. At the same time, the contents were mixed thoroughly and a timer started.

A pipette was used to remove 10.0 cm^3 samples of the reaction mixture every 5 minutes. The samples were immediately run into flasks containing sodium hydrogencarbonate solution, which quenched the reaction.

The volume of sodium thiosulfate solution needed to react with the iodine in each quenched sample was then determined by titration.

(b) The results were recorded in a table

Volume of sodium thiosulfate / cm^3	Time the sample was quenched / minutes
	0
18.50	5
16.10	10
13.50	15
10.90	20
8.50	25

(i) Complete the table by estimating the volume of sodium thiosulfate that would be required for titration at time = 0. (1)

(ii) Plot a graph of volume of sodium thiosulfate on the vertical axis, against time on the horizontal axis. (3)

(iii) Calculate the gradient of the line drawn through the points. Include units in your answer. (2)

(c) Assume that the volume of sodium thiosulfate required is proportional to the amount of iodine in the reaction mixture.

Deduce the order of reaction with respect to iodine. Justify your answer. (1)

AO3: Evaluation of methods

Student 1 described how to carry out the recrystallisation in Step **7** to obtain a pure sample of methyl 3-nitrobenzoate.

Step A	*Dissolve the impure solid in some hot methanol.*
Step B	*Cool the solution in an ice-bath.*
Step C	*Separate the crystals using suction filtration.*
Step D	*Dry the crystals by mixing them with solid anhydrous sodium sulfate in a stoppered boiling tube.*

(i) The student's description of **Step A** omitted an important detail.
State how the method for **Step A** should be changed.
Justify your answer.
(2)

(ii) Describe what the student should do after **Step A** and before carrying out **Step B**.
Justify your answer.
(2)

(iii) Give a reason why **Step D** would not work and describe how the student should dry the crystals.
(2)

Evaluation of methods – Examiner's report

Many candidates have a good knowledge of recrystallisation and have obviously carried this out as they knew the reasons for the errors in the description of Student 1

Others would benefit from more experience with this practical technique. Many candidates knew that the minimum amount of hot methanol should be used but not all of them knew that this was to make a saturated solution

The use of hot filtration to remove the insoluble impurities was known by many candidates

The method described by the student to dry the crystals is seen frequently by candidates when they are describing recrystallisation

It was interesting to see that some candidates understood why this would not work

AO3: Use of data

(b) A sample of an aqueous solution of manganate(VI) ions is prepared from an aqueous solution of manganate(VII) ions and solid manganese(IV) oxide under appropriate conditions.

The relevant standard electrode potentials are

$$MnO_4^- + e^- \rightleftharpoons MnO_4^{2-} \qquad E^\ominus = +0.56\,V$$

$$MnO_4^{2-} + 2H_2O + 2e^- \rightleftharpoons MnO_2 + 4OH^- \qquad E^\ominus = +0.59\,V$$

$$MnO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons MnO_2 + 2H_2O \qquad E^\ominus = +2.26\,V$$

(i) Choose appropriate standard electrode potentials to calculate $E^\ominus_{cell}$ for the formation of manganate(VI) ions in **acidic** solution.
Use your calculated value of $E^\ominus_{cell}$ to explain why manganate(VI) ions cannot be prepared under acidic conditions. (2)

(ii) Explain, in terms of standard electrode potentials, why manganate(VI) ions can be prepared in a **concentrated** alkaline solution. (2)

Use of data – Examiner's Report

The majority of candidates could select the correct two half-equations needed to calculate the E^{θ}_{cell} value and realised that the reaction does not occur because it is negative

Those candidates who calculated a positive value should have checked their working as they were told that the reaction does not take place

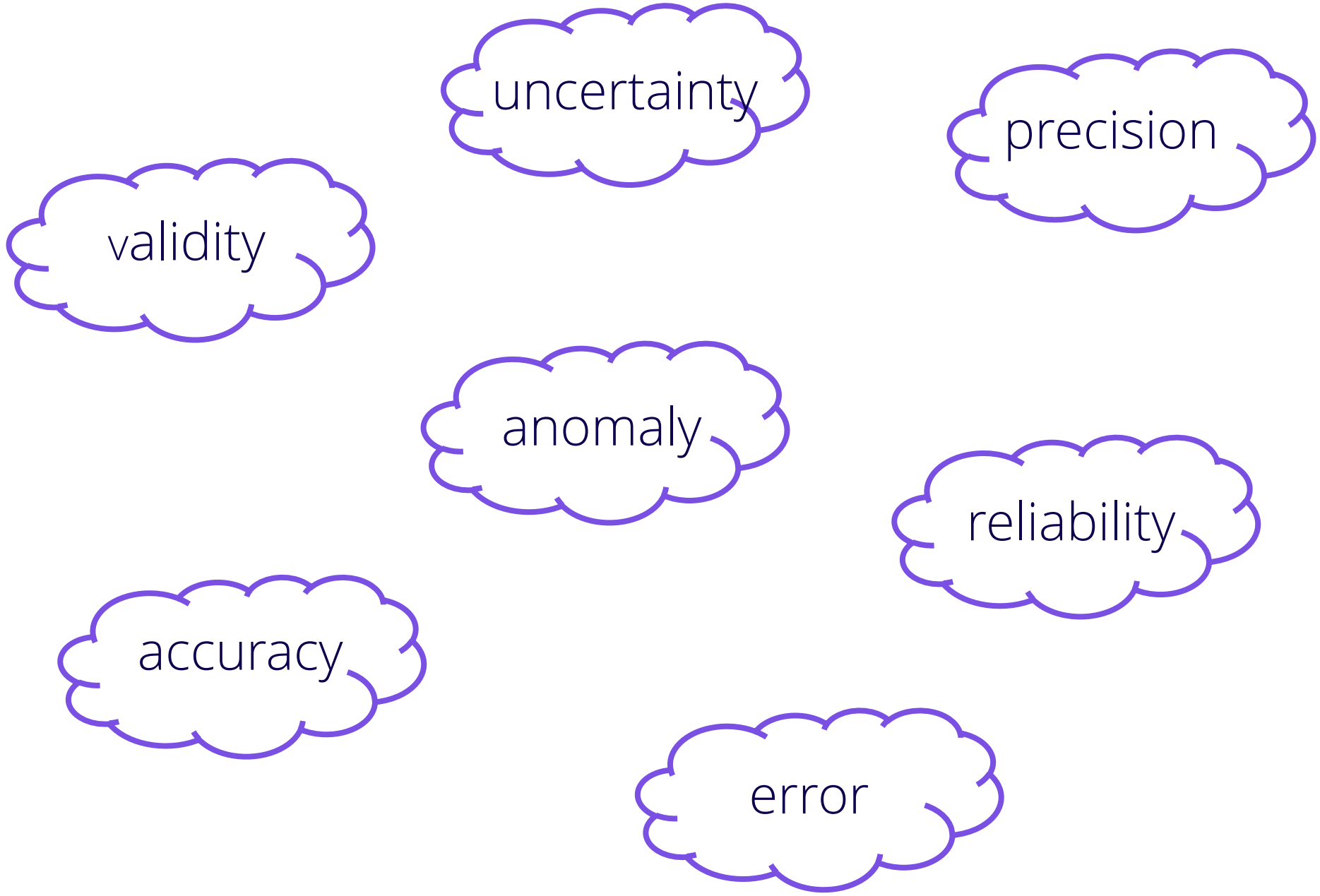
There were some very good explanations about the effect of using concentrated alkali

However, many candidates wrote vague answers and did not make it clear which of the three half-equations they were writing about

Some candidates showed the working for E^{θ}_{cell} to be negative for the formation of manganate(VI) ions under standard alkaline condition but they then wrote a positive sign so the reaction could be feasible

Teaching AO3

Terminology



Accuracy versus precision

An **accurate** measurement is one which is close to the ‘true’ or ‘accepted’ value

If repeated measurements give the same result each time, the measurements are said to be **precise**

Error versus uncertainty

Error is the difference between the measured value and the ‘true’ or ‘accepted’ value of the thing being measured

Uncertainty is a quantification of the doubt about the measurement result

Activity 9 AO3 in exams

Use the mark schemes provided on-screen to mark the student responses on the next slides

We will go through each question one at a time

Activity 9 AO3 in exams

An experiment was carried out to determine the enthalpy change of neutralisation for the reaction between sulfuric acid and sodium hydroxide.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

Procedure

Step **1** 25.0 cm^3 of 1.25 mol dm^{-3} sulfuric acid was placed in a polystyrene cup. The polystyrene cup was then placed in a beaker. A thermometer was used to measure the temperature of the acid and a clock was started.

Step **2** The temperature of the sulfuric acid was measured every 30 seconds for 2½ minutes.

Step **3** 50.0 cm^3 of 1.25 mol dm^{-3} sodium hydroxide solution was added to the acid in the polystyrene cup at 3 minutes and the mixture was constantly stirred.

Step **4** The temperature of the mixture in the polystyrene cup was measured at 3½ minutes and then every 30 seconds until the clock reached 10 minutes.

Give the reason why the polystyrene cup in Step **1** was placed in a beaker. (1)

Answer	Additional Guidance
An answer that makes reference to the following point: • to prevent the polystyrene cup from 'falling over'	Accept descriptions Allow to stabilise the polystyrene cup Allow to prevent spillages Ignore references to heat loss

Activity 9 – AO3 in exams

Student 1 To reduce heat loss to the surroundings, and possibly to prevent any spilling or loss of liquid outside of the apparatus when adding species into

Student 2 For support and insulation.

Student 3 To reduce /~~prevent~~ heat losses. To insulate it better.

Student 4 to provide stability.

Answer	Additional Guidance
An answer that makes reference to the following point: • to prevent the polystyrene cup from 'falling over'	Accept descriptions Allow to stabilise the polystyrene cup Allow to prevent spillages Ignore references to heat loss

Activity 9 – AO3 in exams

An experiment was carried out to determine the enthalpy change of neutralisation for the reaction between sulfuric acid and sodium hydroxide.

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Step **4** The temperature of the mixture in the polystyrene cup was measured at 3½ minutes and then every 30 seconds until the clock reached 10 minutes.

State the purpose of measuring the temperature every 30 seconds for 2½ minutes in Step **2**. **(1)**

Answer	Additional Guidance
An answer that makes reference to the following point: • to determine a consistent/steady/constant temperature (before adding the sodium hydroxide)	Allow for determine a mean initial temperature Allow reference to achieve room temperature Ignore just to have a more accurate temperature Do not award references to the temperature cooling since this implies the effect after the reaction

Activity 9 – AO3 in exams

Student 1 It's done to obtain a more accurate temperature by taking a mean TD all these temperatures ÷ 2½ mins

Student 2 to measure the initial temperature before the reaction starts

Student 3 to get reliable readings for the experiment

Student 4 TO ensure that the the temperature of H_2SO_4 stays constant and there is little to no error to find ΔT later on

Answer	Additional Guidance
An answer that makes reference to the following point: • to determine a consistent/steady/constant temperature (before adding the sodium hydroxide)	Allow for determine a mean initial temperature Allow reference to achieve room temperature Ignore just to have a more accurate temperature Do not award references to the temperature cooling since this implies the effect after the reaction

Activity 9 – AO3 in exams

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Step **3** 50.0 cm^3 of 1.25 mol dm^{-3} sodium hydroxide solution was added to the acid in the polystyrene cup at 3 minutes and the mixture was constantly stirred.

Step **4** The temperature of the mixture in the polystyrene cup was measured at 3½ minutes and then every 30 seconds until the clock reached 10 minutes.

Explain why the temperature was not measured at 3 minutes. (2)

Answer		Additional Guidance
An explanation that makes reference to the following points:		
• the temperature will be changing	**(1)**	Allow the temperature was not uniform/the same throughout the mixture Allow the temperature is still rising Ignore just the temperature will be inaccurate
• because it takes time to add 50 cm^3 of sodium hydroxide	**(1)**	Allow because that's when the sodium hydroxide was added Allow because you cannot add the alkali and measure the temperature at the same time (1) Ignore references to the reaction 'just' starting or hasn't finished If no other mark awarded, allow (1) for the thermometer was used for stirring/ the mixture was being stirred

Activity 9 – AO3 in exams

Student 1

Thermometer was used for stirring.
The reaction had not yet occured ~~to~~
~~the electrons~~ Temperature recorded would be
inconsistent throughout polystyrene cup.

Student 2

At 3 minutes, the temperature is rising greatly and it takes time for temperature to be fixed as the reaction is ongoing.

Answer		Additional Guidance
An explanation that makes reference to the following points: • the temperature will be changing	**(1)**	Allow the temperature was not uniform/the same throughout the mixture Allow the temperature is still rising Ignore just the temperature will be inaccurate
• because it takes time to add 50 cm^3 of sodium hydroxide	**(1)**	Allow because that's when the sodium hydroxide was added Allow because you cannot add the alkali and measure the temperature at the same time (1) Ignore references to the reaction 'just' starting or hasn't finished If no other mark awarded, allow (1) for the thermometer was used for stirring/ the mixture was being stirred

Activity 9 – AO3 in exams

Student 3

because it would take time to for the reaction to take place. temperature is measured before and 30 s after adding the reactant to have an efficient change in enthalpy. and the acid was not stirred → the reactant needs to completely mix into the solution which would take time.

Answer		Additional Guidance
An explanation that makes reference to the following points: • the temperature will be changing	**(1)**	Allow the temperature was not uniform/the same throughout the mixture Allow the temperature is still rising Ignore just the temperature will be inaccurate
• because it takes time to add 50 cm^3 of sodium hydroxide	**(1)**	Allow because that's when the sodium hydroxide was added Allow because you cannot add the alkali and measure the temperature at the same time (1) Ignore references to the reaction 'just' starting or hasn't finished If no other mark awarded, allow (1) for the thermometer was used for stirring/ the mixture was being stirred

Activity 9 – AO3 in exams

Student 4

To ~~calculate the highest~~ The reaction is reaching its optimum. The change in temperature is too fast to measure. The temperature is increasing in rapid speed.

Answer	Additional Guidance
An explanation that makes reference to the following points: • the temperature will be changing **(1)**	Allow the temperature was not uniform/the same throughout the mixture Allow the temperature is still rising Ignore just the temperature will be inaccurate
• because it takes time to add 50 cm^3 of sodium hydroxide **(1)**	Allow because that's when the sodium hydroxide was added Allow because you cannot add the alkali and measure the temperature at the same time (1) Ignore references to the reaction 'just' starting or hasn't finished If no other mark awarded, allow (1) for the thermometer was used for stirring/ the mixture was being stirred

Teaching AO3

Doing practical work

- The specification for IAL Chemistry contains a number of practical activities that form part of the subject content
- Exam questions expect students to be familiar with methods for these practicals
- Questions also expect students to apply their knowledge of practical methodology to unfamiliar scenarios

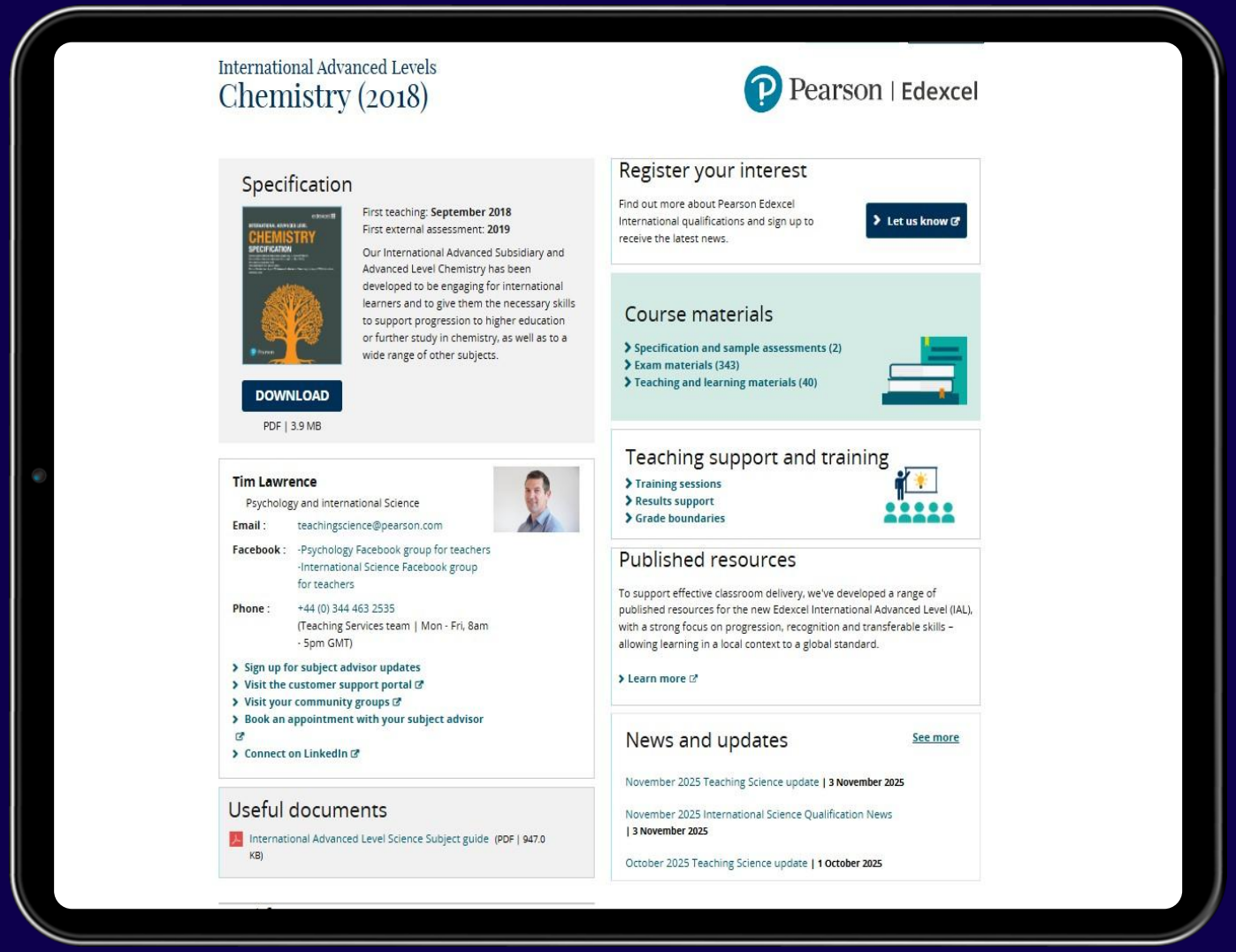
Teaching AO3

Doing practical work

- Why should students do practical work?
- Are students getting knowledge or skills from practical activities?
- When do you do practical activities: before or after teaching the theory of a topic?

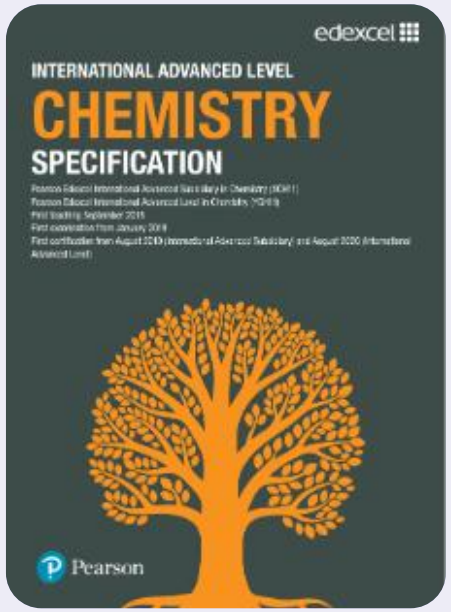
Support

Support for you at every Stage

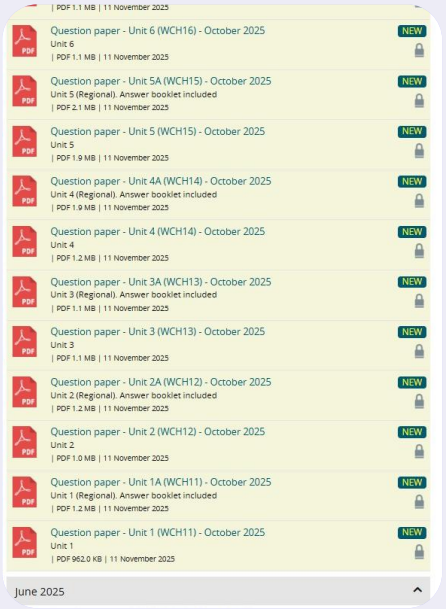


Teaching and Learning Materials

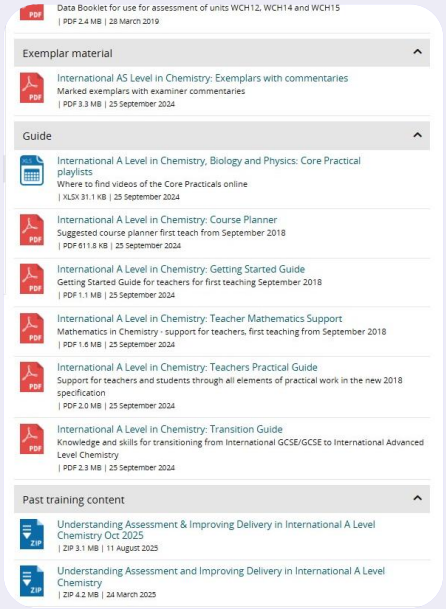
4MA1



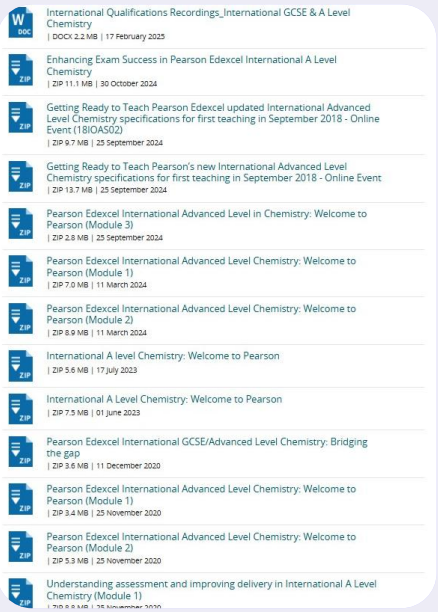
Specification



Past Papers

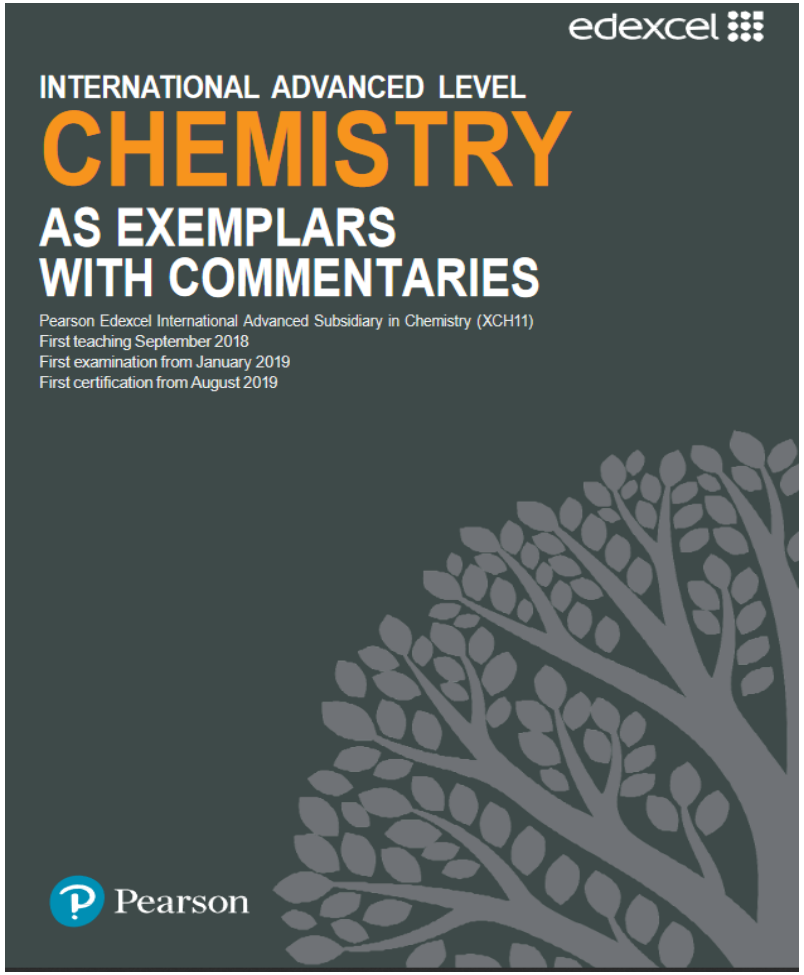


Teaching and Learning Materials



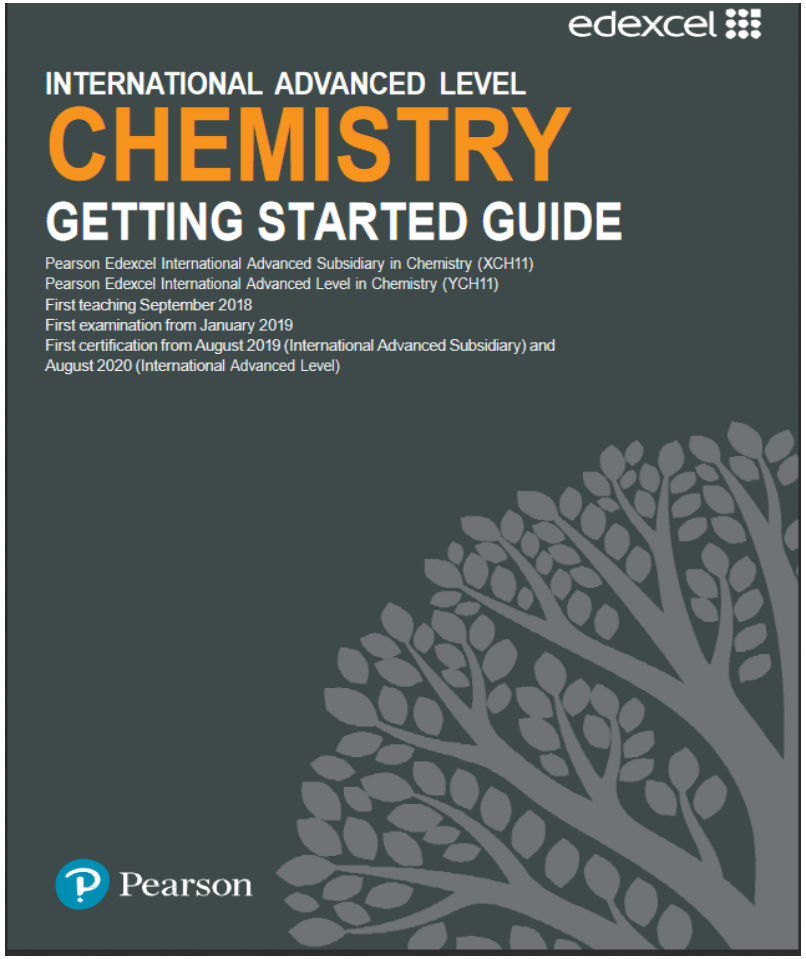
Past Training Content

Exemplar material



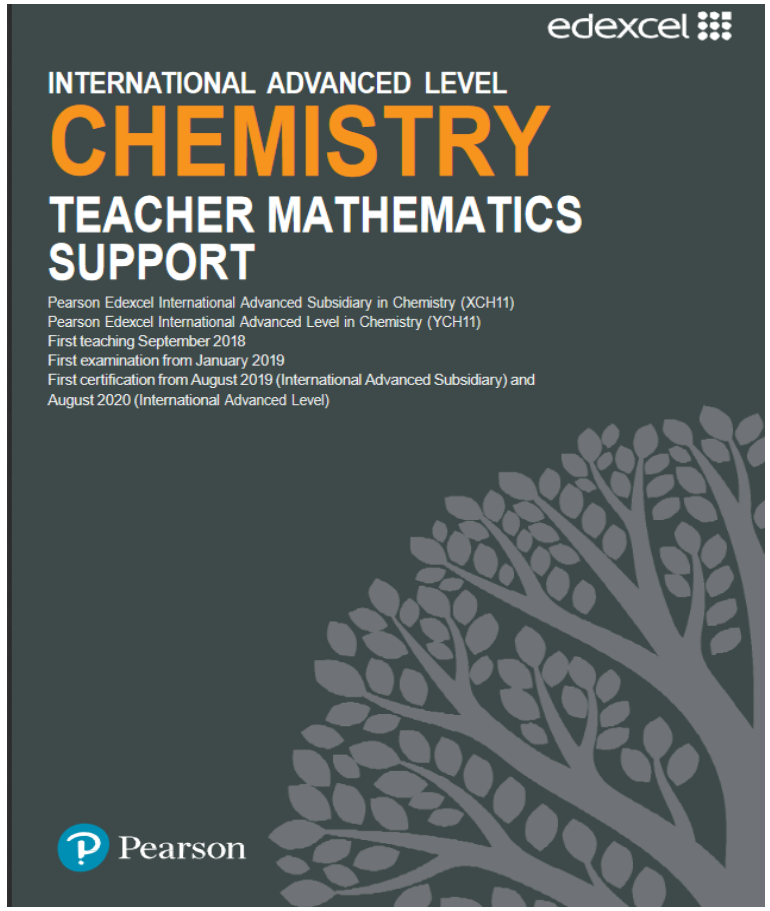
- Marked exemplars with examiner commentaries
- Only available at the moment for IAS

Getting Started Guide



The Getting Started Guide provides an overview of the Edexcel IAL Chemistry (2018), provides information about the content and assessment, and gives you a better understanding of what these mean for you and your students

Teacher Mathematics Support

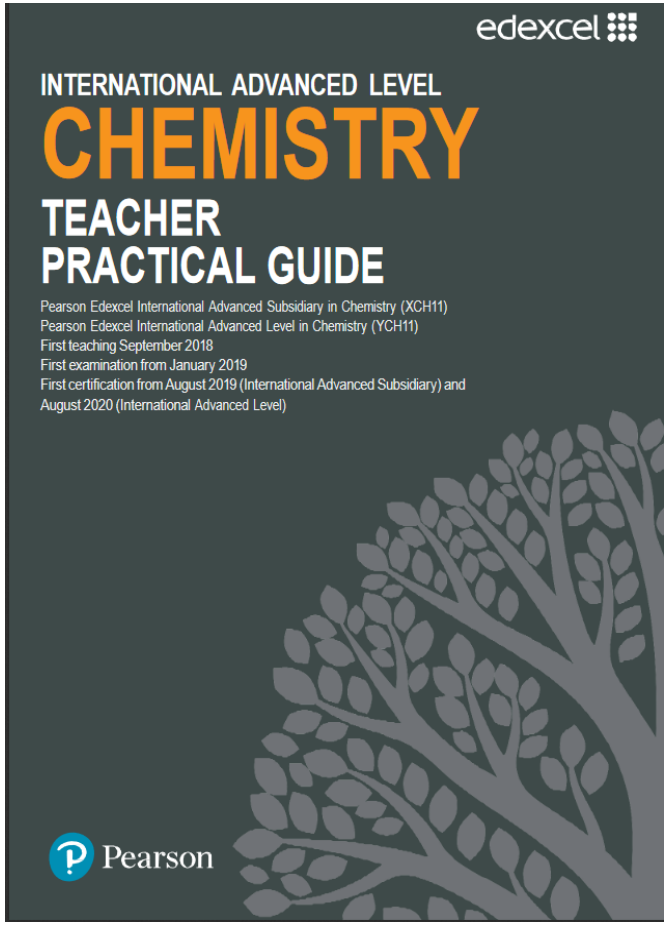


This covers selected topics that students find difficult.

These are:

- Mole calculations
- Enthalpy changes
- Reaction rates
- Equilibrium calculations
- Acid base equilibria and pH calculations
- Electrode potentials

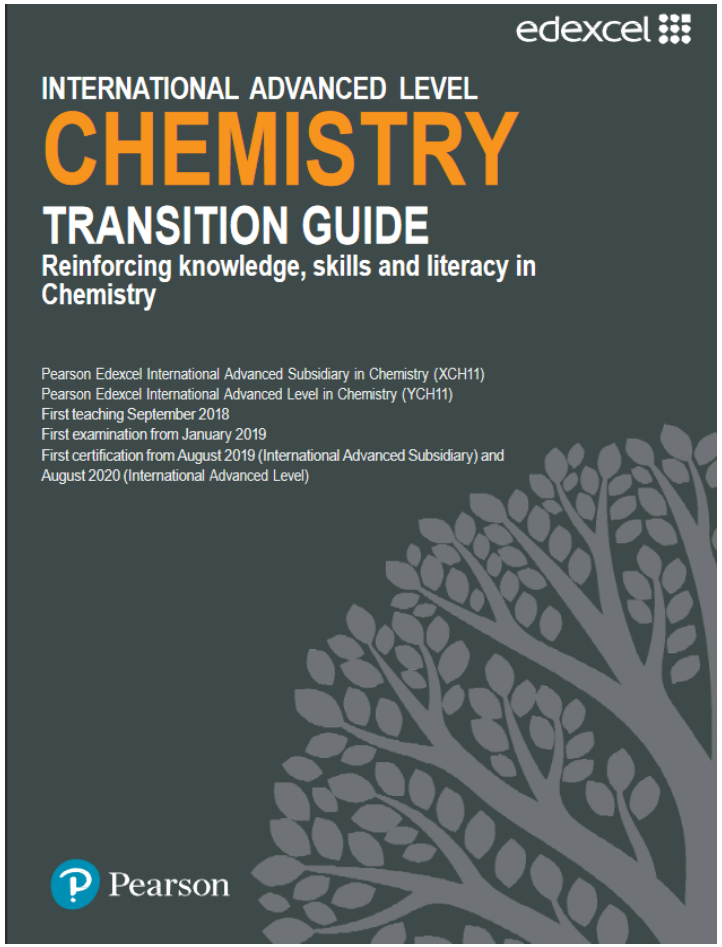
Teacher Practical Guide



This guide is designed to:

- support you and your students through all elements of practical work in the International AS and A Level specifications
- explain how the requirements for practical skills can be developed throughout the course using both core practicals and other specification content

Transition Guide

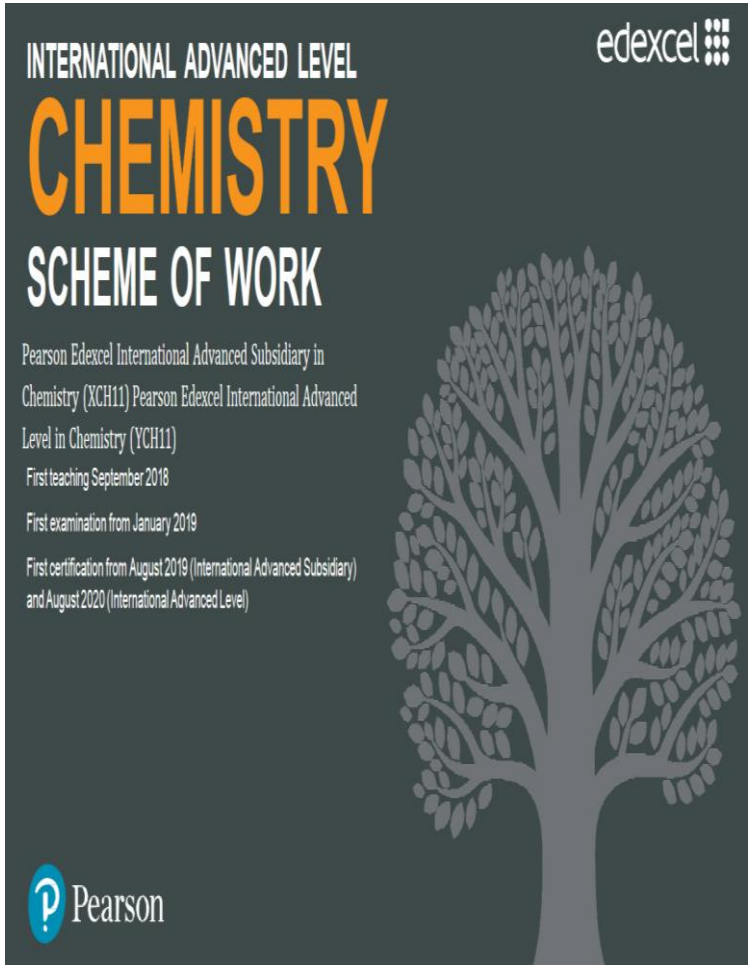


The transition guide includes:

- mapping of Edexcel International GCSE to the new Edexcel IAL Chemistry specifications
- baseline assessments
- summary sheets
- student worksheets
- practice questions

The teacher version also includes answers for assessments, worksheets and exam practice questions

Scheme of Work

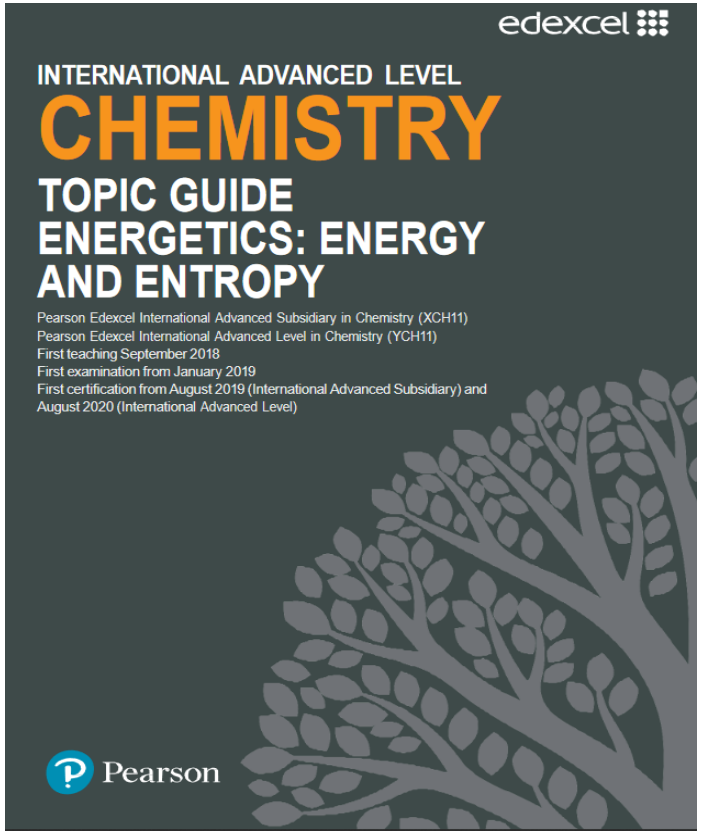


The scheme of work is broken up into units and topics, so that there is greater flexibility for moving topics around to meet planning needs

It includes:

- Recommended teaching time for topics, though of course this is adaptable according to individual teaching needs
- Classroom activities, teaching points and suggested teaching resources
- Objectives for students at the end of the topic area and examples of integrated transferable skills

Topic Guide Energetics: Energy & Entropy

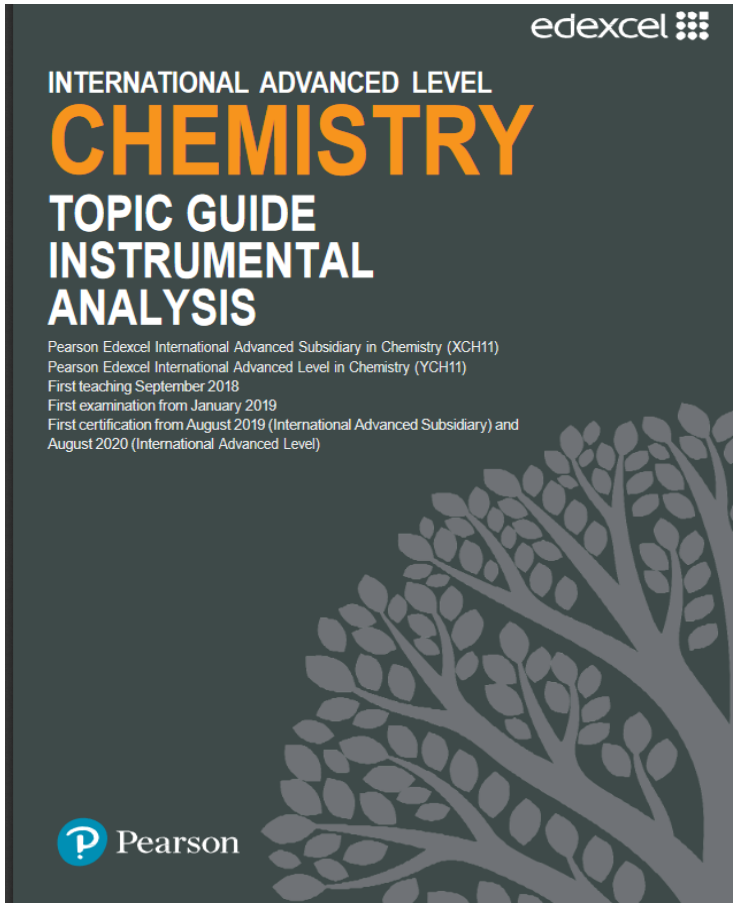


Included in this guide are:

- some ideas on how to address common misconceptions in both new and previously included content
- possible teaching sequences for key specification points where there is new or challenging content
- worked examples that teachers could use to support students in developing their understanding

Topic Guide

Instrumental Analysis

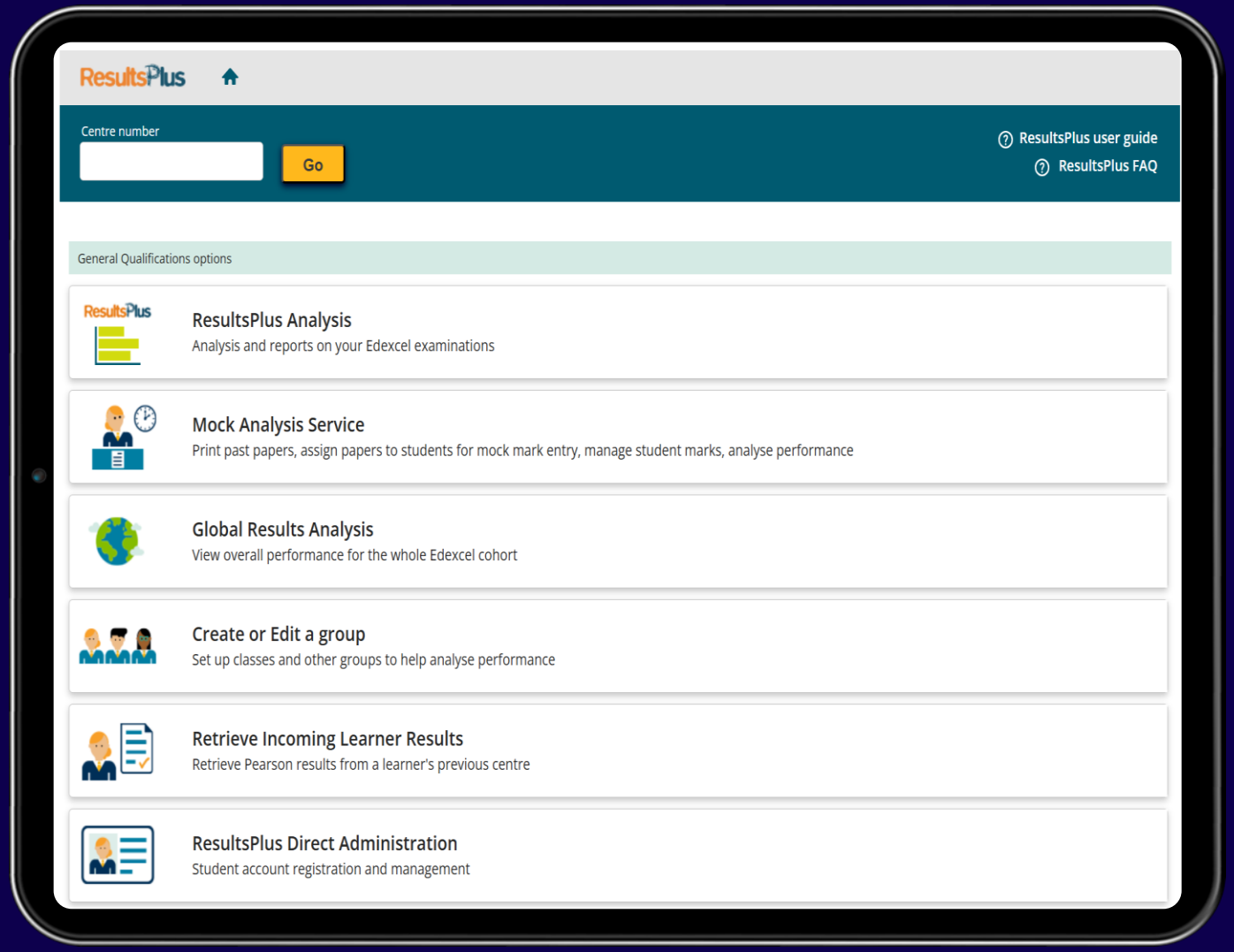


Included in this guide are:

- some ideas on how to address common misconceptions in both new and previously included content
- possible teaching sequences for key specification points where there is new or challenging content
- worked examples that teachers could use to support students in developing their problem-solving skills
- links to external websites that can be used to further students' understanding

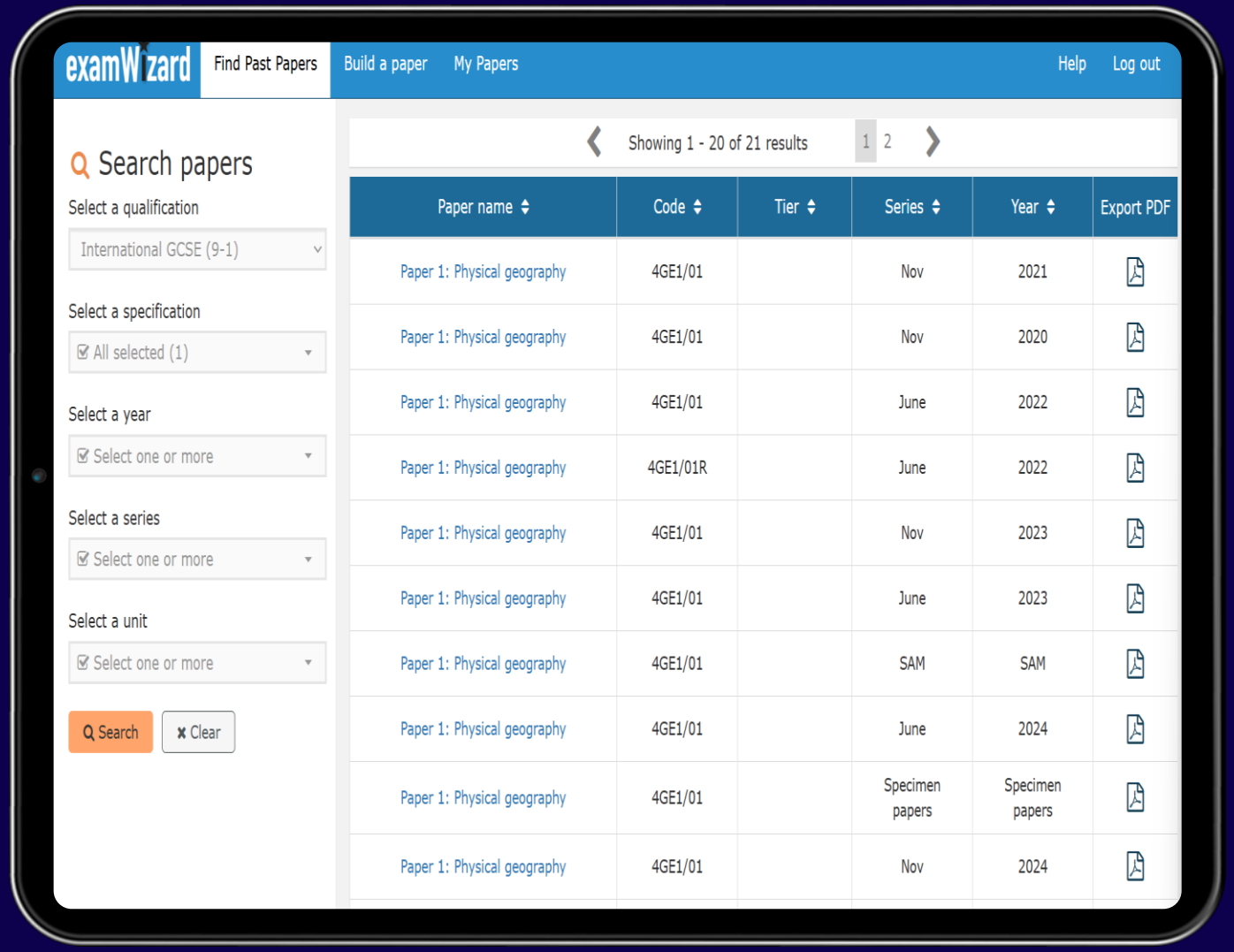
Results Plus

- Provides detailed analysis of your learners performance.
- Identify potential topics, skills and types of question where students may need to develop their learning further.
- See actual scores for each exam question for a student, class or group.
- Understand how your students' performance compares with class and Pearson Edexcel national averages.
- Acquire data that may support effective learning and teaching approaches.



Exam Wizard

- Saves time by creating your own mock paper exams, topic tests, homework or revision activities.
- Uses our Pearson back catalogue of exam questions to practice and develop these skills with your learners'.
- Gain access to past papers and test questions to create tailored learners plans, which target individuals weaknesses.
- Works in conjunction with ResultsPlus to help create exam practice resources for whole cohorts or individual learners.

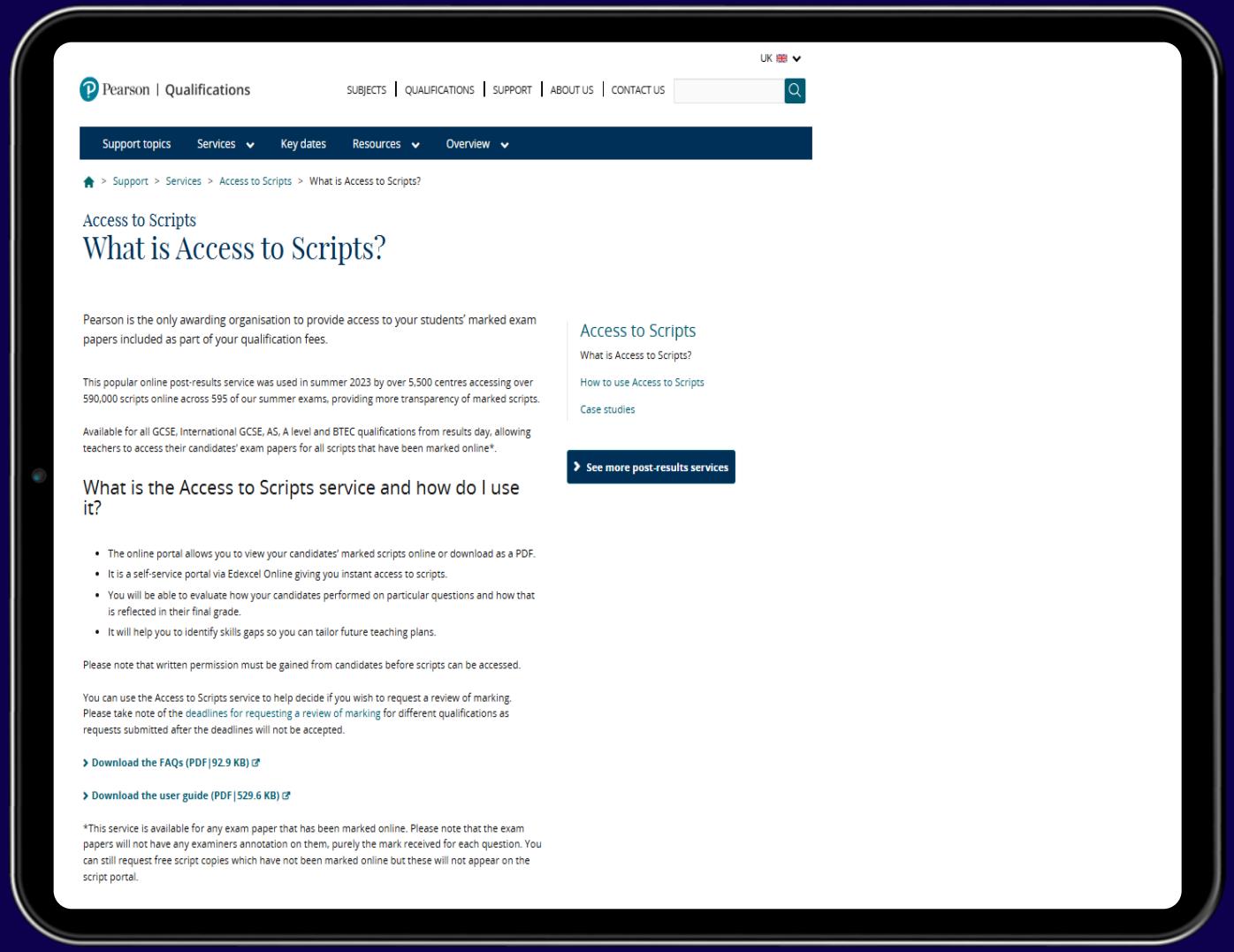


Access to Scripts

Access to Scripts is an online service, included as part of your qualification fees, that allows you to view your candidates' marked scripts online or download as a PDF.

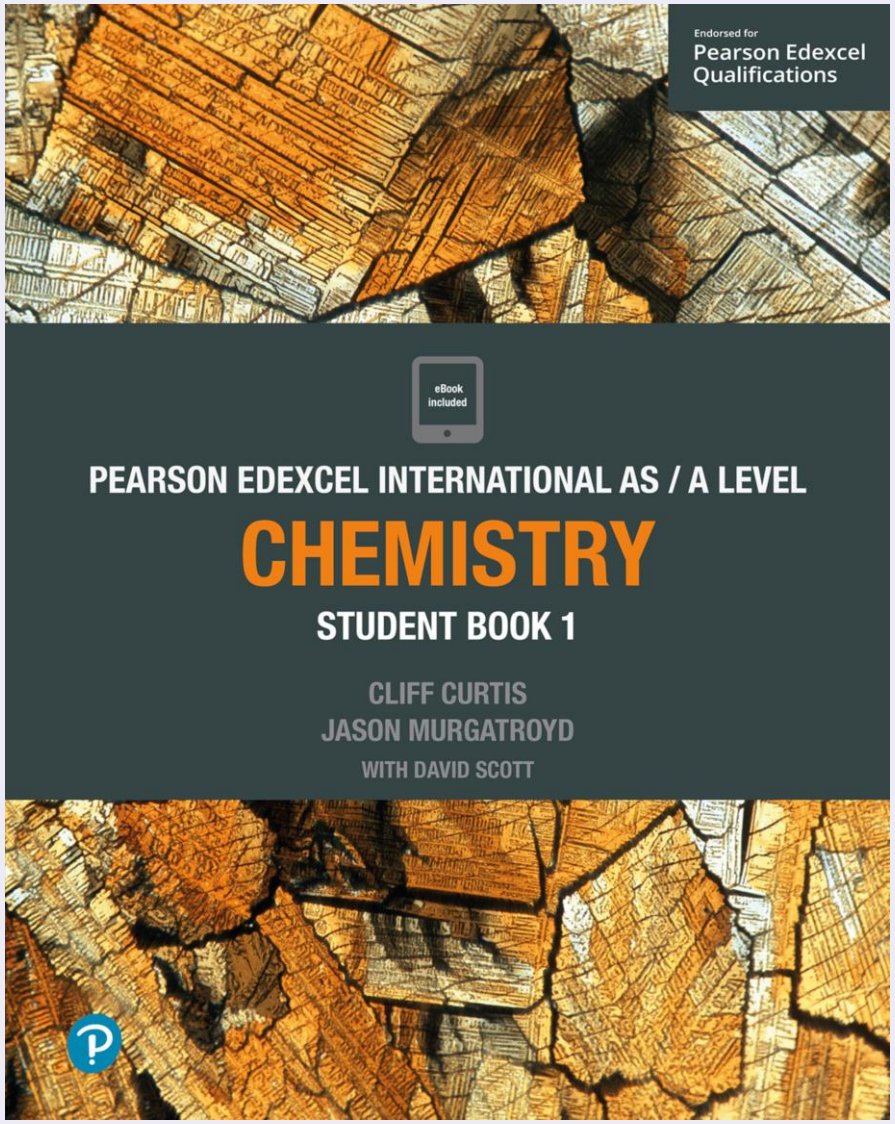
The Access to Scripts service provides a rich source of information, enabling detailed analysis to inform teaching and learning and support students - giving insights and visibility that performance data alone cannot provide.

Pearson is the only awarding organisation to provide access to your students' marked exam papers included as part of your qualification fees.



Paid for Resource

Developed for the latest International A Level Science specifications, these resources are specifically designed for international students, with a strong focus on progression, recognition and transferable skills, allowing learning in a local context to a global standard.



For more information and access to samples visit:

www.pearson.com/international-schools

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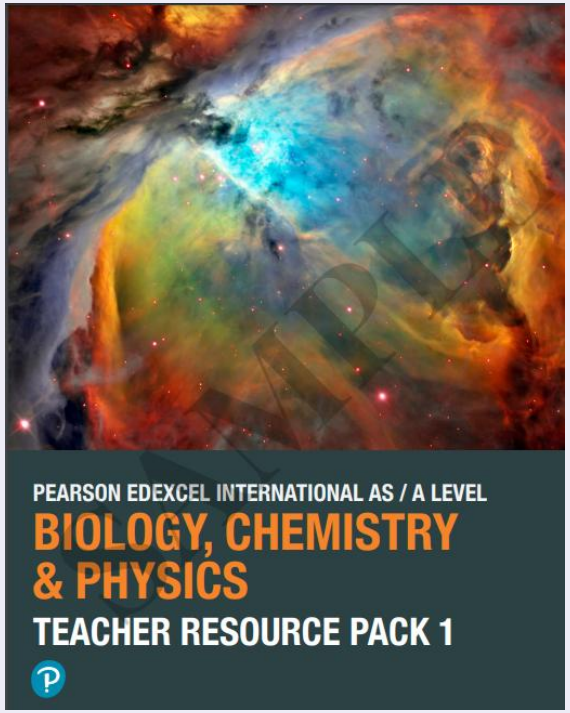
The Online Teacher Resource Packs are designed to accompany the Student Books and are available as annual online subscriptions

Containing:

- Detailed and comprehensive teaching plans for every section of the book
- Practice assessments and accompanying mark schemes for every chapter following the exam format
- Student book answers and Exam Practice questions
- Practicals support for core practicals includes student worksheets, exam style questions and teacher and technician notes
- Guide to Thinking Bigger



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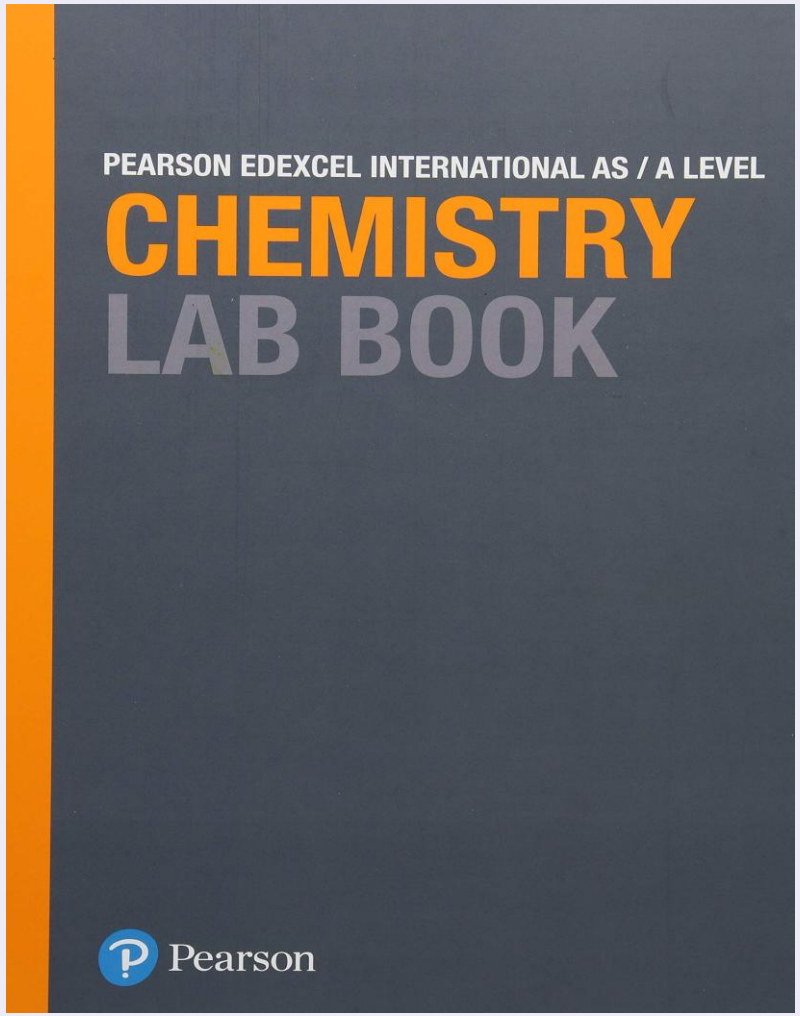
Pearson have also published a Lab Book that covers all of the Core Practicals.

These Science resources have been written to support the Pearson Edexcel International Advanced Levels (IAL) which are globally recognised qualifications which open doors to top local and international universities worldwide. International A Levels have a modular structure, yet remain comparable to A levels, as confirmed by NARIC (The national agency responsible for providing information and expert opinion on qualifications and skills worldwide).



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Jonathan Wong (top) & Tim Lawrence (bottom)

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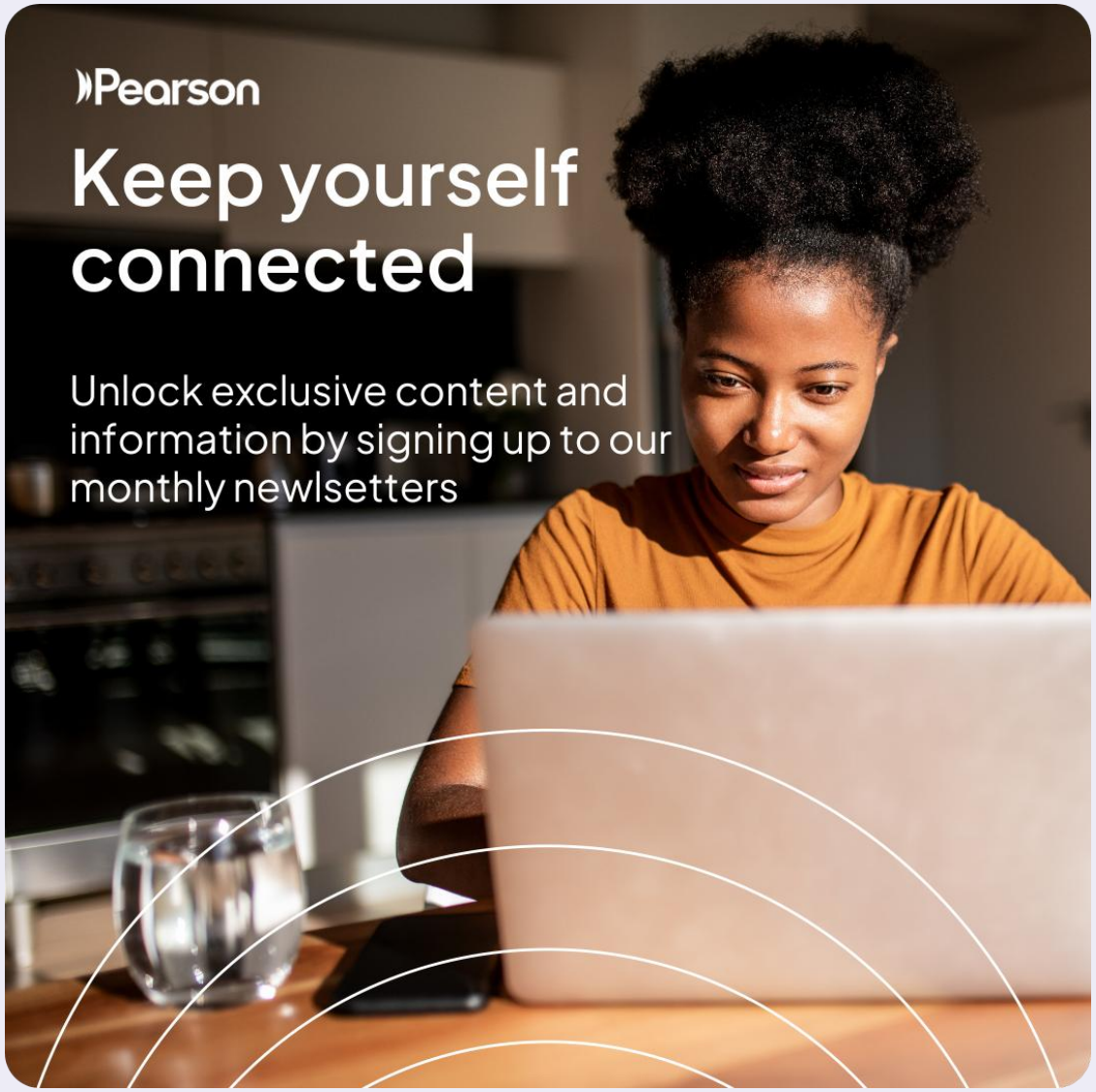

Questions

Pearson

Thank you